

THE GREAT GLOBAL VITAMINS CONSPIRACY: SANCTIONS AND DETERRENCE *

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ABSTRACT

This paper is an excerpt of a comprehensive examination of the global bulk vitamins cartels of the 1990s. In terms of its precision and breadth of coverage, the quantitative information now available on vitamins surpasses that of almost any other modern cartel. For example, the internal records of the major defendants have yielded monthly transaction prices for 53 bulk vitamin products over periods of up to 22 years.

Evidence is presented that these 16 interrelated cartels were the largest discovered international price-fixing schemes of the late 20th century in terms of affected commerce and direct overcharges. On the other hand, the percentage increases in bulk vitamin prices wrought by the cartels were merely average. The formation of the cartels by and large occurred in markets that were in terms of their structures and historical modes of behavior ideally suited for overt collusion. Although organizationally similar in many respects, the cartels also displayed a wondrous variety of collusive conducts. Only six of the cartels died natural deaths.

There is little question that the convicted members of the vitamins cartels were in absolute monetary terms the most heavily sanctioned defendants in the history of antitrust law. Yet, it is equally non-controvertible that the impressive corporate monetary sanctions imposed worldwide were inadequate to deter recidivism.

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JEL Classification Nos. L41, L44, L65, L11, L13, N60, K21, K14

INTRODUCTION ¹

To paraphrase an Iranian propaganda slogan, the vitamins cartel was the “Mother of All Global Cartels.” It was the most elaborate, longest lasting, and most harmful of the international cartels discovered by the U.S. Department of Justice (DOJ) the 1990s. It was also the biggest U.S. cartel discovered since the Great Electrical Conspiracy of the 1950s. Moreover, the success in vitamins spawned the formation of other international cartels. The initial steps in establishing global conspiracies in vitamins were taken in 1985, but these early efforts required renegotiation and the addition of more products and more conspirators in 1988 and 1989. Most of the vitamins cartels did not end until early 1999.

By 1990 the early signs of financial success in vitamins price fixing were so convincing to the participants that they were moved to explore the feasibility of forming more feed or food ingredient cartels. Memoranda have come to light that show the citric acid cartel was formed in 1991 by Hoffman-La Roche explicitly because of its profitable prior experience in vitamins.² Then the cartel contagion spread within Archer Daniels Midland (ADM) from its citric acid division to its lysine operations in 1992.³

From 1988 to 1992 21 chemical manufacturers headquartered in seven nations joined the bulk vitamins cartels, and the number of markets infected by price fixing would grow 16 distinct products.⁴ Sales by these cartels exceeded \$30 billion, an amount that is quite likely the largest of any discovered international conspiracy since 1990 (Connor and Helmers 2006). The pharmaceutical manufacturers involved became virtually addicted to the infusion of monopoly profits, giddy financial results that prompted the conspirators to continue their clandestine activities for up to 15 years. These illegal activities persisted in the face of several public prosecutions of parallel conspiracies, multiple antitrust investigations of the vitamins industries, mounting economic sanctions by antitrust authorities, and strenuous efforts to stop the collusion by some of the conspirators’ own company lawyers. The conspirators simply burrowed deeper and developed more elaborate methods of subterfuge.

¹ Dates, references, and other facts about the vitamins cartels can be found in Appendixes D and E of Connor (2000), Connor (2001), and Connor (2006b).

² ADM was involved in at least two U.S. price-fixing conspiracies prior to 1991, carbon dioxide and high fructose corn syrup. In 1991-92 ADM became the prime mover in two more cartels, the global citric acid and lysine cartels (Connor 2001).

³ Ironically, after a cartel is discovered by antitrust authorities, much like the methods used by public health officials to trace the spread of venereal diseases, a reverse contagion process works to assist in cartel prosecutions. Under the corporate leniency programs of the United States, the EU, and other jurisdictions, amnesty for antitrust violations can be obtained if a company under investigation agrees to cooperate with officials by revealing a cartel in a second product market.

⁴ Every commercial vitamin except K and D2 were cartelized. One of the 16 products is “other carotenoids,” which consists of four compounds each with unique uses.

The vitamins conspirators erected a mechanism of customer exploitation that incorporated almost every technique of cartel organization that had ever been devised. These exploitive techniques resulted in historic monopoly overcharges on customers. Buyers of animal feeds; of fortified foods; of meat, poultry, fish, eggs, and milk; of vitamin supplements; and of cosmetics in every corner of the world paid inflated prices for these goods. These overcharges later appeared as extraordinarily high profits on the income statements of the participating vitamin manufacturers.

Most of the conspiracies were exposed to the world one day in May 1999 at a widely publicized Department of Justice press conference in Washington DC. Eventually, the antitrust authorities of at least nine countries and the European Union would open formal investigations of the vitamins cartels, and several of them would impose record fines on the companies involved.⁵ For the first time in the history of the 1890 Sherman Act, the United States imprisoned several high-ranking foreign executives for price fixing. In addition to actions of government prosecutors, more than 100 law suits were filed by buyers of bulk vitamins in the United States, Canada, Australia, and the United Kingdom seeking compensatory and punitive damages. In 2004 the U.S. Supreme court became involved in the vitamins cartels by issuing a ruling that significantly altered the way in which defendants in international cartels can be sanctioned. By the end of 2005, the members of these cartels had in absolute dollar terms become the most harshly punished antitrust violators in the history of the world. These worldwide prosecutions have turned the vitamins cartels into a “poster child” for general deterrence.

The principal purpose of this paper is to detail the size of the economic harm generated by the vitamins cartels and the monetary sanctions imposed and to assess the effectiveness of those sanctions to deter recidivism. Despite the heavy sanctions imposed by prosecutions around the world, the most somber lesson to be drawn from these dreary episodes is that the crime of price fixing pays.

Uses of Vitamins

Nowadays, about 30% of world production ends up in pills and capsules for purchase over the counter as nutrition supplements. Except for vitamin B4, large amount of all the vitamins and carotinoids are purchased by pharmaceutical companies to be mixed and packaged for sale directly to consumers (Table 1). Indeed, the primary use of vitamins B1, B6, and B12 is for human nutrition supplements. In more recent years, it is common to find vitamin E and other vitamins added to cosmetics and skin creams.

⁵ The United States, Canada, EU, and Australia each imposed record monetary fines. Two early investigations of the French competition-law council failed to discover incriminating evidence. As of early 2005, Brazil’s antitrust authorities were still investigating, Mexico’s decision was unknown, Japan’s and Switzerland’s had decided to issue only cease-and-desist orders, and New Zealand’s had exceeded the statute of limitations.

Table 1. Relative Size of the Feed, Food, and Pharmaceutical Channels for Vitamins						
	World 1987-1998			U.S. 1990-1998		
Product	Feed	Food	Pharma	Feed	Food	Pharma
	<i>Percent^a</i>					
E	73	3	23	34	13	52
C	8	50	42	1	66	33
A	87	6	7	85	7	8
B4 Choline chloride	100	0	0	100	0	0
B5 Cal Pan ^b	69	3	22	40	9	51
B2 Riboflavin	75	8	17	18	31	51
B3 Niacin	73	11	14	43	25	32
B6	42	8	49	1	14	85
H Biotin	85	4	10	75	7	18
B12	58	2	40	30	3	67
B1	35	16	49	1	24	75
D3	93	3	4	43	0	57
Folic acid (B9)	79	17	15	16	44	40
Beta carotene	8	64	28	10	47	44
Other carotenoids ^c	92	7	1	23	77	1
Total	43	26	30	40	24	36

Source: März (1996) and Bernheim (2002a: 32-60).
-- = Not available
^a Percent of value of sales. Feed includes pet food and vitamins used in blends and premixes. Some rows may not add to 100% because of cosmetic and technical uses or because of rounding.
^b Calcium pantothenate.
^c Includes primarily canthaxanthin but also astaxanthin, apocarotenal, and apo-ester.

MARKET STRUCTURE

Because of its early technological lead and continuing improvements in the synthetic chemistry of vitamins manufacturing, Hoffmann-La Roche quickly became the dominant producer in the 1930s. While its shares of most vitamins markets slid somewhat, Roche retained its premier position throughout the 1990s, with an average 50% global share of its product lines. Roche was also the most diversified of the producers, making 13 of the 16 cartelized products and selling all of them.⁶ Only BASF came close to Roche in its degree of diversification (Table 2). When the vitamins cartels were formed in 1989-1991, Roche's average global share of the markets for 14 major vitamins was 46%. BASF, Rhône-Poulenc, and Takeda Chemical Industries were second, third, and fourth, with market shares of 18%, 8%, and 7%, respectively. Thus, the four largest companies supplied almost 80% of the global market for vitamins sold in bulk or in blends. Companies below the top four tended to be specialized in the manufacturing of one or two products.

Market Seller Concentration

It is inappropriate to view all vitamins as a single market at the manufacturers' level. True, when consumers buy multivitamins at retail or when feed manufacturers purchase vitamin premixes, these items contain blends of many vitamins. However, when the multivitamin supplement makers or feed premix companies buy vitamins, it is done on a vitamin-by-vitamin basis so that they can tailor the blends to the needs of the specific target group of end users. Whether speaking of human or animal populations, the metabolic functions for each vitamin are unique. One vitamin cannot be substituted for another with the expectation of avoiding some specific health or growth problem in a given species. Moreover, the manufacturing techniques used to make one vitamin will not work to make another. The combination of factories, machines, raw materials, technical knowledge, and other supply factors are unique to each vitamin.

Thus, differences in demand and supply characteristics assure that each of the 16 vitamins falls into its own separate market. Moreover, there is a sharp distinction between bulk vitamins destined for consumption by humans and those made for animal-feed market. Human-grade vitamins must meet higher standards of purity, must be packaged in containers affording greater protection from contamination, and typically are sold in lower strengths so as to avoid toxic effects.⁷ In some cases, food-grade, pharmaceutical-grade, and cosmetic vitamins may form separate markets. For example, vitamin powders would be preferred for tablets or dry food applications, whereas liquids would be needed for capsules, beverages, or skin creams. Of course, in a pinch human-grade vitamins might be substituted for feed-grade, but the typically higher prices of the former (on an active-ingredient or 100%-basis) would generally rule this out as a regular practice. Finally, within the human grades of vitamins, a distinction may be made between natural and synthetic versions, a distinction that is important for marketing purposes. Many consumers, especially those who shop in health-food outlets, will be willing to pay more for the natural version. In vitamin E, natural versions may be made with old-fashioned extraction methods or with newer fermentation techniques. In the United States, three manufacturers are specialized in the production of natural vitamin E (ADM, Eisai, and Henkel). Although only about

⁶ Technically there are four carotinoids, but beta carotene and other carotinoids will be counted as two products. Vitamin premixes is not shown in Table 2.

⁷ In some countries, pharmaceutical grades of bulk vitamins are purer than grades suitable for fortification of foods, but this is not typically the case. Very few vitamins have only one commercial type of vitamin.

20 percent of total vitamin E demand, the natural segment has been growing considerably faster than the synthetic version.

The significance of these market features is that the number of suppliers will be fewer for one vitamin type than all types of vitamins in the aggregate.¹² That is, seller concentration will be higher for natural human-grade vitamin E than for all grades and types of vitamin E. Thus, in general market shares for all types of a vitamin will understate the shares held by companies in the market for one type of that vitamin.

Table 2 shows the best available data on the global production shares of the 21 corporate members of the vitamins cartels. Looking at the individual vitamins markets, it is clear that the typical product market was dominated by at most three or four firms. An alternative measure of market shares is one based on value of sales. In general production shares and sales shares are quite close (Bernheim 2002a: 30-31). The main difference is that the sales shares of the big three manufacturers --- Roche, BASF, and Rhône-Poulenc – are one or two percentage points lower than their production shares. That implies that at the time the cartels were being launched in 1989-1990, the top three companies had lower rates of capacity utilization, whereas the remaining producers were operating at higher levels of capacity utilization. As the initiators and leaders of the vitamins cartels, the ability of the big three to quickly ramp up production with their existing plants was a distinct bargaining advantage during the negotiations that lead to firm cartel agreements.

Table 3 summarizes the degree of global seller concentration in the vitamins industries around 1990. These data include every major producer in the world, not just the members of the cartels. One measure of seller concentration is the four-firm concentration ratio (CR4), which is the sum of the market shares of the top four sellers in a market. Mean four-firm concentration in 1990 was an extremely high 97%. Because the vitamins cartels contained all of the top three of or four producers, cartel control is almost the same as CR4 in most markets. In only three bulk vitamin markets was CR4 below 90%, namely, biotin (88%), B6 (about 75%), and B4 (67%).⁸ The global markets for vitamins A, B2, B3, B9, B12, D3, E, and carotinoids are especially highly concentrated. Table 3 also shows the Herfindahl-Hirschman Index of global concentration.⁹ A value of 1800 or above is considered to be dangerously high for effective market performance. The minimum index for vitamin manufacturing is 2703 and the mean is 3980. A Herfindahl index of 3980 describes an industry that is practically a duopoly, because it is equivalent to an industry comprised of two large firms with 43% of the market each and one small firm with 14%. Market concentration is similar at the regional levels in Western Europe and North America (Connor 2006c: Tables 5 and 6).

⁸ As will be related below, the vitamin B4 manufacturers would devise a special form of conduct to solve the problem of relatively low sales concentration.

⁹ The Herfindahl index takes the market shares of each seller in an industry, squares it, and sums the squared shares. A monopoly has an index value of 10,000.

Table 2. Global Production Shares, 20 Companies and 15 Straight Vitamins, Early 1990s

Company	A	B1	B2	B3	B4	B5	B6	B9 ^a	B12	C	D3	E	H ^b	Caro- tinoids	World Markets ^c
	<i>Percent</i>														
Roche	48	44	54	S	S	36	49	39	S	46	43	46	45	83	46
BASF	30	2	30	S	15	21	3	S	S	7	13	28	S	16	17
Rhone- Poulenc	21		S	S		S			62	S		13	S		8
Takeda		31	3				12	23		26					7
Eisai												12			2
Daiichi						29	12								1
Lonza				58										5	2.3
E. Merck	S	S	S				5			10			10		2
Hoechst									7	S					1
Solvay	S		S							S	44	S	S		0.6
Akzo					15										0.8
Degussa				22 ^e											0.6
Reilly				22 ^e											0.3
Nepera				6											0.3
Chinook					19										1.0
Mitsui					10										0.5
DuCoa					18										1.0
UCB					13										0.7
Kongo								15							0.1
Sumitomo ^f								20						17	0.6
Tanabe		S												20	0.6
Cartel total	99	77	87	86	90	86	81	97	69	89	100	99	97	100	93

S = Sold but did not manufacture

Sources: Connor (2006c: Appendix Table 6).

a) Better known as folic acid

b) Better known as biotin

c) The total bulk vitamin sales of the company divided by global sales around 1990-1991. Excludes sales of premixes. The weighted average share with global market sales as weights of Roche, BASF, Rhone-Poulenc, Takeda, Daiichi and Lonza were 50%, 20%, 19%, 24%, 21%, and 33%, respectively.

e) Degussa and Reilly were joint venture partners.

f) Sumitomo's subsidiary Sumika sold folic acid.

Table 3. Global Market Concentration in 16 Vitamins Industries, Circa 1990			
Product	Firms <i>Number</i> ^a	Four-Firm Concentration Ratio	Herfindahl Index of Concentration <i>Percent</i> ^b
E	5	99	3214
C	7	87	3013
A	4	100	3646
B4 Choline chloride	6	100	3785
B5 Cal Pan ^c	5	95	2703
B2 Riboflavin	5	94	3887
B3 Niacin	4	98	3887
B6	7	87	2927
H Biotin	6	100	2846
B12	3	97	4239
B1	4	98	3312
D3	3	100	3954
Folic acid (B9)	6	97	2683
Beta carotene	2	100	7048
Other carotenoids	2	100	7450
Vitamin premixes	3	100	4934 ^d
Mean	4.6	96.8	3980

Source: März (1996), Bernheim (2002a: iii and 32-60), and Connor (2006c: Appendix Table 6).
-- = Not available
a) There were about 50 in China; however, for the calculations in this table they are treated as one company, which overstates concentration in some industries.
^b Percent of value of sales. Feed includes pet food and used in blends and premixes. Some rows may not add to 100% because of cosmetic and technical uses or because of rounding.
^c Calcium pantothenate.
d) Only Roche, BASF, and Rhone-Poulenc made premixes; assumed that their shares of the premix market were the same as their shares of all straight vitamins in 1987-1999.

Cartel Control of Markets

The four industry leaders attracted a total of 19 companies to the fictional collusive organization they would call “Vitamins, Inc.” The four largest companies controlled 78% of world wide production of bulk vitamins. The remaining 15 smaller manufacturers later convicted for price fixing collectively controlled only about 15% of the world market, but most of these smaller companies had significant market shares in one or two of the vitamin industries.¹⁰ Indeed, it appears that Vitamins, Inc. was comprised of every manufacturer of vitamins with more than a 10% share in each of the 16 cartelized markets.¹¹ Some of the more specialized companies have large shares in the few product markets in which they participate. Lonza, for example, was dominant in the vitamin B3 market. Only about 7% of global production remained outside the grasp of the vitamins cartels in the early 1990s, most of it in China.

In every case Vitamins, Inc. began colluding with very high degrees of worldwide control in each of the markets – 93% on average. In all but three of the markets the cartel controlled 90% or more of the market. Such high degrees of control meant that because the building of new capacity took years, the cartel was protected from entry by noncooperative price-cutters that would undermine the cartel’s price increases. Moreover, market control by Vitamins, Inc. in Western Europe and the United States was practically the same as at the global level. On average, the cartels would start out colluding with control over 90% to 91% of these two jurisdictions.

The market shares of individual manufacturers varied across the two regions in predictable ways. Most of the European firms (BASF, Lonza, Akzo, etc.) had greater penetration of the European market than the U.S. market. Similarly, U.S. firms tended to have higher shares in their home country than in Europe. Except for biotin, the Japanese manufacturers had more success penetrating the U.S. market than the European one; moreover, one can infer that Japanese and Chinese firms had higher shares in Asian markets than in Europe.

However, there are four markets in which the cartels began with lower levels of regional control than world control. In the cases of vitamins B1, B6, and B12, the cartels had much higher market control in Western Europe than in the United States; for vitamin C the reverse is true. Low regional cartel control may have contributed to the fragility of three of these cartels.

In most of the cartels control slipped during the conspiracy periods. For the nine cartels for which the information exists, five experienced significant entry by sellers outside the collusive group. Vitamins, Inc. lost about 20 percentage points of global market share from the founding of the biotin (B9) and vitamin C cartels until their demise.¹² In vitamins B1, B2, and B6 markets, the cartels lost 8 to 10 percentage points during the conspiracies. All of these are water-soluble vitamins. In four of the five cases, it was Chinese vitamins manufacturers who were responsible for the erosion of cartel control. On the other hand, despite high prices Vitamins, Inc. held on to its market shares in vitamins A, D3, H, and carotinoids. There is no information on the remaining five vitamins.

¹⁰ The mean market share held by the smaller manufacturers was 16.6% (Table 2). In 90% of the cases, the small companies’ shares were 9% or higher.

¹¹ The Japanese firm Alps Pharmaceutical had a 10% global share of the vitamin B5 market, and Nippon Chemical had a similar share of vitamin B12 (Connor 2006c: Appendix table 6). These are quite exceptional cases, because the next highest share of a fringe firm was 5% (Korean manufacturer E. Sung in biotin).

¹² De Roos (2004) has a sophisticated model that explains the dynamics of the vitamin C cartel.

Buyer Concentration

Buyer concentration in the bulk vitamin and vitamin premix markets is generally quite low. Animal feed manufacturers are numerous because many serve local markets; there were more than 2000 in the United States alone in the 1990s (Schiek and Connor 1997). Many large agricultural producers of pork, chicken and eggs purchase bulk vitamins directly from chemical manufacturers. There are a similar number of food processing companies¹³ that purchase vitamins to fortify their products. In large markets there are dozens of pharmaceutical companies that buy bulk vitamins to make multivitamin pills or capsules. Finally, there are scores of chemical brokers and wholesalers that purchase large quantities of vitamins and resell them in smaller amounts to small farmers, feed mills, or food processors.

A report by the European Commission has some information on buyer concentration in Western Europe (EC 1976:4-5). This report noted that the dominant firm Hoffmann-LaRoche maintained accounts for about 5000 buyers for its products. Twenty-six of its most important customers accounted for merely 16% of its sales of bulk vitamins.

Homogeneity

At first blush, the markets for bulk vitamins appear to be rather heterogeneous. Within nearly all the 16 vitamin “families” (A, E, C, B1, etc.), there are those suitable for human consumption and those made for incorporation in animal feeds, and the latter cannot legally be substituted for sale to pharmaceutical or food-processing companies. Moreover, some vitamins are available in alternative physical forms, such as, oils, dry powders or aqueous solutions. Finally, all the vitamin families are marketed in a range of strengths that are based on the percentage of active vitamin compound. For example, choline chloride (vitamin B4) is typically sold in four forms: aqueous 70%-pure, aqueous 75%, dry 60%, and dry 50%. The wet forms of choline chloride tend to be preferred by different customers than the dry powders. These four items are animal feed ingredients and account for 99% of the value of all choline chloride (Bernheim 2002a: 41). Most other bulk vitamins are sold in six to 12 versions that account for the vast majority of sales in the vitamin family.¹⁴

Although there are multiple quality grades and strength levels available for most bulk vitamins, it is clear that for a given grade of bulk vitamin there is little or no differentiation across producers. A vitamin has a unique molecular structure with unique biological properties. Vitamins are widely viewed as “commodities,” that is, products so homogeneous that delivered price net of discounts is the only factor driving buyers’ decisions. For each vitamin there is likely to be one variety, typically the modal one, that drives the prices of all other varieties of the same vitamin. Human-grade tends to sell in fixed price relationship to the same vitamin’s feed grade; the same is true of different strengths when converted to a 100%-pure basis. Prices of 100%-pure human and 100%-pure feed versions of the same vitamin are very highly correlated over time.¹⁵ This customary pricing practice is convenient for collusion, because sellers need only agree on one

¹³ Biotechnology companies like ADM purchase large quantities of vitamins to optimize the metabolism of the microbes they have harnessed to produce amino acids and even vitamins themselves. It is ironic that ADM received such large settlements from the vitamins cartels that it was required to report the amounts because they had a material effect on profits in some of its financial quarters.

¹⁴ Vitamin premixes are sold in thousands of different formulas. Roche alone offered about 4,200 premixes in the 1990s (Bernheim 2002a: 187). BASF marketed almost 3,000.

¹⁵ Bernheim (2002a: 84-121) has carefully constructed such time series for 1980-2001. Feed and human price patterns are nearly identical for all vitamins except perhaps vitamins B3 and beta carotene.

price for each vitamin, from which the prices of all other types will be priced using historical premiums or discounts.

The only departure from perfect product homogeneity may be in after-sales services provided by the leading manufacturers. In the earlier decades of the vitamins industries, manufacturers sold most of their output directly to food, feed, and pharmaceutical manufacturers. The manufacturers' representatives were in a position to pass on fresh research findings about dosages and effectiveness to their customers. Slowly, as the research moved into the public domain and government agencies set recommended levels, the need for this type of after-sales service dried up. However, in the 1980s Roche and BASF leveraged their large product portfolios by developing networks of premix plants to serve agricultural producers and feed manufacturers. Sales of these premixes may have involved after-sales technical advice. A survey of this issue by the UK Competition Commission found that a few premix customers found customer support important in choosing a supplier (UKCC 2001: 13); however, the Commission later concluded that competition between suppliers of bulk vitamins "... is primarily on price" (*ibid.* p. 16). The European Commission is of the same opinion (EC 2003).

Entry Conditions

Getting access to the sophisticated synthetic chemistry needed to produce most vitamins is difficult. That and mastering the implementation of large scale manufacturing of vitamins appear to be the major barriers to entry. Entry is slow and impeded by sunk costs and excess capacity. A report of the European Commission summarized technical barriers from an internal 1972 memorandum by Roche:

"Mass production of synthetic vitamins ...requires heavy investment, since the synthesizing process is in large measure unique to each group of vitamins and highly specialized equipment is necessary. Plants used for manufacturing vitamins of one group cannot therefore be used for producing vitamins for another group, nor is the conversion of [a] plant for such production a simple matter...[P]roductive capacity is normally geared to the estimated growth in demand over 10 years...At present there is surplus capacity throughout the world for the production of vitamins" (EC 1976: 2).

Technological impediments vary somewhat across vitamins. Actual entry patterns reveal differences in the height of entry barriers in the manufacture of vitamins (Connor 2006c: Table 7). Producing the "oil-soluble" vitamins A, B3, D, and E seems to present the greatest difficulties for entry because they are still largely in the hands of the original producers, Roche, BASF, and Rhône-Poulenc; the same appears to be true for beta carotene and canthaxanthin. A somewhat lower degree of technological barriers to entry is revealed by production by Japanese chemical companies. Although evidence is spotty, Takeda, Eisai, and Daiichi seem to have begun producing vitamins B1, B2, B5, folic acid, and biotin a decade or two later than the big three European pioneers.¹⁶ The more moderate barriers for these B type vitamins can be inferred by the less advanced state of Japanese pharmaceutical and organic-chemicals R&D up to the 1950s; however, by the 1970s the general scientific prowess of Japanese research had caught up to U.S./Western European levels in most fields.

Finally, there are a few cases of vitamins where more recent entry has occurred on a large scale in newly industrializing countries with relatively backward scientific infrastructures. The case

¹⁶ In the case of vitamin H (biotin), the Japanese entrants were Tanabe and Sumitomo, each with about 20 percent of the world market.

of China in the 1980s and 1990s is particularly instructive, because the Chinese government has made investment in chemical industries with high export potential a high priority. Rapid rates of growth in Chinese exports of certain vitamins may be taken as an indicator that *technological* barriers to industry entry are fairly modest, especially access to knowledge about the synthetic chemistry required to implement feasible manufacturing methods. Thus, in those cases where Chinese vitamin exports were becoming competitive in the same markets to which the major European producers also exported, one can safely assume that patents or technological secrecy no longer protect the primacy of the established pioneer firms. There were six vitamin markets with large or growing Chinese exports to the United States in the 1990s: vitamins C, B1, B2, B6, B12, and folic acid. China's vitamin C imports were especially large, accounting for 54 percent of the value of total U.S. imports in 1996; B12 was next with 27 percent. The other four B vitamins were in the 8 to 13 percent import-penetration range, but growing. It is noteworthy that these are almost the same vitamins with significant Japanese production (B12 is the exception). However, there is little evidence of large-scale Chinese entry into synthetic production of vitamins A, E, B3, D, K, or – all markets supplied nearly exclusively by the pioneering, mostly European manufacturers. Therefore, technological barriers to entry appear to remain high for this last set of vitamins.¹⁷

The major significance of these suggestions about technological barriers in understanding the evolution of vitamin price fixing is the fact that the Chinese exporters were spoilers for the cartels. The Chinese vitamin companies were too small, too numerous, and too inclined to be aggressive about exporting – all characteristics that made them unsuitable candidates to recruit to the vitamins cartels. Whenever Chinese chemical companies could adopt production methods that made their vitamin production price-competitive (assisted by Chinese government export subsidies), they aggressively captured U.S. market shares that in some cases were so large that the cartels affected were unable to sustain their conspiracies. This certainly happened in the case of vitamin C around 1995. Chinese incursion into the U.S. market was also one factor for the early demise of the cartels established in vitamins B1, B2, B6, B12, and folic acid.

Summary of Structural Conditions

Most of the bulk vitamins industries were highly concentrated on a global level and had severe barriers to entry due to technological secrecy, market foreclosure of key inputs, or economies of scale or scope in production.¹⁸ Not counting an unknown number of small but aggressive Chinese vitamins manufacturers, the typical vitamin industry comprised from two to five companies that controlled more than 95% of worldwide output. Combined with the undeniable homogeneity of the products, these are the archetypes ripe for formation of durable collusive arrangements.

Few of the vitamins industries do not quite reach these monopolistic standards.

¹⁷ Connor (2006c: Table 8) provides additional specificity on the technical sources of possible barriers to entry into the manufacture of bulk vitamins.

¹⁸ The premix business had different types of barriers: availability of a complete array of bulk vitamins, mastery of the science animal nutrition and least-cost rations, an ability to offer custom blends tailored to specific customers, and a sales force trained to offer after-sales technical advice.

MARKET SIZE AND GROWTH

The sizes of the major vitamins markets varied considerably. Overall, however, the sales of the 16 vitamins and carotenoids that were affected by cartels were far greater than any other price-fixing conspiracies uncovered by antitrust authorities in the mid 1990s. Estimates of annual vitamin sales are shown for the world and four regions in Table 4.

Global sales of bulk vitamins sold “straight” were \$2.8 billion per year.¹⁹ Another product that was subject to price fixing in the 1990s was feed premixes.²⁰ Premix sales are very large, but are known with some precision only in North America. Counting premix sales, Vitamins, Inc. garnered annual worldwide sales of \$3.8 billion. As will be discussed below in greater detail, the vitamin cartel endured for as little as three and one-half years and as long as ten years.

For the entire affected periods of the 1990s, total sales in nominal dollars amounted to \$26.9 billion (Connor 2006c: Table 4A). Some of the vitamins markets may have been cartelized in the late 1980s, and their affected sales were \$7.0 billion. During the cartel periods, sales in the U.S. market accounted for about 28% of the global total and Canada for an additional 1.9%. In the U.S. market, three types of direct buyers may be distinguished. Western Europe accounted for 36% of global sales. Buyers in Asia, Africa, and Latin America purchased 35% of the cartelized vitamin products. One reason for the large global shares of Europe and North America is the fact that about half of the value of vitamins sold are for animal-feed use, and consumption of grain-based feeds for meat, poultry, and aquaculture production is especially intense on those continents. That is, relative to feed-grade, human-grade vitamins have higher geographic shares in Asia, Africa, and Latin America.

Vitamins A, C, and E are by far the largest of the bulk vitamins markets, accounting for 42 percent of total vitamin sales worldwide. Seven more vitamins and carotenoids had average annual sales of at least \$100 million per year in the 1990s. The smallest global vitamin markets are for folic acid and vitamin D3.

Vitamin markets in the 1990s could be described as mature. As recently as 1960-1975, the markets for bulk vitamins had seen their volumes expand by 10% per year (EC 1976). The average rate of volume growth worldwide for all vitamins in the mid-1990s was down to 2% to 3% per year. Only vitamins E and B5 (Cal Pan) could be described as growing rapidly, and this might be due to temporary factors such as recent publicity about the health benefits of antioxidants (including E and C).²¹ Most vitamin markets displayed negative or nearly zero volume growth in the 1990s. Rates varied across marketing channels as well, with cosmetic use of vitamins the fastest growing.

Table 4A shows total affected commerce of the vitamins cartels, and uses producer price indexes from Europe and the United States to express affected sales in present (real 2005) values. Global real affected sales were \$30.6 billion.

¹⁹ “Straight” vitamins are unblended product forms; the internal sales records of the largest vitamins makers use the German term “tel quel.” Straight vitamins included in premixes manufactured by the vitamins defendants are included.

²⁰ Sellers were convicted criminally and in civil actions of fixing the prices of feed premixes in Canada and the United States, but as of 2005 not in any other jurisdiction. Documents are not clear as to whether food-fortification premixes were cartelized. Affected sales of these products are approximate.

²¹ Epidemiological studies released in the 1980s appeared to demonstrate reductions in heart disease and certain types of cancer associated with consumption of vitamins A,C,E, and B3; but controlled experiments with human subjects a decade later failed to find any positive health benefits.

Table 4. Annual Sales of Bulk Vitamins, 1990s Collusive Periods					
Product	United States ^a	Canada ^b	Western Europe ^c	Rest of the World ^d	World ^f
<i>Million nominal U.S. dollars</i>					
A	89.6	6.9	159.9	73.6	329.9
B1	14.3	1.8	29.1	22.6	68.0
B2	29.1	2.5	49.3	20.7	100.2
B3 Niacin	35.6	1.9	33.3 ^e	33.9	104.7
B4 Choline	43.5	13.7	58.3	20.9	136.4
B5	22.4	1.7	37.6	8.4	70.1
B6	13.5	3.8	20.9	27.1	65.3
B9 Folic acid	3.3	0.6	5.7	1.3	10.9
B12	14.0	0.5	18.8 ^e	25.3	58.4
C	205.4	14.4	251.1	293.3	764.2
D3	7.8 ^e	0.5 ^e	10.7	7.1	26.1
E	180.0	13.0	229.2	87.1	509.3
H Biotin	30.3	2.0	26.9	41.8	101.1
Beta carotene	49.0	3.5	89.2	23.3	165.0
Carotinoids, other	14.5 ^e	0.8	84.5	140.6	240.1
Subtotal	752.6	60.6	1,107.8	836.9	2757.9
Premixes	291.4	19.3	375.0 ^e	355.2 ^e	1040.9
Total	1,044.0	85.5	1,482.8	1186.5	3798.8
<p>Source: Appendix Table 1, annualized by dividing by the guilty-plea period.</p> <p>a) Affected sales divided by plea periods; sales in the extended conspiracy period are 33.5% higher.</p> <p>b) Affected sales divided by Canadian "conspiracy period".</p> <p>c) Affected sales divided by EU conspiracy period. If not available, used U.S. dates.</p> <p>d) Estimated as a residual.</p> <p>e) Estimated as a proportion of more certain data available in other regions.</p> <p>f) Data from Bernheim (2002a: 33) divided by mean of U.S. and EU conspiracy periods.</p>					

Table 4A. Affected Sales of Bulk Vitamins, Collusive Periods					
Product	United States ^a	Canada ^b	Western Europe ^c	Rest of the World ^d	World ^f
	<i>Million nominal U.S. dollars</i>				
All vitamins in 1990s	7555	546	10308	8189	26600
All vitamins in 1980s	1974	143	2694	2140	6951
	<i>Million real 2005 U.S. dollars</i>				
All vitamins in 1990s	8996	667	11500	9432	30595
Source: Connor (2006c: Appendix Table 1) a) Sales in the extended conspiracy period 1985-1999 are 33.5% higher. b) Affected sales during the Canadian "conspiracy period". c) Affected sales during the EU conspiracy period. If EU not available, used U.S. dates. d) Estimated as a residual. f) Data from Bernheim (2002a: 33).					

TRADE AND LOCATION OF PRODUCTION

In the early 1990s the 21 members of the vitamins cartels of the 1990s owned 54 generally large vitamin production facilities that accounted for more than 90% of world production (Connor 2006c: Table 10). Twenty of these 54 plants were located in Western Europe, 19 in North America, 11 in Asia, and four in Latin America. In addition there were more than 60 generally smaller plants operated by fringe firms in China, India, Eastern Europe, and a couple of other places. Around 1990 these smaller plants supplied about 7% of world demand, but by the late 1990s they accounted for about 15%.

Western Europe, Japan, and China produced considerably more than was needed for consumption in those regions. Roughly speaking, those three regions manufactured about 40-54%, 20-25%, and 10% of the world's vitamins, respectively, yet they accounted for only about 50% of world consumption. Exports from those areas flowed to North America, Africa, Latin America, and other nations of Asia. North America imported about half of its demand (30% of the world's demand) and the rest of the world about three-fourths of the remaining 20%.

THE VITAMINS CONSPIRACIES

Collusion Begins

Makers of organic chemical intermediates have one of the highest rates of cartel formation of any industry, and vitamins are organic chemicals (Connor and Helmers 2006). Nearly 100 international cartels were formed in the chemical industries in the early 20th century (Leiden University 2005). One of them formed in 1928 pooled patents and divided world exports in vitamin D (Hexner 1946:347-349). International cartel conduct is more common among European and Japanese manufacturers than in North America. Because vitamins production was even more highly concentrated and more difficult to enter in the 1970s and 1980s than in the 1990s, it seems likely that overt collusion was practiced at least among firms within if not across the Western European and Japanese markets prior to 1990.²²

Global Cartel Connections

The initial financial success in raising the prices of vitamins A and E in 1990 prompted the formation of 12 additional cartels in 1990 and 1991.²³ However, there is considerable evidence to suggest that the effectiveness of the vitamin cartels inspired the formation of the citric acid cartel a year later. Moreover, there is irrefutable evidence that it was ADM's satisfaction with its citric acid scheme that incited an ADM officer to start the lysine cartel less than a year after citric acid was under way. Not only is there enough information on which cartel spread the infection that caused cartel fever elsewhere, but also there is a fair degree of certainty about which companies and which persons were the carriers. The causal chain of events linking the three global cartels is sketched in Connor (2006c: Figure 1).

Cartel Organization and Methods

The vitamins cartels resemble the innards of a Swiss watch. There were wheels within wheels (Figure 1).

Twenty-one manufacturers joined one or more of the conspiratorial groups that met to agree on prices and tonnage quotas, to monitor implementation, and to enforce those agreements. Of the 21 participants, 14 belonged to only one cartel, and seven belonged to multiple cartels. Hoffmann-la Roche was a member of 14 cartels.

²² Plaintiffs in the civil suits in the United States appear to have had some direct evidence of illegal collusion on a global basis in most of the bulk vitamins markets in the late 1980s. What the nature of that evidence is not generally known. Bernheim (2002a) cites several depositions that appear to provide direct evidence of collusion. Indirect evidence comes from highly suspicious U.S. transactions price movements in most bulk vitamins markets beginning in 1985 or 1986 and ending in late 1988 or early 1989. These price patterns trace the "hump-shaped" pattern that is characteristic of effective collusive behavior. The price humps are preceded by about four years of falling prices. It appears that collusion may have broken down briefly prior to the more durable cartels that were renegotiated in 1990 or 1991. These suspicious price patterns are observed in all the markets for oligopolistically structured vitamins markets except folic acid and B12 (Connor 2006c: Table 10A).

²³ As is explained below, the vitamin B3 and B4 cartels were organized before and separately from the 14 Roche cartels.

Price fixing was arranged for at least 16 products: 13 bulk vitamins, two carotenoids, and feed premixes.²⁴ In all but two of these cartels Roche, BASF, or Rhône-Poulenc took the lead in initiating the conspiracy. These may be called the “Roche cartels.” The first two cartels to be formed were at meetings held in 1989 for vitamins A and E. A year later the Big Three European firms and Hoechst formed four more cartels among themselves in the markets for vitamin B12, two carotenoids,²⁵ and premixes. In early 1990, Roche contacted Eisai of Japan, which was the only significant producer of vitamin E besides Roche and BASF. The last Roche cartel was formed in either 1990 or 1993 when Solvay agreed to join with Roche and BASF to cartelize the vitamin D3 market.²⁶ Except for D3, these six cartels were all up and running by early 1990 and formed the “core set” of cartels. The six core cartels are symbolized by the dark circle in the center of Figure 1.

Shortly thereafter in 1990-1991, Roche and BASF reached out to other European and Japanese rivals to consolidate their control of the five core cartels and establish seven more cartels (the four small circles intermeshed with the large grey circle). First, in 1990 Roche contacted Daiichi to form the vitamin B5 cartel, which was underway by early 1991 (Figure 2). Second, Roche approached E. Merck and Takeda to complete the membership of the vitamin C cartel and to recruit Takeda for the vitamin B1 and B2 cartels. Third, Takeda agreed to become the go-between in establishing the folic acid (B9) and biotin (H) cartels. In each case Takeda and two of the smaller Japanese manufacturers were needed to surpass the threshold of global control to make price fixing feasible. Therefore by early 1991, all 14 of the Roche cartels were successfully raising the prices of bulk vitamins.

²⁴ The mix of products that were subject to legal action varies by jurisdiction. The U.S. Government extracted guilty pleas from manufacturers of ten products, but private U.S. plaintiffs received settlements or favorable trial judgments on all 16 products. In Europe, no fines have yet been levied for vitamins B3 and B12 and premixes.

²⁵ Collusion between Roche and BASF in the market for beta carotene began a couple of years earlier than for canthaxanthin and the other carotenoids.

²⁶ The vitamin D3 cartel was not criminally sanctioned in North America. The EU dates the start of collusion as January 1994, but the private plaintiffs set the date at January 1990. The pattern of U.S. transaction prices support the earlier date (Bernheim 2002a:118-119).

Figure 1. Wheels Within Wheels: 16 products, 21 companies

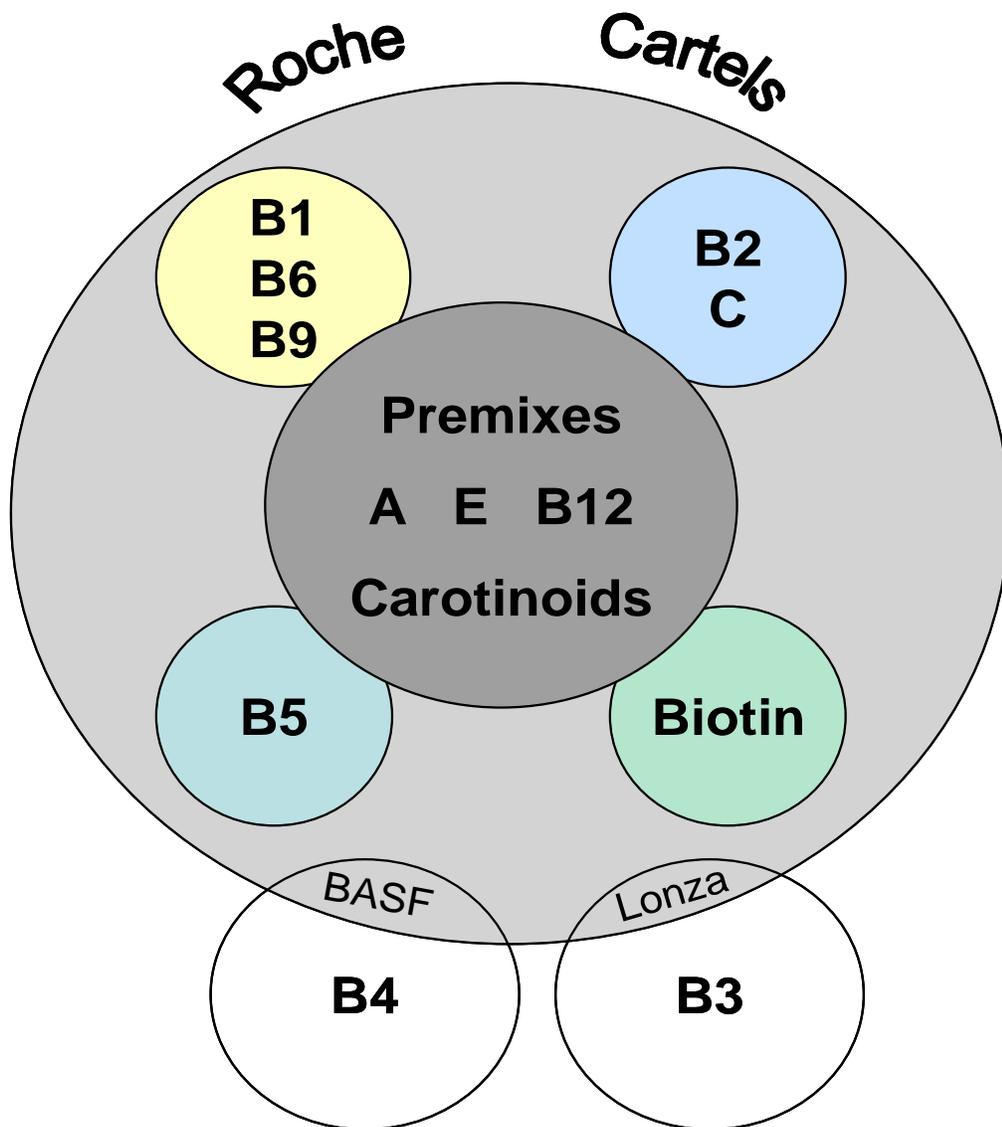
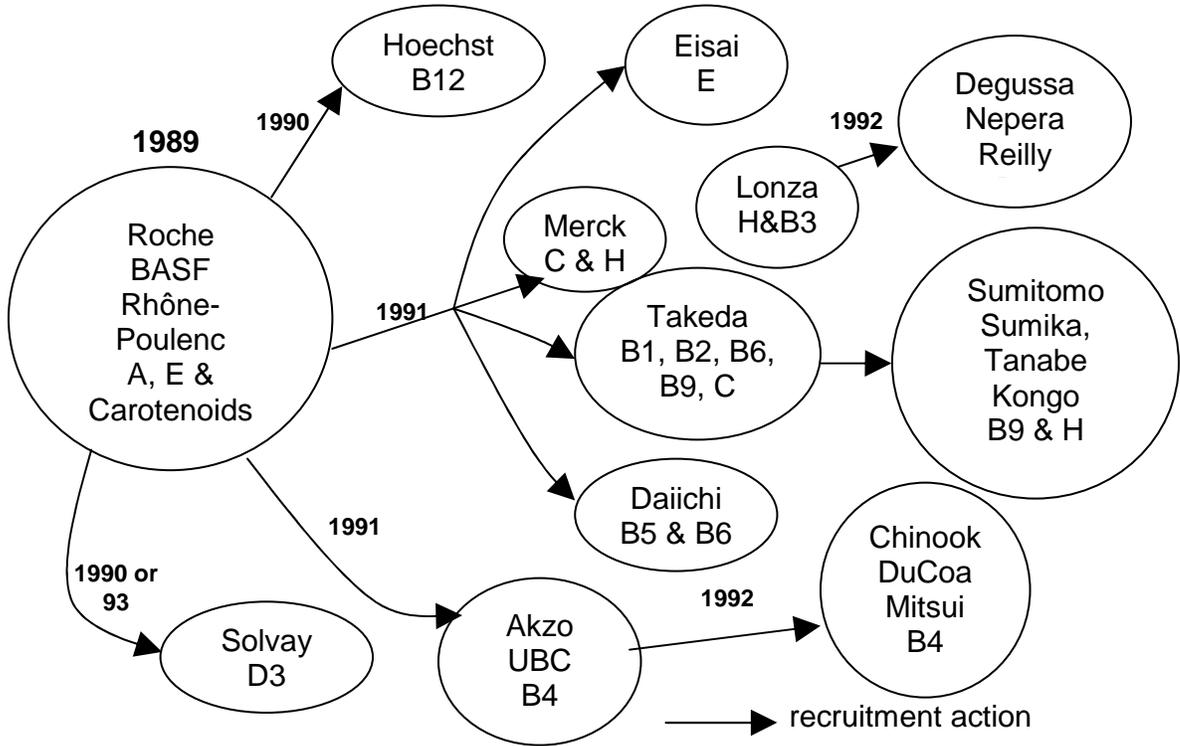


Figure 2. Vitamins in the 1990s: A Web of Conspiracies



Two more cartels got started later. They did not have Roche as a member, but they did have connections with other companies that had joined with one of the Roche cartels. That is why they are visualized as two small white circles just touching the large grey circle in Figure 1. First, the vitamin B3 cartel was launched in early 1992 by the dominant global producer, Lonza, which had begun colluding in the biotin market with Roche and others a year earlier. Lonza seems to have been the ringleader of this cartel that brought in one German producer and two smaller U.S. manufacturers. Second, the choline chloride (vitamin B4) cartel was the most remote from the Roche cartels. It comprised two branches, one centered in North America that had begun in 1988 with a Canadian, a Japanese, and a U.S. company. The other branch was initiated by BASF in 1991; together with two other European choline chloride makers, BASF negotiated an agreement with the three North American manufacturers that divided the two geographic markets through a cessation of trans-Atlantic trade in early 1992. Thus, though briefly joined by negotiations, the result was the establishment of two autonomous cartels, each branch with a geographic hegemony.

CHALLENGES TO COLLUSION AND RESPONSES

Like the I.G. Farben cartel in the 1930s, the vitamins cartels employed almost every trick in the price-fixer's book.²⁷ Large managerial resources were expended on complex price-fixing structures. After getting underway, in order to continue to be effective a cartel must deal with five problems: reconciliation of disparate member interests that may require renegotiation of the agreement, adaptation to a changed environment, unilateral defection (secret price cutting by members), entry by nonmembers, and avoiding detection by either customers or antitrust authorities. The purpose of this section is to pull together examples of conduct in the vitamins cartels that addressed these problems.

Renegotiating Agreements

It is virtually impossible to conclude a contract that has clauses to handle every eventuality, and cartel agreements are no exception. There are many recorded instances of flexible behavior among the cartelists that helped resolve disputes and thus preserve the fruits of collusion. The first example is the re-establishment of the 1985-1988 cartels. Roche and BASF learned from the breakdown of those agreements, principally by working out new rules and management structures for vitamins A and E in 1989-1990. These cartels became the models, but not all of the details were adopted for every other vitamin cartel.

Quarterly meetings were standard for most of the cartels. At these face-to-face meetings prices and quotas could be adjusted, anger could be vented, and solutions devised. The cartels almost always involved top managers with the authority to implement significant changes in a cartel's strategy. When prices did not respond sharply enough, it was not unusual for the original members to recruit new members, such as when Eisai was added to the vitamin E cartel after one year. To attract new capacity to the club, the leading members would at times diplomatically yield some of their production to give the newcomer an increase in its production. Roche went to great lengths to accommodate BASF's desire to replicate most of Roche's broad product line; the long-term deal in carotinoids was only the most extreme example of Roche's generosity. Of course, it made sense for Roche to keep BASF happy, because BASF was in the strongest position to retaliate.

In general the vitamins cartels did not engage in rigging bids, but because the vitamin C market had a few large buyers, an exception was made. The geographic regions selected for setting different prices usually was limited to three (Europe and the Middle East, North America, and the rest of the world). However, some cartels identified up to five price zones. If production was interrupted, such as the fire at Rhone-Poulenc's vitamin E plant, the cartel seized the opportunity to raise prices far higher than had been planned a few months earlier.

Monitoring Adherence to Quotas

Checking prices on transactions was not feasible, so the major technique for detecting cheating was for the members to share their internal production records with each other at the quarterly meetings. These data were used to compute company shares globally or in some cases regionally. Shading price would be revealed by a market share in excess of an allocated quota.

Occasionally such data would not prove to be sufficient, and they would be supplemented with government export data. The members knew the location of each member's plants and frequently a country would have only one plant, so a surge in national exports could serve to

²⁷ The conduct of the 16 cartels is discussed in greater detail in Connor (2006c).

cross-check members' production claims. Takeda was confronted with such evidence in the vitamin B2 cartel. Another related technique used in the choline chloride cartel was to create exclusive territories for two semi-autonomous branches. Trade data would detect departures from the hegemony agreement.

Even the best-intentioned criminals will exceed their grasp. Therefore, most of the vitamins cartels had compensation policies. Whenever a company exceeded its quota, that firm was obligated to sell the excess production at cost to an under achiever in the cartel. Resale of the transferred product would restore the planned division of monopoly profits. It is an understanding of this sort that makes increases in interfirm, intracartel sales an indicator of cartel activity.

Punishing Cheaters

Roche frequently took upon itself the role of the bully in a cartel. In clear if softened language, the EC decisions refer to multiple displays of anger directed by Roche representatives toward alleged cheaters.²⁸ In mid 1993 Roche thought that it had evidence of cheating in the vitamin B5 cartel; Roche and Takeda decided to punish Daiichi by matching the latter's price cuts.

The vitamin cartels rarely employed two punishment strategies suggested by cartel theorists. One method of disciplining putatively uncooperative cartelists is to instigate a price war. At the end of the first wave of cartels in the late 1980s, mild price wars may have occurred, but in the collusion of the 1990s nothing like full-blown wars occur. Another approach to instilling cartel discipline is the "trigger mechanism" – a threat announced at the beginning of a cartel to revert to competitive pricing if cheating is detected. Only in one cartel history is such a threat cited – that of E. Merck in biotin – but it is not particularly credible as it was a small producer.

Dealing with Arbitrageurs

The managers of Vitamins Inc. were well aware that international geographic arbitrage was capable of causing prices to fall below some optimal level in one of its regions. Vitamins are storable commodities, cheaply transported, and subject to unanticipated price changes because of multiple currency regimes. The vitamin B5 vignette is the clearest example of the cartelists' fear of arbitrage. The rule adopted was to keep price in one currency zone less than 10% above or below the prices (when converted to a common currency) in all other currency zones. If the geographic price spreads were kept below 10%, international transshipment would not be profitable. Exactly the same point was made in an internal Roche memorandum to its vitamins A and E sales managers. And in the vitamin C cartel, the Coca Cola Company was identified as a likely arbitrageur were vitamin C to become under priced in any part of the world.

Containing Aggressive Fringe Producers

The record is rather incomplete, but various tactics were employed to try to inhibit the expansion of fringe production, not all of them successful.

Testimony to the European Commission admitted that even in cases where the fringe was miniscule, the cartels considered measures to eliminate imports from fringe producers. Most of the exports were initially of low quality suitable only as feed grade, and there are statements that the cartels price discriminated against this grade. That is, they developed sub standard products or sold feed-grade vitamins at a significantly lower price on a 100% basis than the human grades that had less fringe competition. Another trick was for Roche and BASF to raise the prices of selected straight vitamins because rival premix makers would then be at a price disadvantage in premixes compared to Roche and BASF. Indeed, there are statements in the record that suggest

²⁸ A personal communication to the author by a plaintiff's lawyer alleges that Roche executives had accompanied such accusations with loud shouting and throwing of heavy objects at his client.

that the intent was predatory. In the vitamin B5 market this strategy caused Daiichi to complain to Roche and BASF about excessive selling prices. Finally, side payments were at times proposed to deal with troublesome fringe rivals. In 1993, Roche proposed that the biotin cartel purchase all of Il Sung's output as a way of boosting prices.

Perhaps the most blatant example of rival containment is Roche's 1981 acquisition of the Danish vitamin maker Grinsted. This manufacturer had global production shares large enough to foil effective price fixing in the markets for vitamin C, B1 and B6. A few years later Roche and others formed cartels in all three markets. There are similar anomalies in other industries. E. Merck, Glaxo, and other European producers with seemingly snug positions in the vitamin B2 and B12 industries suddenly and conveniently exit just before a new cartel begins operations.

The vitamin conspirators were feckless in the face of many fringe producers. ADM's obstinate refusal to play ball in the vitamin B2 market is one example. More numerous are failures to co-opt the Chinese producers.

Maintaining Secrecy

The members of the vitamins cartels went to extraordinary lengths to hide their activities. The announcements about price increases were by pre-arrangement rotated among sellers to give the false impression of mere price leadership. Sensitive data on production levels was reported verbally at meetings so as to avoid a paper trail. Many incriminating documents found in raids were supposed to have been destroyed. Misleading information was given to in-house counsel trying to detect illegal behavior. False testimony was given to government investigators so as to stymie investigations. When investigators were close to discovering business records about the conspiracies, the participants turned to storing cartel records in unlikely places beyond the reach of the authorities.

ENDGAME: THE CONSPIRACIES UNRAVEL

As mentioned above, there were wheels within wheels. Working groups organized around various combinations of vitamins and their principal suppliers were formed, each of which can rightly be identified as cartels themselves. The vitamin B3 and B4 cartels discussed below were operating on nearly separate tracks from their start, but the remaining working groups were overlapping and strongly interconnected. The difference between the interlocking cartels and a Swiss watch is that when one cartel wheel broke, the other parts kept spinning.

A high proportion of the Roche cartels' meetings took place in Switzerland and Japan. Swiss cartel laws exist on the books, but in the 1990s the Swiss antitrust authority rarely prosecutes international cartels, could only impose fines if a cartel has been previously warned, and metes out only modest fines in any case. Japan's Fair Trade Commission operates in a similarly timid fashion. Thus, the members of Vitamins Inc. must have felt comfortable meeting in Japan and Switzerland. However, cartel meetings also took place occasionally in Germany, France, and other European venues. The European Commission did not learn about the conspiracies until the U.S. DOJ made them public in May 1999. The vitamins cartel brushed off a 1993 raid by French competition authorities as inconsequential, a correct judgment as it turned out. The companies in Vitamins, Inc most feared discovery U.S. Justice Department and its investigative arm the FBI. As a consequence, they avoided meeting on U.S. soil and took other steps to hide their meetings.

Short-Lived Cartels

The 16 vitamins conspiracies ended in one of two ways. One set of cartels sowed the seeds of their own destruction by raising prices in industries where the members of the cartels could not prevent the market entry and expansion of fringe producers. The elevated prices gave even inexperienced or inefficient vitamin manufacturers sufficient expected profits to justify investing in plant capacity. In most of these cases the fringe producers were located in China. It is possible that the firms that formed these cartels underestimated the competence of their potential rivals or overestimated their own abilities to cow or co-opt the outsiders. It is also possible that the collusive groups knew that their collective market power would erode after a few years of high prices, but reasoned that a few years of handsome profits were better than a continuation of pre-cartel conduct. Because the cartels lost their grip, the conspiracies in these six markets proved to be relatively fragile.

In only five of the 16 markets did the cartels experience significant erosion in the degree of control, namely, vitamins B1, B2, B6, B9, and C (Connor 2006c: Table 11). In the case of vitamin B2, the cartel was unable to thwart the rise of the Archer Daniels Midland Company. ADM had purchased a plant and its fermentation technology from Coors brewing; this biotechnology proved to be more efficient than the cartel members' synthetic technology. In the other four markets, it was aggressive export expansion of Chinese producers that accounted entirely for the cartels' loss of market control. In the vitamin C market, the value of exports from China increased 250% from 1990 to 1995. In many of the vitamins markets the success of many producers was short-lived. For example, in 1995 there were 28 Chinese companies making vitamin C and at least eight making vitamin B1. By 2001, after prices returned to competitive levels, consolidation left only five vitamin C companies and only two vitamin B1 manufacturers in China (UKCC 2001: 10).²⁹

Another common feature of these five product markets was the participation of Takeda or Daiichi in at least one of the industries; perhaps these companies were less committed to the cartel agreements and more troublesome about their assigned quotas. The sixth brief cartel, biotin, fell apart for other reasons.³⁰ All six of these cartels began in early 1991 and ended in either 1994 or 1995. The mean duration of the short-lived vitamins cartels (B1, B2, B6, B9, H, and C cartels) was 3.9 years. The other five were quite small. In terms of affected sales, the six short-lived conspiracies accounted for only 21% of the sales of all 16 cartels (Appendix Table1).

The End of the Durable Cartels

The second and more numerous set of vitamins cartels was terminated by private and government investigations in the United States of allegations of illegal price fixing. Credible complaints by vitamin premix companies about the putatively predatory behavior of the two dominant sellers, Hoffmann-La Roche and BASF, triggered a private investigation by an intrepid class-action law firm in mid 1997. The results of the private investigation were shared with DOJ prosecutors who decided to reopen an investigation of vitamins price fixing out of their Dallas, Texas regional office. The big break in the DOJ investigation came in late 1998 when Rhone-Poulenc, the world's third-largest vitamin firm, decided to take advantage of the Division's

²⁹ Although far smaller in numbers the Chinese survivors retained substantial production shares of the global markets for vitamin C (25-26%) and B2 (one with 29% of the pharma-grade market, the other with 10% of the larger feed-grade market).

³⁰ The biotin (vitamin H) cartel was also short-lived (less than four years in North America), but entry by fringe firms does not explain this pattern. Rather the fact that it had five members may have led to its relatively early demise.

relatively untested Corporate Leniency Program.³¹ This program offered nearly automatic amnesty for qualified price fixers on condition that the applicant provides sufficient evidence of illegal collusive behavior about which the DOJ was not aware.

All the other vitamins cartels endured for six to ten years in the 1990s.³² It is noteworthy that none of the vitamins cartels ended because of a breakdown in internal cohesion. Disagreements among cartelists are inevitable, but the dissension among the members of the vitamins cartels never reached intolerable levels. As far as is known, Rhone-Poulenc was not unhappy with its market share or the financial performance of the cartels in which it participated. Nor did any other participant in the vitamins cartels actually stop cooperating and either complain to competition authorities or become an aggressive, price-cutting outsider. In other words, absent legal intervention the second set of more durable cartels might have continued indefinitely.

Most of the cartels were operating smoothly up to the end, despite increasing signals to outsiders that collusion was afoot. According to one source, U.S. investigators first got wind of the vitamins cartel and Roche's role in it in late 1996 from sources at ADM cooperating with the DOJ in its investigation of the citric acid cartel. At that time ADM was making biotin (vitamin H) and was soon to enter production of vitamins E and C. Perhaps Barrie Cox had learned about the vitamin price fixing from one of his contacts at Hoffmann-La Roche.³³ Another possibility is that ADM had learned of rumors of price fixing when it studied the new vitamin markets it was entering. As a result of the tip, the FBI interviewed Dr. Kuno Sommer in March 1997 (Barboza 1999).

Dr. Kuno Sommer was at the time president of Roche's Vitamin and Fine Chemicals division.³⁴ Sommer had to agree to the interview because of Roche's promise to the DOJ to cooperate in the citric acid case. During the FBI interviews Sommer denied the existence of any vitamin cartel, and the DOJ apparently decided to wind down its investigation for the meanwhile. What the investigators did not know at the time is that Sommer had pre-arranged his denial with other conspiring company officers at Roche. Their agreement to deceive the FBI constitutes obstruction of justice, a very serious offense under U.S. law.

More evidence of illegal price fixing began to appear. In late 1997, a partner of the law firm Boies & Schiller with experience in representing class-action plaintiffs claims to have discovered evidence of vitamin price fixing in the course of preparing a patent-infringement suit. Soon after Roche dropped a counter-claim in the case, he began hearing many complaints from Roche customers. Vitamin buyers reported several instances of inexplicable behavior. Customers who habitually purchased from Roche would not be able to get price quotes from BASF or other suppliers, and vice versa. Buyers of vitamin C were threatened with unspecified retaliation should they try to resell purchased products. A manager of a small vitamin premix company in Little Rock, Arkansas quoted a BASF executive as threatening his company with the following words: "You need to remove yourself [from the premix business] or you'll be forced out of the business" (Barboza 1999). The Little Rock company and many others did in fact fail.

In late 1997 or early 1998, lawyers working for Roche heard about allegations that some managers in the company were fixing vitamin prices (Barboza 1999). Apparently, they discovered some corroborating evidence because a top Roche official issued a directive specifically ordering that the conspiracy stop. This directive was defied. The only effect was to move the cartel's meetings from hotels and other public places to the homes of the vitamins executives. This subterfuge extended the cartel's life by another year.

³¹ Spratling and Arp (2005) offer one of the most comprehensive overviews of cartel leniency programs. A radically revised version of the DOJ's Corporate Leniency Program was effective in late 1993. However, DOJ officials were still giving speeches about the new policy in 1995; moreover, details and important amendments to the Program were announced in 1998 and 1999 (*ibid.* note 11)

³² The one exception is biotin, which lasted for slightly more than four years.

³³ Andreas Hauri was Roche's global sales manager for both vitamins and citric acid.

³⁴ This unit manufactures and sold flavors and fragrances, but the majority of the Division's sales were vitamins and vitamin premixes.

In March 1998, Boies & Schiller filed a civil price-fixing suit in U.S. District Court in Dallas, Texas on behalf of several direct purchasers of bulk vitamins. The buyers were a mix of animal feed manufacturers and blenders of bulk vitamin premixes. Plaintiffs in civil suits against Roche and BASF alleged that predatory pricing forced many premix companies to fold; the vitamins sold to feed manufacturers as a premix were priced below cost at the same time bulk vitamins sold to premix companies were sold at monopoly prices.

Perhaps these and other allegations were forwarded to the DOJ because a grand jury was established in Dallas, Texas in November 1997 to investigate vitamin price fixing. The FBI interviewed officers of animal-feeds firms, but little progress was made for the first year. In the summer of 1998, one of the vitamin manufacturers, the Swiss firm Lonza, began to negotiate a guilty plea agreement with the DOJ. Although signed in secret in September, the size of Lonza's fine shows that it could not provide much useful information about the "Roche Group" conspiracies.

On a somewhat separate track, the North American choline chloride cartel was derailed in June 1998. Perhaps because of customer complaints or an internal investigation, top executives of Bio-Products, Inc. got wind of the illegal collusion being carried out by Tom Stigler, vice president and general manager of Bio-Products feed ingredient group (Barnett 2005:8-15). Stigler was confronted by his supervisors who were previously unaware of the price-fixing conspiracy.³⁵ Stigler confessed his role and ceased contacts with his co-conspirators. Bio-Products immediately applied for and was granted amnesty by the DOJ. In return for immunity from prosecution for the company and its officers, Bio-Products cooperated by supplying information to federal prosecutors about the choline chloride cartel.³⁶ That summer, the company began competing for customers. On September 23, 1998 FBI agents raided the offices of DuCoa and Chinook and carted off incriminating documents. While that police action effectively ended the choline chloride cartel, the information delivered to the DOJ would have had little of value in cracking the other 15 vitamins cartels.

The DOJ's biggest break in its investigation came in January 1999. Following brief negotiations, the third largest vitamin manufacturer, Rhône-Poulenc, was admitted to the Department's leniency program. As the first of the conspirators to come forward and admit its culpability, Rhône-Poulenc probably met all the conditions for full amnesty. Conditional upon satisfactory cooperation with the DOJ's vitamin price-fixing probe, Rhône-Poulenc would receive a tangible benefit: no U.S. government fine would be levied on the company and none of its officers indicted. Although Rhône-Poulenc's compensation was substantial, the DOJ's demands were likewise. Rumor has it that Rhône-Poulenc's managers were required to attend a conspiracy meeting in February 1999 and tape record it.

Whatever the evidence provided by Rhône-Poulenc, it must have been highly incriminating. Within two months both Roche and BASF had agreed to plead guilty and pay record-setting U.S. fines of \$725 million. Within two years, 24 criminal convictions would be obtained. Rhône-Poulenc's motives were hardly pure. Not only did it save more than \$100 million in U.S. fines, the company was now free to carry out its long-planned merger with Hoechst. In the end, it was the urge to merge that broke the vitamin cartel's cover.

³⁵ Stigler took elaborate precautions to mislead his company by, for example, filing fraudulent travel records when he traveled to cartel meetings.

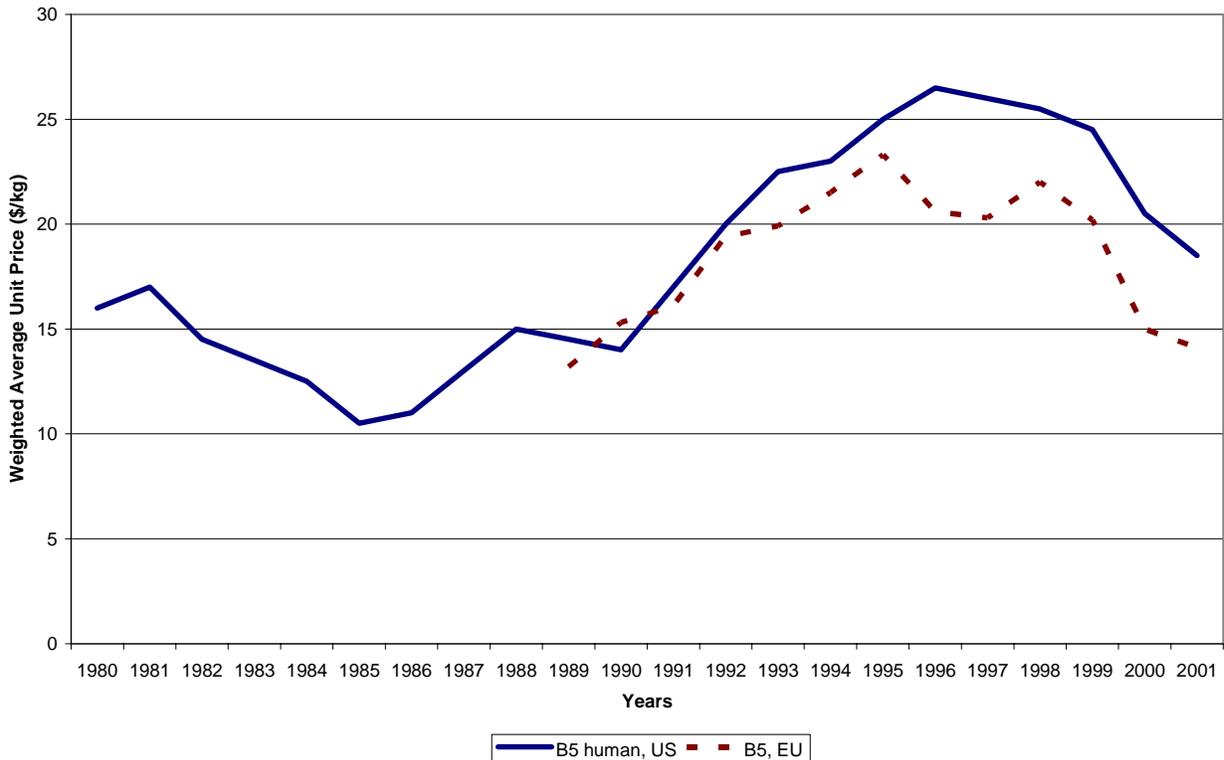
³⁶ Six years later Stigler would testify in court against one of his fellow conspirators.

PRICE EFFECTS

Like many pharmaceutical products, the consuming public has a high regard for the benefits and efficacy of vitamins. There is something particularly reprehensible about price-fixing schemes that affect products destined for vulnerable populations. Children, pregnant or lactating mothers, the sick, and the elderly often need supplementary vitamins to achieve full health. These groups, as well as practically every household, ultimately paid the price of price fixing in vitamins. The purpose of this section is to document as precisely as possible the extent of these economic injuries.

By the time the cartels of the 1990s reached their peak pricing, U.S. transaction prices mostly were 20 to 70 percent higher than in the immediate pre-conspiracy period. In the case of the short-lived cartels like vitamins B1 and C, prices peaked at 20 to 40% above their 1989 levels (e.g., Figure 3). However, for the majority, more durable conspiracies peak prices were reached six to eight years after the pre-cartel year. These price increases typically were in the range of 50 to 90%. Figures 6 to 8 illustrate the transactions prices of three more disciplined and more durable vitamins cartels: vitamins E (human grade), A (feed grade), and B5 (human). Maximum U.S. prices were reached in 1997, and these apogees were 65 to 90% above the 1989-1990 starting points. EU prices traced similar, if slightly dampened, paths.

Figure 3. U.S. and EU Transactions Prices of Bulk Vitamin B5, Human Grade, Annual 1980-2001



Like an exciting roller-coaster, the decline in vitamin prices observed after the government announced the guilty pleas in May 1999 was much more precipitous than the earlier increases. This suggests that the post-conspiracy period was far more competitive than the pre-conspiracy period. The major members of the convicted cartels may have been trying to repair bruised customer relations and retain their market shares the old-fashioned way – cutting prices to the bone.

There were just two exceptions to the roller-coaster price pattern in prices. Beta Carotene and the other carotinoids³⁷ were unusual among all the cartelized vitamins in that they were manufactured by a true duopoly, Hoffmann-La Roche and BASF. The two-firm structure persisted after formal collusion ceased at the end on 1998. The highly cooperative, indeed monopolistic behavior cemented during the lengthy collusive period seems to have continued after 1998, a result predicted for small-firm industries by dynamic game theories (Tirole 1990: 245-253). Lags in downward adjustment of prices after the end of formal collusion were characteristic of all the vitamins cartels, durable and fragile. Arriving at the low prices that signaled a new, more competitive equilibrium took from 12 to 36 months for all but the two carotenoid duopolies (Kovacic et al. 2006). The carotinoids were unique because there were no signs of a slackening of monopolistic pricing behavior a full three years after the cessation of collusive meetings (Figure 9). After 1998, the three largest manufacturers (Roche, BASF, and Rhone/Aventis) continued secretly to exchange sales data for the purposes of monitoring “the previously agreed market shares” and avoiding “price deterioration.”³⁸

For several reasons, the increase in U.S. market prices from the initiation of price fixing in 1990 or 1991 may not measure accurately the *effect of collusion* alone. The vitamins defendants proffered three principal arguments to support their position that U.S. prices rose because of natural, competitive market forces.³⁹ The most frequent competitive explanation of ballooning prices in the 1990s was rising prices of raw materials, intermediate materials, transportation, or manufacturing expenses. In some cases the proximate causes of the putative cost increases were claimed to arise from government regulations concerning product quality or environmental standards. Second, the defendants argued that in the 1990s the U.S. dollar generally weakened against the Yen and most European currencies. Third, the vitamin manufacturers proposed that rapid increases in demand resulted in insufficient production capacity.

Bernheim (2002a: Chapter 9) demolishes these arguments by confronting them with market data and facts contained in the defendants internal records. First, variable costs did not vary significantly during the collusive periods for any of the vitamins.⁴⁰ Costs were generally flat or slightly declining.⁴¹ More tellingly, variable costs were not relatively low in the years before or after the collusive periods. Second, the defendants’ foreign-exchange arguments were not supported.⁴² After adjusting for foreign-exchange movements, variable costs expressed in dollars

³⁷ There were three “other carotinoids.” However, price data are available for only canthaxanthin, the largest of the three products. It is not clear if the two others were cartelized in the U.S. market.

³⁸ Partial quotations from deposition testimony of Dr. Thomas Wehlage, a BASF representative made on January 10, 2002 (Bernheim 2002a: footnote 139).

³⁹ These explanations were contained in contemporaneous documents found in the defendants’ files, in depositions given by managers, or in statements made to journalists writing in chemical-industry trade magazines (Bernheim 2002a: 122-124, 140, 145, and 150). Except for the exchange-rate explanation, these also apply to prices in the rest of the world.

⁴⁰ Vitamin B1 may be an exception. Given the oligopolistic market structure of the vitamins industries, one would expect to see pass-on rates of less than 100%, which would show up as greater variation in costs than in prices.

⁴¹ Although irrelevant for price-change decisions, fixed costs also generally declined. Nor did prices or fixed costs rise when major companies exited.

⁴² Two economic principles tend to suggest that fluctuations U.S.-dollar exchange rates have little explanatory power. First, it is generally accepted that the pass-through of changes in the prices of imported inputs to changes in domestic prices is generally around 50%. Second, many of the raw materials purchased for foreign production of vitamins were in fact denominated in U.S. dollars.

were even more constant before, during, and after collusion than was the case before such adjustments.

Third, there is no relationship between surges in the quantity of vitamins demanded and increases in vitamin prices. The major increases in consumer demand were the result of publicity about the health benefits of mega doses of vitamins E, C and beta carotene. Annual increases in global consumption of these three vitamins reached 15 to 20% in the early 1990s. While these rates of increase are quite high, similarly high increases in demand had occurred in the mid to late 1980s. Price increases from shifts in demand would only be observed if the demand shifts were unexpected. Moreover, when aggregated over species changes in the demand for animal-grade vitamins were exceedingly steady throughout the 1980s and 1990s.⁴³ Nor were there significant shifts in the ratio of human to animal uses of vitamins. What all these demand factors amount to is a highly predictable demand environment for bulk vitamins, a situation that lends itself to accurate planning for capacity expansions well in advance of needs. Shortages that drive up prices are unlikely to develop in such markets. In fact, the defendants' own estimates of global capacity utilization tended to decline during the collusive periods for the major vitamins.⁴⁴ Therefore, surges in demand were predictable, and changes in capacity constraints do not correlate with price changes in the 1990s.

What I judge to be the best of several estimates of U.S. average price increases of the vitamin cartels are summarized in Table 5. The method of calculating the overcharges are predictions from richly specified econometric models that explains monthly variation in prices of 37 vitamin products from 1980 to 2001 (Bernheim 2002a: Chapter 10).⁴⁵

Price increases in the 1990s averaged 44% and varied from 16 to 80% across the 16 vitamins cartels. Many factors explain the height of the overcharges, duration being one. There is a difference between the six cartels that were under stress and fell apart fairly quickly (about four years) and the ten more durable agreements. Duration does not only result from a failure of fringe producers to mount serious challenges to cartel control but also seems to signal the cohesiveness and discipline among the members of some of the cartels. On the one hand, the six more fragile coalitions achieved mean overcharges of only 27.4% during the plea-periods of the 1990s; for the extended, dual-episode conspiracy period the mean was a similarly below-average 30.3% (Table 5). On the other hand, the ten long-lasting cartels achieved significantly higher mean overcharges of 43.3% and 51.0% for the plea-period and extended-period, respectively. The greater price effects of the durable cartels are important, because they accounted for 79% of plea-period affected sales. I also prepared estimates for Canada, Europe and the world.

⁴³ The principal basis for estimating the demand for animal grades was changes in the slaughter rates for meat animals. There are notable production cycles for hogs and cattle, but these cycles were not positively correlated. Some species have experienced alterations in genetic types that could absorb high intensities of vitamins in feed rations, but such alterations were gradual.

⁴⁴ Capacity is an elusive concept. It depends on engineering estimates of maximum possible output, and assumptions about operating days of production per year, maintenance schedules, substitutability among plants for alternative outputs, and strategic decisions about optimal excess capacity. An interesting comment by a deposed Hoffmann-La Roche expert is: "...[A]ctual output is a fact. Capacity is an opinion." (Bernheim 2002a: 145). Roche's own estimates of global capacity utilization for vitamins A, E, and C tended to average 75 to 80% in the 1990s (*ibid.* 148-150).

⁴⁵ The list of proxies for demand and supply shifters is quite extensive and tailored to the specific vitamin product. The model was generally fitted to prices prior to the conspiracy period and for the periods one year after the conspiracy periods. Bernheim (2002a) does not use post-cartel data for those industries that are duopolies because the post-cartel tacit pricing conduct in those markets seemed to be as profitable as that during the conspiracy period. Then the estimated parameters for these relatively competitive periods were used to predict the conspiracy-period "benchmark prices" -- the prices that would that have been observed absent explicitly collusive conduct. The difference between the benchmark price and the actual price is the estimated cartel overcharge for each month. Table 5 shows the mean price increase for all months of each vitamin's conspiracy period.

Table 5. U.S. Vitamin Price Mark-Ups Based on Econometric Modeling		
Product	Plea Period ^a	Extended Conspiracy Period ^b
	<i>Percent</i>	
Vitamin E	63.2	61.3
Vitamin A	48.8	56.7
Vitamin C ^c	31.0	35.3
Vitamin B1 ^c	22.1	23.8
Vitamin B2 ^c	29.9	37.6
Vitamin B3	18.5	21.2
Vitamin B4	50.7	50.8
Vitamin B5	45.0	61.6
Vitamin B6 ^c	31.5	17.5
Folic Acid (B9) ^c	28.6	28.7
Vitamin B12	80.4	95.7
Vitamin D3	15.6	22.7
Beta carotene	44.4	60.0
Canthaxanthin	24.2	33.9
Biotin (vitamin H) ^c	21.3	39.1
Vitamin premixes	41.9	45.6
Total	43.7	48.2

Source: Bernheim (2002a: vi, 8-9), converted from the given Lerner Indices.
a) Generally guilty pleas in the U.S. or elsewhere from 1990 to about 2001 or shorter.
b) Includes the plea periods plus several periods during 1985-1989.
c) One of the six short-lived cartels.

Customer Overcharges

Profits generated by price fixing are a transfer of income from customers to the stockholders of the companies in the cartel. With no available substitutes, vitamin buyers had no choice but to continue making purchases at the cartel-inflated prices. The amount of this overpayment is called the customer overcharge. The size of the vitamin overcharges can be vitally important information for assessing felony fines in the United States and for judging the adequacy of civil antitrust settlements. Table 6A converts the overcharges from nominal currency (in the year the fines were imposed) to a common year, 2005. Even though inflation was fairly low from 1990 to 2005, this adjustment makes quite a difference. Measured in today's dollars, the damages from the vitamins cartels of the 1990s amounts to \$13.6 billion – a figure almost double the “old dollars” in Table 6. Table 7 summarizes the overcharges for 16 products and four geographic regions relative to a conventional metric – affected commerce.

Table 6. Global Overcharges by the Vitamins Cartels, 1990-1999					
Product	United States ^a	Canada ^b	Western Europe ^c	Other ^d	World ^f
	<i>Million current U.S. dollars</i>				
Beta carotene	120	8.6	176	73	378
Canthaxanthin	22.5	1.5	95	244	363
Biotin (H)	25	1.8	18.5	38	83
Choline chloride (B4)	158	13.5	138	226	535
Folic acid (B9)	2.6	0.5	7.7	1.8	12.6
Vitamin A	270	20.3	377	215	882
Vitamin B1	9.1	1.3	6.6	12	29
Vitamin B2	31.7	2.5	49	24	109
Vitamin B3	41.7	2.3	39	40	123
Vitamin B5	57	4.3	92	26	179
Vitamin B6	13	3.6	22	33	73
Vitamin B12	50	1.3	47	93	191
Vitamin C	242	17.0	231	368	1128
Vitamin D3	9.7	0.7	8.9	9.6	29
Vitamin E	642	46	719	337	1744
Premixes	602	40	774	711	2127
Total 16 products	2297	165.1	2800	2315	7577
<p>a) From Connor (2006c: Appendix Table 13); includes umbrella effects. b) Assumed same overcharge rates as in the United States. c) Based on before-and-after benchmark prices shown in the annex of the EC decision, where available. Otherwise, used U.S. rates. d) Clarke and Evenett (2001) found that vitamin imports by countries with weak antitrust laws were 50% higher than North America and the EU. To be conservative, assumed rates 20% higher than the U.S. and EU average (partly because China was immune to cartel effects for some of the B vitamins). f) Sum of the other columns.</p>					

Table 6A. Real Global Overcharges by the Vitamins Cartels, 1990-1999					
Product	United States ^a	Canada ^b	Western Europe ^c	Other ^d	World ^f
	<i>2005 U.S. dollars</i>				
Beta carotene	138.4083	9.919262	193.4066	82.16095	423.8951
Canthaxanthin	25.95156	1.730104	104.3956	274.6201	406.6974
Biotin (H)	30.37667	2.18712	21.36259	44.99704	98.92342
Choline chloride (B4)	191.9806	16.4034	159.3533	267.614	635.3513
Folic acid (B9)	3.159174	0.607533	8.891455	2.131439	14.7896
Vitamin A	319.9052	24.05213	417.0354	245.9954	1006.988
Vitamin B1	11.05711	1.579587	7.621247	14.20959	34.46753
Vitamin B2	38.23884	3.015682	55.74516	28.10304	125.1027
Vitamin B3	49.40758	2.725118	43.14159	45.76659	141.0409
Vitamin B5	67.53555	5.094787	101.7699	29.74828	204.1485
Vitamin B6	15.79587	4.374241	25.40416	39.07638	84.65064
Vitamin B12	60.75334	1.579587	54.27252	110.1243	226.7298
Vitamin C	294.0462	20.65614	266.7436	435.7608	1017.207
Vitamin D3	11.188	0.807382	9.78022	10.80473	32.58033
Vitamin E	760.6635	54.50237	795.354	385.5835	1996.103
Premixes	713.2701	47.39336	856.1947	813.5011	2430.359
Total 16 products	2731.738	196.6278	3120.472	2830.197	8879.035
<p>a) From Table 6; includes umbrella effects. To allow for the opportunity cost of capital, adjusted by the U.S. prime rate of interest plus 1% from the midpoint of the conspiracy to the year the cartel was first fined; then from the latter year, the figure is raised to \$2005 using the producer price index of the appropriate region.</p> <p>b) Assumed same overcharge rates as in the United States.</p> <p>c) Based on before-and-after benchmark prices shown in the annex of the EC decision, where available. Otherwise, used U.S. rates.</p> <p>d) Clarke and Evenett (2001) found that vitamin imports by countries with weak antitrust laws were 50% higher than North America and the EU. To be conservative, assumed rates 20% higher than the U.S. and EU average (partly because China was immune to cartel effects for some of the B vitamins).</p> <p>e) Estimated by author; highly uncertain.</p> <p>f) Sum of the other columns.</p>					

Table 7. Global Overcharges Relative to Affected Commerce, 1990-1999					
Product Market	United States	Canada	Europe	Rest of the World ^a	World ^b
	<i>Percent</i>				
Beta carotene	30.7	30.7	30.7	37.1	31.7
Canthaxanthin	19.4	19.4	19.4	23.4	21.9
Biotin (H)	17.5	17.5	14-15	19.2	17.3
Choline chloride (B4)	33.7	33.7	33.7	41.1	36.5
Folic acid (B9)	22.3	22.3	38-39	36.0	33.2
Vitamin A	32.8	32.8	20-22	33.3	28.9
Vitamin B1	18.1	18.1	5-8	15	12.2
Vitamin B2	23.0	23.0	20-22	26	22.9
Vitamin B3	15.6	15.6	15.6	15.8	15.7
Vitamin B5	31.0	31.0	29-31	37.7	31.1
Vitamin B6	24.0	24.0	29-31	32	29.8
Vitamin B12	44.7	44.7	31	46	40.9
Vitamin C	23.6	23.6	17-23	26	30.8
Vitamin D3	13.5	13.5	7-12	14	12.1
Vitamin E	38.7	38.7	31-35	43	36.8
Premixes	29.5	29.5	29.5	28.7	29.2
Total	30.4	30.4	23-24	28.3	28.5
<p>Source: Table 6 and Appendix Table 1.</p> <p>a) The rest of the world includes Latin America, south and east Asia, and Oceania. Because nearly all these countries (except China and Japan) import vitamins, and nearly all have weak antitrust enforcement, overcharge rates are expected to be higher than those in Europe and North America. Following Clarke and Evenett (2002, 2003), the average overcharge for such countries is 33% of sales, which is 25% higher than their estimates for the U.S. and EU. Therefore, the overcharge rates are adjusted to be 20% higher than the mean U.S. - EU rates to allow for lower prices in China.</p> <p>b) The rates for the U.S. and EU are given equal weights, and the rest of the world a double weight.</p>					

PROSECUTIONS OF THE VITAMINS CARTELS

For government trust-busters, the vitamins conspiracies of the 1990s were the greatest catch in antitrust history.⁴⁶ Following on the heels of the DOJ's victories in lysine and citric acid, these earlier cases pale in comparison to the vitamins case in scope, size, complexity, longevity, or nearly any other conceivable measuring stick. Twenty-one chemical manufacturers fixed the prices of 16 vitamin products in nearly every country⁴⁷ of the world for up to 16 years. The cartels' global sales during the conspiracies amounted to grand total of \$27 billion. Illicit profits made by the cartels totaled more than \$8 billion. Fifteen corporations⁴⁸ and 15 individuals would be judged guilty of price-fixing felonies.

Government prosecutors did not punish the defendants for ten allegedly cartelized vitamins in the late 1980s. No mention is made in U.S., Canadian, or EU documents that the earlier conspiracies may have existed. The case for price fixing rests with allegations made by plaintiffs in the U.S. treble-damages suits and some fairly compelling, if circumstantial price data (Bernheim 2002a, Kovacic et al. 2006). The absence of indictments for conspiracies in the late 1980s is not proof of innocence because it may simply be explained by the inherent difficulties of obtaining old business records, the unreliability of the memories of witnesses, or the absence of other evidence that can withstand the rigors of a judicial review.

Prosecution began in the United States in 1997. It was an eight-year odyssey (Figure 5).

In 1999 Canadian prosecutions followed, with the Canadian Competition Bureau (CCB) expanding the DOJ charges into new vitamin markets. In late 2001, the European Commission issued the first and most sweeping of three vitamins decisions imposing record fines on ten manufacturers. Meanwhile, in the United States and Canada, private damages suits came to an end around 2004 mainly through negotiated settlements. Appeals Courts issued decisions on vitamin-cartel matters as late as 2005.

The United States

The Investigation Phase

The U.S. DOJ had been busy prosecuting the lysine and citric acid cases throughout 1996 and early 1997. These investigations were centered in the DOJ's Chicago and San Francisco offices, respectively. In late 1996 the FBI had received information about a possible price fixing conspiracy in the vitamins industry (Hammond 2001). Initial suspicions focused on the vitamins B3 and B4 markets. In March of 1997, FBI agents working with the DOJ's branch office in Dallas, Texas interviewed Dr. Kuno Sommer in the United States about the matter (Barboza 1999). Sommer was the global head of vitamins marketing for Hoffmann-La Roche, the world's leading

⁴⁶ After an FBI investigation in 1997 failed to turn up sufficient evidence of cartel activity, it was closed. However, evidence provided by buyers of suspicious parallel behavior caused a private damages suit to be filed a year later, and the DOJ's interest was piqued once again. In mid 1998, one of the smaller European members of two cartels offered to plead guilty and cooperate with DOJ investigators. A formal grand jury investigation began in 1998 that eventually cracked the case wide open in early 1999.

⁴⁷ There is some doubt whether the conspiracies affected all of the bulk vitamin markets in Russia and other territories of the former USSR, some of which restricted imports in the 1990s. In the 1980s the USSR was quite closed to trade and appears to have been self sufficient in most of the vitamins. In China, aggressive exporters likely dampened but did not eliminate the effects of global price fixing for four or five products.

⁴⁸ Fifteen companies pleaded guilty to felonies, one was found guilty in a civil trial, and four of the 19 perpetrators escaped fines because of the statute of limitations (but the four paid settlements in private civil actions). One of the seven individuals was indicted and remains at large.

manufacturer of vitamins. Roche made at least 11 vitamins in plants located in Switzerland, Germany, Scotland, Japan, and the United States. The company was widely reported to enjoy a

Figure 5. Time Line, Vitamins Prosecutions, 1993-2005	
Date	Event
1993	French antitrust authority raids Rhone-Poulenc, finds nothing
Late 1996	DOJ gets complaints about price fixing in B3 and B4 markets
March 1997	Roche pleads guilty in citric acid cartel, promises DOJ cooperation
March 1997	Roche's head of vitamins lies about cartel in FBI interview
Nov. 1997	DOJ starts formal grand-jury investigation in Dallas, Texas
Dec. 1997	U.S. civil suit filed, the first of many
June 1998	Bio-Products secretly granted amnesty for information about B4 cartel
Sept. 1998	Lonza is secretly indicted & cooperates with DOJ about B3 cartel
Sept. 1998	Major trial victory for DOJ; 3 ADM officers found guilty in lysine case
Dec. 1998	Roche offers to settle private suit
Dec. 1998	Rhone-Poulenc receives amnesty from DOJ, provides crucial evidence
March 1999	Lonza's U.S. guilty plea and fine is announced
May 1999	Roche and BASF admit guilt, pay record U.S. fines for 10 cartels
May 1999	Rhone-Poulenc receives amnesty from EC, investigation starts
Sept. 1999	Takeda, Eisai, and Daiichi plead guilty in U.S., pay large fines
Sept. 1999	Chinook is second member of B4 to plead guilty in U.S.
Sept. 1999	Canada announces large fines for 5 participants in 9 cartels
Nov. 1999	U.S. federal class proposes a \$1.17 billion settlement
May 2000	Swiss antitrust authority warns members of vitamins cartel
May 2000	Degussa, Reilly, and Nepera plead guilty to B3 price fixing
July 2000	EC sends its Statement of Objections to 13 manufacturers
Jan. 2001	New Zealand warns 3 vitamin companies
Sept. 2000	DuCoa pleads guilty in U.S., the last corporate plea
March 2001	Australia fines Big Three for animal-feed vitamins
April 2001	Japan's FTC warns two Japanese vitamin producers
Nov. 2001	Major EC decision; 11 firms ordered to pay \$848 million in fines
Dec. 2002	Brazil issues adverse ruling
April 2003	Korea fines 6 large vitamin manufacturers
June 2003	Detailed EC decision of Nov. 2001 released
Aug. 2003	Last of 15 convicted firms pleads guilty in Canada
2003-2004	Direct U.S. purchasers settle for about \$4 billion
Dec. 2004	EC announces decision in B4 against 6 firms; 3 pay fines
April 2005	Canadian historic class-action settlement is approved by the courts
2006	Brazil's decision still under appeal
Source: Connor (2006c).	

45 to 50 percent share of the global markets for bulk vitamins. Sommer also served on Roche's small management committee that formed the pinnacle of the company's management structure. If anyone should have known about vitamins price fixing within Roche, it was Sommer.

Sommer denied that Roche was involved in any such illegal activity. He was interviewed under the March 1997 citric acid guilty-plea agreement in which Roche had promised full cooperation from its employees in any antitrust investigation, so Sommer's denial would have serious legal consequences if he did not answer truthfully. Not only is it a federal felony for the person being interviewed, but also misleading the FBI could cause the Department of Justice to revoke concessions given to Roche itself in the citric acid case. In particular, the DOJ had given Roche a large reduction in its fine, and it had immunized Roche officers from being personally indicted for their roles in the conspiracy. Later it came to light that Sommer had prearranged with others at Roche to lie about the cartel's existence. However, because Roche was the only vitamin co-conspirator with a cooperation pledge in 1997, Sommer's denials must have slowed the FBI's investigation considerably.

In November 1997, the DOJ investigation picked up speed again. Press reports revealed that numerous executives responsible for procuring vitamins for animal-feeds manufacturers were being interviewed about possible price fixing activities in the industry. Moreover, word leaked out that a grand jury had been opened in Dallas, Texas to assist the DOJ in its vitamins investigation. This grand jury would toil away in secret for another 14 months before the first fruits of the investigation would become public. Initial suspicions were focused on the vitamins B3 and B4 industries, but leads began to develop about the larger vitamins A, E, and C markets (Hammond 2001:6-7).

In December 1997 a civil antitrust suit was filed against a large number of vitamins manufacturers alleging a vast price-fixing conspiracy against U.S. buyers of bulk vitamins (Donovan 2005:188-194). The suit was filed by David Boies III⁴⁹ of the Birmingham, Alabama firm of Bainbridge & Strauss following publication in November of an article in *The Wall Street Journal* about a grand-jury investigation of vitamins price fixing. In statements to the press couple of years later, Boies' firm would take a great deal of credit for initiating the convictions of the mighty vitamins defendants. While the firm probably shared what information it had about the vitamins cartels, the Dallas DOJ office seems to deserve most of the credit.

By mid-summer 1998 strong and persistent rumors had begun circulating among Washington antitrust lawyers that indictments were likely in the case of vitamins A, C, E, and riboflavin; Roche and BASF were mentioned as targets of the vitamin probe.⁵⁰ In March 1998, it would become known that the Dallas grand jury had made considerable progress in two product markets, vitamins B3 (niacin) and B4 (choline chloride), both of which have their main applications in animal nutrition. Two major developments took place behind the scenes. First, in June 1998 or soon thereafter the Ohio firm Bio-Products entered into the DOJ's amnesty program and began to turn over all that its employees knew about the choline chloride cartel. Second, in September 1998, the dominant manufacturer of vitamin B3, the Swiss firm Lonza, was indicted and agreed to plead guilty for criminal price fixing. However, in an unusual move for the DOJ, Lonza's indictment and guilty plea were kept secret under a court seal for six months. The most likely explanation for

⁴⁹ David III is the son of David Boies II, who is best known for his role as the chief litigator in the U.S. Government's prosecution of Microsoft Corporation for monopolization at a trial in late 1998 (Donovan 2005). In May 1999, David Boies II and his firm Boies & Schiller would become co-lead counsel for the federal class of vitamins plaintiffs.

⁵⁰ While grand jury proceedings are almost always secret, those who testify are free to talk about their own testimony, and it is often in the interest of those testifying to pool their information.

the secrecy is that knowledge about Lonza's cooperation would have alerted other, bigger targets in the vitamin industry and thereby imperiled the DOJ's investigation. Lonza's cooperation was a break for the DOJ's investigation, but it was only a small break.

Lonza Pleads Guilty

One member of the vitamin B3 cartel was the first to be prosecuted by U.S. antitrust authorities. The world's leading manufacturer of vitamin B3, Lonza, pleaded guilty in September 1998, but the company's plea was kept under seal until March 1999. Lonza's guilty plea was vague on the dates of the vitamin B3 conspiracy, merely noting that it began as early as January 1992 and ended sometime around March 1998. Although Lonza's cooperation was secured for the B3 investigation, delays in announcing further guilty pleas suggested that the DOJ probe ran into roadblocks. It is known from subsequent prosecutions that Lonza's co-conspirators were the small New York manufacturer Nepera and the Indiana manufacturer Vitachem. Vitachem was a joint venture between the large German chemical firm Degussa and a smaller Indiana firm, Reilly Industries. The three firms controlled almost 90 percent of the global market for niacin, with Lonza accounting for two-thirds of the presumptive cartel's sales. In the U.S. market the three producers had more equal shares. The vitamin B3 market was not affected by Chinese production.

In retrospect, it seems that Lonza itself must have been the first to come forward sometime in early or mid 1998 and agreed to provide evidence about the vitamin B3 conspiracy. Lonza's cooperation was secured by a fairly small fine (only \$10.5 million) and by the DOJ's agreement not to seek criminal charges against any of Lonza's executives. The fact that Lonza did not receive amnesty from the DOJ probably reflects the fact that it initiated the conspiracy; ringleaders do not qualify for amnesty. The relatively large fines imposed on Degussa and Nepera seem to imply that they resisted making guilty pleas for some time.

Lonza's information on the vitamin B3 cartel did not lead the U.S. investigation directly to the main Roche cartels. None of the leading manufacturers in the world's vitamins industry make vitamin B3. However, Lonza does manufacture one other vitamin, biotin (vitamin H). Lonza, together with two German and two Japanese manufacturers, control about 95% or more of the world biotin market. The dominant world producer of biotin with about 45% of the market is none other than Hoffmann-La Roche. Biotin should have been the bridge for U.S. investigators to learn about the larger web of Roche cartels. Yet, oddly the United States, unlike Canada and the EU, never prosecuted any of the five members of the biotin cartel.⁵¹

Convictions in Vitamin B3

In May 2000, after a very unusual delay (21 months after Lonza pleaded guilty) three companies and two individuals pleaded guilty to criminal price fixing in the market for vitamin B3. The three manufacturers convicted were Degussa-Hüls of Frankfurt am Main, Germany; Reilly Chemicals, Inc. of Indianapolis, Indiana; and Nepera, Inc. of Harriman, New York. Degussa and Reilly owned a joint venture that made B3 in the United States and a small plant in Belgium. Nepera was a relatively small U.S. manufacturer of B3, but the fact that Nepera's President and Vice President for sales were the only two persons convicted in this cartel suggests that Nepera was one of the companies resisting a plea bargain.

The plea agreements for Lonza, Degussa, and Nepera admit that each of the companies began conspiring "as early as January 1992." U.S. transaction prices show a suspicious jump in

⁵¹ The biotin cartel ended in late 1995, so the statute of limitations does not seem responsible for the decision not to indict. Shortly after the biotin cartel ended, Lonza ceased production. Lonza might have qualified for amnesty in the B3 case by informing the DOJ about the biotin cartel.

B3 prices in 1991. Both Nepera and Degussa seem to have resigned from the cartel in July 1995, but in Degussa's case it handed on its conspiratorial role to its joint-venture partner, Reilly Industries.⁵² Prices declined for five years thereafter. When the conspiracy ended in March 1998, the two largest U.S. sellers of B3, Lonza and Reilly, were still conspiring.⁵³ In addition, the DOJ stated that there were unnamed co-conspirators that were not indicted. By May 2000, four companies had paid \$33.5 billion in criminal fines, and two Nepera executives were to be sentenced to a total of 20 months in prison. Degussa seems to have paid the largest U.S. fine relative to its sales during the conspiracy, a sign that it was uncooperative with the DOJ.

The Big Three Plead Guilty

With fairly solid evidence of a broad conspiracy in several vitamins markets in the hands of government investigators by late 1998, in the time-honored fashion of prosecutors everywhere, they turned the screws tighter on the smaller vitamins manufacturers. Rhône-Poulenc was a vulnerable target. It was the smallest of the Big Three vitamin manufacturers, holding about 9 percent of the global market. Rhône-Poulenc was amenable to a deal because it had previously announced its intention to merge with Hoechst, and such a merger could not be consummated if the uncertainty of severe price fixing sanctions hung over their heads. Whatever Rhône-Poulenc's motives, it agreed in late 1998 to cooperate with the DOJ's broader vitamins investigation. In fact, Rhône-Poulenc was formally admitted into the DOJ's amnesty program after it provided crucial evidence for prosecutors. Not only did its executives, who were deeply involved in colluding on vitamins A, E, B2, and B12, begin to provide incriminating details, but also its vitamins managers gave the DOJ the kind of evidence that is most persuasive with juries – tape recordings of an actual cartel meeting.⁵⁴ The meeting in February 1999 was one of "Vitamins Inc.'s" top-flight occasions, with all of the companies' top officers present. The cartel had at that time gone into deep cover, so this last meeting was probably held in one of the participant's private homes in Switzerland or Germany.⁵⁵ When the DOJ approached the lawyers representing Roche and BASF with the overwhelming evidence provided by their former co-conspirator Rhône-Poulenc, the two cartel ringleaders quickly agreed to plead guilty.

DOJ negotiations in March to May of 1999 mainly involved the size of the corporate fines to be paid by Roche and BASF and the number of executives to be indicted. The Division was in an especially strong bargaining position because in late 1998 it had won a major trial decision against three executives of ADM for cartels behavior. Under the twice-the-harm rule for sentencing of corporate felons, Roche was presented with the doubtless astounding news that their company was facing U.S. fines of up to \$1.9 billion (plus about \$2.8 billion in tag-along civil penalties).⁵⁶ BASF was liable for up to \$640 million in U.S. fines. Although the third and fourth to agree to plead guilty, a major concession offered to Roche and BASF by the DOJ was the right for both companies to be designated in second place when applying for leniency.⁵⁷ A second place

⁵² There may have been a change in ownership or management of the joint venture, Vitachem, Inc. Reilly's participation began in September 1994. It paid the lowest fine of the four conspirators (\$2 million). Nepera's exit may also be explained by its take over in 1995 by Cambrex Corp., which was not charged by the DOJ.

⁵³ It is not clear if the unnamed co-conspirators might be corporations or individuals. No executives from either Degussa or Reilly were required to plead guilty, so they were probably granted immunity.

⁵⁴ The existence of such tapes has not been formally acknowledged by the DOJ, but when asked about it at a press conference, Gary Spratling artfully avoided denying it. Barboza (1999) accepts the story.

⁵⁵ In the European Union, European Commission investigators can only search places of business for documents, not private homes.

⁵⁶ Roche imposed an estimated \$942 million in overcharges on U.S. direct buyers of vitamins in 1990-1999, an amount that can be doubled to calculate the government fine and tripled as an award to direct buyers (Connor 2006c: Appendix Table 13). Similarly, BASF generated \$320 million in U.S. overcharges.

⁵⁷ Spratling (2000) would later assert that Roche and BASF were "tied for second place" after Rhône-Poulenc, but he is not counting Lonza for some reason.

position confers the expectation that the applicants will receive the second largest discounts on their fines. The DOJ would later praise Roche and BASF for their exemplary cooperation.

The DOJ prosecutors likely pointed out the material benefits of a downward departure in their ultimate fines if only they too would cooperate. The decision to pay even the greatly reduced fines offered by the DOJ was obviously not an easy one to make for Roche and BASF. There is a revealing detail in the plea agreement signed by BASF, an appended letter from its general counsel to the DOJ dated May 18, 1999 committing BASF to plead guilty under the DOJ's terms: the meeting of BASF's Executive Committee at its Ludwigshafen headquarters to approve the deal must have been rancorous, because it lasted seven and one-half hours.

On May 19, 1999 the *Wall Street Journal* announced to the world that momentous guilty pleas of price fixing in the vitamins industry would be made public the next day. The announcement day itself was full of dozens of coordinated events. In the morning of May 20th, a press conference was held at the headquarters of the Department of Justice in Washington, attended by the Attorney General Janet Reno, the Assistant Attorney General for Antitrust Joel Klein, and many other top officials of the DOJ and FBI. At about the same time, officers of Roche and BASF appeared with DOJ prosecutors in U.S. District Court in Dallas, Texas to file their guilty pleas and explain to the Court how the fines and jail sentences were arrived at. The DOJ and the Big Three vitamins makers also released statements to the press. Rhône-Poulenc's statement admitted that it had engaged in criminal price fixing and would face harsh civil penalties in the future for its crimes; it also pointed out that it had been admitted to the DOJ's amnesty program and thereby would save tens of millions of dollars in potential U.S. penalties. Joel Klein spent much of the day being interviewed about the plea agreements. The world's business press would be filled with news of the deal the next day.

The deals involved an almost unimaginable stepping up of price fixing sanctions. Hoffmann-La Roche agreed to pay \$500 million in fines, almost five times the previous record antitrust fine. BASF paid \$225 million. These fines were roughly proportional to each company's U.S. and global market shares. (Had Rhône-Poulenc been fined, it could have paid as much as \$450). As the "second firms" to confess and with promises to cooperate, Roche and BASF were entitled to great leniency (Spratling 2000). Although a huge public relations coup for the DOJ, both fines reflected discounts of 65 to 75% from what could have been obtained had the DOJ gone to court and won in trial (Connor 2006c: Appendix Table 13). As odd as it may sound, settling for \$725 million in fines was a good deal for the defendants.

Information on how the 1993 DOJ leniency program works was well publicized in speeches by antitrust officials (e.g., Spratling 2000). Amnesty is granted to the first firm to confess to its role in a criminal antitrust conspiracy, but only if the DOJ was unaware of the cartel and the first-comer was not a leader or enforcer in the cartel. That is, the first to offer this valuable information and to agree to cooperate automatically receives a 100-percent discount on the fine specified by the U.S. Sentencing Guidelines. However, the second firm to confess also receives a substantial break as well, typically a 50- to 80-percent discount from what is specified by the Guidelines.⁵⁸ Attracting a second cartel member to the prosecutors' side is important if the other conspirators decide to go to trial. If a cartel is large enough to have third and fourth firms, they too may apply for leniency, but their fines will involve successively smaller discounts from their maximum fines. The degree of leniency will increase for these late-arrivals if they are quick to confess, relatively small players in the cartel, offer valuable information, created modest overcharges, or can show that the conspiracy was not condoned by top management (Spratling 2000).⁵⁹

⁵⁸ As a ringleader Roche was not qualified to be granted full amnesty, but could qualify for second-place.

⁵⁹ It is difficult to reconcile all of Spratling's criteria with the actual outcomes of these two cases. For example, Roche and BASF were tied for second place in the race for leniency in vitamins, yet the second largest ringleader (BASF) got a smaller percentage discount than the number-one ringleader. The later arrivals in this populous cartel also received discounts that were larger than the promised percentages. In sum, the DOJ was more lenient than its policy dictated.

Besides the corporate fines eight senior executives of Roche and BASF were indicted for criminal price fixing. The four Roche officials were Dr. Kuno Sommer (former head of global vitamins marketing, promoted to President of Roche's fragrances and flavoring division), Dr. Hugo Brönnimann (President of the vitamins division), Andreas Hauri (head of global vitamin marketing), and a former Roche executive whose name is secret.⁶⁰ At BASF, four officers with similar positions were indicted: Reinhard Steinmetz, Dieter Suter, Dietz Kaminski, and Hugo Strotmann. In addition to these eight, ten more managers were listed by name as unindicted co-conspirators. While all eight top executives were fined, the DOJ saved its harshest treatment for Kuno Sommer. He had not only fixed prices but also made false statements to DOJ investigators in March 1997. In addition to a \$100,000 personal fine, Sommer had to agree to a four-month prison sentence. This was the first time in U.S. antitrust history that a European had agreed to serve prison time for price fixing.

At its press conference, DOJ officials were grave and scolding. Janet Reno began by saying that the \$500 million fine was,

“. . . the highest fine the Justice Department has ever obtained in any criminal case. We mean business.”

Joel Klein elaborated on the DOJ's view:

“The vitamin cartel is the most pervasive and harmful criminal antitrust conspiracy ever uncovered . . . The enormous effort that went into maintaining the conspiracy reflects the magnitude of the illegal revenues it generated . . . These cartels . . . are powerful and sophisticated and, without intervention by antitrust authorities, will often go on indefinitely.”

Klein's assistant Gary Spratling provided added a pithy characterization:

“Simply put, the vitamin cartel was as bad as they get.”

When asked by a reporter why he thought the vitamin cartel lasted so long, Spratling gave three reasons. First, the Antitrust Division had only stepped up its efforts directed at global price fixing since the 1995-1996 lysine cartel case. Second, the conspirators had gone to great lengths to cover up their conspiracy. Third, the DOJ's leniency program had been very useful in attracting Rhône-Poulenc's cooperation, but the 1993 revision needed years to become well known.

A day after the DOJ press conference, the Chairman of Roche, Franz Humer, and the company's CEO met with the press. Humer said:

“I am personally absolutely shocked at what has happened. You will understand that this was not part of our responsibility. We really don't know what [the Roche price fixers] did.”

He claimed to have learned of the conspiracy only in February 1999; two previous internal investigations by the company in 1997 and 1998 (in response to civil suits brought against Roche by vitamin buyers in the United States) had failed to uncover any skullduggery. Huber said that he would take steps to avoid a repetition of antitrust offenses, but his plan was rather vague. The

⁶⁰ The unnamed executive is probably a retired predecessor of Sommer or Brönnimann who will be apprehended if he tries to enter U.S. territory. Hauri was one of the Roche officials first contacted by ADM's Terrance Wilson and Barrie Cox when they first traveled to Europe to launch the citric acid cartel (Connor 2001). Hauri paid the largest monetary fine for his recidivism.

only concrete step taken was firing Kuno Sommer and Hugo Brönnimann; the six other managers mentioned in Roche's guilty plea agreement were left in their jobs.

Humer's performance at this press conference raised a chorus of critical comments. In an article laced with acid language, *New York Times* writer Edmund Andrews derided Humer's statements:

“. . . the chairman and chief executive of Roche Holdings AG pronounced themselves blameless and clueless . . . ”

An article appearing in the *Financial Times* of London commented that:

“The fine is a severe blow to the reputation of Roche, one of the world's oldest and most conservative pharmaceutical companies.”

Industry analysts were not long in issuing glum predictions about the financial implications for Roche *et al.* By June 1999, they were speculating that the total antitrust costs for the defendants would be at least \$2 billion. Although promptly denied by Roche, one chemical-industry analyst estimated that Roche alone would face antitrust liabilities of \$1 billion or more and might want to sell its vitamins/fine chemicals division. The analyst's statement would turn out to be prescient but short of the mark. Five years later Roche did sell its vitamins division, but its antitrust bill would amount to \$2.5 billion.

In October 1999, a Roche spokesperson was interviewed about the vitamin conspiracy. In a statement that is quite revealing about the company's continuing attitude of myopic self-deception, she said:

“We can't dispute the facts and we've decided it is of no value to unravel it. The situation is behind us. We've paid dearly for it.”

Public-relations specialists often see their role as putting a positive spin on any adverse news facing their employers or clients. The truth is that Roche and its fellow conspirators in vitamins still faced a bewildering array of legal problems. The civil suits in the United States and Canada were still being filed or negotiated. More to the point, Roche *et al.* were besieged by investigations by antitrust officials of many nations, and several of these actions were at early stages in late 1999.

Smaller Firms Plead Guilty

The press releases of the U.S. Department of Justice make it clear that it regarded each of the punished⁶¹ nine vitamins cartels as cogs in one vast machine of collusion.⁶² Although the fines meted out on the first three companies would account for 80% of the total, ten more corporate guilty plea agreements followed those of Lonza, Roche, and BASF. The fines came in three waves of public announcements.

This time it was *USA Today* that broke the news about further indictments in its June 17, 1999 edition. Seven companies and the vitamins they made were specifically mentioned. The first wave of post-Roche guilty pleas came on September 9, 1999. Takeda Chemical Industries, Eisai Co., and Daiichi Pharmaceutical paid fines of \$72, \$40, and \$25 million, respectively, for price fixing in the markets for vitamins E, C, B2, and B5. It is typical for conspirators that take longer to admit their guilt to be fined at a higher rate than companies that settle early and cooperate. Negotiations with these three companies had dragged on for about seven months. However, the

⁶¹ The DOJ did not fine the participants of seven cartels. Reasons are discussed below.

⁶² For example, in a September 30, 2002 release about a fine on a choline chloride defendant, the Assistant Attorney General for Antitrust is quoted as saying: “This latest case, the 29th in the long running and highly successful vitamins investigation...”

fine paid by Eisai was discounted by 75% -- the same rate as had been accorded Roche and BASF (Connor 2006c: Appendix Table 14). That is, Eisai was treated as though it too was “second in line” for leniency. The other Japanese firms, Takeda and Daiichi, received generous discounts of 59% and 40%, respectively. Given that Takeda was the ringleader of at least six Japanese cartelists, the reason for its large discount is particularly difficult to square with DOJ fining policy. No officers of the three companies were individually sanctioned.

The large U.S. fines paid by the three Japanese chemical companies were widely reported in the companies’ home country. Perhaps to counter the adverse publicity, the companies imposed on themselves additional sanctions. At Takeda Chemical Industries all employees were to be required to take new training in antitrust principles. The company’s president, Kuno Takeda, took a 15 percent pay cut for three months, and all members of the board of directors ordered a 5%, three-month pay cut for themselves. Moreover, Kuno Takeda resigned his post as Chairman of the Japan Federation of Pharmaceutical Manufacturers. Daiichi and Eisai announced very similar sanctions for their boards, presidents, and employees on the same day. Although there is a certain ritualistic flavor to their public self-flagellation, at least it makes the point that the companies’ entire governance structures accept some of the burden of responsibility for the companies’ criminal behavior. In any case, the Japanese companies’ responses stand in stark contrast to the “clueless and blameless” stance of Roche’s top officials.

Later in September 1999 the second, much delayed corporate conviction for choline chloride was announced. Chinook Group Ltd. of Canada became the 8th firm prosecuted in the vitamins scandal. Recall that Chinook’s co-conspirator had confessed to price fixing 15 months earlier and that the FBI had raided Chinook’s offices one year earlier. These actions should have yielded considerable evidence against Chinook. On the other hand, previously two of its officers had been indicted for the same crime but had refused to plead guilty or otherwise cooperate. Moreover, it is also apparent that the third participant in the cartel, DuCoa and its managers were also refusing to cooperate with prosecutors.⁶³ These developments indicate that because of resistance by the company’s owners and management the DOJ had considerable trouble obtaining corporate guilty pleas from both Chinook and DuCoa. At Chinook, two U.S. employees (John Kennedy and Robert Samuelson) and one Canadian employee (Russell Cosburn) were found guilty of felonious conspiracies. Yet considerable evidence led a U.S. court to conclude that the two controlling owners of Chinook were also aware of and encouraged the price fixing; they were Robert Copeland and Patrick Stayner, CEO and VP for Finance.⁶⁴ Yet, neither Copeland nor Stayner were indicted by U.S. or Canadian authorities.

Chinook agreed to pay a \$5 million criminal fine for its role in the price fixing vitamin B4. Chinook was the largest member of and instigator of the North American branch of the choline chloride cartel. Under the double-the-harm standard, Chinook was liable for a U.S. fine of up to \$145 million. Instead, its 97% discount suggests that the collapse of prices in the choline chloride market had driven Chinook into poor financial shape. Normally, it would have been the most heavily fined but for its inability to pay.

The DOJ winded down its investigation in 2000. The second wave came in May 2000. Four corporate and two personal price fixing convictions were announced that came close to

⁶³ Despite pressure applied by the DuCoa’s parent company, DuCoa’s owners did not agree to plead guilty until September 2000. DuCoa’s President and three other officers responsible for its price fixing were indicted but not sentenced until 2004.

⁶⁴ Prosecution of Chinook, Ltd. was also complicated by its ownership structure (see *In Re: Vitamins Antitrust Litigation*, Misc No. 99-197 (TFH), MDL No. 1285). Chinook, Ltd. was the manufacturing entity that controlled its U.S. manufacturing subsidiary Chinook Inc., a Minnesota corporation. However, both of these operating entities were owned and controlled by a Canadian holding company, Cope. Peter Copeland was President and Chairman of both Cope and Chinook, Ltd., and all of Chinook’s senior management reported directly to Copeland, including the VP for Sales Russell Cosburn who was imprisoned for price fixing in Canada. Copeland testified that he was aware of the meetings and authorized Cosburn and Stayner attendance at the meetings. Copeland and Stayner personally attended at least two of the price-fixing meetings.

tidying up the slate. The Darmstadt, Germany-based pharmaceutical firm E. Merck pleaded guilty to fixing the price of vitamin C and agreed to pay a \$14 million fine. Roche, BASF, and Takeda had previously admitted their guilt in the vitamin C case, and E. Merck would be the last member of this cartel to be punished. In addition, three companies were convicted in the vitamin B3 cartel: Degussa-Hüls (Germany), Nepera (a subsidiary of the U.S. firm Cambrex Corp.), and Reilly Industries (a privately owned Indiana firm). Degussa was awarded the smallest antitrust-fine discount of any of the 13 vitamin cartelists, a paltry 29%. The distribution of the \$19 million in fines suggests that Degussa was a co-leader of the cartel, but its high fine may also have been a consequence of recalcitrance in settling with the government. Degussa's guilty plea came 18 months after the largest member of the B3 cartel (Lonza) had capitulated and agreed to supply the DOJ with information. Degussa's small discount is also surprising because its partner in crime, Reilly Industries, was granted a 78% downward departure from the maximum.⁶⁵

The fourth member of the vitamin B3 cartel was Nepera, which was the smallest company in the vitamin B3 cartel. Its \$4 million fine was one of the most heavily discounted (83%). Its large discount probably reflects a low ability to pay the fine. Both of the men convicted and given prison sentences were Nepera executives. As the DOJ usually reserves the right to insist on prison sentences only for ringleaders of cartels, their imprisonment probably signals an initial refusal to accept responsibility for their actions.

Much later, in September 2002, the second member of the choline chloride conspiracy, DuCoa, pleaded guilty and paid \$500,000, by far the smallest fine of the 13 convicted firms in the United States. Three of DuCoa's officers pleaded guilty, and its last president was convicted at trial in Texas in December 2004 (DOJ 2005). He received the longest prison sentence (30 months) of any of the convicted vitamins defendants. It appears from this turn of events that the owners of DuCoa might not have been aware of the price fixing going on in the company's vitamin sales department. From 1988 to 1997, DuCoa was a 50-50 joint venture of the giant chemical company DuPont and the equally huge food manufacturer ConAgra. DuCoa's case is unique in that the company was sold to a new owner, DCV Corp., during the middle of the vitamin B4 conspiracy. DCV maintains that it knew nothing of the price fixing. Indeed, DCV has sued DuCoa's former owners, DuPont and ConAgra, for failing to reveal a material fact prior to the acquisition of DuCoa. The imposition of a nominal fine on DuCoa lends credence to the notion that the company's new owners had no knowledge of the conspiracy.

Table 7A gathers information on the DOJ's discount policies with regard to price-fixing fines. DOJ press releases counted the number of indictments and convictions as though the 16 cartels were in fact one grand conspiracy, but its discounting behavior betrays a more piecemeal approach. The first vitamin conspirator to agree to plead guilty was Mitsui's U.S. subsidiary Bio-Products, Inc. It received amnesty around July 1998 for being the first to inform the DOJ about the choline chloride cartel and escaped a nearly \$100-million liability for providing substantial information about co-conspirators Chinook and DuCoa (Barnett et al. 2005). Lonza was the second firm to begin cooperating with the DOJ, but could not qualify for amnesty because it was the leader in the vitamin B3 cartel; it received a 72% discount from the maximum possible fine.⁶⁶

The DOJ evidently regarded the Roche cartels as legally separate events from the vitamins B3 and B4 conspiracies, because it conferred amnesty on Rhone-Poulenc in February 1999. Roche and BASF, the "second" firms to plea (actually third or fourth), received similar generous discounts of 81 and 72%, respectively. These are large discounts because they were the co-creators of 14 cartels that caused billions of dollars of U.S. injuries. (One possible explanation is the fact that seven officers of Roche and BASF agreed to serve substantial prison

⁶⁵ Recall that Reilly and Degussa were joint owners of a production and marketing joint venture; as far as is known this subsidiary was equally controlled by the two parents.

⁶⁶ The DOJ's policy is to grant 70-80% discounts for second cooperators (Spratling 2000). Lonza could have been first; its plea is dated September 1998, but its cooperation probably began a month or two earlier. Bio-Products decided to cooperate in June 1998, and probably applied for amnesty a month or two later.

sentences even though they resided in Europe.) The three largest Japanese firms stuck together, refusing to plead guilty until four months after Roche and BASF. With ample information flowing from the Big Three to convict Takeda, Eisai, and Daiichi, it appears the Takeda was the only one to volunteer to fully cooperate because its discount was 75%. It is DOJ policy to regularly grant discounts of 50 to 70% to late-arriving firms that are fully cooperative (Spratling 2000). Thus, the discounts of 25% to 44% for Eisai, Daiichi, E. Merck, and Degussa indicate that their negotiations with the DOJ were difficult ones. On the other hand, these four firms procrastinated for up to a year before paying their fines, and none of their managers were indicted.

The remaining 11 corporate conspirators received fines of 99 to 100%. In three cases ability to pay was an issue, and in two more cases the statutes of limitations could have intervened. But by far the most common explanation for no fines was that the size of the affected sales in four cartelized markets fell below a certain threshold.

To sum up, 14 chemical companies were convicted by the United States for price fixing in markets for bulk vitamins. U.S. fines on the unlucky 14 and 15 of their officers accumulated to \$915 million (Tables 16 and 17). In real (2005) dollars, U.S. fines were \$677 million (Table 9A). Two firms received amnesties that might otherwise have added \$550 million in fines, and seven firms went unpunished. Because of discounts on fines, the vitamins conspirators paid only 19% of the maximum possible fines of \$4.8 billion. In addition, 16 senior executives of the vitamins manufacturers were criminally indicted, of which 15 received personal sentences that averaged \$110,000 in fines and 8 months in prison.⁶⁷ The most injurious cartels in the past half-century were also the most expensive for the perpetrators.⁶⁸

⁶⁷ A few were not sentenced as of early 2006.

⁶⁸ The affected sales of the great U.S. electrical power-generating-equipment cartel were estimated to be \$7 billion per year in the 1950s for a similar duration.

Table 7A. Discounts on U.S. Corporate Fines					
Date of Plea	Company	Maximum ^a	Paid	Discount	Reason for Discount
		<i>Million U.S. dollars</i>		<i>Percent</i>	
7/1998	Bio-Products	97.8	0	100	Amnesty
9/1998	Lonza	38	10.5	72	Second to plea
2/1999	Rhone-Poulenc	450	0	100	Amnesty
5/1999	Hoffmann-La Roche	2624	500	81	"Second" to plea (tie)
	BASF	818 ^d	225	72	"Second" to plea (tie)
9/1999	Takeda	176	72	59	Fourth to plea (tie?)
	Eisai	160	40	75	Fourth to plea (tie?)
	Daiichi	63	25	40	Fourth to plea (tie?)
	Chinook	145	5	97	Ability to pay
5/2000	E. Merck	32	14	44	Unknown
	Degussa	18.4	13	29	Unknown
	Nepera	23.4	4	83	Ability to pay
	Reilly	10.0	2	78	Junior partner?
9/2000	DuCoa	47.4	0.5	99	Ability to pay
None	Akzo Nobel	10.0	0	100	Statute of limitations?
	UCB	10.0	0	100	Statute of limitations?
	Solvay	10.0	0	100	D3 market too small
	Sumitomo	10.0	0	100	B9 & H market small
	Tanabe	10.0	0	100	H market too small
	Kongo	10.0	0	100	B9 market too small
	Hoechst	10.0	0	100	B12 market too small
	Total 21 companies	4,773	911	81	

Source: Connor (2006c: Appendix Table14).
a) If above \$10 million, double the harm in the United States; otherwise the \$10 million statutory cap.

Table 8. Global Monetary Antitrust Sanctions, by Company 1999-2005

Companies	Fines ^a				Private Suits ^d	Total
	U.S.	Canada	EU	Other		
	<i>Million nominal U.S. dollars</i>					
Roche	500.0	42.0	410.0	9.3	1468-1736	2492-2697
BASF	225.0	16.2	308.4	4.3	441-521	994-1074
Takeda	72.0	2.8	32.9	0.0	383-454	491-562
Rhone-Poulenc	0 ^b	11.6	4.5 ^b	2.8	274-324	292-342
Eisai	40.0	1.7	11.7	0.2	93-110	147-164 ^e
Daiichi	25.0	2.1	20.8	0.1	64-74	112-124
E. Merck	14.0	0.55	8.2	--	50.7	73.5
Lonza	10.5	0.6	29.2	0	28.5	68.8
Mitsui/Bioproducts	0 ^f	0.4	--	0	53.4	53.8
Tanabe	0	0	0 ^c	0	45	45.0
Akzo Nobel	0	0.55	28.0	0	7.5	36.1
UCB	0	0.0	13.8	0	9.0	22.8
Degussa	13.0	1.3	--	0	8.7	23.0
Sumitomo	0	0	0 ^c	0	17.5	17.5
Chinook	5.0	1.2	0 ^c	0	6.9	13.1
Solvay	0	0	8.1	0.01	--	8.1
Nepera	4.0	0.12	0 ^c	0	3.5	7.6
Reilly	2.0	0.02	--	0	4.2	6.2
Hoechst	0	1.2	--	0	0	1.2
DuCoa	0.5	0	0 ^c	0	0.4	0.9
Kongo	0	0	0 ^c	0	0	0
Total	915 ^g	83.1	847.6	16.4	2966-3466	4821-5320

Source: Appendix Table 2.

-- No information, no sales in the jurisdiction, or pending

^a Fines announced as of early 2005 by U.S., Canada, EU, Australia, and Korea. EU investigations of vitamins B3 and B12 may be pending.

^b Amnesty for vitamins A&E.

^c Guilty but saved by the statute of limitations.

^d U.S. settlements widely reported to be more than \$2 billion. Includes settlement by National Association of Attorneys General for \$335 million for indirect buyers in 23 states (\$305 mil.) and 43 states as direct buyers (\$30 mil.). Legal defense fees are probably 5-10% more than settlements payouts. Also includes Canadian private suits totaling \$105 million.

^e Annual report 2000 said "total losses" were 5.7 billion yen (about \$188 mil.).

^f Amnesty for vitamin B3.

^g Includes fines on individuals.

Table 9. Monetary Sanctions by Vitamin Product, 1999-2005

Product Market	U. S. Govt.	U.S. Private	Canada ^b	Europe	Rest of the World	World
	<i>Million nominal U.S. dollars^a</i>					
Beta carotene	62	187-220	9.9	81	0	339-372
Canthaxanthin	0	4-5	0.2	78	0	84-85
Biotin (H)	0	94-98	0	0	0	94-98
Choline chloride (B4)	5.5	98	9.9	88	0	202
Folic acid (B9)	0	14-16	0	0	0	14-16
Vitamin A	97	404-475	22.4	117	5.6	645-716
Vitamin B1	0	31-35	0	0	0	31-36
Vitamin B2	28	73-86	4.0	62	0	167-179
Vitamin B3	30	58	4.2	0	0	91
Vitamin B5	39	88-104	6.1	99	0.1	233-248
Vitamin B6	0	28-33	0	0	0	28-33
Vitamin B12	0	6.5-7.5	5.2	0	0	11.5-12.5
Vitamin C	175	463-533	29.2	104	5.4	776-846
Vitamin D3	0	0	0	38	0	38
Vitamin E	262	884-1039	43.4	180	5.8	1374-1529
Premixes	218	605-710	70.4	0	0	891-1056
Total	915	2860-3360	205	847	16.9	4845-5345

Source: Appendix Table 2.

a) The EU assigns fines by product, but most other fines and settlements are allocated by the affected sales of the product and then within the product by company market share. Converted C\$1 to US\$ 0.826.

b) Includes private settlements for single damages to direct and indirect purchasers that account for 51% of the total.

Table 9A. Real Monetary Sanctions by Vitamin Product, 1999-2005						
Product Market	U. S. Govt.	U.S. Private	Canada ^b	Europe	Rest of the World	World
	<i>2005 U.S. dollars ^a</i>					
Beta carotene	52.4	118.9	8.2	52.7	0	232.2
Canthaxanthin	1.1	2.6	0.17	51.1	0	55.0
Biotin (H)	0	42.1	0	0	0	42.1
Choline chloride (B4)	2.4	43.0	4.58	35.4	0	85.5
Folic acid (B9)	0	6.6	0	0	0	6.6
Vitamin A	74.8	232.9	16.7	69.1	4.68	400.6
Vitamin B1	0	14.5	0	0	0	14.5
Vitamin B2	19.5	38.0	2.7	32.9	0	93.1
Vitamin B3	22.9	30.7	2.36	0	0	56.0
Vitamin B5	20.9	50.9	4.55	58.4	0.08	134.9
Vitamin B6	0	13.4	0	0	0	13.4
Vitamin B12	0	3.1	3.12	0	0	6.27
Vitamin C	111.9	218.6	18.1	51.0	3.74	405.3
Vitamin D3	0	0	0	24.7	0	24.7
Vitamin E	202.2	509.7	32.4	106.3	4.85	857.9
Premixes	168.5	348.5	52.5	0	0	569.6
Total	676.6	1673.8	145.6	481.7	13.36	2991.1
<p>Source: Appendix Table 2. To allow for the opportunity cost of capital (i.e., the absence of prejudgment interest), fines and settlements are adjusted downward by the U.S. prime rate of interest plus 1% from the midpoint of the conspiracy to the year the cartel was fined; then from the latter year, the figure is raised to \$2005 using the producer price index of the appropriate region.</p> <p>a) The EU assigns fines by product, but most other fines and settlements are allocated by the affected sales of the product and then within the product by company market share. Converted C\$1 to US\$ 0.826.</p> <p>b) Includes private settlements for single damages to direct and indirect purchasers that account for 51% of the total.</p>						

Ten That Got Away

Eleven of the 21 corporate participants were indicted by U.S. DOJ. Two of the 11 pleaded guilty but were given amnesty for being the first to come forward with information to prosecute the remaining 19 cartelists and 16 of their managers.

How can two firms be first? As related above, Rhone-Poulenc offered to cooperate in the DOJ's on-going vitamins investigation sometime around December 1998. Rhone-Poulenc had become an early participant in two of the largest Roche-organized cartels – vitamins A and E. The second firm to be designated “first in line” for amnesty was Bio-Products, an Ohio manufacturer of choline chloride controlled by the world's largest trading company, Japan's Mitsui & Co. (Barnett et al. 2005: 29).⁶⁹ It is unlikely that Rhone and Bio-Products were tied for position. A more reasonable explanation is that as a legal matter the DOJ, despite pronouncements to the contrary, viewed the chlorine chloride cartels as almost entirely separate from the other 15 vitamins cartels.

Bio-Products gave sufficient information to the DOJ to convict two North American manufactures, Chinook and DuCoa, for criminal price fixing. The president of Bio-Products also testified at trial against the president of DuCoa (*ibid.* p.8). However, Akzo Nobel, BASF, and UCB, the three members of the European branch of the choline chloride cartel, were not indicted by the DOJ. By agreeing to stop exporting to the North American market from 1992 to 1998, these firms were directly responsible economically and legally for the price increases in the United States.⁷⁰ Even if Bio-Products had no information on this strategy, both Canada and the European Commission were well informed about the European branch. Moreover, the three European manufacturers paid substantial settlements to U.S. buyers to settle a class action. Thus, unless justified by a decision to conserve prosecutorial resources, the DOJ's inaction is puzzling.

The DOJ declined to indict companies that arranged cartels in seven markets: vitamins B1, B6, B12, D3, folic acid, biotin, and canthaxanthin. This decision affected three Japanese manufactures of biotin and folic acid. While Roche was the world leader in these two products, Sumitomo, Tanabe, and Kongo Chemicals each held 15 to 20% global market shares in the two markets and caused an estimated \$20 million in overcharges in the U.S. market. Neither the inability to pay nor the statute of limitations were factors inhibiting prosecution of the sellers in these two cartels. It is true that folic acid was an exceptionally small market (less than \$12 million in affected sales), but the biotin market was substantial (\$144 million).

In the case of vitamins B1 and B6, the participants were companies fined for their participation in other cartels. Neither lack of information nor the statute of limitations explains the DOJ's inaction. Both cartels generated modest U.S. sales (\$104 million) and equally modest overcharges (about \$14 million). The vitamin D3 cartel had \$72 million in affected commerce and \$10 million in overcharges. By failing to prosecute, Solvay got a pass on U.S. fines.

Hoechst was the junior member of the global vitamin B12 cartel, which it dominated along with Rhone-Poulenc. Neither manufacturer was indicted for fixing prices in this medium-size market (\$112 million in affected U.S. sales). As mentioned previously, the fact that Rhone and Hoechst were planning to merge was a likely factor in Rhone's decision to seek amnesty.⁷¹ It is likely that the DOJ's failure to press ahead with legal action in vitamin B12 was a concession to Rhone when it agreed to confess. Without such a deal, the two firms faced U.S. fines of up to \$82 million.

⁶⁹ Mitsui denies management control, but in a 2005 U.S. civil trial a jury found otherwise. Mitsui saved a possible \$98 million fine when it was accepted into the amnesty program.

⁷⁰ Calculating the damages to the U.S. market from this behavior may be more challenging than for the other cartels.

⁷¹ The merged company (Aventis) became a reality in December 1999.

Finally, the DOJ did not prosecute the cartel that fixed the prices of canthaxanthin and other carotenoids. The industry is a duopoly of Roche and BASF; their conspiracy generated \$116 million in U.S. sales and \$24 million in overcharges. Its omission is a mystery.

To summarize, ten out of 21 corporations that engaged in vitamins collusion in the 1990s received no fines in the United States. Two of them were large companies that sought and received full amnesty, while the remaining eight firms were generally small ones. Two of the three large European manufacturers that had by agreement withheld exports of vitamin B4 to the United States were unsanctioned by the DOJ. Moreover, no fines were imposed for price fixing in any markets with less than \$150 million in affected commerce, namely, vitamins B1, B6, B12, D3, folic acid, biotin, and canthaxanthin. While each of these cartels was relatively small, the aggregate amount of affected U.S. commerce was significant -- \$560 million or 7.4% of the total. As a result, eight cartelists escaped criminal prosecution. No impediments to prosecution were noted, so the reluctance to indict seems to rest upon in a decision to conserve prosecutorial resources.

Canada

The cartels in the global bulk vitamins markets attracted more coordinated enforcement activity outside the United States than any others in history. At least eight jurisdictions launched formal antitrust investigations of price fixing: Canada, the European Union, Switzerland, Japan, Australia, New Zealand, Brazil, and Mexico. No where was there a greater determination to prosecute swiftly and vigorously than in Canada.

The Canadian Competition Bureau (CCB) began its investigation sometime before early 1999, aided by long-standing cooperative agreements and years of actual coordination in cartel matters with the U.S. DOJ. On September 22, 1999 the CCB recommended precedent-setting corporate fines for five vitamin manufacturers, and the Federal Court of Canada agreed to accept its recommendation. Officials said that prices of vitamins were pushed as high as 30 percent above competitive levels.

Fines of Canadian \$85.5 million were imposed on Roche Holdings, BASF, Rhône-Poulenc, Eisai, and Daiichi for nine of the vitamins cartels in A, C, E, B2, B4, B5, B6, beta carotene, and premixes. Unlike the United States, vitamin B6 was listed as one of the cartelized markets.⁷² Affected sales in Canada by the five defendants totaled between \$650 and \$700 million. These were by far the largest criminal fines in Canadian legal history. The federal prosecutor stated that these fines “were big enough to eliminate most illicit profit” made by the cartel in Canada⁷³, but he admitted that the defendants were given a discount below what could have been imposed by the Court, mainly because the guilty pleas spared the Crown the expense of litigating a conviction. He noted that the defendants still faced monetary penalties from civil suits; class-action suits have been permitted in Canada since 1992 but seldom had been litigated at that time.

Additional corporate fines were imposed by Canada’s courts over the next four years. On September 24, 1999, Chinook Group Ltd. was fined C\$5 million; the VP for sales of Chinook was sentenced that same month to nine months of confinement to be served as community service. The last participants in the choline chloride conspiracy to be sentenced (in August 2003) were Akzo Nobel and Bio-Products, which were required to pay C\$1 and \$0.8 million fines, respectively. Neither UCB nor DuCoa were indicted. On October 20, 1999 Hoechst was fined C\$370,000 for colluding in the market for vitamin B12. The other Canadian supplier, Rhone-Poulenc, was not punished for fixing the price of this vitamin. Neither the United States nor the EU

⁷² Another difference is that BASF was fined for its role in preventing exports of choline chloride to Canada, a violation ignored by the DOJ.

⁷³ The data below indicate that in real terms only about 25% were disgorged by government fines.

fined any companies for the vitamin B12 conspiracy, though both firms did pay U.S. buyers civil settlements for this product. On February 24, 2000 Takeda agreed to pay a C\$5.2 million fine for its role in the vitamins C and B2 cartels. On March 30th of that year E Merck was also fined C\$1 million for vitamin C. Takeda and Merck completed the quartet of firms responsible for global collusion in vitamin C.

The next-to-last corporate prosecutions in Canada were announced on October 16, 2002. Degussa, Lonza, Nepera, and Reilly were forced to pay C\$3.9 million in criminal fines in the vitamin B3 case. That amounted to a total of 15 corporate convictions and almost exactly C\$100 million in fines for about C\$824 million in Canadian affected commerce. In addition, four businessmen from Switzerland, Germany, and Canada were convicted and paid C\$650,000 in fines.⁷⁴ Converted to nominal U.S. dollars, the totals amounted to about 83 million in fines and 546 million in sales – approximately a 15% ratio.

The European Union

On May 20, 1999, the DOJ trumpeted its second and largest wave of sanctions. Later that month the EU's antitrust chief, Karel van Miert, stated that Roche, BASF, and Rhône-Poulenc were cooperating with its investigation. Van Miert also prepared the European public for lower fines than those imposed by the United States. Shortly thereafter a new Competition Commissioner took over the helm of DG-COMP – Mario Monti.

The Roche Cartels

In the week before the DOJ's momentous vitamins-prosecution announcement, the Big Three vitamin manufacturers rushed to Brussels (EC 2001). Already alerted to Rhone-Poulenc's membership in the DOJ's amnesty program, on May 4th Hoffmann-La Roche wrote to the Commission and informed it of the company's intention to cooperate with any investigations of cartel activity; on May 6th BASF did likewise; and on May 17th Roche and BASF jointly visited the Commission and repeated their intention to cooperate. However, in what may have been a costly decision, neither company handed the EC a written statement (a proffer) or documentary evidence that month.⁷⁵ Meanwhile, on May 12th Rhone-Poulenc announced to the EC that it had violated the EU's competition law and that it sought leniency under the Commission's Leniency Notice of 1996. Later, the EC would decide that Rhone-Poulenc was qualified to meet all the conditions of its leniency program.⁷⁶

An EC investigation officially begins when it sends letters to targets requesting information about possible violations. From June to October 1999 the DG-COMP received letters and documents from 11 members of the vitamins cartels. All but Sumitomo admitted to anti-competitive behavior. After about a year of study DG-COMP had arrived at preliminary conclusions about the guilt of the responding corporations.⁷⁷ In July 2000, the European Commission sent its Statement of Objections (legal warnings that are similar to target letters in the United States) to 13 vitamin manufacturers informing the companies that they were the objects of a price-fixing probe. The Commission's mailing included a redacted copy of its

⁷⁴ They are Russell Cosburn of Chinook and three former employees of Hoffmann-La Roche, Roland Brönnimann, Andreas Hauri, and Kuno Sommer.

⁷⁵ It was not until June 4th and June 15th that the two companies sent memoranda to the EC admitting their violations. BASF supplied a bundle of documents on June 23, 1999. Both Roche and BASF are judged to be instigators, which would disqualify them for leniency in any case.

⁷⁶ By the time the EC's decision was adopted in November 2001, Rhone-Poulenc had merged with Hoechst to become Aventis (now named SANOFI Aventis). Aventis was granted a 100% reduction in fines for Rhone's violations but only 10% for Hoechst's cartel activities. Roche and BASF each received a 50% reduction.

⁷⁷ The EU has no authority to sanction individuals involved.

investigation file. The next step is for the targeted companies to respond to the Commission's preliminary factual findings, either in writing or at a confidential oral hearing. Ten of the targets attended an oral hearing held on December 12, 2000 and all but two accepted the Commission's findings.

The Commission's conclusions and its response to objections by the parties are contained in a dense 89-page decision dated November 21, 2001; a slightly redacted version was released on June 10, 2003. Counting Rhone-Poulenc and Hoechst as two entities, the decision identified 14 violators as having cartelized the markets of 14 bulk vitamins from periods beginning as early as December 1998 to as late as February 1999.⁷⁸ Like other antitrust authorities DG-COMP did not investigate hints of vitamin cartel activity in the 1980s.⁷⁹ Unlike U.S. and Canadian practice, the EC regarded each of the 12 cartels as somewhat separate violations. The decision did not address allegations of cartels in vitamin B3, B4, B12, or vitamin premixes.⁸⁰ The EC vitamins decision is a treasure trove of information on the industrial structure, economic dimensions, and behavior of the vitamins cartels.

The EC ordered 11 of the 14 companies to pay fines that totaled an impressive \$759 million, an amount only slightly lower than that imposed by the United States (Table 8). The lion's share (95%) of the fines was paid by Roche (\$410 million) and BASF (\$308 million). Rhone-Poulenc was granted amnesty for its participation in the vitamins A and E cartels, but its new parent Aventis was fined \$4.5 million for Hoechst's collusion in D3. The amnesty provision was worth €217 million (\$193 million) to Rhone-Poulenc. In addition, the participants in the vitamins B1, B6, biotin, and folic acid cartels were not fined because of the Commission's five-year "statute of limitations."⁸¹ The time that elapsed between the date the investigation began and the date the violation ceased ranged from five years and two months to five years and five months. As a result of its slow start, the Commission levied no fines on five otherwise guilty firms: Lonza, Kongo, Sumitomo, Sumika, and Tanabe. Roche, BASF, Takeda, and five other firms benefited greatly from the five-year rule. The EC has been criticized for its tendency to delay the start of its investigations, which has allowed many cartel violators to escape punishment (Arman 2005). The net reduction in fines from the EC's slowness to act benefited the 13 firms to the tune of €290 million (\$257 million).

Choline Chloride (Vitamin B4)

The European branch of the global choline chloride cartel was investigated and fined by the Commission for slightly more than five and one-half years: from May 26, 1999 to December 9, 2004 (EC 2004).⁸² After completing its investigation, the EC intended to fine all six members of the global conspiracy, but again was foiled by its procrastination and the five-year "statute of limitations." In this instance, the EC seems to have blundered badly by not opening its investigation earlier. Even if the DOJ did not share the fact that Bio-Products had been approved

⁷⁸ Sumika is identified as an independent company, whereas most other sources indicate that Sumika is a controlled subsidiary of Sumitomo Chemical.

⁷⁹ Consistent with Bernheim's (2002a) analysis, at least one target firm admitted to "collusive contacts" in the 1980s that ended in 1989 when prices fell temporarily (EC 2001: endnote 21). Given the turnover among managers and unavailability of 15-year-old corporate records the lack of follow-up may be justified on pragmatic grounds.

⁸⁰ The decision contains a short paragraph that relates that the respondents (Roche and BASF) admitted discussions on fixing premix prices in Europe but that "...there had never been any effective agreements...since most sales were made as 'straights'" (EC 2001: ¶129). Under a conspiracy theory of cartels, such an excuse would not be tolerated. Even as a matter of simple logic it is suspect. A separate decision on choline chloride is discussed below.

⁸¹ Technically this is not a parliamentary act, rather, the rule is contained in Article 1 of the European Council's Regulation (EC) No. 2988/74 and Article 25 of Regulation No. 1/2003.

⁸² This 77-page decision was published in late 2005. It is the most complete source of information on the choline chloride market and the cartel's operations.

for amnesty in June 1998, the EC must have been aware of Chinook's well publicized guilty plea in September 1999. Even more unsettling is the EC's own admission that Chinook's legal counsel met with the Commission a month later and that the company delivered considerable written information about the choline chloride cartel in December 1999 (EC 2004:17). Yet, the Commission inexplicably declined to investigate what must have been clear evidence of a global cartel with effects spilling over into the EU market.⁸³ Instead, the EC waited until late May 1999 to formally open its probe in response to a formal application of leniency from Bio-Products on April 28, 1999 (*ibid.*).⁸⁴

From the EC's point of view, the choline chloride cartels operated at "two levels," a group of three sellers within the EU and a global organization of six firms (EC 2004: 21). UCB and Akzo argued that the global and European arrangements were separate infringements (*ibid.*). Yet, from a legal point of view the EC ruled that the multiple branches or levels constituted a "single and continuous infringement" of the EU's competition rules (*ibid.*, pp.50-53). A ruling that there were two infringements would have favored the European firms, because the EC increases the fines for more durable cartels. The global group got started by November meeting in Germany in November 1992, whereas the European branch may not have begun anticompetitive discussions until March 1994. Price targets were discussed by the three European manufactures at its last meeting in Aachen, Germany in October 1998.

By contrast, the EC had no evidence of North American participation at price-fixing meetings after April 1994. This is the main factual basis for exculpating the North American conspirators. The EC's interpretation of the cessation of collusion by the North American producers is at odds with its view that there was only one collusive group. It is true that North American exports to Europe began soon after April 1994, but this is hardly conclusive evidence that some of a permanent, full, or irrevocable abandonment of the global agreement. Besides, there were collusive bilateral contacts between BASF and some American firms regarding Latin American sales (EC 2004:35). Moreover, Chinook and Bio-Products provided ample evidence of continuing successful collusion in the North American market. European buyers were harmed until at least September 1998, because absent the North American cartel geographic arbitrage on a much larger scale would have broken the European cartel.

The EU's choline chloride investigation lasted for 68 months. In the decision of December 9, 2004 the three European manufacturers of choline chloride were fined a total of €66.34 million or \$88.4 million (EC 2004:60-75). BASF, the smallest of the three, received the largest fine of \$36 million (Appendix Table 2A). The fines were calculated by starting at the minimum point for a "very serious" infringement (€20 million per firm), because the EU affected sales of \$408 million were judged to be "relatively small." Then the Commission decided to create four firm-size categories based on the six companies' *global* market shares; as a result, the three European companies got fine reductions of 36 to 53%. Then, in the name of deterrence, the preliminary fines were raised by 100% for Akzo Nobel and 50% for BASF using the companies' 2003 global sales as a guide. A further increase of 55% was implemented for all three because of the cartel's 5.5 years' duration,

⁸³ The documents submitted by Chinook totaled 255 pages (EC 2004: footnote 38). It is not known whether they contained information on the European branch of the cartel, but it is known that Chinook and UCB had many meetings and other contacts throughout the cartel's existence. Moreover, Chinook's submissions did describe Chinook's admission that it attended illegal cartel meetings and the 1992 agreement that prevented the North American members of the global cartel from exporting to Europe.

⁸⁴ In letters sent July 1999 and October 1999, Chinook claimed that its November 1999 meeting with the Commission was in fact an application for leniency, and it disputed Bio-Product's right to qualify for amnesty (EC 2004: ¶52). The Commission replied in September 1999 that "„Chinook's legal counsel had insisted ...on the provisional, exploratory and informal nature of the contacts." (*ibid.*). Memories of this meeting vary. When Bio-Product's counsel met with the Commission in April 1999, he specifically cited full cooperation under the 1996 Leniency Notice. It appears from this episode that it is necessary for counsel to specifically cite (perhaps in a proffer letter) the EC's Leniency Notice when applying for leniency. In this particular case the leniency decision was mooted by the EC's finding about the early ending date of the global-level conspiracy.

and BASF received a further 50% enhancement for recidivism involving a 1994 EU decision. No attenuating circumstances, including leniency, were permitted to moderate the fines. The final adjustments were modest reductions of 20 to 30% for various degrees of investigative cooperation (timely delivery of evidence, degree of detail provided, or a decision not to contest the facts).

Four aspects of the EC's fining procedures appear to be arbitrary. The percentages applied for enhancements or reductions have evolved over time to become somewhat consistent across cases, but are nevertheless difficult to square with a deterrence framework. Relative to the harm caused in the EU market, BASF's fine ended up being three times harsher than Akzo's Connor 2006c: Appendix Table 2B). Singling out BASF for recidivism was also curious, because the other two firms were also recidivists. The reduction in fines because of the allegedly small size of the chlorine chloride market is difficult to accept; it was in fact the fifth largest of the nine vitamins cartels fined by the EU. Finally, the four market-share categories are arbitrary. Only two were used in the other vitamins cases; worse, the top two categories were populated by the North American targets that had already been eliminated from consideration.

Chinook, Bio-Products, and Nepera were not sanctioned simply because their active collusion was deemed to have ended more than five years before the EC's investigation began in May 1999.

Other Jurisdictions

Eight other nations⁸⁵ investigated the vitamins cartels, but only three of them punished a few members of the global vitamins cartels. In the aggregate the fines were small (Table 9).

In March 2001, an Australian court approved fines recommended by the Australian Competition and Consumer Commission for three vitamin suppliers that admitted fixing prices of bulk vitamins A and E sold to animal-feed companies. The three Australian subsidiaries of Hoffmann-La Roche, BASF, and Rhône-Poulenc (now Aventis) agreed to pay penalties of Australian \$26 million (US\$14.3 million), a record amount under the country's 1974 Trade Practices Act. In fact, the A\$15 million paid by the Roche subsidiary was more than double the previous record amount. The Commission Chairman stated that the settlement was a lenient one because of the defendants' cooperation in avoiding a costly trial. Price fixing allegations concerning human vitamins were under investigation in 2003, but not yet completed by early 2006.

Another antitrust authority that imposed monetary sanctions in vitamins is the Korean Fair Trade Commission (KFTC 2003). Korea is totally dependent on imports for its bulk vitamins, so obtaining evidence was especially difficult in this case. In April 2003 the KFTC announced that it was demanding \$3.1 million from six foreign manufacturers: Roche, BASF, Aventis, Eisai, Daiichi, and Solvay. Affected sales in Korea were \$185 million. The KFTC gave one example of price changes caused by the cartel. Compared to the year before the cartel, import prices of vitamin B5 rose to a 1997 peak 70% above the base price.

Brazil opened an investigation of the vitamins cartels in 1999 that focused on the three largest companies and their three largest products (UNCTAD 2002:5-6). These three products achieved more than \$500 million in affected sales. Through interviews with managers of the three companies' Brazilian subsidiaries, the Brazilian antitrust authority issued an adverse decision in December 2002. In 2005, a study by one of Brazil's antitrust authorities (the SDE) found that the Big Three members of the cartel had caused Brazilian import prices for the seven largest vitamin products to rise by \$183 million (30 to 37%). The companies' appeals were still active in early 2006.

⁸⁵ No information can be found about the French, Mexican, or Taiwanese investigations.

One of the more surprising developments concerned Swiss reactions to the vitamin cartel. In early May 2000, the Swiss competition-law agency WEKO came to the fairly obvious conclusion that the global vitamin cartel had affected vitamin prices in Switzerland. Therefore, WEKO issued an injunction against its national champion Hoffmann-La Roche and its co-conspirators to cease price fixing. This is in fact the maximum sanction WEKO could impose for a first-time price fixer. Only if Roche or its co-conspirators *repeat* their crime can they be fined under current Swiss law. With the weakness of Swiss sanctions so fully revealed to the world, to avoid the appearance of a cover-up for Roche both houses of the Swiss parliament passed motions in late May supporting the imposition of fines for first-time offenders. Swiss competition law is now aligned more closely with that of the EU Member States.

Among the jurisdictions with well established antitrust laws, Japan is notable for the near absence official actions taken publicly against foreign conspirators in international cartels; nor has it punished admittedly guilty domestic cartelists, namely, the two lysine or six vitamins companies headquartered in Japan. The two Japanese lysine companies (Ajinomoto and Kyowa Hakko) issued press releases apologizing for their actions, but did not immediately fire any of its employees involved in price fixing. After raiding the offices of ten vitamin manufacturers in January 2000, the Japan Fair Trade Commission (JFTC) found no evidence of cartel behavior by any of the European producers. However, three of the largest Japanese vitamin manufacturers imposed a number of sanctions upon themselves immediately after their guilty pleas in the United States. The presidents and all board members of the three companies voluntarily took fairly significant pay cuts; their presidents resigned from honorary positions in various Japanese trade associations. In April 2001, the JFTC issued warnings against Daiichi and Eisai for their collusive activities in the markets for vitamins B5 and E.

New Zealand took similar action. In January 2001 the Commerce Commission sent warnings to the local subsidiaries of Roche, BASF, and Aventis. A statement by the Commission said that bringing charges was not possible because the last New Zealand meeting about prices occurred in 1994, and the Commerce Act has a three-year statute of limitations.

Private Suits

Significant private antitrust damages actions are found only in those nations that have a legal system based on English Common Law, notably in the United States and Canada. Recently cartel damages have been sought in the UK, Australia, and Germany.

United States of America

Private treble damages suits filed in the United States resulted in the largest antitrust settlements in history. Scores of class actions were filed in many federal courts around the United States, and these were consolidated in one principal action⁸⁶ that was argued in the U.S. District Court for the District of Columbia in 1999 to 2003. This consolidated suit had approximately 4,000 plaintiffs, firms that had purchased bulk vitamins in the United States directly from the major manufacturers. Most were manufacturers of animal feeds, foods, pharmaceuticals, or vitamin premixes; some were farmers or farm cooperatives; and some were chemical wholesalers. Not all eligible buyers registered as plaintiffs.⁸⁷

⁸⁶ *In re Vitamins Antitrust Litigation* dealt with the Big Six defendants and their products. Prosecution of the "Little Twelve" and some of the smallest products (vitamins B3, B4, B9, and H) proceeded on separate tracks.

⁸⁷ One can only speculate on the motives of buyers that failed to join the class action. Some failed to hear of it, some kept no records of purchasers, and some were too small to be bothered. Perhaps some were reluctant to endanger

The presiding judge decided to split off the main suit and create three other groups with somewhat different issues: the niacin and biotin group (with defendants Lonza, Degussa, Nepera, Reilly, Sumitomo, and Tanabe), the choline chloride group (BASF, Akzo Nobel, Chinook, Bio-Products-Mitsui, DuCoa, and UCB), and E Merck.

Each of the defendants had retained a couple of law firms, and the federal class was represented by scores of law firms. At least 500 lawyers feasted on fees that would top \$250 million (Boies 2004:254). In May 1999 plaintiffs' firms chose three among them to act as co-lead counsel, including a well known litigator, David Boies II (Donovan 2005). His firm had been collecting inculpatory, if mostly circumstantial evidence for more than a year and had been one of the first to file a complaint. Boies (2004) relates that Roche first offered to settle in December 1998, five months before their guilty pleas were announced. He also claims that he offered the Big Three a settlement offer of \$400 million in April 1999, but at the meeting of plaintiffs' firms one month later he was told to settle for a minimum of \$550 million. Roche and BASF were eager to accept, but Rhone-Poulenc was unwilling to pay at the same rate as the other two. A settlement agreement with the Big Three defendants was reached in about six months, very quickly compared to most large treble damages cases. With the last-minute addition of the three largest Japanese defendants, Boies presented a preliminary agreement for \$1.17 billion to Judge Hogan on November 3, 1999. Fees of \$123 million were added later.⁸⁸ The proposed settlement was hailed by many as the largest antitrust class-action sum in history. Later, Boies and company were able to obtain a further \$225 million from the 12 smaller, but recalcitrant defendants.

Boies' (2004) inside account of the settlements reveals that the lead counsel of the federal class aimed at extracting at most single damages from the vitamins defendants (p. 250). However, the settlement amount was only about 18% of direct purchases of bulk vitamins and 51% of estimated overcharges.⁸⁹ Several of the largest buyers were dissatisfied with the amount negotiated by class counsel, partly because they believed that the overcharges were at least twice as high as represented by class counsel. Thus, in March 2000 about 300 companies formerly in the federal class decided to opt out of the main settlement. They then filed separate law suits (often called "direct actions") to recover treble damages.

Direct-action plaintiff's lawyers pressed the defendants to get as much information as possible to prosecute their claims. Most of the details about the scope of discovery requests are confidential and must be inferred from expert's reports that have come to light. Defendants' ended up divulging a great deal of financial and economic information to the plaintiffs (Bernheim 2002a, 2002b). Hundreds of thousands of transactions of vitamins products were revealed. Monthly prices from as far back as 1980 and as recently as 2001 were made available for scores of specific grades of bulk vitamins; these dates extended far beyond the longest guilty-plea periods. Internal data on plant locations, production capacities, quantity of output, input costs, and sales to various locations were given to plaintiffs for the purpose of expert analyses.⁹⁰ Scores of

their business relationships with the defendants. Possibly defendants made restitution to some customers prior to litigation.

⁸⁸ These fees, as a share of the anticipated \$1.17 billion, would have been a low 10.5%; adding the additional \$225 million, the ratio would have been 8.8%. However, the reduced payout to the rump class after the opt-outs fled raised the fee rate to above 50%.

⁸⁹ Less than six months is insufficient time to obtain the type of data under discovery that would have allowed accurate economic estimates of the overcharges. Moreover, the initial settlement did not allow for price fixing that may have occurred in the 1980s. Class counsel claimed that the settlement was 23% sales (Boies 2004:254).

⁹⁰ Bernheim (2002: xxi-xxii) calculates that all plaintiffs incurred overcharges of \$2.103 billion in current dollars (3.507 billion in damages converted to 2002 dollars). Of that total, 47% was imposed on the direct-action plaintiffs and 53% on the remaining federal class. In addition, during the possible 1985-1989 collusive episodes damages for the opt-outs amounted to a further \$209 million (2002 dollars) or an additional 21%; because of the greater lapse of time from the 1980's episode, the damages were an additional \$465 million (in 2002 dollars) or 28%. Class plaintiffs made no claims of damages from collusion in the 1980s.

depositions were taken. From the time that plaintiffs' law firms first met to organize, three years elapsed until their expert's analysis was prepared.

Plaintiffs also attempted to obtain relevant records of written submissions by the defendants to the Canadian and EU antitrust authorities (Spratling and Arp 2005: 39-40). One set of documents were the amnesty applications made by some of the defendants. Both the Canadian and EU governments opposed turning over these documents. Judge Hogan ruled that the European Commission must provide the submissions, but the Canadian government did not. As a result of these and other discovery motions, Canada and the EU amended their leniency-program rules to permit entirely *oral* leniency applications and witness interviews.⁹¹ These policies are consistent with U.S. practice.

Although only about 3% of the number of plaintiffs, the direct-action plaintiffs represented 75% of all plaintiffs' bulk vitamin purchases during the conspiracies of the 1990s (Denger 2005). Thus, the opt-outs were generally much larger buyers than those remaining in the federal class after March 2000. Most of these opt-outs were represented by Kenneth Adams, who later outlined the terms of their settlement (Greene 2005). He asserted that his clients received a settlement of almost \$2 billion. Thus, as a percentage of their nominal purchases in the 1990s the opt-out firms' settlement was about 77%.⁹² This compares to the 15 to 18% received by the buyers who stayed in the federal class. That is, Adams' clients recovered *five times* as much per dollar purchased than the remaining members of the class.⁹³ Denger (2005:7) extrapolates these data to all the opt-outs and suggests a recovery of \$3.6 to \$4.3 billion.⁹⁴ Together with the recovery and fees of the federal class (mentioned above), direct purchasers were paid \$4.2 to \$4.9 billion.

Although Boies and the other class counsel may be open to criticism for negotiating a sweetheart deal without full information with the Big Six, they worked much harder during 2000-2004 in pursuing many of the Little Twelve remaining defendants. Except for two financially weak firms in the vitamin B4 cartels, plaintiffs obtained much higher settlement per dollar of sales by exploiting the legal rule of joint and several liability (Boies 2004: 255-260). Although some of these figures may be exaggerated, Boies asserts that the four vitamin B3 suppliers paid out 63% of their U.S. cartel sales.; that in 2002 Sumitomo agreed to an amount equal to 82% of its cartel revenues; and that E. Merck's \$50-million settlement was 89% of the company's affected sales. The most lucrative victory for the vitamins plaintiffs was in a jury trial that was held because Mitsui refused to admit that it had managerial control over its 100%-owned subsidiary, vitamin B4 producer Bio-Products. With strong economic testimony by the plaintiffs' expert and a poor showing by Mitsui's legal team, the jury decided that Mitsui owed trebled damages of \$114 million.⁹⁵

⁹¹ Officially, the EC prefers written submissions by companies applying for leniency (Spratling and Arp 2005:40-41). The oral applications are transcribed by the EC and are reviewed and certified by counsel for the applicant. The EC maintains that these transcripts are Commission documents, not company documents, and are hence not discoverable by U.S. litigants. The discoverability of "paperless" leniency applications is still in doubt.

⁹² However, as a percentage of nominal dollar purchases for the *extended* 1985-1999 conspiracy period, the opt-outs recouped only 61%. Moreover, it is proper to compare the \$2 billion to the present value of the affected commerce of the cartels, which would further lower the percentage.

⁹³ One of the largest opt-outs was Tyson Foods. In fiscal years 2002-2004 the company's distributions from various settlements were so large (\$306 million) that they had to be reported in their annual stockholders' reports. Similarly, arch price fixer ADM reported distributions of \$175 million.

⁹⁴ Denger hints that the remaining opt-outs got from three to five times what they would have received (\$350 million) had they remained in the federal class. This follows from his statement that the recovery of direct buyers from the Big Six defendants alone was \$3 to \$4 billion and the known \$225 million from the smaller defendants. Legal and experts' fees exceeded \$250 million.

⁹⁵ Plaintiffs had masterfully been able to get the three members of the EU branch of the B4 cartels to settle for \$22 million, but they estimated that trebled damages were \$135 million. Thus the jury gave the buyers everything they had asked (\$135 minus \$22 million). Prior to trial, Mitsui could have settled for the remaining *single* damages of \$25 million. After the verdict, to avoid the uncertainty of an appeal, the plaintiffs agreed to a \$53-million payment.

Indirect buyers received relatively little compensation. The biggest settlement was prosecuted by the National Association of Attorneys General. The \$305 million they recovered was the largest such suit in U.S. history. This settlement was distributed to commercial indirect purchasers, consumers, and more than 40 states as direct buyers. A few other indirect-purchaser recoveries are known.

Canada, Australia, and the United Kingdom

The most successful private suits were launched in Canada, which has had a law authorizing class actions for single damages since 1992. Canadian courts began authorizing substantial recoveries in the late 1990s. The vitamins litigation was settled in the Supreme Court of British Columbia in April 2005 (for BC residents only) and in Ontario Superior Court (for the rest of Canada) in March 2005.⁹⁶ There were 20 corporate defendants. Unlike the United States, the courts consider three groups of plaintiffs simultaneously: direct buyers, indirect commercial buyers, and consumers. Including fees, the vitamins settlement aggregated to C\$127 (\$US 105) million on total Canadian affected sales of C\$870 million (14.5%).⁹⁷ The settlement was by far the largest private antitrust suit in Canadian legal history. Approximately 75% of the funds were distributed to direct buyers and 17% to indirect buyers; the latter was handled through a *cy pres* process by giving the funds to selected consumer and trade associations. The settlement amount was strongly affected by an analysis of a University of British Columbia economist that concluded that Canadian overcharges were 12 to 16% of affected sales.

In Australia, a class action was filed in 1999 against the three largest vitamin makers on behalf of buyers of eight animal-grade bulk vitamins. In late 2004 class counsel and the defendants were still at an impasse. As of early 2006 no news was available about a settlement or court proceeding.

An important private antitrust case captioned *Provimi v. Roche Products* came before the English High Court (Olsen 2005). *Provimi* is part of a German company that purchased bulk vitamins in Germany and the UK, and Roche Products is a UK subsidiary of Roche Holdings of Switzerland. In its 2003 ruling the high court permitted the plaintiff to seek compensation for damages on its German purchases in a UK court on the theory that Roche Products' conduct in the UK implemented the cartel throughout Europe. This preliminary decision⁹⁸ might make UK courts the fora of choice for European victims of international cartels, so long as the buyer has some connection with the UK (Joshua 2005). The UK has liberal discovery rules that favor plaintiffs in cartel cases.

Sanctions Summary

Global sanctions levied on the corporate participants in the vast vitamins cartels of the 1990s are shown in Table 10. The total outlays in the six years following their discovery in 1999 by U.S. prosecutors were in the range of \$6.4 to \$7.1 billion. Government fines, originating almost entirely from three jurisdictions, accounted for less than 30% of the total. Estimated settlements by direct buyers in the United States comprised the biggest category of penalties, 55 to 70%. The remaining types of sanctions are relatively minor: indirect purchaser suits in North America (5%) and non-U.S. private suits (2%). Expressed in 2005 dollars and adjusted for inflation and the absence of prejudgment interest, the monetary sanctions are quite a bit lower (Table 10A).

Not shown are the individual criminal convictions 17 high ranking executives of these companies. In the United States, 16 men were sentenced to pay fines that averaged about

⁹⁶ Although these decisions include methionine, the text covers vitamins only and excludes post-judgment interest.

⁹⁷ The affected sales when measured at prevailing exchange rates in the 1990s is closer to \$US 546 million

⁹⁸ The parties settled out of court before an appeal could be argued.

\$200,000. When evaluating the force of expected sanctions on cartel deterrence, it is difficult to know how to weight the impact of expected individual prison sentences as compared to corporate penalties.

Type of Sanction	Known	Estimated	Total
<i>Millions nominal U.S. dollars^a</i>			
Government fines:			
United States	915.2	--	915
European Union	847.3	--	847
Canada	82.3	--	82
Australia	13.7 ^e	--	14
Korea	3.1	--	3
Other countries ^b	--	0	0
Subtotal fines	1787.5	0	1788
Direct buyers:			
U.S., major vitamins ^c	365	2112-2612	2577-3077
U.S., E. Merck	51	--	51
U.S., niacin & biotin group	157-161	--	159
U.S., choline chloride group ^d	74.5	--	75
Canada, all products	96 ^f	--	96
Australia (anticipated)	--	5-10	8
Subtotal Direct Purchasers	743.5-747.5	2107-2622	2860-3370
Indirect buyers:			
Nat'l. Assn. of Attorney's Gen.	305	--	305
California	96	--	96
Massachusetts	19.6	--	20
Other United States	--	75-100 ^e	88
Canada	21 ^f	--	21
Subtotal Indirect Purchasers	441.6	75-100	517-542
Total	2973-2978	2182-2722	5165-5700
Sources: Press releases of antitrust authorities, press reports, law firms' web sites, Appendix Table 2, Denger (2005), and Boies (2004).			
^a Fines and settlements outside the United States are translated into U.S. dollars on the date of announcement. Includes legal fees where known.			
^b Investigations are reportedly still underway in 2005 by Brazil. Mexico's fines unknown.			
^c Follows from a November 1999 agreement between about 4,000 plaintiffs in a federal class action and the seven largest defendants. Some of the settlements are secret and are estimated, others were publicly reported.			
^d Includes \$21.5 million in civil settlements by BASF, Akzo Nobel, and UCB Chemicals			
^e Estimated			
^f Canada combines direct and indirect (18% of the settlement) purchasers into unified legal actions; includes fees.			

Table 10A. Summary of Real Corporate Fines and Settlements, Vitamins Cartels, 1999-2005

Type of Sanction	Known	Estimated	Total
<i>Millions of 2005 U.S. dollars^a</i>			
Government fines:			
United States	677	0	677
European Union	482	0	482
Canada	60	0	60
Australia	17.1	0	17
Korea	3.9	0	4
Other countries ^b	0	0	0
Subtotal fines	1293	0	1293
Direct buyers:			
U.S., major vitamins ^c	167	968-1197	1135-1410
U.S., E. Merck	23.4	0	23
U.S., niacin & biotin group	72-74	0	73
U.S., choline chloride group ^d	34.1	0	34
Canada, all products	70	0	70
Australia (anticipated)	0	4-8	6
Subtotal Direct Purchasers	368	973-1202	1341-1616
Indirect buyers:			
Nat'l. Assn. of Attorney's Gen.	140	0	140
California	44	0	44
Massachusetts	9.0	0	9
Other United States	0	34-46	40
Canada	15.4	0	15
Subtotal Indirect Purchasers	208.4	34-46	242-248
Total	1816	1007-1248	2822-3065

Sources: Table 10 and producer price indexes and prime rates of interest.

^a Fines and settlements outside the United States are translated into U.S. dollars on the date of announcement. Includes legal fees where known.

^b Investigations are reportedly still underway in 2005 by Brazil. Mexico's fines unknown.

^c Follows from a November 1999 agreement between about 4,000 plaintiffs in a federal class action and the seven largest defendants. Some of the settlements are secret and are estimated, others were publicly reported.

^d Includes \$21.5 million in civil settlements by BASF, Akzo Nobel, and UCB Chemicals

^e Estimated

^f Canada combines direct and indirect (18% of the settlement) purchasers into unified legal actions; includes fees.

ASSESSING THE SANCTIONS

How heavy were the fines and settlements? To answer that, the monetary sanctions are compared first to the value of affected commerce (Tables 19 and 19A) and second to the overcharges (Tables 20 and 20A). Fines, sales, and overcharges are estimated for each combination of cartelized product and region, but the reliability of these ratios vary across markets (see box).

Table 11. Global Monetary Sanctions Relative to Affected Sales							
Product Market	United States			Other Jurisdictions			World
	Govt.	Private	Total	Canada ^a	EU	Other	
	<i>Percent of nominal U.S. dollars</i>						
Beta carotene	15.7	51.9	67.6	34.3	14.2	0	29.9
Canthaxanthin	0	5.1	5.1	2.5	16.0	0	5.1
Biotin (vitamin H)	0	66.9	66.9	5.9	0	0	20.1
Choline chloride (B4)	1.2	21.0	22.2	23.4	21.7	0	13.8
Folic Acid (B9)	0	131	131	0	0	0	39.6
Vitamin A	11.8	53.3	65.1	34.4	7.7	0.9	22.3
Vitamin B1	0	66.5	66.5	0	0	0	14.0
Vitamin B2	20.3	57.5	77.8	33.9	26.4	0	36.3
Vitamin B3	11.1	21.5	32.6	27.7	0	0	11.6
Vitamin B5	21.3	51.9	73.2	41.6	32.1	0	41.8
Vitamin B6	0	57.2	57.2	0	0	0	12.6
Vitamin B12	0	6.3	6.3	185	0	0	2.6
Vitamin C	17.1	48.5	65.6	39.3	9.0	0.4	22.1
Vitamin D3	0	0	0	0	38.7	0	15.8
Vitamin E	15.8	58.0	73.8	35.3	8.3	0.7	30.6
Premixes	10.7	32.2	42.9	46.3	0	0	13.4
Total	12.1	41.2	53.3	37.7	8.2	0.2	19.2
Sources: Appendix Tables 1 and 2.							
Note: U.S. and Canadian fines and settlements are in most cases allocated across markets using the market shares of the defendants. For estimated ranges, the mid point is used. Nominal U.S. dollars are used, which causes the ratios to be overstated.							
a) Includes 2005 private settlements for single damages to direct and indirect purchasers that account for 51% of the total.							

Table 11A. Real Global Monetary Sanctions Relative to Real Affected Sales							
Product Market	United States			Other Jurisdictions			World
	Govt.	Private	Total	Canada ^a	EU	Other	
	<i>Percent of 2005 U.S. dollars</i>						
Beta carotene	11.6	26.3	37.9	25.3	8.4	0	17.4
Canthaxanthin	0.8	2.0	2.8	1.8	9.5	0	3.0
Biotin (vitamin H)	0	24.1	24.1	0	0	0	7.4
Choline chloride (B4)	0.4	7.6	8.0	9.2	7.5	0	4.9
Folic Acid (B9)	0	47.1	47.1	0	0	0	14.6
Vitamin A	7.6	23.9	31.5	22.4	4.1	0.63	11.5
Vitamin B1	0	23.8	23.8	0	0	0	5.2
Vitamin B2	11.7	22.8	34.5	19.5	12.4	0	16.8
Vitamin B3	7.2	9.7	16.9	13.4	0	0	6.2
Vitamin B5	9.6	23.3	32.9	27.1	17.1	0.11	20.6
Vitamin B6	0	20.4	20.4	0	0	0	4.6
Vitamin B12	0	2.3	2.3	97.4	0	0	1.1
Vitamin C	8.9	17.5	26.5	20.6	3.8	0.22	9.3
Vitamin D3	0	0	0	0	22.9	0	9.2
Vitamin E	10.3	25.9	36.2	23.0	4.4	0.54	15.9
Premixes	7.0	14.4	21.4	30.2	0	0	6.8
Total	7.5	18.6	26.1	21.8	4.2	0.14	9.8

Sources: Table 11.
Note: U.S. and Canadian fines and settlements are in most cases allocated across markets using the market shares of the defendants. For estimated ranges, the mid point is used. Nominal U.S. dollars are used, which causes the ratios to be overstated.
a) Includes 2005 private settlements for single damages to direct and indirect purchasers that account for 51% of the total.

Penalties Relative to Affected Sales

Each product in Table 11 was the subject of either government fines or a settlement. There are 14 bulk vitamins that were fined by at least two of the three most active antitrust authorities; U.S. plaintiffs received payouts for 14 products. The absence of sanctions shows up as a zero in Table 11, and there are four products listed as cartels where no authority fined a company for price fixing (B1, B6, folic acid, and biotin). The reasons these four were skipped by the authorities appears to be because of their small size or because a statute of limitations prevented prosecution. The mean affected sales of the four is \$55 million in the United States and \$80 million in the EU, and the mean overcharge is less than \$20 million. Vitamin D3 is similarly small. For these reasons, all 16 cartels are listed in Table 11.

Measured in nominal dollars, total monetary sanctions averaged about 19% of global affected sales. The highest fines were levied by Canada (17% of sales) with the United States slightly smaller (12%) and the EU the smallest of the three (8%). As a percentage of affected

commerce in the rest of the world, fines by Australia and Korea are negligible.⁹⁹ By far the most intense sanctions are those extracted by private treble damages suits in the United States. When combined with U.S. fines, the vitamins defendants paid penalties equal to 53% of their U.S. revenues during the cartel periods. Canada's sanctions are not far behind with a combined ratio of 38% of affected sales. Relative to affected commerce in their jurisdictions, North American monetary sanctions are five or six times higher than the EU's. Therefore, the United States lives up to its reputation as the most fearsome antitrust jurisdiction.

Within jurisdictions but across products the sanctions/sales ratios have their lowest variation in Canada. This pattern reflects a policy of starting with standard fines of 20% of Canadian affected sales for most members of a cartel and granting modest fine discounts for early pleaders or enhancements for late pleaders (Low 2005); compensation for single damages are also proportional to Canadian sales. With the notable exception of choline chloride, where ability to pay was a factor, U.S. fines are also a fairly steady share of affected commerce across the product markets. The EU displays much more variability across vitamins products. This is to be expected because the EU's starting fines are rather arbitrary, because its fining policies are not tied to affected sales in the jurisdiction, and because its numerous adjustments are also unrelated to EU sales. There is a clear inverse relationship between the absolute size of a market's sales and the EU's cartel fines. Vitamins A, E, and C were the largest cartelized markets, but violators paid the lowest EU fines.

There is an interesting connection between U.S. fines and the intensity of private settlements. Most private antitrust suits are follow-on actions. With guilty pleas made, private plaintiffs need not prove the fact of illegal collusion; they have the burden only of proving the extent of damages. Because the DOJ chose not to prosecute some of the cartels for reasons of administrative convenience, private litigants seem to have had a more difficult time extracting substantial settlements in the markets for vitamin B12 and other carotinoids.¹⁰⁰ Indeed, absent government prosecutions, U.S. buyers did not sue the vitamin D3 makers. On the other hand, private plaintiffs obtained relatively large settlements in the markets for vitamins B1, B4, B6, folic acid, and biotin – all markets with no or spotty U.S. prosecutions. Companies that were not fined anywhere in the world (Sumitomo, Tanabe, Kongo, etc.) paid significant civil penalties in the United States and Canada. Even the three European makers of chlorine chloride, which were mostly passive supporters of the cartel, incurred substantial penalties.

The ratios shown in Table 11 are frequently discussed in the antitrust law literature, but such calculations are flawed. Government fines are imposed many years later than the cartel revenues were made; the average lag between the middle of a conspiracy and DOJ fines is about five years; and for civil cases and fines in the EU the lag averages about eight years. Because courts do not award prejudgment interest, the numerator is overstated compared to the sales dominator. When both the penalties and affected commerce are expressed in more appropriate real 2005 dollars, the harshness of the penalties is moderated considerably (cf., Tables 19 and 19A). On average the real ratios are 50% lower than the unadjusted ratios. For the slower legal processes such as EU fines and private suits, the properly calculated penalty/sales ratios are half the size of the conventional ratios.

Penalties Relative to Injury

Another way of assessing the harshness of monetary sanctions is to divide them by the overcharges imposed by the cartels (Table 12). From the point of view of deterrence, these ratios are far more meaningful than the more common sanctions/sales ratios. As the overcharges are

⁹⁹ Fines as a proportion of affected sales within Korea were less than 2%.

¹⁰⁰ In the vitamins B3 and B4 cases, ability to pay hampered plaintiffs' efforts to collect settlements.

close to the amount of illegal profits garnered by the members of the cartels, the sanctions/overcharge ratios are indicative of the degree to which antitrust sanctions were successful in disgorging those profits. A ratio of 100% or slightly higher¹⁰¹ means that most or all of a cartel's monopoly profits were transferred from the defendants to taxpayers or purchasers. Ratios higher than 100% imply that sanctions contained a punitive element, an outcome expected to result from U.S. treble damage suits. Low ratios indicate that members of a cartel as a group retained a significant portion of their collusive profits.

Global monetary sanctions from government and private legal actions amounted to about two-thirds of the vitamins cartels' economic injuries. Canadian government fines were the highest (about 60%), and U.S. and EU fines fell well below the global mean at 40% and 30%, respectively. Again, the private damages suits in the United States were the harshest antitrust remedy. Private litigants received full compensation for most of their overpriced vitamins, but relatively little punitive element is in evidence from private actions alone. However, when combined with the U.S. Government's fines, total U.S. sanctions were 76% higher than the injuries on direct buyers.¹⁰² Taking into consideration prejudgment interest and the probability of detection, total sanctions were woefully short of optimally deterring defendants like those in the vitamins cartels.

There is considerable variability in government sanctions/overcharges ratios across products in all jurisdictions. This is to be expected in Canada and Europe because the United States is the only antitrust regime that bases its fine directly on the harm (when corporate fines exceed \$10 million). The majority of the vitamins defendants were fined under the double-the-harm rule. Yet, no U.S. fine comes close to 200% because of the granting of generous leniency discounts. Together with the settlements in follow-on private actions, double-damages or higher were achieved in about ten of the 16 cartels. On the other hand, some sanctions fell short of double or treble damages. U.S. sanctions were especially low for the following products: canthaxanthin, choline chloride, premixes, and vitamins B12 and D3. In several cases the low rates are connected to the absence of fines by U.S. courts. Without previous criminal guilty pleas, private plaintiffs lack the kind of *prima facie* evidence necessary to prevail in court. For choline chloride the issue for two of the three defendants was ability to pay.

The absence of private antitrust litigation in Europe is a major factor explaining the very low sanctions/overcharge ratios in Europe. Total public and private cartel penalties were almost *four times* higher in Canada than in the EU; U.S. penalties were almost *six times* heavier than those in Europe. But in the rest of the world, the near absence of penalties of any kind brings the sanctions/overcharge ratios to clearly sub optimal levels for deterrence purposes. The vitamins defendants paid out at most 67% of their illegal gains to governments or victims. Even if U.S.-style antitrust enforcement were found everywhere in the world, only in the unlikely eventuality that the probability of cartel detection exceeded 60% would cartel formation be thwarted.

Because the penalties and overcharges are from different time periods, it is appropriate to calculate the fines and overcharges in real dollars (Table 12A). On average the real-dollar ratios are about *50% lower* than the nominal-dollar ratios. In Canada and the United States, where fines are imposed quickly after a cartel is discovered, the adjusted ratios are about 40% lower than the unadjusted ratios. Private suits and EU fines take about three years longer to resolve; their real penalty/injury ratios are about 55% lower.

¹⁰¹ Vitamins sanctions were paid from one to four years after the collusion ended and as long as 20 years after the cartel began making monopoly profits. Thus, payments were made in significantly depreciated currencies compared to the value of those currencies during the affected periods. For the most durable cartels, ratios of even 200% could be equivalent to purely nonpunitive disgorgement. This issue is addressed below.

¹⁰² The relatively small payouts to indirect buyers are included in the sanctions numerator.

Table 12. Global Monetary Sanctions Relative to Overcharges, 1999-2005

Product Market	United States			Other Jurisdiction			World ^a
	Govt.	Private	Total ^a	Canada _b	EU	Other	
	<i>Percent of nominal U.S. dollars</i>						
Beta carotene	52	156-183	222	112	46	0	94
Canthaxanthin	0	18-22	20	13	83	0	23
Biotin (vitamin H)	0	376-392	384	0	0	0	116
Choline chloride	3.7	62	66	71	64	0	38
Folic Acid (B9)	0	538-615	577	0	0	0	119
Vitamin A	36	150-176	199	107	31	2.6	77
Vitamin B1	0	341-396	369	0	0	0	116
Vitamin B2	88	230-271	339	156	127	0	159
Vitamin B3	72	139	211	178	0	0	74
Vitamin B5	68	154-182	236	137	108	0.4	134
Vitamin B6	0	215-254	235	0	0	0	42
Vitamin B12	0	13-15	14	385	0	0	6
Vitamin C	72	191-220	278	166	45	1.5	72
Vitamin D3	0	0	0	0	427	0	76
Vitamin E	41	138-162	191	91	25	1.7	83
Premixes	36	101-118	151	170	0	0	46
Total	40	125-146	176	124	30	0.7	67

Sources: Tables 14 and 17.

? = Questionable estimates.

Note: U.S. and Canadian fines and settlements are in most cases allocated across markets using the market shares of the defendants. For estimated ranges, the mid point is used. Nominal U.S. dollars used.

a) Mid points of ranges shown to left.

b) Includes private settlements for single damages to direct and indirect purchasers that account for 51% of the total.

Table 12A. Real Global Sanctions Relative to Real Overcharges, 1999-2005							
Product Market	United States			Other Jurisdiction			World ^a
	Govt.	Private	Total ^a	Canada _b	EU	Other	
	<i>Percent of 2005 U.S. dollars</i>						
Beta carotene	37.9	85.9	123.8	82.3	27.2	0	54.7
Canthaxanthin	4.3	10.1	14.4	9.8	48.9	0	13.5
Biotin (vitamin H)	0	138.8	138.7	0	0	0	42.6
Choline chloride	1.3	22.4	23.6	27.9	22.2	0	13.4
Folic Acid (B9)	0	208.5	208.5	0	0	0	44.5
Vitamin A	23.4	72.8	96.2	69.6	16.5	1.9	39.5
Vitamin B1	0	131.0	131.0	0	0	0	42.0
Vitamin B2	51.0	99.4	150.3	90.0	59.1	0	74.4
Vitamin B3	46.3	62.2	108.5	86.7	0	0	39.7
Vitamin B5	30.9	75.4	106.3	89.4	57.4	0.3	66.1
Vitamin B6	0	84.8	84.8	0	0	0	15.8
Vitamin B12	0	5.1	5.6	202.4	0	0	2.7
Vitamin C	38.1	74.4	112.4	87.6	19.1	0.8	39.7
Vitamin D3	0	0	0	0	252.4	0	75.8
Vitamin E	26.6	67.0	93.6	59.5	13.4	1.2	42.8
Premixes	23.6	48.9	72.5	110.9	0	0	23.4
Total	24.8	61.3	86.0	74.0	15.4	0.5	33.7

Sources: Tables 14A and 17A.
? = Questionable estimates.
Note: U.S. and Canadian fines and settlements are in most cases allocated across markets using the market shares of the defendants. For estimated ranges, the mid point is used. Nominal U.S. dollars used.
a) Mid points of ranges shown to left.
b) Includes private settlements for single damages to direct and indirect purchasers that account for 51% of the total.

DATA QUALITY

The data used to construct the ratios in Tables 19 and 20 vary in their completeness, precision, and reliability.

The numerators (amounts of **fin**es or **set**tlements) are generally fairly precise and reliable, especially for EU fines. U.S. and Canadian fines are also precise for individual firms, but the company fines for some products had to be distributed across the relevant products in proportion to affected sales in each jurisdiction (Appendix Table 12). Given the fining policies in North America, this is a reasonable procedure, but a step that may degrade precision. All non-U.S. fines and affected sales were translated into U.S. dollars on the date the fines were levied or averaged across the collusive dates, respectively.

Affected sales by industry for the United States and the world were taken from the most reliable internal source, namely, the Data Books kept by Hoffmann-La Roche (Bernstein 2002a). These numbers were cross-checked for accuracy against the sales records of other defendants and direct buyers. Canadian sales were mostly derived from a spreadsheet posted on the Canadian Competition Bureau's web site. EC (2001, 2004) gave affected commerce in Western Europe for most years of the cartels; a few earlier years were estimated by backward projection. Sales in the rest of the world are the least reliable because they are residual amounts. For affected sales by firm and product, market shares were used to distribute industry sales; world production shares are slightly more accurate than the sales shares available for the United States, Canada, and EU. Uncertain estimates are signaled by showing a range rather than a point estimate (Appendix Table 1).

Overcharge rates by market are the most accurate for the U.S. market because several methods were applied to verify the percentages. The Canadian rates were assumed to be the same as in the United States. Overcharges in the EU are somewhat more approximate because they were calculated from EC price series using only the before-and-after method (Appendix Tables 3 and 4). The rest of the world relies on a combination of the U.S. and EU numbers. Global price effects are a weighted average of the regional rates. To prepare firm-level overcharges, the total overcharge for each region and product was distributed across each participant according to its share of the region's market. That is, because all members of a cartel in a given region charged very similar prices, they are assumed to have the same percentage overcharge. Because production cost may vary, the firm-level overcharges are somewhat less accurate than the more aggregated figures.

Intensity of Penalties Summarized

The intensity of penalties is summarized in Tables 21 and 22. Government antitrust fines in all jurisdictions amounted to 6.7% of the global affected commerce of the international vitamins

cartels of the 1990s.¹⁰³ The 6.7% figure is a combination of relatively high fines/sales ratios in North America, a medium fine intensity in the EU, and insignificant fines in the rest of the world. The range of intensities of private settlements across jurisdictions is similar but more pronounced. Direct purchasers worldwide received compensation equal to 11.7% of the value of their purchases. However, nearly all of the vitamins payouts went to buyers in the United States and Canada. Economic theory suggests that indirect buyers should be burdened with at least half of the passed-on overcharge. Yet, indirect purchasers in the United States received compensation at a rate (6.7%) that was much lower than their counterparts farther up the vertical chain (37%). Except in Canada, legal instruments to compensate indirectly injured buyers are completely undeveloped.¹⁰⁴

The upshot is that, measured in current dollars, the vitamins defendants disgorged about 20% of their cartel-period sales to citizens, taxpayers, and buyers of vitamins. However, measured in more appropriate real dollars, penalties were 11.6% of cartel revenues (Table 13A). The main reason that the sanction/sales ratio is lower in real dollars is that prejudgment interest is not paid by antitrust violators; additionally, violators reap illegal profits throughout the collusive period, yet even quickly levied sanctions are paid in depreciated currencies. Fines in most jurisdictions are returned to the national treasuries and become in effect tax reductions or supplement government expenditures.¹⁰⁵ Private suits in North America principally compensate direct buyers and indirect commercial buyers for their cartel-generated losses and pay plaintiffs' law firms for their costs and entrepreneurial risk.¹⁰⁶ Citizens and customer-victims of North America are being better served by their anticartel laws than are residents of the rest of the world.

The evidence on whether settlements from these private suits yielded punitive damages is addressed next.

¹⁰³ If the sales of the possible vitamins cartel episodes of the late 1980s were included, all the ratios in Table 13 would be about one-fourth lower.

¹⁰⁴ Although not shown in Table 13, Canadian indirect buyers did get *cy pres* relief that was equal to about 4% of manufacturer-level affected sales or 1% of consumer-level sales.

¹⁰⁵ The United States has a unique program that distributes all federal corporate fines to the States to fund each State's program to compensate victims of violent crimes.

¹⁰⁶ Approximately 5% to 15% of most settlements as large as those in vitamins go to legal fees and costs of experts. Because the contingency-fee system is used for antitrust class actions in North America, plaintiffs' counsel finance the costs of prosecution for several years and are awarded risk premiums by the courts for the uncertainty of the outcomes.

Table 13. Summary of Fines and Settlements Relative to Affected Sales

Type of Sanction	Known	Estimated	Total
	<i>Percent of nominal U.S. dollars^a</i>		
Government fines:			
United States	12.1	0	12.1
Canada	15.1	0	15.1
European Union	8.2	0	8.2
Rest of the world	0.2	0	0.2
Subtotal fines	6.7	0	6.7
Direct buyers:			
United States	8.6	28-35	37.4
Canada	17.6 ^b	0	17.6
European Union	0	0	0
Rest of the world	0	0.1	0.1
Subtotal direct purchasers	2.8	7.9-9.9	11.7
Indirect buyers:			
United States	5.6	1.2	6.7
Rest of the world	0 ^b	0	0
Subtotal indirect purchases	1.7	0.3-0.4	2.0
Subtotal United States	26.3	29.0-35.9	55.3
Subtotal Canada	36.5	0	36.5
Subtotal European Union	8.2	0	8.2
Subtotal Rest of the world	0.2	0.1	0.3
Total all jurisdictions	11.2	8.2-10.2	20.4
<p>Sources: Table 10 and Appendix Table 1. Includes a few sanctions not found in Table 11. ^a Fines and settlements outside the United States are translated into U.S. dollars on the date of announcement. Includes legal fees where known. Some ratios use mid points of ranges. ^b About 18% of the Canadian settlement was distributed to non-profit organizations to benefit indirect commercial buyers and consumers.</p>			

Table 13A. Summary of Real Fines and Settlements Relative to Affected Sales			
Type of Sanction	Known	Estimated	Total
	<i>Percent of 2005 U.S. dollars^a</i>		
Government fines:			
United States	7.5	0	7.5
Canada	9.0	0	9.0
European Union	4.2	0	4.2
Rest of the world	0.2	0	0.2
Subtotal fines	3.8	0	3.8
Direct buyers:			
United States	3.6	12-15	15.8
Canada	10.5 ^b	0	10.5
European Union	0	0	0
Rest of the world	0	0.1	0.1
Subtotal direct purchasers	1.6	4.5-5.6	6.7
Indirect buyers:			
United States	2.4	0.5	2.8
Rest of the world	0 ^b	0	0
Subtotal indirect purchases	1.0	0.1-0.2	1.1
Subtotal United States	12.4	13.7-16.9	26.1
Subtotal Canada	21.8	0	21.8
Subtotal European Union	4.2	0	4.2
Subtotal Rest of the world	0.2	0.1	0.3
Total all jurisdictions	6.4	4.7-5.8	11.6
Sources: Table 10A and Appendix Table 1. Includes a few sanctions not found in Table 11.			
^a Fines and settlements outside the United States are translated into U.S. dollars on the date of announcement. Includes legal fees where known. Some ratios use mid points of ranges.			
^b About 18% of the Canadian settlement was distributed to non-profit organizations to benefit indirect commercial buyers and consumers.			

Table 14 repeats the analysis in Table 13 but uses instead overcharges or monopoly profits as the metric. These data are the most relevant for drawing conclusions about cartel deterrence. Recall that estimates of vitamins overcharges averaged about one-third of affected sales (Table 7). Thus, the sanctions/overcharges ratios in Table 14 are on average three times larger than the ones in Table 13.

In terms of government fines, Canada, the United States, and the EU are again the jurisdictions with the harshest sanctions, ranging from roughly 30% to 50% of the overcharges in their regions. However, because the rest of the world levies minuscule fines on international cartels, total global fines recoup only 22% of the illegal vitamins profits.

Private treble-damages suits in the United States were remarkably effective in transferring vitamins damages back to the victims. Although slightly exaggerated because nominal dollars are the basis of these calculations, private U.S. actions for direct and indirect buyers amounted to about 145% of U.S. overcharges. The lion's share (85%) of settlements goes to direct buyers. While not as high as the 300% specified by the Sherman Act, settlements have had a significant punitive component. In Canada, the 71% ratio is not a bad outcome for a relatively untested single-damages law. As in the United States, direct buyers were compensated to a far greater extent than indirect purchasers. Because economic theory implies that distributors and consumers pay the majority of passed-on cartel overcharges, this result suggests that the legal systems of North America are under-serving indirect buyers. On a global basis, the global vitamins price fixers paid no punitive damages.

When the numerators and denominators are adjusted for the time value of money and for inflation, the ratios are markedly lower (Table 14A). Because of delays in enforcement and the duration of the vitamins cartels, government fines recoup less than one-eighth of the real illegal profits. The delays in private suits in North America are even longer. Combined with the absence of prejudgment interest, the real-dollar vitamins settlements provide no punitive damages. *No matter how high the probability of detection, no jurisdiction in the world is safe from cartel recidivism.*

Some legal writers are of the opinion that the vitamins sanctions are egregiously supra-deterrent (Waller 2003: 221-225).¹⁰⁷ Others, even those critical of the high settlements in U.S. private litigation, believe the sanctions in the vitamins cases were justified by the deterrence aim of antitrust (Baker 2004). Combining both public and private sanctions into the numerator, it is apparent that with a 194% ratio the U.S. legal system provides the greatest potential for deterring cartel formation (Table 14). Moreover, a good share the U.S. sanctions (the portion of the penalties above 100%) are punitive damages. Canada is the only other jurisdiction that has a modest punitive element in its public-private system of anticartel penalties. The European Union lags far behind North America in its potential for cartel deterrence. Even from an *ex post* point of view, if its vitamins fines are the best that the EU can muster, private cartel formation ought to flourish in Western Europe.

¹⁰⁷ "Based solely on harm to the US market Hoffmann[-La Roche] will have paid in excess of six times the harm it caused..." (Waller 2003:234). Waller provides no details on his data sources.

Table 14. Summary of Fines and Settlements Relative to Overcharges, 1999-2000

Type of Sanction	Known	Estimated	Total
	<i>Percent of nominal U.S. dollars^a</i>		
Government fines:			
United States	39.8	0	39.8
Canada	49.9	0	49.9
European Union	30.3	0	30.3
Rest of the world	0.7	0	0.7
Total fines	21.9	0	21.9
Direct buyers:			
United States	28.3	92-114	123
Canada	58.2	0	58.2
European Union	0	0	0
Rest of the world	0	0.2-0.4	0.3
Total Direct purchasers	8.9	38-46	50.9
Indirect buyers:			
United States	18.3	3.3-4.3	22.1
Canada	12.7	0	12.7
Rest of the world	0	0	0
Total indirect purchasers	4.9	0.9-1.2	5.9
Subtotal United States	85.8	94-117	194
Subtotal Canada	120.7	0	121
Subtotal European Union	30.3	0	30.3
Subtotal Rest of the world	0.7	0.2-0.4	1.1
Total all jurisdictions	39.3	29-36	71.7
Sources: Tables 14 and 18. Includes a few sanctions not found in Table 11.			
^a Fines and settlements outside the United States are translated into U.S. dollars on the date of announcement. Includes legal fees where known. Some ratios use mid points of ranges.			

Table 14A. Summary of Real Fines and Settlements Relative to Real Overcharges, 1999-2000

Type of Sanction	Known	Estimated	Total
	<i>Percent of 2005 U.S. dollars^a</i>		
Government fines:			
United States	24.8	0	24.8
Canada	30.5	0	30.5
European Union	15.4	0	15.4
Rest of the world	0.5	0	0.5
Total fines	14.0	0	14.0
Direct buyers:			
United States	11.9	38-49	51.9
Canada	35.7	0	35.7
European Union	0	0	0
Rest of the world	0	0.1-0.2	0.1
Total Direct purchasers	3.1	13-16	14.7
Indirect buyers:			
United States	7.8	1.3-1.8	9.4
Canada	7.8	0	7.8
Rest of the world	0	0	0
Total indirect purchasers	1.7	0.4-0.4	2.0
Subtotal United States	44.5	39-51	86.0
Subtotal Canada	74.0	0	74.0
Subtotal European Union	15.4	0	15.4
Subtotal rest of the world	0.3	0.1-0.3	0.5
Total all jurisdictions	18.2	13-17	33.7

Sources: Tables 9A, 17A, 22, and 20A. Includes a few sanctions not found in Table 11.

^a Fines and settlements outside the United States are translated into U.S. dollars on the date of announcement. Includes legal fees where known. Some ratios use mid points of ranges.

OVERVIEW AND CONCLUSIONS

This paper is a comprehensive examination of the global bulk vitamins cartels of the 1980s and 1990s. In terms of its precision and breadth of coverage, the quantitative information now available on vitamins surpasses that of almost any other modern cartel. For example, the internal records of the major defendants have made available summaries of monthly transaction prices for 53 bulk vitamin products over periods of up to 22 years.

The size of these cartels is extraordinary. Evidence is presented that these 16 interrelated cartels were collectively the largest discovered international price-fixing schemes of the late 20th century. Affected real commerce in the 1990s totaled \$30.6 billion, and direct overcharges mounted to \$13.6 billion. The formation of the cartels by and large occurred in markets that were in terms of their structures and historical modes of behavior ideally suited for overt collusion. Although organizationally similar in many respects, the cartels also displayed a wondrous variety of collusive conducts. The vitamins cartels endured twice as long as the average international cartel. Only four of the cartels died natural deaths. Had it not been for public and private investigations in the United States two-thirds of them might be operating clandestinely today.

On the other hand, vitamins cartels were typical in several ways. The percentage increases in bulk vitamin prices wrought by the cartels averaged about 44%, which is about average for successful international cartels since 1990. Also, the vitamins cartels were typical in their geographic spread: affected sales and overcharges were distributed roughly equally in three regions, North America, Western Europe, and the rest of the world.

Antitrust scholars and enforcement officials frequently cite these cartels as the most effectively punished international price-fixing conspiracies in history. There is little question that the convicted members of the vitamins cartels were in absolute monetary terms the most heavily sanctioned defendants in the history of antitrust law. From 1999 to 2005, the defendants paid about \$5 billion in fines and settlement payouts, of which more than 80% resulted from U.S. government and private legal actions. Moreover, 20 heavy individual criminal sentences were imposed on the managers of the cartels.¹⁰⁸ Yet, it is equally non-controvertible that the impressive corporate monetary sanctions imposed worldwide were inadequate to deter recidivism.¹⁰⁹ In nominal monetary terms global public and private penalties amounted to only 19% of the cartels' affected commerce and 67% of their world-wide damages. *Measured in real 2005 dollars, the global vitamins sanctions represent merely 34% of worldwide damages, and no jurisdiction achieved punitive damages..* With sanctions well below 100% of profits, no matter the probability of being caught, it is simply rational for international cartels to be formed.

U.S. monetary penalties for corporations were the world's highest, but well below treble damages. Adjusting for the time value of money, U.S. penalties were below single damages. Even if company penalties in the rest of the world were to be raised to levels found in the United States, cartel recidivism is still inevitable because cartelization is a crime that pays.¹¹⁰

¹⁰⁸ There were 17 men sentenced, 16 in the United States, four in Canada, and three in both countries. The United States imposed average fines of \$110,000 and prison sentences of 8 months.

¹⁰⁹ Investigative reporter Jock Ferguson (2002) reports several accusations of independent U.S. vitamin premix makers that Roche and BASF were attempting to reassert their market dominance through loyalty rebates, full-line forcing, price discrimination, and other possibly predatory tactics. Bernheim (2002a) cites depositions from some vitamins defendants indicating that there were attempts to re-establish some cartels soon after they were exposed by the DOJ.

¹¹⁰ When evaluating the force of expected sanctions on cartel deterrence, it is difficult to know how to weight the impact of expected individual prison sentences as compared to corporate penalties.

EPILOGUE

One of the more sanguine observations of this study was the role played by Chinese vitamins manufacturers in destroying global price fixing in a few markets. Now, like a horror story in which a monster believed dead springs to life to wreck havoc one last time, the former spoilers in the world markets for vitamins have transmogrified from friends of consumers to fiends. With the assistance of a parastatal industry association, Chinese makers of vitamin C have been alleged to have fixed the price of exports to the U.S. market, where they control 85% of imports (Wilke and Chen 2006). After a meeting in November 2001 of the newly formed Vitamin C Chapter of the China Chamber of Commerce of Medicines, spot prices rose by 200% within a month. Minutes of the meeting (posted on a public web site) clearly show the Chapter's intention to raise prices. A civil damages suit has been launched in the United States.

NEW REFERENCES ¹¹¹

ABA. *Competition Laws Outside the United States (Two Volumes)*. Chicago: ABA Section of Antitrust Law (2001).

_____. *Competition Laws Outside the United States (First Supplement)*. Chicago: ABA Section of Antitrust Law (2005).

Achilladelis, Basil. Innovation in the Pharmaceutical Industry, in *Pharmaceutical Innovation: Revolutionizing Human Health*, Ralph Landau *et al.* (editors). Philadelphia: Chemical Heritage Press (1999).

Ashurst. *Study on the Conditions for Claims for Damages for Breach of Competition Rules in Europe*. Ashurst Consulting (2004).

Arlman, Sjoerd. *Crime but No Punishment: An Empirical Study of the EU's 1996 Leniency Notice and Cartel Fines in Article 81 Proceedings*. Master's Thesis, Economics Department, University of Amsterdam (August 2005).

Aubert, Cecile, Patrick Rey, and William E. Kovacic. The Impact of Leniency and Whistleblowing Programs on Cartels. Paper presented at the Amsterdam Center for Law and Economics Conference *Remedies and Sanctions in Competition Policy*, Amsterdam, 17-18 February 2000. [<http://www.kernbureau.uva.nl/acle/object.cfm/objectid=F07DE744-C1D1-4F2E-876EEB31F7FA5B9F>]

Barnett, Thomas O. *et al. Brief for Appellee United States of America: U.S. v. Daniel T. Rose, U.S. Court of Appeals for the Fifth Circuit*. (2005).

¹¹¹ A few citations can be found in Connor (2001).

Bernheim, B. Douglas. Expert Report of B. Douglas Bernheim, *In Re Vitamins Antitrust Litigation*, MDL No. 1285, U.S. District Court for the District of Columbia (May 24, 2002a).

_____. Rebuttal Report of B. Douglas Bernheim, *In Re Vitamins Antitrust Litigation*, MDL No. 1285, U.S. District Court for the District of Columbia (July 17, 2002b). (October 10, 2005)

Bloom, Margaret. The Great Reformer: Mario Monti's Legacy in Article 81 and Cartel Policy. *Competition Policy International* 1 (Spring 2005): 55-78.
[<http://ssrn.com/abstract=702647>]

Brenner, Steffen. An Empirical Study of the European Corporate Leniency Program. Berlin: Humboldt University (March 29, 2005).

Burnside, Alec. European Cartel Enforcement and Investigations. Address at the annual Spring Meeting of the Antitrust Section of the American Bar Association, Washington, DC (April 2-4, 2003).

Bush, Darren, John M. Connor, *et al.* How to Block Cartel Formation and Price-Fixing. Washington, DC: American Enterprise Institute-Brookings Joint Center, Brief 04-01 (2004). (<http://www.aei-brookings.org/publications/abstract.php?pid=728>)

Camilli, Enrico Leonardo. Optimal and Actual Fines in Cartel Cases: The European Challenge. Paper presented at the Amsterdam Center for Law and Economics Conference *Remedies and Sanctions in Competition Policy*, Amsterdam, 17-18 February 2005.
[<http://www.kernbureau.uva.nl/acle/object.cfm/objectid=F07DE744-C1D1-4F2E-876EEB31F7FA5B9F>]

Clarke, Julian L. and Simon J. Evenett. *The Deterrent Effects of National Anti-Cartel Laws: Evidence from the International Vitamins Cartel: Working Paper 02-13*. Washington, DC: AEI-Brookings Joint Center for Regulatory Studies (December 2002).

_____. The Deterrent Effects of National Anticartel Laws: Evidence from the International Vitamins Cartel. *Antitrust Bulletin* 48 (2003): 289-726.

Connor, John M.. *Global Price Fixing: "Our Customers Are the Enemy": Studies in Industrial Organization No. 24*. Boston: Kluwer Academic (2001).

_____. Private International Cartels: Effectiveness, Welfare, and Anticartel Enforcement: Staff Paper 03-12. W. Lafayette, IN: Department of Agricultural Economics, Purdue University (November, 2003), 145 pp.
[<http://agecon.lib.umn.edu/cgi-bin/view.pl>]

_____. Global Antitrust Prosecutions of Modern International Cartels. *The J. of Industry, Competition, and Trade* 4 (September 2004a): 239-267.

_____. Global Cartels Redux: The Amino Acid Lysine Antitrust Litigation, in *The Antitrust Revolution (Fourth Edition)*, John E. Kwoka and Lawrence White (editors). Oxford: Oxford University Press (2004b).

_____. Collusion and Price Dispersion, *Applied Economics Letters* 12 (2004c): 335- 338.

_____. Effectiveness of Antitrust Sanctions on Modern International Cartels, in *The Political Economy of Antitrust* by Vivek Ghosal and Johan Stennek (editors). Amsterdam: North-Holland (accepted 2005, forthcoming 2006a).

_____. Price-Fixing Overcharges: Legal and Economic Evidence, *Research in Law and Economics* 22 (forthcoming 2006b).

_____. *The Great Global Vitamins Conspiracies: Working Paper*. (March 2006c) [www.ssrn.org].

Connor, John M. and Robert H. Lande. How High Do Cartels Raise Prices? Implications for Reform of Sentencing Guidelines. *Tulane Law Review* (forthcoming 2006a).

Connor, John M. and Yuliya Bolotova. A Meta-Analysis of Cartel Overcharges. *International Journal of Industrial Organization* (forthcoming 2006b). [http://papers.ssrn.com/sol3/papers.cfm?abstract_id=788884]

Connor, John M. and Gustav Helmers. *Statistics on Private International Cartels: Working Paper*. (forthcoming April 2006). [www.ssrn.org]

Crawford, Krysten. No More Mr. Nice Guy. *Corporate Counselor* (June 2004): 84.

Davis, Ronald W. *Empagran* and International cartels – A Comity of Errors. *Antitrust* 19 (2004):58-65.

de Roos, Nicolas. Collusion with a Competitive fringe: An Application to Vitamin C, unpublished manuscript (January 2004).

Denger, Michael L. Remarks. ABA Section of Antitrust Law Spring Meeting, Chair's Program, "A New Approach to Cartel Enforcement Remedies Is Needed" (April 24-26, 2002).

_____. Prepared Statement of Michael L. Denger Before the Antitrust Modernization Commission Hearing Panel on "State Indirect Purchaser Actions: Proposals for Reform," Washington, DC (June 27, 2005). [http://www.amc.gov/commission_hearings/pdf/Denger.pdf]

Donovan, Karen. *Goliath: The Trials of David Boies*. New York: Pantheon (2006).

EC. *Commission Decision of 9 June 1976 relating to a proceeding under Article 86 of the Treaty establishing the European Economic Community (IV/29.020 – Vitamins)*. Brussels (August 6, 1976).

_____. *Commission Decision of 21 November 2001 relating to a proceeding pursuant to Article 81 of the EC Treaty and Article 53 of the EEA Agreement (COMP/E-1/37.512 – Vitamins)*. Brussels (November 21, 2001) [published January 10, 2003].

_____. *Commission Decision relating to a proceeding pursuant to Article 81 of the EC Treaty and Article 53 of the EEA Agreement (CASE COMP/E-2/37.533 – Choline Chloride)*. Brussels (December 9, 2004). [published late 2005]

Ferguson, Jock. Vitamin Giants. *The Nation* (July 3, 2002).

First, Harry. Antitrust Enforcement in Japan. *Antitrust Law Journal*, 64 (Fall 1995): 137-.

_____. The Vitamins Case: Cartel Prosecutions and the Coming of International Competition Law. *Antitrust Law Journal* 68 (2001): 711-733.

Geradin, Damien and David Henry. The EC Fining Policy for Violations of Competition Law: An Empirical Review of the Commission's Decisional Practice and the Community Courts' Judgments. Paper presented at the Amsterdam Center for Law and Economics Conference *Remedies and Sanctions in Competition Policy*, Amsterdam, 17-18 February 2005. [<http://www.kernbureau.uva.nl/acle/object.cfm/objectid=F07DE744-C1D1-4F2E-876EEB31F7FA5B9F>]

Giudici, Paulo. Private Antitrust Law Enforcement in Italy. *The Competition Law Review* 1 (August 2004):61-85.

Goldman, C.S. *et al.* Private Access to Antitrust Remedies: The Canadian Experience, address before the Section of Antitrust law, American Bar Association spring meeting, Washington, DC, April 2-4, 2003.

Greene, Jenna. Monopoly Masters. *Legal Times* (March 21, 2005): 35.

Hammond, Scott D. When Calculating the Costs and Benefits of Applying for Corporate Amnesty, How Do You Put a Price Tag on an Individual's Freedom?, speech at the 15th Annual National Institute on White Collar Crime, San Francisco, California, March 8, 2001.

Harding, Christopher and Julian Joshua. *Regulating Cartels in Europe: A Study of Legal Control of Corporate Delinquency*. Oxford: Oxford University Press (2003).

Hinloopen, Jeroen. The Pro-Collusive Effect of Increased Cartel Detection Probabilities. University of Amsterdam unpublished paper (November 2004).

_____. Internal Cartel Stability with Time-Dependent Detection Probabilities. Paper at the Amsterdam Center for Law and Economics Conference *Remedies and Sanctions in Competition Policy*, Amsterdam, 17-18 February 2005.

ICN. *Defining Hard Core Cartel Conduct, Effective Institutions, Effective Policies: Vol 1: Report Prepared by the ICN Working Group on Cartels*. Bonn, Germany (June 2005).
[www.internationalcompetitionnetwork.org]

Joshua, Julian M. After Empagran: Could London Become a One-Stop for Antitrust Litigation? *Competition Law Insight* (August 9, 2005).

_____. Combinations, Concerted Practices and Cartels: Adopting the Concept of Conspiracy in European Community Competition Law. *Journal of International Law and Business* 29 (2004): 647-681.

Joshua, Julian M. and Peter D. Camesasca. EC Fining Policy against Cartels after the Lysine Rulings: The Subtle Secrets of X. *Global Competition Review* 5 (2004): 5-10.

KFTC. The KFTC Imposes Surcharges on the International Cartel of Vitamin Companies: Press Release (April 23, 2003).

Kovacic, William, Robert C. Marshall, Leslie M. Marx, and Matthew E. Raiff. Post-Plea Pricing: Lessons for Competition Policy from the Vitamins Cartel, in *The Political Economy of Antitrust*, Vivek Ghosal and Johan Stenneck (editors). Amsterdam: North- Holland (2006).

Leiden University. Cartel Data Set: Chemical and Pharmaceutical Industries. (2005). [<http://history.leidenuniv.nl/index.php3?m=26&c=448>].

Levenstein, Margaret and Valerie Y. Suslow. Contemporary International Cartels and Developing Countries: Economic Effects and Implications for Competition Policy. *Antitrust Law Journal* 71 (2004): 801.

Low, D. Martin. Cartel Enforcement, Immunity, and Jurisdiction: Some Recent Canadian Developments, speech at the International Bar Association, Rome, Italy (May 17-18, 2004).

_____. "Re: Canadian Cartel Fines," personal communication dated October 31, 2005.

Maks, J.A.H., M.P. Schinkel, and I.A.M. Bos. Perverse Incentive Effects on Bounding Fines for Infringements of Competition Law: the Dutch Case. Paper presented at the Amsterdam Center for Law and Economics Conference *Remedies and Sanctions in Competition Policy*, Amsterdam, 17-18 February 2005.
[<http://www.kernbureau.uva.nl/acle/object.cfm/objectid=F07DE744-C1D1-4F2E-876EEB31F7FA5B9F>]

- Marcos, Francisco. The Enforcement of Spanish Antitrust Law: Critical Assessment of the Fines-Setting Policy and of the Legal Framework for Private Enforcement Actions. Paper presented at the Amsterdam Center for Law and Economics Conference *Remedies and Sanctions in Competition Policy*, Amsterdam, 17-18 February 2005.
[<http://www.kernbureau.uva.nl/acle/object.cfm/objectid=F07DE744-C1D1-4F2E-876EEB31F7FA5B9F>]
- Mehra, Salil K. More is Less: A Law-and-Economics Approach to the International Scope of Private Antitrust Enforcement. *Temple Law Review* 77 (2004):47-70.
- Marshall, Robert C., Leslie M. Marx, and Matthew E. Raiff. Cartel price Announcements: The Vitamins Industry. Working Paper, Duke University (2005).
- Normann, Hans and Elaine Tan. The Effects of Cartel Policy: Evidence from the German Cable Industry. Working Paper, Royal Holloway College, University of London (October 2005).
- Olsen, Gregory P. Enhancing Private Antitrust Litigation in the EU. *Antitrust* (Fall 2005): 73-79.
- Posner, Richard A. *Antitrust Law: Second Edition*. Chicago: University of Chicago Press (2001).
- Scherer, F.M. Some Principles for Post-Chicago Antitrust Analysis. *Case Western Reserve Law Review* 52 (2001): 5-23.
- Shavell, Steven. *Economic Analysis of Public Law Enforcement, Discussion Paper No. 405*. Cambridge: Harvard Law School (February 2003).
- Spagnolo, Giancarlo. *Divide et Imperia: Optimal Deterrence Mechanisms against Cartels*. Atlanta: International Industrial Organization Conference (March 2004).
- Spratling, Gary R. and D. Jarrett Arp. The Status of International Cartel Enforcement Activity in the U.S. and Around the World, address at the Fall Forum, Section of Antitrust Law, American Bar Association, Washington, DC (November 16, 2005).
- Sprigman, Christopher. Fix Prices Globally, Get Sued Locally? U.S. Jurisdiction over International Cartels. *University of Chicago Law Review* (forthcoming 2006).
- UKCC. *BASF and Takeda Chemical Industries Ltd: A Report on the Acquisition by BASF AG of Certain Assets of Takeda Chemical Industries Ltd*. London: UK Competition Commission (July 2001).
- UNCTAD. *Recent Important Competition Cases in Developing Countries (TD/B/COM.2/CLP/26)*. United Nations (April 18, 2002).
- Waller, Spencer Weber. Private Law, Punishment, and Disgorgement: The Incoherence of Punishment in Antitrust. *ITT Chicago-Kent Law Review* 78 (2003): 207-236.

Wehmhöner, Nonthika. Optimal Fining Policies. . Paper presented at the Amsterdam Center for Law and Economics Conference *Remedies and Sanctions in Competition Policy*, Amsterdam, 17-18 February 2005.

[<http://www.kernbureau.uva.nl/acle/object.cfm/objectid=F07DE744-C1D1-4F2E-876EEB31F7FA5B9F>]

Werden, Gregory J. and Marilyn J. Simon. Why Price Fixers Should Go to Prison. *Antitrust Bulletin* (Winter 1987): 917-937.

Wilke, John R. and Kathy Chen. As China's Trade Clout Grows, So do Price-Fixing Accusations. *Wall Street Journal* (February 10, 2006): A1.

Wils, Wouter P.J. The Commission's New Method for Calculating Fines in Antitrust Cases. *European Law Review* 23 (1998): 252-263.

_____. Is Criminalization of EU Competition Law the Answer? *World Competition* 28 (2005): 117-159.