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**OFFICE OF INDUSTRIES WORKING PAPER**  
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**AN ANALYSIS OF THE IMPACT OF EUROPEAN UNION AND  
UNITED STATES DAIRY POLICIES ON EU-U.S. TRADE IN  
MILK PROTEIN CONCENTRATE**

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**Office of Industries  
U.S. International Trade Commission**

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**ABSTRACT:** During 1996-2000, U.S. imports of milk protein concentrate (MPC) increased rapidly. At the same time, Commodity Credit Corporation (CCC) stocks of non-fat dry milk (NFDM) went from nothing to more than 500 million pounds. Consequently, U.S. milk producers attributed low milk prices and dairy farmer income during this period to the increased imports of MPC. U.S. milk producers were especially concerned with MPC imports for two reasons. First, MPC between 40 and 90 percent protein had been classified in subheading 0404.90.10 of the Harmonized Tariff Schedule of the United States (HTS). Thus, MPC was not subject to the tariff-rate quotas applied to many other dairy products. Second, MPC produced in the European Union (EU) and exported to the United States was eligible for production and export subsidies. Along with the high U.S. internal milk protein prices maintained by the Dairy Price Support Program, and volatile world prices of NFDM, these policies created economic rents for trade in MPC between the European Union and the United States. To test the relationship between these policies and U.S. imports of MPC, these economic rents, which were not directly observable, were estimated by combining a set of identifiable variables: (1) the CCC purchase price, (2) the EU export refund, (3) EU casein production aid, and (4) the world price of NFDM as expressed by the Western Europe export price. A vector autoregression model was then estimated using monthly U.S. imports of MPC and the estimate of economic rents. This estimation showed that nearly 40 percent of the variability in U.S. MPC imports was attributable to the estimate of economic rents. These results demonstrate that U.S. and EU policies can not be analyzed in isolation when evaluating the impact of dairy policies on U.S. MPC imports.

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## INTRODUCTION<sup>1</sup>

One of the most controversial issues currently facing the U.S. dairy industry is the extent to which imports of milk protein concentrate (MPC) (box 1) adversely affect milk prices and producer revenues. This debate was sparked by U.S. dairy producers' projections that the growth of MPC imports from 1996 to 2000 would continue, and result in U.S. MPC imports that exceeded 100,000 metric tons by the year 2010.<sup>2</sup> However, MPC imports fell off dramatically in 2001 and the growth that served as the basis for this projection has not continued. Also during this time, U.S. milk producers experienced volatile prices and low incomes. Commodity Credit Corporation (CCC) stocks of non-fat dry milk (NFDm) went from almost nothing to record levels during the same period, contributing to the controversy. U.S. milk producers blamed the increased CCC purchases, and by extension low milk prices and incomes, on subsidized exports of MPC from the European Union (EU).<sup>3</sup> MPC imports from the European Union were a critical factor because this product had been classified by U.S. Customs and Border Protection (CBP) under subheading 0404.90.10 of the Harmonized Tariff System of the United States (HTS), and was, therefore, not subject to tariff-rate quotas (TRQs) that limited imports of many other dairy products, including non-fat dry milk (NFDm). Thus, U.S. milk producers lobbied Congress to introduce legislation that would apply TRQs to MPC.<sup>4</sup> As part of the legislative process, the U.S. Senate's Committee on Finance requested that the U.S. International Trade Commission (USITC) investigate the competitive conditions of various milk protein products in the U.S. market.

While conducting this investigation, the authors undertook a detailed analysis of the factors affecting U.S. imports of MPC from the European Union. This analysis was based on responses to foreign producers' questionnaires, as well as extensive fieldwork and interviews with European producers and EU Commission officials. In researching the circumstances surrounding the surge in MPC imports from the European Union during 1997-2000, the authors discovered that U.S. producers were partially correct in their assumptions: U.S. MPC imports from the European Union consisted mostly of low-protein MPC blended from NFDm and casein that was subsidized by export refunds and casein product aid. And though these subsidies were necessary to induce EU processors to manufacture these products, the subsidies alone were not sufficient to induce trade between the European Union and the United States; willing buyers, as well as willing sellers, were required.

Willing buyers were created when the price gap between milk protein products in the United States, mostly NFDm, and milk protein products on the world market was sufficiently large to induce U.S. processors to search for alternative sources of milk protein. The CCC purchase price for NFDm, which places a floor on all U.S. milk protein prices, thus becomes a contributory factor because it can not be adjusted in response to changing world markets, but only in response to the CCC's cost of purchasing and storing NFDm. Therefore, government policies in both the European Union and in the United States were considered when trends in U.S. MPC imports from the European Union were analyzed.

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<sup>1</sup> This working paper is an extension of research undertaken in connection with U.S. International Trade Commission (USITC) general fact finding Investigation No. 332-453 requested by the Senate Committee on Finance, the results of which were reported in *Conditions of Competition for Milk Protein Products in the U.S. Market*.

<sup>2</sup> Peter Vitaliano, National Milk Producers Federation, testimony before the USITC, Investigation No. 332-453, *Conditions of Competition for Milk Protein Products in the U.S. Market*, Dec. 11, 2003, transcript p. 29.

<sup>3</sup> The European Union refers to Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom, i.e., the EU-15 before expansion in May 2004.

<sup>4</sup> This legislation also applied to casein and caseinates imported under HTS heading 3501; however, imports of these products are not specifically addressed, except in the context that casein is used to produce MPC.

**Box 1****What is milk protein concentrate?**

Milk protein concentrate (MPC) is a milk powder that contains both of the major forms of protein found in milk — casein and whey — and is defined by the U.S. Customs and Border Protection (CBP) as “any complete milk protein (casein plus lactalbumin) concentrate that is 40 percent or more protein by weight.” MPC may be produced by the ultrafiltration of skim milk — the process used most often in New Zealand and Australia; by blending different milk protein products (such as casein and non-fat dry milk) — the process used most often in the European Union (EU); or by co-precipitation — a process pioneered in New Zealand, but now applied primarily in Europe. The protein content of MPC can vary considerably, ranging from 40 percent to over 90 percent. MPC is often referred to by its protein concentration; e.g., MPC with a protein concentration of 42 percent is referred to as MPC 42.

MPC has many uses and can be found in variety of food products, as well as industrial products. How MPC is used depends mostly on the protein content. MPC with protein concentrations of 40-59 percent protein is used mostly in the manufacture of other dairy foods, such as yogurt, ice cream, and frozen deserts. MPC of 70 percent protein or more is typically used in processed cheese products (including cheese products outside U.S. Food and Drug Administration (FDA) standards of identity) and specialty nutrition products (such as infant formula, medical nutrition, and sports bars and beverages) tailored to the nutritional needs of athletes, the elderly, and health-conscious individuals. Examples include lactose-free products, Powerbars®, and SlimFast® shakes. MPC may also be used to replace NFDM to adjust the protein content of cheese milk (standardized milk used to produce cheese) in order to improve cheese yield and quality; though, MPC may only be used in cheeses that do not have FDA standards of identity, such as pizza cheese, which is a substitute for Mozzarella.

U.S. Customs and Border Protection does not differentiate MPC by production process, so all imports of MPC between 40 and 90 percent protein are classified under subheading 0404.90.10 of the Harmonized Tariff Schedule of the United States, and are subject to a duty of \$3.70 per mt (about 0.1 percent ad valorem equivalent). The U.S. market for MPC is roughly 40,000 to 50,000 mt annually, virtually all of which has been supplied by imports until recently. Domestic production of MPC has been limited, but commercial production of MPC in the United States began in 2003.

Source: Primarily summarized from USITC publication 3692, *Conditions of Competition for Milk Protein Products in the U.S. Market*.

The purposes of this research were to (1) develop a composite policy variable to approximate the economic rents generated by U.S. and EU dairy policies;<sup>5</sup> (2) develop and estimate a vector autoregression (VAR) model of the statistical relationship between the composite policy variable and U.S. imports of MPC from the European Union; and (3) use the statistical evidence from the VAR model to test the hypothesis that U.S. and EU dairy policies had a distinct and measurable impact on U.S. MPC imports from the European Union. As a related outcome, we propose that this method of combining a set of disparate U.S. and non-U.S. policies into a composite variable for econometric applications with trade data has a general usefulness in empirically gauging if, and how, the collective effects of a set of disparate, and perhaps unconnected, policies have on trade flows. And perhaps of equal importance, we hope to provide a method of policy analysis that permits measurement of the effects, on a highly-focused variable of interest, in this case, U.S. MPC imports, of a set of policies so disparate and varied in source or scope that these policies may not often be concurrently considered as a cogently organized set with such focused effects.

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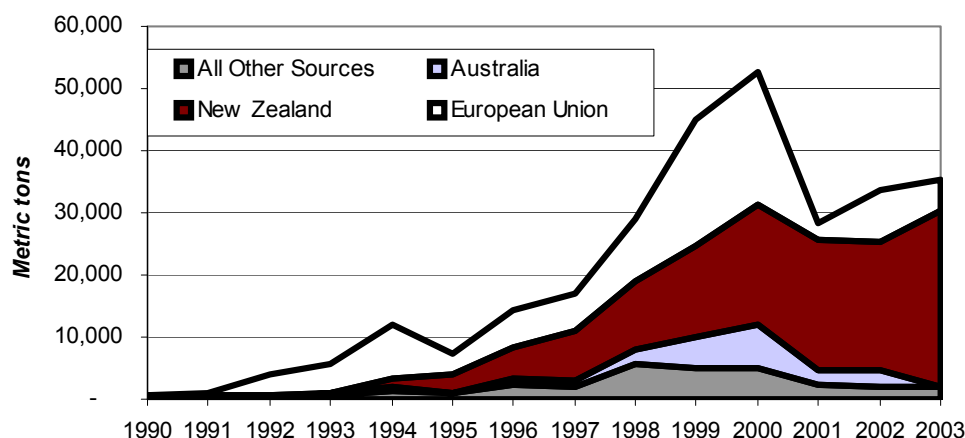
<sup>5</sup> In this context, economic rents refer to Paretian factor rents or the opportunity cost of manufacturing and trading MPC in the U.S. market as compared to selling the MPC ingredients on world or domestic European markets.

## Background and Recent Trends in U.S. Imports of Milk Protein Concentrate

In the 1980s, U.S. MPC imports<sup>6</sup> from all sources were less than 1,000 metric tons (mt) annually. Imports increased during the early-1990s and reached 12,000 mt by 1994, but dropped to 7,300 mt in 1995. Starting in 1996, imports of MPC grew rapidly, reaching nearly 53,000 mt in 2000 (figure 1). After peaking in 2000, U.S. MPC imports fell dramatically to less than 28,500 mt in 2001, and stabilized around 35,000 mt in 2002 and 2003. Through July 2004, U.S. MPC imports were down more than 24 percent, totaling 19,000 mt compared with nearly 25,000 mt during January - July 2003.

U.S. MPC imports from the European Union were a primary component of the overall import patterns described above (figure 1). While MPC imports from the EU dominated this import category during the early 1990s, EU market share has deteriorated considerably over time. During 1991-1995, MPC imports from the European Union represented 68 percent of total U.S. MPC imports. Though U.S. imports of MPC from the European Union continued to increase between 1996 and 2000, the EU share of these imports dropped to about 40 percent. After 2000, however, U.S. MPC imports from the European Union declined dramatically and the EU share averaged less than 17 percent of these imports.

**Figure 1**  
**Annual U.S. Imports of milk protein concentrate classified under subheading 0404.90.10 of the Harmonized Tariff Schedule of the United States, 1990-2003**



Source: U.S. Department of Commerce, USDA.

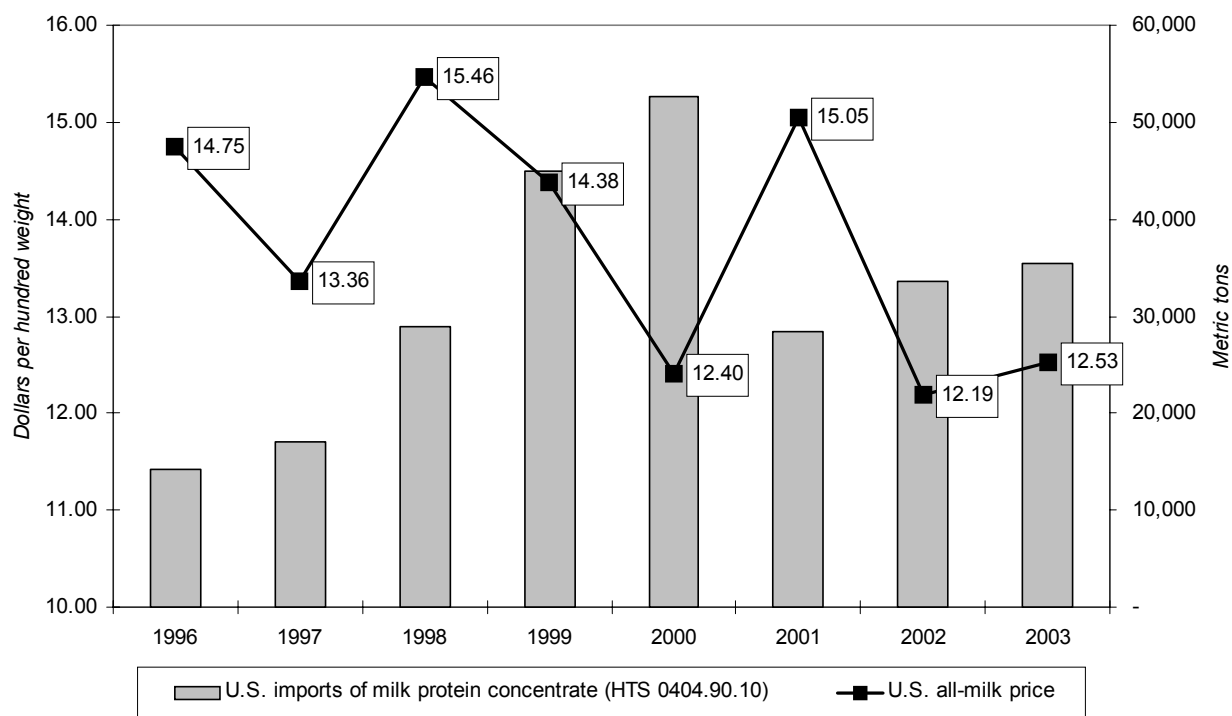
The late 1990s was also a decade of volatile milk prices, which appeared to coincide with the changes in U.S. MPC imports; the simple correlation between the change in annual MPC imports and the change in annual average all-milk price was -0.51. As MPC imports increased by 82 percent from 1998 to 2000, the all-milk price<sup>7</sup> fell by 20 percent, from \$15.46 per hundredweight (cwt) in 1998 to \$12.40 per cwt in 2000 (figure 2). Then, as MPC imports were almost halved in 2001, milk prices rebounded to

<sup>6</sup> Throughout this analysis, milk protein concentrate (MPC) is used to refer to only those products classified under subheading 0404.90.10 of the Harmonized Tariff Schedule of the United States (HTS). Products classified as milk protein concentrate in HTS heading 3501 are not considered by this analysis.

<sup>7</sup> The all-milk price is published monthly. It is the average price of all the milk sold to plants and dealers. It covers the whole country, including California and other milk not under the control of Federal Milk Marketing Orders (USDAd).

**Figure 2**

**U.S. imports of milk protein concentrate under subheading 0404.90.10 of the Harmonized Tariff Schedule of the United States, and the U.S. all-milk price, 1996-2002**



Sources: U.S. Department of Agriculture; U.S. Department of Commerce

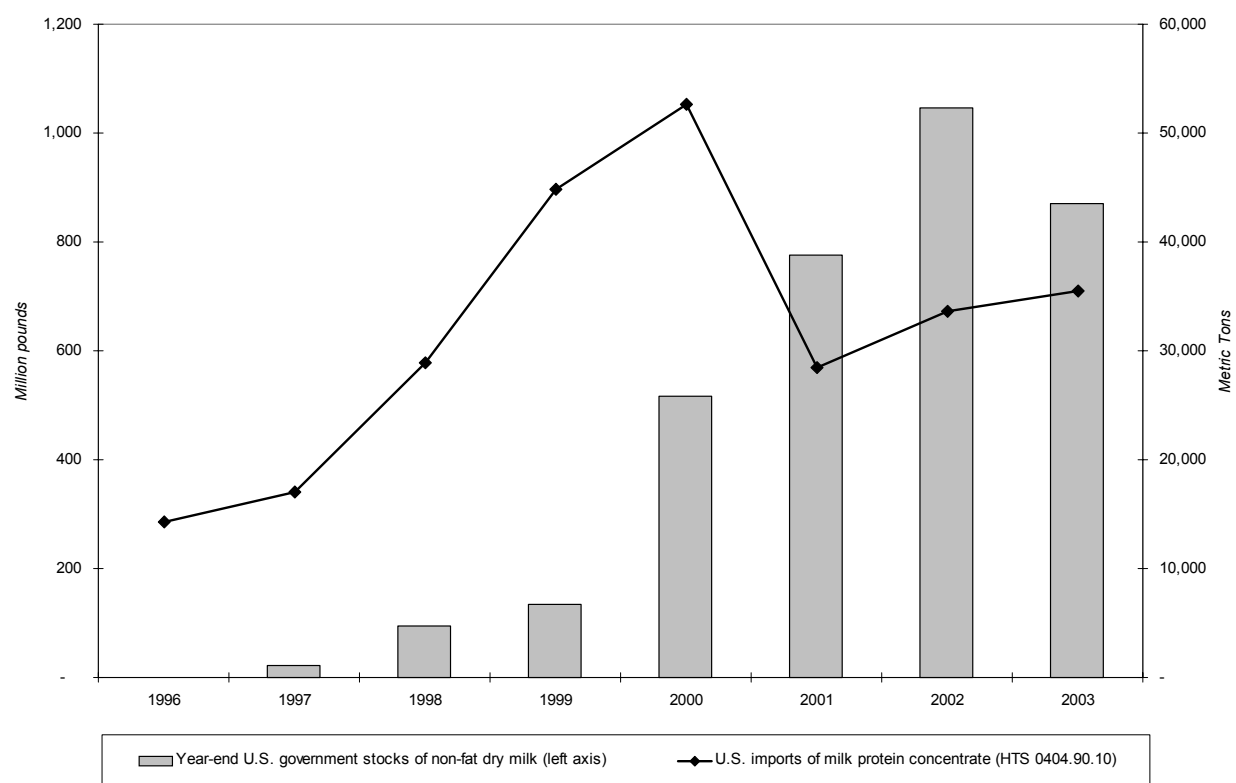
\$15.05 per cwt. An 18 percent increase in MPC imports between 2001 and 2002, coincided with a 19 percent drop in the all-milk price, resulting in the lowest milk prices in more than 20 years as the all-milk price fell to \$12.19 per cwt. Between 2002 and 2003, a 6 percent increase in MPC imports coincided with a 3 percent increase in the all milk price. During early 2004, as U.S. MPC imports slowed from the previous year's level, the all-milk price increased from \$13.20 per cwt in January to a record \$19.40 per cwt in May.

Increased CCC stocks of NFDM also appeared to coincide with increased imports of MPC during the late 1990s; the simple correlation between annual imports of MPC and year-end CCC stocks of NFDM was 0.36. As MPC imports increased by 170 percent from 1996 to 2000, CCC stocks increased from zero to 516 million pounds (figure 3). However, as MPC imports dropped by 50 percent between 2000 and 2001, CCC stocks continued to increase reaching, 776 million pounds at year's end. CCC stocks continued to accumulate and totaled more than 1 billion pounds by the end of 2002, 35 percent greater than at the end of 2001; meanwhile, MPC imports increased by 18 percent. Between 2002 and 2003, however, CCC stocks dropped by 17 percent while MPC imports increased by 6 percent. In 2004, CCC stocks and MPC imports both continue to decline.

U.S. milk producers argued that MPC imports were a key factor in the low milk prices described above. They conjectured that U.S. MPC imports, consisting of mostly low-protein blended product from the European Union, substituted for domestically produced NFDM in the cheesemaking process. Moreover, they contended that MPC exports from the European Union were unfairly subsidized. U.S.

**Figure 3**

**U.S. Government stocks of non-fat dry milk, and U.S. imports of milk protein concentrate classified under subheading 0404.90.10 of the Harmonized Tariff Schedule of the United States, 1996-2002**



Sources: U.S. Department of Agriculture; U.S. Department of Commerce

milk producers asserted that this displacement caused market prices of NFDM to fall to the CCC purchase price, resulting in record government stocks, and ultimately in lower milk prices and declining producer incomes. U.S. milk producers also claimed that EU processors manufactured and exported MPC to deliberately circumvent the 5,260 mt TRQ on NFDM, beyond which imports face an over-quota tariff of about 40 percent ad valorem equivalent (AVE). By mixing NFDM, which is about 36 percent protein, with other products containing high concentrations of dairy protein, such as casein, EU exporters were able to create a blended milk powder with a protein content of over 40 percent. This blended product was then classified as MPC under subheading 0404.90.10 of the Harmonized Tariff Schedule of the United States (HTS) and subject to negligible duty treatment of \$3.70 per mt (less than 1 percent AVE).

MPC users and importers disagreed with U.S. milk producer claims. Users and importers argued that most MPC imports were of the high-protein variety that did not substitute for domestically produced NFDM. Therefore, users and importers claimed that U.S. MPC imports were not responsible for low milk prices. Moreover, U.S. domestic users indicated that high-protein MPC, which was not produced in the United States, was crucial for the production of many food products. They argued that the real reason for the growth of imports was that U.S. Government dairy programs made U.S. milk protein, most widely available in the form of NFDM, uncompetitive vis-à-vis imported milk protein in the form of MPC.<sup>8</sup>

<sup>8</sup> For example, in 1999 U.S. MPC imports rose more than 55 percent from the previous year's level, while U.S. skim milk prices were close to double those in the international market.



Consequently, low milk prices in the United States were the result of an over supply of domestically produced milk protein and weakness in dairy demand.<sup>9</sup> As a result, users and importers argued that lower U.S. milk prices and dairy farmer incomes should not be attributed to imports.<sup>10</sup>

In response to the arguments of U.S. milk producers, on March 6, 2003, legislation was introduced in both the U.S. House of Representatives (H.R. 1160) and the U.S. Senate (S. 560) to impose TRQs on certain MPC products. Under these bills, imports of MPC would be limited to about 50 percent of recent trade volumes, beyond which an over-quota tariff of about 50 percent AVE would apply. As of October 2004, these bills had gained 198 cosponsors in the U.S. House of Representatives and 36 cosponsors in the U.S. Senate. The House version of this bill has been referred to the House Ways and Means subcommittee on Trade and the Senate version has been referred to the Committee on Finance. As of October 2004, no further action had been taken on these bills.

New Zealand, the European Union, and, to a lesser extent, Australia represented the major sources of U.S. MPC imports during 1990-2003 (figure 1). As indicated above, the European Union dominated the market in the early 1990s. Between 1995 and 2000, however, U.S. MPC imports from New Zealand grew relative to those from the European Union, such that New Zealand's market share increased to 37 percent while the EU's market share slipped to 40 percent. In 2001, total U.S. imports dropped dramatically to just below 29,000 mt, 46 percent lower than in 2000. This decline was almost entirely the result of decreased imports from the European Union, which fell from 21,300 mt to 2,720 mt; whereas, imports from New Zealand continued to increase. Consequently, New Zealand supplied an average of 72 percent of U.S. MPC imports annually between 2001 and 2003, compared with an annual average of 17 percent supplied by the European Union. Despite a drop of 14 percent in volume through July 2004, New Zealand's share of U.S. MPC imports has increased to 87 percent compared to less than 12 percent of U.S. MPC imports supplied from the European Union.

Official U.S. trade statistics for MPC (HTS subheading 0404.90.10) do not differentiate MPC imports with a protein range of 40-90 percent by protein content. The USITC was, however, able to report U.S. MPC imports broken out by protein content from data collected during its investigation.<sup>11</sup> From 1998 to 2000, imports of MPC 40-49 from the European Union increased by 158 percent, from 6,904 mt to 17,820 mt, and accounted for nearly one-half of the total increase in U.S. MPC imports over this period. Between 2000 and 2001, however, imports of MPC 40-49 from the European Union dropped by 62 percent, from 17,820 mt to 3,588 mt, representing close to 80 percent of the drop of all U.S. MPC imports. The small recovery of imports between 2001 and 2002 was also driven by an increase in imports of low-protein MPC from the European Union. The USITC survey showed that U.S. imports of MPC from Oceania, which steadily increased and did not fluctuate appreciably during 1998-2002, were mainly MPC with a protein concentration of 70-79 percent.

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<sup>9</sup> Coalition for Nutritional Ingredients, testimony before the USITC in connection with investigation 332-453, Dec. 11, 2003; Coalition for Nutritional Ingredients, "Exploding the myths about MPC, casein, and caseinates," May, 2003.

<sup>10</sup> Coalition for Nutritional Ingredients, prehearing submission, in connection with investigation 332-453, Dec. 1, 2003.

<sup>11</sup> U.S. International Trade Commission (USITC). *Conditions of Competition for Milk Protein Products in the U.S. Market. Investigation No. 332-453*. Washington DC: USITC, Pub. No. 3692, May, 2004; also found at <ftp://ftp.usitc.gov/pub/reports/studies/pub3692.pdf>; table 6-2.

## **INFLUENCE OF GOVERNMENT POLICY ON U.S. IMPORTS OF MILK PROTEIN CONCENTRATE FROM THE EUROPEAN UNION**

The competitiveness of EU milk protein products in world markets is heavily influenced by EU Government programs under the Common Agricultural Policy. Major EU policies that impacted dairy producers and processors during 1996-2002 included: the target price for milk, the intervention price for butter and NFDM, delivery quotas, high tariffs and TRQs on dairy product imports, production aid for skim milk and NFDM used in animal feed, production aid for skim milk used in casein production, processing support for butter used in food manufacturing, and export refunds. These policies influenced management decisions by EU dairy processors seeking to maximize the return to a fixed milk supply by adjusting production to the most profitable product mix.<sup>12</sup> More specifically, policies affected how European manufacturers marketed NFDM during 1996-2002. Based on discussions with EU dairy processing companies, there were generally three options for disposing of surplus NFDM during this period. The first option was to sell NFDM into EU intervention stocks and receive the EU intervention price.<sup>13</sup> However, this option was constrained by EU regulations that limit the period when intervention purchases can be made to April 1 through August 31 of each year. A second option was to export NFDM at world market prices. This option required export refund licences because the internal EU price of NFDM was greater than the world price. However, export refund licenses were cumbersome to acquire, destination-specific,<sup>14</sup> subject to reduction coefficients,<sup>15</sup> and restricted by export subsidy provisions of the World Trade Organization (WTO) Agreement on Agriculture.<sup>16</sup>

Interaction of the U.S. Dairy Price Support Program (DPSP, see below) and EU policies with world market conditions created the third option during 1996-2002. This option was to blend NFDM with casein to produce MPC 42<sup>17</sup> for export to the United States. This option offered EU processors three major advantages over selling NFDM into intervention stocks or onto the world market: (i) the price of MPC 42 was largely based on the U.S. price of NFDM,<sup>18</sup> which was generally maintained well above the world price through the DPSP;<sup>19</sup> (ii) NFDM used to produce MPC for export to the United States was,

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<sup>12</sup> The EU delivery quota system effectively caps milk production available to individual processors. Therefore, any processor's product mix decision becomes a zero sum game, where an increase in the production of one product must necessarily be offset by a decrease in the production of other products.

<sup>13</sup> Intervention in the NFDM market is used to support farm-gate milk prices. Chapter II of Council Regulation 1255/1999 outlines the basic measures for market intervention programs and EU Commission Regulation 214/2001 provides detailed rules for intervention in the NFDM market.

<sup>14</sup> The United States was not a designated destination, and therefore NFDM exports to the United States were not eligible for export refunds.

<sup>15</sup> To manage the distribution of export refund licenses to ensure a balanced flow of exports throughout the year and limit exports to WTO commitments, the EU Commission could apply a reduction coefficient to license applications in any given distribution period. If the quantity of applications exceeded the quantity of licenses that the EU Commission desired to issue in a given distribution period, the reduction coefficient, based on the ratio of licenses applied for to the quantity the EU Commission desired to issue, could be applied to all applications, which resulted in each applicant receiving only a portion of the licenses that were applied for. Before May 2000, this provision was not applied to NFDM used to manufacture MPC, which had been classified as a non-Annex I product.

<sup>16</sup> The Agricultural Agreement negotiated during the Uruguay Round limited the quantity and expenditure for export refunds of NFDM and other dairy products. Unused commitments, however, could be carried over to subsequent years and used without penalty until June 30, 2000.

<sup>17</sup> MPC 42 is a blend of 10 percent casein and 90 percent NFDM. Source: European Dairy Association, selected members of the casein industry committee, interviews by USITC staff, Brussels, Belgium, Oct. 15, 2003.

<sup>18</sup> The price of MPC 42 in the U.S. market is directly related to the NFDM support price. MPC 42 prices collected by the USITC questionnaires, however, can not be disclosed because they contain confidential business information. Therefore, the U.S. NFDM price was used as a proxy for the MPC 42 price. Based on the protein content, MPC 42 prices would be expected to be slightly above the U.S. NFDM support price level.

<sup>19</sup> The Dairy Price Support Program attempts to support raw milk prices by requiring the U.S. Department of Agriculture to purchase domestic surpluses of butter, cheddar cheese, and NFDM at prespecified prices.

unlike pure NFDM, eligible for export refunds because MPC had been classified as a non-Annex I product,<sup>20</sup> and (iii) casein that was mixed with the NFDM was eligible for EU casein production aid.<sup>21</sup> The confluence of decisions related to these three policies with world market conditions during 1996-2002 created economic rents that could only be accessed via trade in MPC between the European Union and the United States, creating a superior return for EU processors on the production and sale of NFDM in the form of MPC 42 in the U.S. market, versus the sale of NFDM into EU intervention or onto the world market. Not only did these economic rents provide the opportunity for EU milk protein processors and exporters to increase revenues; they provided opportunities for U.S. milk protein end-users to reduce their cost of milk protein.

## **QUANTIFYING POLICY-DERIVED BENEFITS FROM EU-U.S. TRADE IN MILK PROTEIN CONCENTRATE**

As described previously, several U.S. and EU policy instruments contributed to the economic rents generated from low-protein MPC trade between the United States and the European Union. However, the data necessary to directly measure the level and distribution of these economic rents were not available. Discussions with EU processors suggested that publically available and reliable proxies existed. To estimate these economic rents, a composite variable, hereafter identified as net potential revenue (POTREV), was developed based on publically available data. Use of the term “revenue” is not meant to imply that only producers or exporters benefitted from this trade. In reality, these rents would have been divided among EU processors and exporters and U.S. users and importers based on negotiated or contracted sales prices, shipping costs, and the costs of production.

POTREV represents the economic rents generated from producing and exporting, to the United States as MPC 42, a blended milk protein product consisting of about 90 percent NFDM and 10 percent casein, over and above the revenues that would be generated from selling the product into the world market. Thus, POTREV was calculated by summing the U.S. CCC purchase price, 90 percent of the NFDM export refund converted to a dollar value, and 10 percent of the EU casein production aid converted to a dollar value, less shipping and U.S. import costs, less the Western European export price for NFDM. U.S. average monthly imports of MPC by quarter, and net potential revenue and its components are shown in table 1.

### **U.S. Support Price and the CCC-EU Price Gap**

The CCC purchase price for NFDM is a contributing factor to economic rents associated with U.S. MPC imports from the European Union. According to EU industry officials, the price of MPC 42 in the U.S. market is largely based on the U.S. price of NFDM. The CCC purchase price for NFDM under the DPSP acts as a floor for the U.S. NFDM market price. During 1997-2003, a surplus of NFDM in the U.S. market resulted in the U.S. market price being at, or close to, the support level. Therefore, the CCC purchase price for NFDM was key in setting returns from selling EU produced MPC in the U.S. market, and also provides a proxy for the MPC 42 price.

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<sup>20</sup> The EU export refund program contains provisions for ingredients used in manufactured products, so called non-Annex I products, to receive export refunds; for example, cream used to manufacture Irish Cream liquors is eligible for export refunds.

<sup>21</sup> European Dairy Association, selected members of the casein industry committee, interview by USITC staff, Brussels, Belgium, Oct. 15, 2003.

Table 1

Monthly mean values of variables used to calculate net potential revenue, the U.S. support price-EU export price gap, and chapter 4 milk protein concentrate (MPC) imports, by quarter, 1996-2002

Year/ quarter	CCC NFDM support price	90 percent of EU export refund	10 percent of EU casein production aid	Gross potential revenue	Shipping and import costs	Western Europe export price	Net potential revenue	CCC purchase-EU export price gap	U.S. imports of MPC from the EU
	(a)	(b)	(c)	(d)=(a)+(b)+(c)	(e)	(f)	(g)=(d)-(e)-(f)	(h)=(a)-(e)-(f)	
	<i>Dollars per metric ton</i>							<i>Metric ton</i>	
1996:1	2,347	570	266	3,183	131	2,114	938	102	161
1996:2	2,347	557	263	3,167	153	1,918	1,095	276	322
1996:3	2,347	670	268	3,284	154	1,834	1,296	359	635
1996:4	2,347	712	267	3,325	145	1,888	1,293	314	886
1997:1	2,310	664	249	3,223	140	1,812	1,271	358	306
1997:2	2,310	645	242	3,197	149	1,697	1,351	465	629
1997:3	2,310	597	231	3,138	135	1,606	1,397	569	572
1997:4	2,310	661	239	3,209	136	1,638	1,436	537	534
1998:1	2,296	665	231	3,192	144	1,473	1,575	678	467
1998:2	2,296	677	234	3,207	136	1,452	1,620	709	606
1998:3	2,296	752	238	3,286	82	1,343	1,860	871	1,103
1998:4	2,296	878	251	3,424	116	1,229	2,079	950	1,102
1999:1	2,227	873	255	3,355	115	1,261	1,980	852	780
1999:2	2,227	856	248	3,331	100	1,217	2,014	910	1,762
1999:3	2,227	850	246	3,323	102	1,289	1,932	837	1,894
1999:4	2,227	805	238	3,270	126	1,392	1,753	710	2,296
2000:1	2,227	683	215	3,125	123	1,463	1,539	641	2,138
2000:2	2,227	540	204	2,971	104	1,607	1,259	516	2,754
2000:3	2,227	375	177	2,779	110	2,045	624	72	1,503
2000:4	2,227	127	153	2,507	116	2,100	291	11	704
2001:1	2,217	124	154	2,495	104	2,083	308	30	237
2001:2	2,136	86	131	2,352	157	2,017	179	-37	154
2001:3	1,984	5	115	2,104	67	2,023	13	-107	287
2001:4	1,984	56	109	2,149	94	1,791	265	99	228
2002:1	1,984	269	95	2,348	110	1,445	793	429	341
2002:2	1,984	534	100	2,618	154	1,200	1,264	630	701
2002:3	1,984	739	174	2,896	138	1,175	1,583	671	908
2002:4	1,911	622	199	2,732	120	1,353	1,259	438	847
<b>Monthly descriptive statistics:</b>									
Mean	2,205	557	207	2,969	124	1,624	1,221	458	888
Standard Deviation	143	265	56	401	30	317	597	317	734
Median	2,227	647	233	3,167	126	1,588	1,333	511	649
Maximum	2,347	892	270	3,444	208	2,188	2,136	988	3,240
Minimum	1,764	0	95	2,100	38	1,150	-33	-199	38

Sources: Compiled from official statistics of the U.S. Department of Commerce, European Commission, U.S. Department of Agriculture; and U.S. International Trade Commission staff estimates.

To maintain the U.S. milk support price, the CCC is required to purchase NFDM and butter. As the cost of purchasing and storing surplus butter relative to NFDM grew in the early 1990s, the United States Department of Agriculture (USDA) made four changes in the ratio of the purchase prices for butter and NFDM that increased the CCC purchase price for NFDM from \$0.79 per pound to \$1.034 per pound

between 1990 and 1993.<sup>22</sup> After these adjustments, the CCC purchase price for NFDM remained at \$1.034 until January 1996 when implementation of the 1996 Farm Bill increased the milk support price from \$10.10 per cwt to \$10.35 per cwt, which resulted in a corresponding increase in the CCC purchase price for NFDM to \$1.0634 per pound. During the next 4 years the milk support price was phased down to \$9.90 per cwt. Correspondingly, the CCC purchase price for NFDM decreased from \$1.0634 per pound in 1996 to \$1.01 per pound in 1999. The CCC purchase price for NFDM remained at \$1.01 per pound until January 2001, when changes in Federal Milk Market Orders necessitated an adjustment of the CCC purchase price for NFDM to \$1.0032 per pound.<sup>23</sup> This price adjustment, however, did not change the butter/NFDM price relationship. In June 2001, the first butter/NFDM price adjustment (tilt) since 1993 was implemented and the CCC purchase price for NFDM was reduced to \$0.90 per pound.<sup>24</sup> However, this tilt was not sufficient to reduce the accumulation of CCC stocks as expected; therefore, a second tilt was implemented in December 2002,<sup>25</sup> which reduced the CCC purchase price for NFDM to the current rate of \$0.80 per pound.

The correlation between the CCC purchase price for NFDM and POTREV was relatively small at 0.44. This reflects that the impact of the CCC purchase price on POTREV is indirect because it is measured by the price gap between the CCC purchase price for NFDM and the EU export price, and, therefore, dependent upon world market conditions. U.S. regulations did not allow the CCC purchase price to respond to changes in world market prices while EU policies adjusted to world market prices was a major contributing factor to the size and volatility of POTREV.<sup>26</sup> The price gap between the U.S. support price for NFDM and the EU export prices was highly volatile, expanding and contracting as EU policies responded to changes in world market prices. Consequently, the correlation between the price gap and POTREV was much higher, 0.94, than correlation between the CCC purchase price and POTREV.

### EU Export Refunds

The second key factor contributing to the level and variability of net potential revenue during 1996-2002 was the level of export refunds, which was highly variable during this period (table 1). From the second quarter of 1996 to the fourth quarter of 1998, the contribution of EU export refunds to net potential revenue rose from \$557 per mt to \$878 per mt. The contribution of export refunds was maintained above \$800 per mt through the fourth quarter of 1999; but, then fell to less than \$100 per mt by the second quarter of 2001. After dropping to \$5 per mt in the third quarter of 2001, the contribution

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<sup>22</sup> The support prices of butter and NFDM must be kept at a ratio that maintains the milk support price. Consequently, a decrease in the support price of one commodity necessary implies an increase in the support price of the other commodity. This action is known as a tilt. Cropp, B., "Marketing and Policy Briefing Papers, Dairy Price Support Program Options." Department of Agriculture and Applied Economics, University of Wisconsin-Madison, found at [http://www.aae.wisc.edu/future/publications/supportprogram\\_cropp.pdf](http://www.aae.wisc.edu/future/publications/supportprogram_cropp.pdf), retrieved on July 21, 2004.

<sup>23</sup> United States Department of Agriculture, Farm Service Agency. "News: USDA Announces Adjustment in 2001 Purchase Prices for Milk and Milk Products." Washington, DC. January 18, 2001. Found at <http://www.fsa.usda.gov/pas/news/default.htm>, retrieved on July 19, 2004.

<sup>24</sup> United States Department of Agriculture, Farm Service Agency. "News: USDA Announces Adjustment in 2001 Purchase Prices for Milk and Milk Products." Washington, DC. May 31, 2001. Found at <http://www.fsa.usda.gov/pas/news/default.htm>, retrieved on July 19, 2004.

<sup>25</sup> United States Department of Agriculture, Farm Service Agency, Kansas City Commodity Office. "Bulk Dairy Products Contract Awards." December 6, 2002. Found at <http://ftp.fsa.usda.gov/public/dairarch/DAIR1206.TXT>, retrieved on July 19, 2004.

<sup>26</sup> The 1996 Farm Bill authorized the U.S. Secretary of Agriculture to tilt the butter/NFDM price ratio as often as twice per year to minimize CCC purchase and storage costs. The Secretary, however, was not authorized to tilt the butter/NFDM support prices in response to world market conditions. The EU Commission, however, was required to adjust export refunds to changes in world market conditions (Court of Auditors).

of export refunds increased to \$739 per mt by the third quarter of 2002. U.S. imports of MPC from the European Union appeared to increase and decrease correspondingly.<sup>27</sup> The high variability of export refunds demonstrated a high degree of correlation, 0.84, with POTREV.

MPC trade was, however, indirectly influenced by additional policy decisions that affected the administration and distribution of export refund licenses. First, the World Trade Organization (WTO) Agricultural Agreement placed caps on the quantity and value of export refund licenses that the European Union could issue. Initially, the EU Commission did not fully utilize their annual commitment, even though the annual quantity of NFDm on which the European Union was allowed to issue export refunds fell from 335,000 mt in the 1995/96 reporting year to 272,500 mt in the 2000/01 reporting year (table 2).<sup>28</sup> This had future consequences because the Agricultural Agreement also allowed that all unused export refund commitments could be carried over and used without penalty in subsequent years. Therefore, the quantity of NFDm on which the European Union could issue export refund licenses actually increased from year to year during the transition period (table 2). However, carry-over provision expired in June 2000.

**Table 2**  
**European Union's export subsidy commitments to the World Trade Organization and intervention stocks for non-fat dry milk, 1995/96 to 2001/02**

Accounting period <sup>1</sup>	Initial commitment		Amount of exports	Carry over from previous period	Available Quantity		Peak non-fat dry milk stocks	
	Quantity	Use Rate			Quantity	Use Rate		
	metric tons	percent			metric tons	percent	metric tons	month
1995/96 . . . . .	335,000	72	241,239	0	335,000	72	( <sup>2</sup> )	( <sup>2</sup> )
1996/97 . . . . .	322,500	84	269,493	93,761	416,261	65	130,000	Jun 1997
1997/98 . . . . .	310,000	57	175,506	146,768	456,768	38	183,800	Jun 1998
1998/99 . . . . .	297,500	74	221,452	281,262	578,762	38	256,700	Jun 1999
1999/00 . . . . .	285,000	146	417,236	357,310	642,310	65	273,500	Aug 1999
2000/01 . . . . .	272,500	47	127,989	0	272,500	47	38,400	Jul 2000
2001/02 . . . . .	272,500	32	86,868	0	272,500	32	120,900	Jun 2002

<sup>1</sup> The accounting period runs from July 1 to June 30.

<sup>2</sup> Not available.

Source: European Union Commission and ZMP Dairy Review.

At the same time that carry-over export refund commitments were accumulating, the European Union was accumulating NFDm intervention stocks. By August 1999, EU member states held 273,500 mt of NFDm in government-owned stocks. Because of the carry-over provision, the EU Commission was able to issue export licences such that U.S. monthly imports of MPC from the European Union exceeded 1,000 mt during the 18-month period from April 1999 through September 2000. U.S. monthly imports of MPC from the European Union averaged 2,092 mt, an annual rate of 25,106 mt, during this 18-month period. During the entire period, 1996-2002, monthly U.S. imports of MPC from the

<sup>27</sup> Changes in U.S. imports of MPC appear to have lagged behind changes in the contribution of export refunds to POTREV. This is most likely influenced by two provision of EU export refund policy; the pre-fixing provision that allowed exporters to apply for and be issued export refund rates well in advance of actual exports; and expiration provisions that allowed export refund licenses to be used several months after they were issued.

<sup>28</sup> The accounting year for World Trade Organization commitments is from July 1 to June 30.

European Union averaged 888 mt, or an annual rate of 10,656 mt. Excluding the 18-month period, the monthly U.S. imports of MPC from the European Union averaged 559 mt, or an annual rate of 6,708 mt. Consequently U.S. imports of MPC from the European Union were nearly 3.75 times greater during this 18-month period than the periods before and after. At the end of this period, intervention stocks had been reduced to 38,400 mt.

In addition to the carry-over provision, the regulations regarding the administrative and distribution of export refunds for NFDM used in the production of MPC were less cumbersome and less restrictive than those for the direct export of pure NFDM. The EU Commission classified MPC blended from basic dairy ingredients, such as NFDM, casein, and whey protein, as a non-Annex I product, thus making the NFDM used to manufacture MPC eligible for export refunds regardless of its destination, including the United States. This program was even more attractive to processors and exporters because, prior to May 2000, applications for export refund licenses for non-Annex I products were not subject to reduction coefficients (see footnote 15), which reduced the uncertainty inherent in the licensing process.<sup>29</sup> Application of reduction coefficients to non-Annex I products after May 2000, therefore, increased uncertainty for EU exporters of MPC to the United States. Under this system, if export license applications in a given period exceed the quantity or value that the EU Commission planned to allocate, a coefficient (based on the ratio of total export refund applications to total export refunds provided) was applied, such that only some portion of each application was awarded. As a result, exporters did not know the actual amount of refund that would be received. According to EU industry officials, this uncertainty made applications for export refunds unattractive for many EU dairy exporters since such contracts required export refunds to be competitive.<sup>30</sup>

### **EU Casein Production Aid**

Production aid for skim milk used to produce the casein used as an ingredient in MPC also contributes to the economic rents of producing and exporting MPC to the United States. Casein production aid was available to EU processors regardless of the casein's intended use. The contribution of casein production aid to POTREV was far less volatile during 1996-2002 than that of other policy instruments. From the first quarter of 1996 until the second quarter of 2000, the contribution of casein production aid to net potential revenue generally decreased, but varied by only \$64, falling from a high of \$268 in the third quarter of 1996 to a low of \$204 in the second quarter of 2000 (table 1). The mean during this period was \$243 per mt. After the second quarter of 2000, the contribution of casein production aid to net potential revenue ranged from \$95 to \$199, averaging \$141, considerably less than during the earlier period. The correlation between POTREV and the casein aid contribution was 0.39, the lowest among the variables contributing to POTREV. Casein production aid was relatively stable when compared to the other variables included in POTREV, therefore, the proportion of net potential revenue contributed by casein production aid was negatively correlated with POTREV; decreasing (increasing) as POTREV increased (decreased).

### **Net Potential Revenue**

The volatility of world NFDM prices relative to internal prices in the protected domestic markets of the United States and the European Union was a major contributor to the volatility of POTREV. Driven by low world prices, both the contribution of the EU export refund and the contribution of the

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<sup>29</sup> Commission Regulation (EC) No 238/2000, *Official Journal of the European Union*, L24/45 (Jan.28, 2000).

<sup>30</sup> Export licenses subject to export refunds must be executed within 4 months of being awarded or the license and the deposit on the license are forfeited. This time is insufficient for companies to negotiate and execute supply contracts for many of these products.

U.S. support price–EU export price gap peaked during the fourth quarter of 1998. From 1996 to 1998, the U.S. support price decreased by only 2 percent. Meanwhile, the gap between the U.S. support price and the EU export price increased by 831 percent, and the contribution of the EU export refund increased by 54 percent. In the first quarter of 1996, the price gap represented 11 percent of POTREV; whereas, EU export refunds represented 61 percent of POTREV. By the fourth quarter of 1998, the portion of POTREV contributed by the price gap had increased to 46 percent, while the portion contributed by the EU export refund had decreased to 42 percent. Correspondingly, POTREV peaked at \$2,079 per mt in the fourth quarter of 1998, a 122-percent increase from \$938 per mt in the first quarter of 1996 (table 1).

### **Relationship Between Net Potential Revenue and U.S. Imports of Milk Protein Concentrate from the European Union**

The relationship between U.S. imports of MPC from the European Union (IMPMPC) and net potential revenue (POTREV) is illustrated in figure 4. The simple correlation between POTREV and IMPMPC was 0.57. As POTREV increased steadily, from \$908 per mt in January 1996 to a peak of \$2,135 in October 1998, IMPMPC increased, but more erratically,<sup>31</sup> from less than 200 mt per month in January 1996 to more than 1,000 mt per month in December 1996, but quickly dropped back to less than 200 mt per month by February 1997. From early 1997 through early 1998, IMPMPC was relatively stable, but then increased rapidly, from a monthly average of less than 500 mt in the first third of 1998 to a monthly average of more than 1,000 mt in the last third of 1998. From its peak in October 1998, POTREV moderated, but remained above \$2,000 per mt through June 1999, and above \$1,500 per mt through February 2000. IMPMPC, however, continued to increase, jumping from an average of less than 1,000 mt monthly in the first third of 1999 to an average of more than 2,000 mt monthly in the second third of 1999, peaking at more than 3,000 mt in May 2000. After POTREV dropped below \$1,500 per mt, IMPMPC declined rapidly and dropped below 500 mt by November 2000. During 2002, however, POTREV began to increase, peaking at more than \$1,500 per mt, which stimulated another surge in U.S. MPC imports from the European Union. Since May 2003, POTREV has not exceeded \$1,000 per mt. During this time, U.S. MPC imports from the European Union have exceeded 500 mt per month only once. These results suggested additional research into the relationship between POTREV and IMPMPC.

### **TESTING THE STATISTICAL RELATIONSHIP BETWEEN NET POTENTIAL REVENUE AND U.S. IMPORTS OF MILK PROTEIN CONCENTRATE FROM THE EUROPEAN UNION**

Net potential revenue (POTREV) and U.S. MPC imports from the European Union (IMPMPC) were estimated as a vector autoregression (VAR) model for two reasons. First, as described above, the recent USITC report on milk protein products clearly established a link between POTREV and IMPMPC. This link is convincingly supported by the previous detailed analysis of POTREV and IMPMPC data and trends. A statistical analysis of such trends with a VAR model will illuminate the existence and strength of evidence supporting the hypothesis that U.S. MPC imports from the European Union have been systematically driven by POTREV movements over time. And second, the analysis below establishes that both variables are likely stationary in levels, thereby having precluded cointegration as an issue and the need to have modeled the system as a vector error-correction model (see Johansen and Juselius 1990, 1992).

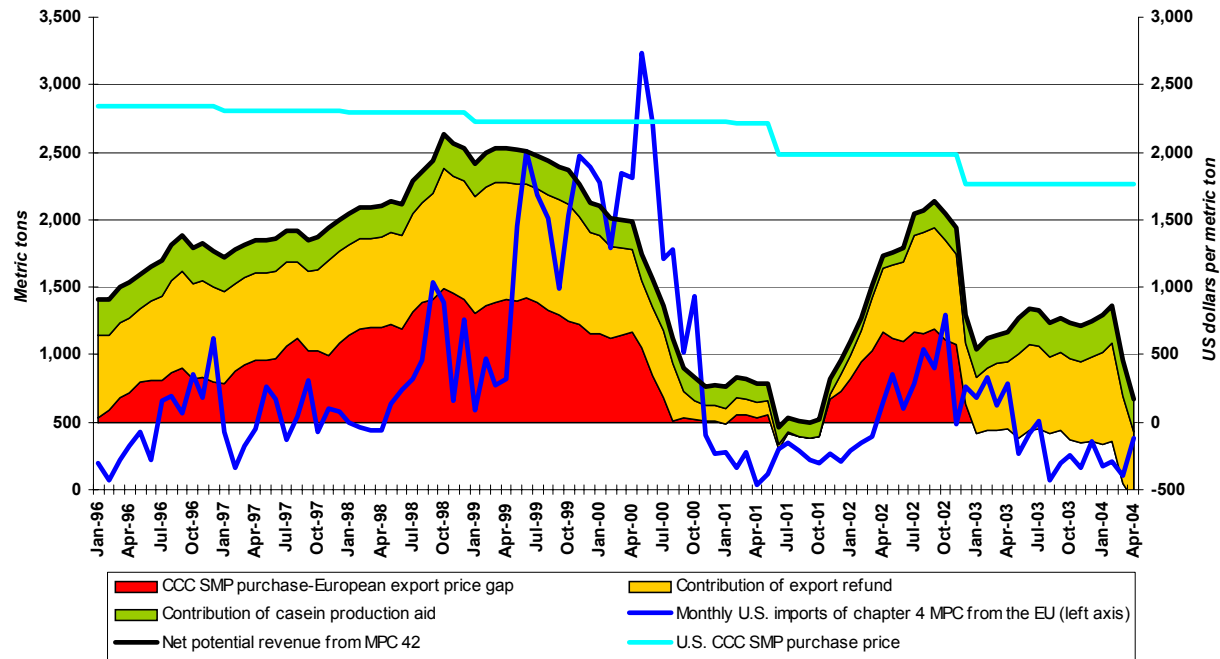
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<sup>31</sup> Export refund licenses are issued at selected times throughout the year. The time between each distribution of export refund licenses is typically more than one month, however the periods between each distribution are not necessarily uniform. Furthermore, export refund licenses are usable for several months after being issued. Therefore, some of the variability in IMPMPC is attributable to the method by which export refund licenses are issued.



**Figure 4**

**Monthly U.S. imports of milk protein concentrate from the European Union, net potential revenue and its components, January 1996 – April 2004**



Sources: U.S. Department of Commerce, U. S. Department of Agriculture, and U.S. International Trade Commission estimates.

VAR modeling methods are well-known and are not reviewed here.<sup>32</sup> Generally, VAR models are reduced-form models of theoretically related sets of series, where each endogenously modeled series is posited as a predetermined number of lags of itself and of the remaining endogenous series (Bessler; Patterson, ch. 14; Hamilton, ch. 11). The chosen VAR specification is as follows:

$$(1) \text{ POTREV}(t) = a_0 + a(s, t-1) \cdot \text{POTREV}(t-1) + a(s, t-2) \cdot \text{POTREV}(t-2) \\ + a(m, t-1) \cdot \text{IMPMPC}(t-1) + a(m, t-2) \cdot \text{IMPMPC}(t-2) + R(s, t)$$

$$(2) \text{ IMPMPC}(t) = b_0 + b(s, t-1) \cdot \text{POTREV}(t-1) + b(s, t-2) \cdot \text{POTREV}(t-2) \\ + b(m, t-1) \cdot \text{IMPMPC}(t-1) + b(m, t-2) \cdot \text{IMPMPC}(t-2) + R(m, t)$$

In this specification, POTREV and IMPMPC represent net potential revenue and MPC imports from the European Union, respectively, with the parenthetical  $t$  referring to the current period- $t$  value, and the parenthetical  $(t-1)$  and  $(t-2)$  terms referring to the two lags. The  $a$  and  $b$  terms refer to the estimated regression coefficients on the net potential revenue and MPC imports, respectively, and the parenthetical terms on these coefficients refer as follows:  $s$  and  $m$  refer to coefficients on POTREV and IMPMPC in each equation, and the  $t-i$ , where  $i = 1, 2$ , refers to the lagged values.  $R(s, t)$  and  $R(m, t)$  refer to the white noise residuals on the POTREV and IMPMPC equations, respectively. The nought-subscripted coefficients refer to the intercept estimates.

<sup>32</sup> Readers interested in detailed descriptions of these methods are referred to Sims, Bessler, and to such texts as Patterson and Hamilton.

## Specification Issues, Cointegration, and Model Adequacy Diagnostics

The lag selection methods of Tiao and Box were employed to the data, and suggested a two-order lag in equations 1 and 2 above. We collected and considered monthly data during the 1996:01-2002:12 period.<sup>33</sup> Given the 6 months needed for the Tiao-Box lag selection procedures, the 1996:07-2002:12 estimation period was rendered. The beginning and ending points for this time series were selected to correspond to three dairy policy events: implementation of the 1996 Farm Bill, which attempted to make dairy policy more market-oriented (Bailey, 1999); the period during which U.S. Government stocks of NFDI increased from zero to more than 1 billion pounds (USITC, 2004); and the point at which butter-powder tilts reduced the gap between the U.S. support price and the European export price to zero or less (figure 4).

A number of binary (dummy) variables were included in each equation. Eleven seasonal binary variables were included to capture seasonal effects. Another binary variable was defined as unity for 2000:04 and thereafter (and at zero otherwise) to account for establishment of an effective reduction coefficient regime for non-Annex I products, as described above. As well, a binary variable was defined at unity during the 1999:05-2000:10 period and zero otherwise to account for an increased availability of EU export refund licenses associated with carried-over WTO export subsidy commitments as described above.

## Cointegration and Data Stationarity Properties

Cointegration was not an issue because evidence, on balance, from three stationarity tests suggested that the POTREV and IMPMPC series are likely stationary in levels. Based on recent VAR econometric research, we conducted tests developed by Dickey and Fuller on the POTREV and IMPMPC levels data.<sup>34</sup> The Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) test results may have encountered well-known problems of bias towards conclusions of nonstationarity when, as in this study, data series comprise small samples and are “almost nonstationary” with roots which approach, but fall short, of unity.<sup>35</sup> Sole reliance on such results and under such conditions as those faced herein may result in inappropriate first-differencing of such “almost nonstationary” series and in serious mis-specification problems arising from inappropriate purging-out of relevant long-run data components (Engle and Granger; Harris, pp. 27-29; and Kwiatowski et. al.). To avoid such problems, we followed procedures in recent VAR econometric research and supplemented the DF and ADF tests with results from additional tests (Babula, Bessler, and Payne, pp. 6-7; Babula and Rich, p. 6). More specifically, we applied three unit root tests to POTREV and IMPMPC levels data: DF tests; the unit root test of Kwiatowski et. al. (hereafter the KPSS test); and the Bayes odds-ratio test provided in Doan (p. 6.20). Following recent research, we concluded that a levels variable was likely stationary if results from at least two of the three tests suggested evidence of stationarity. POTREV and IMPMPC both generated rather inconclusive

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<sup>33</sup> Throughout, the two digits right of the colon refer to monthly dates, such that 2002:01 and 2002:12 refer to January and December of 2002, respectively.

<sup>34</sup> More specifically, we applied well-known Dickey-Fuller and augmented Dickey-Fuller (DF, ADF, respectively) tests developed by Fuller (1976) and by Dickey and Fuller. These tests are summarized in Hamilton (pp. 762-64).

<sup>35</sup> Harris (pp. 27-29) notes that DF-type unit root tests often fail to reject the null hypothesis of nonstationarity when, as in this study, samples are small and/or when time series are “almost nonstationary,” that is, stationary but with roots approaching unity. Kwiatowski et. al. note that classical statistical hypothesis testing generally requires strong evidence to reject a null hypothesis that is nonstationarity for DF-type tests, and recommend using their KPSS test, with the opposing null of stationarity, to generate supplemental evidence when results of DF-type tests are marginal or ambiguous. As part of our precautionary measures against false conclusions of nonstationarity for what may be stationary series with near-unity roots, we conducted the DF or ADF tests at significance levels approaching 10 or 20 percent rather than at levels of 5 percent or less (Babula and Rich, p. 7).

and/or ambiguous evidence of nonstationarity – results that were not unexpected in this agriculturally based scenario with potentially near-unity roots and small samples.<sup>36</sup> However, results from the KPSS and Bayes odds-ratio tests applied to levels of both variables suggested evidence that both series are likely stationary.<sup>37</sup> Since evidence generated by two of these three unit root tests applied to each variable's data levels suggested stationarity, we concluded that POTREV and IMPMPC were likely stationary in levels and we treated the two-variable vector as a stationary one. Consequently, we chose to model the variables as a VAR model in levels rather than as a vector error-correction model since cointegration was likely not a relevant issue.

### **Diagnostic Evidence of the Estimated Model's Adequacy**

Results from Ljung Box portmanteau (Q) and DF tests applied to a VAR model's estimated residuals provide a basis on which to discern specification adequacy of the estimated model (Granger and Newbold, pp. 99-101; Babula, Bessler, and Payne, p. 7; Babula and Rich, pp. 6-7). Since the following VAR equation Ljung-Box Q values fall below the critical chi-square value (19 degrees of freedom) of 36.2, evidence at the 1-percent significance level is insufficient to reject the null hypothesis that each equation has been adequately specified: 17.17 for POTREV and 24.9 for IMPMPC. Following Granger and Newbold's (pp. 99-101) recommendation that one not rely exclusively on portmanteau test evidence to discern model adequacy, we applied DF  $T\tau$  tests to the VAR model's two sets of estimated residuals, with stationary residuals indicative of model adequacy. Because the following two DF pseudo- $T\tau$  values are negative and have absolute values exceeding those of the -4.04 critical value, evidence at the 1-percent significance level is strongly sufficient to reject the null that each set of residuals is nonstationary: -10.1 for POTREV and -8.9 for IMPMPC. Evidence from the Ljung-Box and DF test on the two sets of VAR residuals suggest that both VAR equations have been adequately specified.

Evidence also suggested that the estimated VAR equations did not experience statistical structural change, such that the estimated regression parameters are likely time-invariant and valid over the full estimation period. Chow tests detailed in Kennedy (pp. 87-88) were applied to both equations to test the null hypothesis of no structural change at each of four points: 2000:04, the point when the EU Commission implemented a reduction coefficient for manufactured products that embodied dairy ingredients; 2000:07, the point at which the option for the European Union to carryover unused WTO export refund commitments expired; and at 1999:05 and 2000:11, the beginning and ending dates of the period of increased availability of EU export refund licenses associated with carried-over WTO export

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<sup>36</sup> The augmented Dickey-Fuller or ADF  $T\tau$  test was chosen for POTREV levels, and based on a two-order lag chosen from Akaike and Schwarz lag selection routines provided in Doan, while a DF  $T\mu$  test was chosen for IMPMPC. The pseudo-t values of -2.5 for POTREV and -2.4 percent for IMPMPC suggested that evidence in both cases approached levels adequate at significance levels near the 20 percent level of statistical significance to reject the null hypothesis of nonstationarity. Given our small samples, the chances of stationary series with near-unity roots, and the well-known DF, ADF test problems of results biased towards nonstationarity under such circumstances, we followed Babula and Rich (p. 7) and concluded that evidence of nonstationarity was inconclusive and we applied further supplemental unit root tests (unit root test of Kwiatowski et. al. and Doan's (p. 6.20) Bayes odds-ratio test to the levels data of both variables.

<sup>37</sup> Evidence at the 1% significance level from Kwiatowski et. al.'s KPSS test was insufficient to reject the null hypothesis of stationarity with both variables since the KPSS value (with trend) of 0.19 fell below the critical value of 0.216 for POTREV and since the KPSS value (non-trended) of 0.51 fell below the 0.739 critical value for IMPMPC. Evidence from the Bayes odds-ratio test was sufficient to reject the null hypothesis of nonstationarity for both variables in small samples because POTREV's test value of 0.538 exceeded the -0.101 critical value and IMPMPC's test value of 5.67 exceeded the -1.95 critical value. For details on the Bayes odds-ratio test, see Doan (p. 6.20).

subsidy commitments.<sup>38</sup> For both equations and at all four junctures of potential change, evidence was insufficient at the one-percent significance level to reject the null hypothesis of structural change.<sup>39</sup>

### **Analysis of Forecast Error Variance Decompositions**

Analysis of decompositions of forecast error variance (FEV) is a well-known tool of VAR econometrics for discerning relationships among the two modeled VAR variables. Closely related to Granger causality analysis, FEV decompositions also provided evidence concerning the simple existence of a causal relationship among two variables, here POTREV and IMPMPC (Bessler, p. 111). However, analysis of FEV decompositions goes further than Granger causality tests: a modeled endogenous variable's FEV is attributed at alternative time horizons to shocks in each modeled endogenous variable (including itself), and not only provides evidence of the existence of a relationship among two variables, but illuminates the strength and dynamic timing of such a relationship (Bessler, p. 111; Babula, Bessler, and Payne, pp. 15-17). We provide the FEV decompositions at alternative monthly time horizons for MPC imports, as estimated in the above VAR model. These provide the percentage of MPC variation attributable to movements in net potential revenue and to movements in itself.

Sims and Bessler (p. 111) noted that for a VAR model to generate reliable FEV decompositions, one must fully account for both serial correlation (causal relationships over time) and contemporaneous correlations (causal relationships in current time) among a VAR model's endogenous variables. Bessler and Akleman noted that a VAR typically accounts for serial correlations over time via the chosen lag structure, but says little about contemporaneously correlated current errors or causality relations (Bessler, p. 112; Bessler and Akleman, pp. 1144-1149). A common and traditional way to handle such contemporaneous correlations has been to impose a Choleski decomposition, whereby one imposes a theoretically based Wold causal ordering on the variance/covariance matrix of the estimated VAR (Bessler, p. 111). Given that there are only two variables comprising the VAR model (POTREV and IMPMPC), the choice of orderings was straightforward: POTREV causes IMPMPC or IMPMPC causes POTREV in contemporaneous time. Evidence from USITC fieldwork in the European Union clearly suggested that POTREV has been influencing U.S. MPC imports both in contemporaneous time and over time (USITC 2004). As a result, the chosen ordering of the two-variable VAR was that POTREV causes IMPMPC, with no apparent need to pursue other alternative ways of ordering systems of endogenous VAR variables in contemporaneous time.<sup>40</sup>

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<sup>38</sup> This period, 1999:05 to 2000:11, was selected based on the time over which monthly U.S. imports of MPC from the European Union exceeded 1,000 metric tons per month. This period covered 18 months rather than the 12 months covered by the July 1999 to June 2000 reporting period for WTO export refund commitments for two reasons. First, the increased level of imports would have required that the EU Commission began to increase the level of export refund licenses issued before July 1999. Second, licenses that were issued before June 2000 could continue to be used after June 2000.

<sup>39</sup> Chow tests of structural change were conducted at four junctures of potential structural change: 1999:05, 2000:04, 2000:07, and 2000:11. A critical F-value (5 percent, 16/46 degrees of freedom) of 2.42 tested the null hypothesis of no structural change for each equation and at each of four junctures of potential change. Evidence was insufficient to reject the null when the calculated Chow test value fell below 2.42. The calculated Chow test values were as follows: 0.91 for POTREV and 0.64 for IMPMPC at 2000:04; 1.78 for POTREV and 1.39 for IMPMPC at 2000:07; 1.94 for POTREV and 0.87 for IMPMPC at 2000:11; and 0.45 for POTREV and 1.63 for IMPMPC at 1999:05. In all cases, evidence at the five percent significance level was insufficient to reject the null hypothesis of no structural change.

<sup>40</sup> Given the fieldwork findings just noted and the simplicity of the two-variable VAR, there was no apparent need to explore alternative methods of ordering variables in contemporaneous time. These include structural VAR modeling orderings developed by Bernanke and orderings based on analysis of directed acyclic graphs developed by Bessler and Akleman. See Bernanke (pp. 183-99) and Bessler and Akleman (pp. 1144-1146). A summary of these two alternative methods is provided in Babula, Bessler, and Payne (pp. 8-9).

The well-specified VAR model above clearly establishes evidence supporting the recent USITC trade study on milk protein products that there is a strong statistical relationship among net potential revenue and MPC imports. The FEV decomposition patterns in table 3 emerged.<sup>41</sup>

**Table 3**  
**Forecast error variance (FEV) decompositions of U.S. MPC imports.**

<b>Monthly horizon</b>	<b>Percent explanation of IMPMPC variation from POTREV movements</b>	<b>Percent explanation of IMPMPC variation from own-variation</b>
Month 1 .....	8.43	91.57
Month 2 .....	15.46	84.54
Month 3 .....	22.26	77.74
Month 4 .....	27.77	72.23
Month 6 .....	34.57	65.43
Month 9 .....	38.34	61.66
Month 12 .....	39.17	60.83
Month 18 .....	39.30	60.70

Source: U.S. International Trade Commission staff estimates.

A number of points are noted. First, FEV decompositions suggest that up to about 39 percent of the MPC imports' variation is driven or attributable to movements in net potential revenue by the 18-month horizon. Second, there is a gradual unfolding of this POTREV influence on IMPMPC. More specifically, movements in net potential revenue have MPC influences that are initially small (8 percent at the month-1 horizon), gain in strength through month-3 where they explain up to 22 percent IMPMPC variation, and ultimately explain about 39 percent of the variation in IMPMPC. Appreciable POTREV-induced effects on IMPMPC take a few months to arise.

## SUMMARY AND CONCLUSIONS

U.S. imports of milk protein concentrate classified under subheading 0404.90.10 of the HTS surged to record levels during 1996-2000, and surged again, but to a lesser extent, during 2002. Also during this time, CCC stocks of non-fat dry milk went from near nothing to record levels. Moreover, U.S. milk producers experienced low and volatile prices and incomes during this period. Consequently, U.S. milk producers blamed this surge in imports, and by extension the drop in milk prices and incomes, on subsidized exports of low-protein blended MPC from the European Union, which had been classified by the BCPB under HTS subhead 0404.90.10, and, therefore, not subject to TRQs. U.S. milk producers lobbied the U.S. Congress to introduce legislation that would apply TRQs to these products. As part of the legislative process, the U.S. Senate's Committee on Finance requested that the USITC investigate the competitive conditions of various milk protein products in the U.S. market.

During this investigation, the authors researched the circumstances surrounding the surge in low-protein MPC imports from the European Union during 1998-2002. What was discovered was that U.S. producers were partially correct in their assumptions concerning the surge in U.S. MPC imports: U.S. MPC imports from the European Union did consist of low-protein MPC blended from NFDM and casein that was subsidized by export refunds and casein product aid. Nonetheless, while subsidies were necessary for European Union processors to manufacture these products, subsidies alone were not sufficient to induce trade between the European Union and the United States. Trade required willing buyers as well as willing sellers.

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<sup>41</sup> POTREV is a variable that is, as expected, largely exogenous to the modeled system. No less than about 97 percent of POTREV's behavior can be attributed to movements in itself. As a result, and in an effort to conserve space, no need was discerned to report POTREV's forecast error variance decompositions.

Willing buyers were created only when the price gap between milk protein products in the United States, mostly in the form of NFDM, and milk protein products on the world market was sufficiently large to induce U.S. processors to search for alternative sources of milk protein. The factor that contributed most significantly to the price gap was, therefore, the CCC purchase price for NFDM, which can not be adjusted in response to changing world market situations, but only in response to the CCC's cost of purchasing and storing non-fat dry milk. Consequently, the butter/powder tilt implemented in June 2001 had little or no effect on U.S. imports of MPC, which had already dropped to less than 500 mt per month as the price gap was driven to near zero by world market conditions. As the price gap reopened in 2002, imports again surged to more than 1,000 mt per month, but quickly dropped back after the price gap was eliminated by the December 2002 tilt and world market conditions. Since the December 2002 tilt, the price gap measured as CCC purchase price minus the European Union export price has been negative.

Each of the policy variables examined – export refunds, casein production aid, and CCC purchase price – represents an institutional price, set by government fiat, rather than the market. Furthermore, each policy variable contributed to the total economic rents generated during 1996-2002, and was necessary for trade in MPC to take place. However, no individual policy generated sufficient economic rents to provide both willing sellers and willing buyers. To accommodate this intersection of disparately-sourced policy variables, the POTREV variable was developed as a proxy for these economic rents.

Visual comparison of POTREV with IMPMPC suggested a relationship. To confirm and quantify this relationship a vector autoregression model was developed and analyzed. Results of this analysis generated statistically strong evidence that POTREV did indeed have a Granger causality effect on IMPMPC; specifically, variation in POTREV has likely elicited nearly 40 percent of the variation in IMPMPC. Furthermore, the analysis showed the existence of a learning curve as the impact increased from less than 9 percent in month 1 to nearly 40 percent in month 18.

This analysis clearly demonstrated that European Union policies affecting the competitiveness of milk protein in the U.S. market should not be analyzed in isolation of U.S. dairy policies when investigating their impact on U.S. imports of milk protein concentrate. Furthermore, it demonstrated the worth of developing a method for estimating the economic rents generated by these policies that may be applied to other such investigations. Finally, it demonstrated the value of the vector autoregression technique in confirming and quantifying the relationship between economic rents and U.S. imports of milk protein concentrate.

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