Chapter 11: The Vitamins Conspiracies

Collusion Begins

The vitamins industries were ripe for collusion. 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). 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). Among international cartels discovered since 1990, 30% were in chemical markets. International cartel conduct is also more common among European and Japanese manufacturers than among North American firms. 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 the Western European and Japanese markets prior to 1990.

Origins in the 1980s?

The 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.[1] The likelihood of collusion is reinforced by 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. Moreover, the price humps are preceded by about four years of falling prices, a trend commonly observed prior to the

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[1] Bernheim (2002a) cites several documents obtained during discovery, some of them deposition transcripts, which appear to be direct evidence of agreements in the late 1980s.

formation of cartels. It appears that collusion may have broken down briefly prior to the more durable cartels that were (re)negotiated in 1990 or 1991.

These suspicious price patterns are observed in all the markets for oligopolistically structured vitamins markets except folic acid, and B12 (Table 11.1). In these markets prices declined on average 30% in the early 1980s, then rose 40% until 1989 or 1990, and fell once more about 12% in the year agreements for the 1990s were being hammered out. However, for three duopolies, only steady or increasing prices are observed throughout the decade of the 1980s. The three duopolistic industries consist of carotenoids manufactured globally solely by Roche and BASF from 1980 to the late 1990s. Roche, the original producer of synthetic carotenoids, slowly ceded a portion of its near-monopoly positions to BASF over the two decades. Because prices moved only upward from 1980 to 2000, it appears that Roche and BASF were extraordinarily cooperative in pricing conduct in these industries; that is, whether overtly colluding or tacitly colluding, pricing was practically at monopoly levels (Kovacic *et al.* 2006).

Table 11.1 Collusive Price Patterns in 1980-1991.

Vitamin Product [a]	Prices before Collusion		Prices during Collusion		Prices after Collusion	
	Time	Price Change *Percent*	Time	Price Change *Percent*	Time	Price Change *Percent*
Oligopolies:						
E	1981-6/85	-33	6/85-12/88	+39	1989	-25
A	6/81-12/85	-26	12/85-12/88	+61	1989	-14
C	1/82-6/86	-27	6/86-12/90	+36	1991	0
B5	6/81-12/85	-42	1/86-6/88	+67	6/88-12/90	-13
Niacin feed	6/81-12/86	-33	1/87-12/89	+56	12/89-6/90	-21
Niacin USP	6/81-9/86	-23	9/86-9/89	+33	9/89-9/90	-12

Niacina-mide feed		0		0		0
Niacina-mide USP	6/81-9/86	-23	9/86-9/89	+33	9/89-9/90	-4
B2	1/81-12/85	-27	1/86-6/88	+35	6/88-12/90	-13
Biotin feed	1/82-12/85	-27	1/86-6/88	+40	1/90-12/91	-30
Biotin USP	6/82-12/87	-48	1/88-12/90	+53	1/91-12/91	0
B1	1/82-12/85	-35	1/86-6/88	+49	6/88-1/90	-10
B6	1/81-12/85	-41	1/86-6/88	+52	6/88-12/90	-21
D3 feed	1/83-12/85	-37	1/86-12/88	+19	1/89-12/90	-11
D3 USP	No data	--	1/85-12/89	+25	1990	0
Mean	6/81-6/85	-30	1/86-12/88	+40	1990-91	-12
Duopolies:						
Beta caro-tene	1/80-1/88	0	1/88-12/90	+25	1/91-12/91	0
Cantha-xanthin USP	1/80-1/88	0	1/88-12/90	+17	1/91-12/91	0
Apocaro-tenol	1/80-12/87	0	1/88-12/90	+52	1991	0
Mean	1/80-1/88	0	1/88-12-90	+31	1991	0

a) No price data are available for choline chloride and folic acid. In addition, no collusion alleged for B3, B12, and premixes.

New Negotiations in 1989-1990

Dissention within cartels caused by cheating is the most frequent cause of their demise, but other external factors may have contributed. Decelerating growth rates and standardization of quality had caused the vitamin business to evolve from its former specialty-chemical status to one more like a mature, commodity-type industry in which buyers focused solely on price during purchase negotiations. Ironically a movement towards greater homogeneity of quality would have made price fixing easier.

Another hypothesis about the timing of the vitamins cartels may be derived from the general financial conditions facing the prime movers of the conspiracies. Each of the major chemical companies (Roche, BASF, Rhône-Poulenc, and Hoechst) faced a financial crisis in the late 1980s that became public knowledge when their financial results were later reported for fiscal years 1990 to 1994 (see Chapter 10). Internal projections of poor sales or profitability would have been known to top managers of the companies in 1988-1989. In some cases, profitable pharmaceutical products were losing patent protection. In other cases, one of the periodic bouts of overinvestment in fixed capital was hitting the chemical industry. For some the problems were overstaffing, inflexible labor markets, overcapacity, and unprofitable diversifications, particularly in the companies' core Western European operations. Compounding the companies' woes was the onset of a global recession in 1990, a downturn that lingered for several years longer in Western Europe than in other regions of the world. In Japan too, the miraculous growth that had characterized the post-war period had burst. Japan experienced a nearly zero-growth phase that was to persist throughout the 1990s. Desperate times produce desperate men, and the top managers of the world's great vitamins concerns would not be immune to desperate measures to restore profitability. Price fixing, though illegal for pharmacists to dispense, was a tonic that promised to restore the financial health of these companies' anemic income statements.

Major price increases announced by leading companies are usually faithfully reported by the chemical trade press. The late 1980s was generally a period of modest inflation, and there were relatively few price increases announced for vitamins during that time. However, rounds of list price increases announced in late 1989 (effective January 1990) and early 1990 caused vitamin buyers to sit up and take notice. Market demand for many vitamins was described as flat and in early 1990 and the first signs of a recession were appearing, so the timing of the price increases was unusual. Rhône-Poulenc made the first "official" public announcement in November 1989, but other European producers were doing the same informally to their customers. The most publicized list-price changes came from Roche

and BASF in early March 1990. Roche *raised* its list prices on both human-grade and feed-grade vitamins A and E, while BASF simultaneously *lowered* its list prices. The important result was that both leading producers' list prices now exactly matched. The March 1990 round was the first change in list prices since 1988. The two companies publicly admitted that during 1989 market transaction prices had hovered 20 percent below their list prices, but they promised that the gap would close during 1990. Indeed, the major purposes in the March 1990 changes were to close the gap and to increase margins. A more forthright, if brazen, statement can hardly be imagined.

Cartel Organization and Methods

The vitamins cartels resemble the innards of a Swiss watch. There were wheels within wheels (Figure 11.1).

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 in 14 cartels.

Price fixing was arranged for at least 16 products: 13 bulk vitamins, two carotenoids, and feed premixes. 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, and premixes. In early 1990, Roche contacted Eisai of Japan, which was the only significant producer of vitamin E besides Roche and BASF (Figure 11.2). 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. 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 11.1.

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. Second,

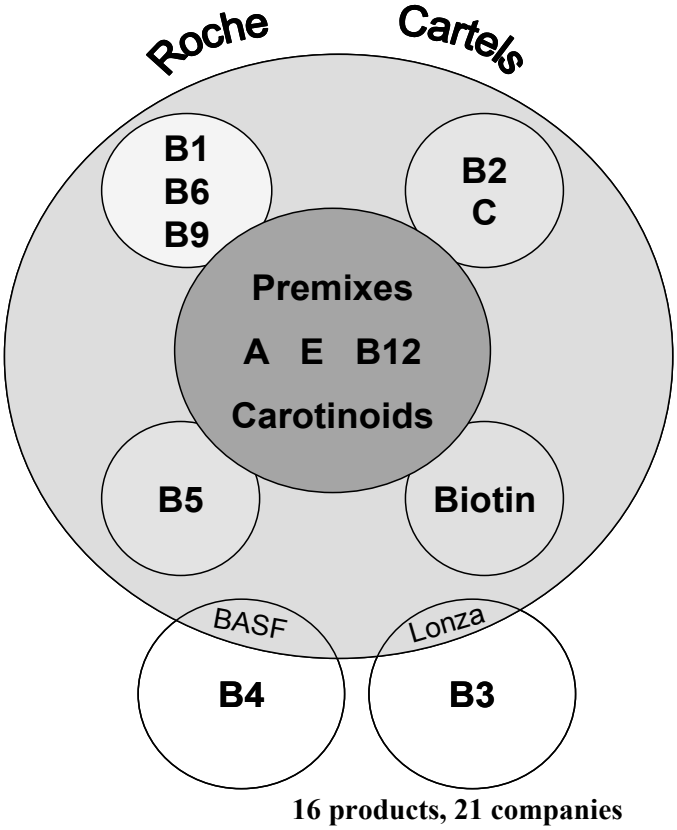

Figure 11.1. Wheels Within Wheels.

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.

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

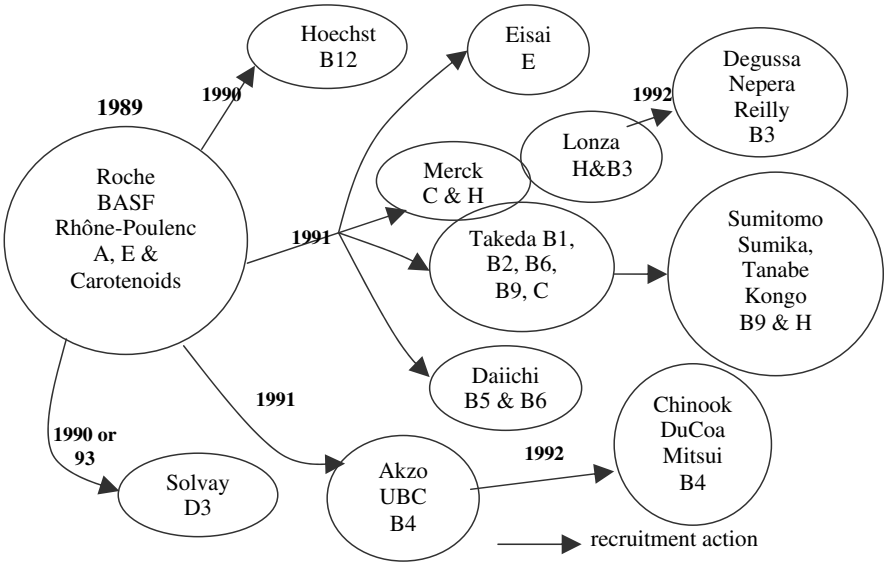

Figure 11.2. Vitamins in the 1990s: A Web of Conspiracies.

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.

Now the conduct of the16 cartels is discussed in greater detail.

The Roche Cartels

Vitamins A & E

Hoffmann-La Roche was the largest seller and took the lead in organizing and managing 14 of the conspiracies. BASF was Roche's willing partner in ten of the collusive schemes. The first and most important group was formed by Roche, BASF, and Rhône-Poulenc for vitamins A and E; soon thereafter the Japanese pharmaceutical company Eisai was drawn in to strengthen the vitamin E cartel. These committees began to refer to themselves as "Vitamins Inc.," a fictional joint venture that would conquer nearly all the vitamins markets of the world.

Against a backdrop of falling prices in the late 1980s, the presidents of the vitamins divisions of Roche and BASF met in a hotel in or near Basel, Switzerland on June 7, 1989 to start the new conspiracy in motion (EC 2003). Two months later the Roche and BASF presidents invited the head of Rhône-Poulenc Animal Nutrition to join them at a planning meeting in Zurich, Switzerland. The three men conferred again in Zurich for two days in September, 1989. By the end of the four days of meetings, the objectives and general organization of the vitamins cartels had been agreed upon.

The three companies agreed to raise the prices of vitamins A and E in stages beginning in early 1990. They also shared data on the size of these markets to arrive at a consensus on 1988 sales volume for each firm and the whole market. They then agreed to freeze their firms' market shares at the 1988 levels for the foreseeable future; growth of the market would be shared proportionally to their quotas. Other rules were adopted regarding sales practices and a compensation scheme to handle year-end deviations from assigned quotas. Late in 1989 a fourth meeting was held in Basel during which country-by-country market shares were set, 1990 sales were forecasted, and sales shares were converted to tonnage quotas for every region of the world. These late summer or fall gatherings came to be known as the "budget meetings."

The planning and management structure created to operate Vitamins, Inc. was in comparison to many contemporaneous international cartels extremely elaborate. Four integrated layers of cartel management were created. The top-level budget meetings were attended by the most senior officers of the companies' vitamins divisions, sometimes accompanied by the chiefs of global vitamins marketing. Budget meetings for the A & E cartels would be held in or near Basel at least once each year

in September or October from 1989 to 1999. After initially setting up the cartels, they became the occasion for approving specific plans for the following year that had been drawn up by their lieutenants. The attendees at the top-level meetings made occasional small adjustments to company quotas and adjudicated disputes that lower level managers could not resolve. In some years a second summit was held in Basel, Paris, or Frankfurt.

At the second level were meetings of the chiefs of global vitamins marketing. They met among themselves two or three times each year to develop specific plans for the following year and to monitor implementation of the annual budgets. One of these meetings occurred at hotels in or near Basel each August. At these meetings, detailed company sales information would be exchanged, and price increases were settled. The price increases were always multiples of 5% and were to take effect in April of the following year. They also agreed which of their members would take the lead in announcing the price increase (usually Roche was designated but occasionally BASF was tapped for the role). Then after the anointed "price leader" announced the new list prices, the others would pretend to follow an increase that had been preordained eight months earlier.

At a third layer of cartel management, the heads of worldwide product marketing met four times per annum. It was their function to monitor the progress of the annual quotas and make a progress report to the next layer above. Sales volumes were reported on a monthly basis.

Finally, regional product marketing managers assembled four times per year to monitor regional quotas, to assess trends in demand and supply, and to make small changes in prices in local currencies. For example, the committee handling sales in the European region met in Basel like clockwork in January, April, July, and October each year; "Europe" included sales in Western Europe, Eastern Europe, Africa, and the Middle East. The other regions were North America, Asia, and South America. Spreadsheets were prepared by the regional marketing managers that identified the participants by code numbers. A special task at the January meeting was to arrange compensatory sales from over-quota members to those that were under-quota. The sales were made at cost so that when the under-quota members resold the product at the cartel price, the excess profits made by the over-quota firms in the previous year were in effect transferred to the under-quota buyer. In 1996 and 1997 both Roche and BASF had to make compensation purchases (*ibid.* p. 225).

With minor variations, the management structure designed for vitamins A and E would be adopted for all the other Roche cartels.

Market Structure and Entry Deterrence

The vitamin A cartel controlled an average of 96% of global sales during the conspiracy years. The remaining 4% of production was in the hands of Russian, Indian, and Chinese manufacturers (*ibid.* p. 225). As the cartel raised prices from 1990 to 1996, the Russian fringe producer entered in 1991 and captured as much as 10% of world production by 1993-1994; even as prices remained high in 1995-1998, Russian supplies ranged from 5 to 8% of production. It seems likely that some of the Russian output was exported to Western Europe. While prices in euros rose each year from 1990 to 1998, the rate of increase was lower than in the U.S. market. Dribbles of Asian product appeared from 1989 to 1998, but total Asian production never exceeded 2% of global supply in the 1990s. Although very little actual entry took place during the conspiracy period, Roche told the European Commission that the cartels contemplated and explored measures to eliminate or deter these marginal producers from entering Europe.

The stability of vitamin A world market shares among the three cartel members is remarkable, which is evidence that the original 1990 quota allocations probably did not need to be renegotiated. For example, Roche did absorb about half of the cartel's loss of market share in the late 1990s, but *within* the cartels Roche's share never wavered from 48%. Similarly, BASF adhered to its assigned 28% cartels quota, and Eisai held to 21% throughout 1990-1998. Market shares were allowed to be different at the regional levels; Roche and Rhône-Poulenc, for example, had higher shares in North America than in the world generally.

The vitamin E industry was slightly less concentrated than vitamin A. The three original conspirators accounted for 87% of the vitamin E world market in 1990, the first year of the cartel's operation. However, without Eisai's cooperation, the cartel found that price increases were somewhat sluggish in the first year. After Eisai joined in early 1991 and raised the cartel's market control to 96%, world prices rose by more than 20% per year through 1993, peaking in 1997-1998.

Higher prices boosted modest fringe production; manufacturers in China, Russia, and Slovakia managed to capture 4% or 5% of world production during the late 1990s. In the mid and late 1980s, none of these fringe firms had had commercial sales. However, there is some indication that Chinese producers may have begun challenging the cartel in its last two years. Chinese output doubled from 1996 to 1997 and reached 11% of global output in 1998; indeed, Chinese production surpassed that of Eisai, the smallest cartel member, in that year. The lion's share of Chinese production, most of it feed grade, was exported. By 1998 Chinese imports captured about 7% of the European market, but euro prices remained

steady 1997-1998. Vitamin E prices did not decline until 1999, the year the cartel was discovered by the U.S. DOJ. Chinese imports may have had a stronger effect in the U.S. market. There the prices of feed grade vitamin E fell about 10% from 1997 to 1998, and human grades of vitamin E by about 5%.

As in the vitamin A case, there is no evidence of dissention among the four members of the vitamin E cartel. The ringleader Roche maintained a steady 46 to 48% share of the cartel's production from 1990 to 1998. The other three members' intracartel shares were similarly invariant over the nine years of collusion.

Pricing Policies

The general principle enunciated repeatedly by the managers of the vitamins cartels was "Price before volume." What this aphorism seems to mean is that the conspirators would give precedence to increasing price at a higher rate than the rate of losses of tonnage due to the price increases.[2] That is, the aim was to increase market price so long as total revenues or profits increased.

The organizers of the cartel prepared planning documents with two prices, one a "target price"[3] and a second "lowest price." Initially, prices for vitamins A and E were set in U. S. dollars (USD) and in Deutsche marks (DEM).[4] A price list distributed to Roche's product managers in March lists target and lowest prices in both dollars and marks. The document reveals that Roche's corporate objective was to raise prices of the two products by 5 to 10% when measured in Swiss francs (CHF). At the same time, an objective was to keep the USD and DEM prices close enough that vitamin brokers could not profit from geographic arbitrage.[5]

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2 "Price over tonnage" must mean more than the fact that they are inversely related. In economic terms Roche was encouraging the cartels to raise price toward the inelastic portion of the demand curve. When demand is inelastic a small percentage increase in results in a smaller percentage decrease in quantity sold. Monopolists and effective cartels will maximize profits when their equilibrium reaches the inelastic zone of demand.

3 Roche and BASF documents obtained by the European Commission use the German word *Ziel* , which can also be translated as aim, goal, intention, or objective.

4 The full published version of the EC vitamins cartel decision (EC 2003) reports the prices of many products in Swiss francs, but translates most of the 1989-1992 monetary figures from DEMs into euros. Officially the euro did not exist until 1999. However, one can use the ecu (the European Currency Unit or ECU), the forerunner of the euro, to convert DEMs into euros. The euro replaced the ecu at par in January 1999. For the years prior to 1999, the ecu will be referred to as the euro.

5 If currency swings between the USD and DEM caused to price of a vitamin to rise by more than 5 or 10% in Germany, then U.S. wholesalers could purchase the vitamin

Sales managers were instructed not to sell at any price that would cause Roche's market share to rise above 48%.

The cartel managers were not averse to reaping windfall profits when the opportunity presented itself. In early 1991, Rhône-Poulenc's vitamin E plant experienced a fire that interrupted production. The temporary reduction in supply was a perfect public excuse to raise prices even more than originally planned. Instead of a 5 to 10% increase in Swiss prices, the cartel opportunistically seized on a 15% increase. Because the Swiss franc appreciated relative to the DEM, in the rest of Europe vitamin A and E prices rose by 24% in 1991.

Cartel managers were ever watchful to the dangers presented by arbitrageurs. In early 1994, Roche sent a memorandum dated 4 February 1994 to its regional sales managers that said that because of currency exchange swings the price gap between Europe and the United States for vitamins A and E had grown to about 10% (EC 2003: p. 223).[6] The memo warns that brokers were using this gap to engage in arbitrage. To counter this behavior, the memo states that the

> "… key focus regarding 1994 is therefore on Europe…Our objective is to bring A prices up by DEM 2 and E prices by 1. Volumes need to be strictly controlled" (*ibid*.).[7]

The pricing goals of the vitamin A and E cartels were ambitious and successful. From 1990 to 1994, the European price of vitamin A rose by 29%; vitamin E increased by 56%. Similar price increases occurred in the rest of the world. The signal success of these cartels was so great that in 1994 Vitamins, Inc. decided to hold prices steady from 1995 on.

Cartel Expansion

The period from January 1990 to January 1991 was especially busy for the three founding members of Vitamins, Inc. In early 1990, the increases in vitamin E prices had been limited to a somewhat disappointing 5 to 10% worldwide (EC 2003: p. 213-215). The cartel managers ascribed this weak price response to an increase in sales by the Japanese pharmaceutical

in the United States at a low price (when denominated in DEMs), pay for transportation to Germany, and reap a risk-free profit when sold at the higher price in Germany (see Bush *et al.* 2004). If the dollar rose against the mark, reverse arbitrage could occur.

6 The average exchange rate in February 1994 was 1.7675 DEM/USD, up from 1.6777 in September 1993, an increase in the exchange value of the U.S. dollar of 5.4%.

7 In 1994, vitamin A was selling in Europe for DEM97 per kilo and vitamin E for DEM57. Thus the price increases were modest, only 1.8 to 2.1% (EC 2003: Tables II and III).

manufacturer Eisai. When the vitamin E cartel began, Eisai had a global share of slightly less than 10%. Thus, in September 1990, the vitamin-division presidents of Roche, BASF, and Rhône-Poulenc journeyed to Japan to woo Eisai into the fold. On October 30, 1990 top executives of Eisai traveled to Basel to finalize a membership agreement. Meeting only bilaterally[8] with the three ringleaders, Eisai agreed to accept a 1600-tonne world quota for 1991 in return for a promise that its share would rise to 11% and remain at 11% for the duration of the cartel. After January 1991, Eisai maintained bilateral contacts only with Roche representatives, so Roche became the primary coordinator of the vitamin E cartel.

Fear of Prosecution

Managers of the vitamin A and E cartels took steps throughout the conspiracy to hide their activities. Meetings were held at hotels and other places away from their offices and curious business colleagues. Eisai engaged in only bilateral contacts with its cartel partners, perhaps to maintain the deniability of cartel meetings. Conspirators in Europe were careful not to leave incriminating documents at their business locations where a dawn raid might lead to their discovery.[9]

In January 1993, the *Conseil de Concurrence* (the French competition-law authority) received complaints from buyers that vitamin manufacturers were raising prices to unjustified levels in concert. The council responded by raiding the headquarters of Rhône-Poulenc Animal Nutrition in Paris. Roche informed Takeda Chemical about the raid, and Takeda kept this record of the message:

> "Nothing was found in the investigation…nothing was found…[Roche] does not consider these inspections problematic: however they are being careful as to how they handle documentation" (*ibid.* p. 223).

Indeed, nothing came of the raid.

Things took a more serious turn in the United States in 1997. The U.S. DOJ had been busy prosecuting the lysine and citric acid cases throughout 1996 and early 1997. In early 1997 the FBI received information about a possible price fixing conspiracy in the vitamins industry. In

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8 Eisai and some other Japanese conspirators seem to have got the idea that bilateral meetings could not violate the antitrust laws.

9 Prior to 2004, EC regulations permitted only places of business to be searched. Executives' cars and homes were off limits.

March of that year, FBI agents interviewed Dr. Kuno Sommer about the matter. Sommer was the global head of vitamins marketing for Hoffmann-La Roche and 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's interview would have serious legal consequences for him and Roche if he did not answer truthfully. First, it is a federal crime to lie to federal investigators; second, he was interviewed under the January 1997 citric acid plea agreement in which Roche had promised full cooperation from its employees in any antitrust investigations.

Sommer denied that Roche was involved in any such illegal activity. Later it came to light that Sommer had prearranged with others at Roche to cover up the vitamin cartels' existence. Because Roche was the only vitamin co-conspirator with a cooperation pledge, Sommer's denials impeded FBI's investigation considerably. However, in late 1997, the DOJ investigation picked up speed again. The DOJ empanelled a grand jury in Dallas, Texas to investigate allegations in December 1997. This grand jury would toil away in secret for 16 months before the first fruits of the investigation would become public. By mid-summer 1998 strong and persistent rumors had begun that indictments were likely; Roche and BASF were mentioned as targets of the vitamin probe.

In response the cartels reduced the frequency of their meetings. The last tripartite meeting of the vitamins A and E cartel took place in Basel in November 1997. Thereafter, the conspirators would meet only bilaterally. Moreover, top-level meetings became "more discrete" (*ibid.* p. 231). Meetings began to take place in executives' homes so that there would be no lodging records to be later discovered. On December 22, 1997 Rhône-Poulenc announced to the other members of the cartels that it had decided to quit the conspiracy. This announcement was a sham as the company continued to meet with Roche and BASF for another year.

Collusion in the vitamin A and E markets did not end until February 1999, a total run of 117 months. Because of the large size of the vitamin A and E markets and the longevity of the cartels, the economic harm caused by these two conspiracies would amount to 36% of the economic injuries caused by all 16 cartels.

Vitamin B12 and the Carotinoids

The vitamin A and E cartels made such promising starts in 1990, that Roche, BASF, and Rhône-Poulenc spread their net wider still. The third market monopolized was the global market for vitamin B12. This cartel was one of the few markets that were not subject to collusion in the 1980s.

One reason that Rhone-Poulenc and Hoechst were unable to collude overtly earlier was their low degree of global control of production (67 to 71%). They faced two presumably competent rivals in Western Europe, Glaxo in the UK and E. Merck in Germany, that accounted for as much as 22% of industry output; moreover, unidentified Asian producers made as much as 12% of global supply in the late 1990s.

Whatever the reasons, Merck shut down production in early 1989 and Glaxo[10] did the same in late 1991, leaving Hoechst and Rhone-Poulenc as the nearly sole producers of vitamin B12 in Europe. These exits gave Hoechst and Rhone-Poulenc the degree of control they needed to collude. Surprisingly, even as prices surged in the early and mid 1990s, Asian production shrank to 10% or less of world production. Chinese entry began on a small scale in 1995 but grew to only 9% of world production in 1998. The late entry suggests that the Chinese and other Asian firms were at a cost disadvantage in making vitamin B12 until near the end of the cartel.

The vitamin B12 cartels began in January 1990, suggesting that planning had occurred in late 1989 simultaneously with the vitamin A and E cartels. In terms of timing, the B12 cartel was virtually coterminous with the A and E cartels, except that it ended about a year earlier. The two firms accounted for only 69% of global supply in 1990, Rhône-Poulenc (62%) and its much smaller German partner, Hoechst (7%). Unlike most cartels, the degree of supply control rose as prices climbed in the mid 1990s, a pattern that further supports a cost advantage by the duopoly. At the cartel's peak the two firms controlled 81 to 86% of world production -- about 95% of the European market but closer to 85% of the North American market. The vitamin B12 cartel was in effect a merger ten years in advance of the late 1999 formal merger of the two companies into the firm called Aventis, renamed Sanofi-Aventis in 2006.[11]

Far larger in scope were the two cartels for carotinoids, the older product beta carotene and three other carotenoids. Like vitamin B12, they were duopolies that endured from early 1991 to December 1997. Roche

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10 Glaxo held an 8% share in 1991 and Rhone's increased by 5 percentage points the next year; it is possible that Rhone acquired Glaxo's plant.

11 Aventis was formed in December 1999, and its headquarters moved to the French province of Alsace about midway between the two companies' former headquarters. As of 2005 neither Aventis nor its predecessor companies have been charged by the United States or the EU in the B12 market. They *were* found guilty by Canada. There is a strong possibility that in 1998 the liabilities created by participation in the vitamins cartel were seen as the only impediment to the impending Aventis merger. Although the U.S. and EU amnesty programs are given most of the credit, the Roche cartels may have been exposed by Rhône-Poulenc as part of a secret deal to obtain merger approval in Europe and the United States.

and BASF are the only known producers of synthetic carotinoids in the world. No entry occurred into these industries, even though they are among the fastest growing vitamin products. As the most recently synthesized vitamin products, technological barriers to entry are substantial.

The first contacts about forming a cartel for carotinoids began in 1991. Formal negotiations began in Basel in September 1992 and concerned beta carotene, the orange colorant and the most mature market of the four carotinoids. BASF was a relatively new producer of beta carotene and had been gaining market share prior to 1991. The 1991 quota agreement began with allotting a global share of 79% to Roche. The plan was to allow BASF's 21% share to increase by about 1 percentage point per year until it would reach 30% in the year 2001. Unlike most of the other vitamins cartels, no regional quotas were assigned. After the initial 1992 meeting, quarterly meetings were held simultaneously with those of the vitamin A and E meetings

Canthaxanthin, the red carotenoid, was the subject of delicate negotiations between Roche and BASF beginning in May 1993. BASF had reached a 33% share in Europe. However, BASF also had plans to enter the astaxanthin market in 1996 when a new plant it was constructing was expected to begin production. As an incentive to Roche not to oppose BASF's entry into astaxanthin, BASF agreed to cut its 1994 production share to 29% with the understanding that its share would grow to 35 to 40% by 2002. In return, Roche agreed to let BASF enter the astaxanthin market unimpeded in 1996 and allow its share to grow to 20% by 2002.

The manufacturing processes for the newer carotinoids must be among the most technically challenging of all the vitamins. BASF, a chemical powerhouse with great depth in R&D capacity, faltered badly in its plan to make astaxanthin. Production did not begin until 1999. Thus, the attempt to collude on the pink carotinoids was never implemented. Roche maintained its monopoly on both pink and gold carotinoids until at least 1999.

The two carotenoids cartels came as close to a blockaded monopoly as any of the cartels. Conduct was calm, orderly, and highly controlled. U.S. carotenoid prices were by far the highest of any vitamin product except biotin – human grades of beta carotene reached nearly $1000 per pound and feed grades of canthaxanthin $1500 per pound. Moreover, prices rose inexorably both before, during, and *after* formal collusion in the 1990s. Roche diplomatically ceded a percentage point or two of market share to BASF each year in order to contain what might have been a more aggressive rate of entry by the smaller partner in the cartels.

Feed Premixes

There is little reliable information about the structure of the industry that sells mixtures of bulk vitamins to large feed and pharmaceutical manufacturers. In general, there seems to be a large number of small premix companies that typically operate a single plant to serve sub national markets. Two larger independent blenders in the United States are ADM and Nutra-Blend. However, two companies stand out in this generally atomistic industry. Hoffmann-La Roche and BASF had leveraged their broad vitamin product lines and knowledge of animal nutrition into chains of premix plants that could serve the whole of North America or the European Union. By 1990 they had expanded their premix operations to occupy leading positions in those markets. Roughly speaking the two firms seems to control about half of the North American and European markets for feed premixes, with Roche about twice the size of BASF. One of their aims in forming the bulk vitamins cartels was to further the development of dominant positions in the downstream premix business.

Vitamins B1, B2, B5, B6, B9, C, and Biotin

Seven of the water-soluble vitamins were cartelized in late 1990 or early 1991; five are in the in the B complex; vitamin C and biotin (vitamin H) are also water-soluble. The proximate cause of the formation of these six cartels was falling profits. According to the European Commission, one participant asserted that the prices of all the B complex vitamins had been falling during the 1980s (EC 2003). Transactions price data in the United States do not support this sweeping claim. Vitamins B1, B2, B5, and B6 had falling nominal prices in the early 1980s, but by 1988 or 1989 prices had recovered to their previous peaks. Only in the cases of biotin and folic acid did prices fail to recover to their previous heights by 1988 or 1989. However, it is true that modest declines in prices did occur in the year or two prior to the re-establishment of the six cartels.

One factor responsible for the decline in prices in the early 1980s was the growth in Japanese exports of B complex vitamins to Western Europe and North America. Roche experienced a large loss of market share from the mid 1970s to 1990. Roche lost 32% of its European share of vitamin B1, 44% of B2, 31% of B5, 43% of B6, 7% of B9, and 61% of biotin. Takeda, Daiichi, Kongo, Sumika, Sumitomo, and Tanabe gained market share during this period. Another factor contributing to the slide in prices in 1989 and 1990 was the weakness of the U.S. dollar relative to the yen, the Swiss franc, and most other European currencies. In most parts of the world outside Europe vitamins were sold in dollars, which adversely

affected profits of companies whose products were sold in currencies other than the U.S. dollar.

To be successful in establishing cartels for the B vitamins, the three founding firms had to reach out beyond the circle of five firms already successfully colluding on four products (Figure 11.1). Each of the new cartels would require only three or four members to control the markets. Generally speaking, the makers of vitamins B1, B2, B6, folic acid, and C met together, but the complexity of the task required two days of work each time.

Vitamin B1

The vitamin B1 (thiamin) cartel began at a January 30, 1991 meeting in Tokyo between Roche and Takeda; several other Japanese vitamins manufacturers were present.[12] Internal Takeda documents showed that Roche and Takeda shared their 1990 production and sales of vitamin B1 for the world and four regions, and agreed to use the 1990 historical shares as the basis for setting 1991, 1992, and 1993 quotas. Roche and Takeda honored their agreement faithfully until the cartel collapsed in mid 1994. From 1991 to 1993 Roche maintained 56 to 57% of cartel production

Prices in the EU had dropped about 5% from 1988 to 1989, despite the withdrawal from production of the third largest manufacturer in 1989. An unusual feature of the vitamin B1 industry was the fact that BASF had decided to cease manufacturing vitamin B1 in 1989, but remained a seller of bulk vitamin B1 through a long term (1989-1994) supply contract with Roche. In 1990 Roche manufactured 50.8% of the world's supply, and Takeda made 36.2%. However, almost one-fourth of Roche's output was committed to BASF under the supply contract, presumably at favorable terms. At the Tokyo meeting, BASF was awarded a market share that kept its sales in a constant ratio with Roche's share. Although BASF never met with Takeda about its role in the cartel, it was kept informed about the prices and share quotas that were set by the other two.

Another feature of the vitamin B1 market was the significant and rapidly growing share of Chinese producers. In 1989, Chinese sales had reached about 9% of global supply (another 3% was made elsewhere). By 1991, China's share would grow to 20%. At their Tokyo meeting Roche and Takeda estimated that the Chinese share would grow to about 25% by

[12] After the initial meeting, Roche and Takeda met quarterly at meetings that combined top-level executives and operational managers. The meetings often lasted two days because the two companies had five products in common: vitamins B1, B2, B6, C, and folic acid. Sometimes BASF would be present for the sessions dealing with vitamins B2 and C, and E. Merck would join the vitamin C sessions.

1993. In fact their expectations would prove to be optimistic, because in 1993 Chinese output would actually reach 38% of world production.

The rapidly growing Chinese exports were flowing mainly to Asia and North America; Chinese imports into Western Europe remained in the 9% to 12% range in the early 1990s, a level that is worrisome but not necessarily destructive of cartel effectiveness. During the 1991-1994 cartel period in North America cartel controlled dropped to less than 60%, which is a level at which it is difficult to maintain collusion.

Another feature of Chinese exports is that initially the Chinese product was a closer substitute for feed grade vitamins than for human consumption. This is demonstrated in the U.S. vitamin B1 market by the differential response of prices to the surge in Chinese imports from mid 1998 to the end of 1989. U.S. prices of *feed-grade* vitamin B1 tumbled by about 15%, whereas the price of *food-grade* product declined by less than 5%. During the 1990s Chinese manufacturers would invest in high-tech equipment that would permit the sale of vitamins with higher levels of purity compatible with pharmacopeia standards.

To respond to the Chinese challenge, Takeda considered offering a "sub-spec" feed-grade product of its own and compete on price. In June 1993, by which time the challenge had turned into a crisis, Takeda instead decided to introduce a discriminatory pricing policy. To woo lost customers back Takeda would match the Chinese on price on feed-grade product while at the same time charging loyal customers a higher price. Roche seems to have adopted the same desperate and ultimately ineffective strategy.

Chinese exports were shipped by several nominally independent firms, but many of them were government owned and belonged to a trade association that provided a degree of centralization of decision making. At no time does the record show that any of the vitamins cartels attempted to recruit or co-opt members of the Chinese chemical industry. Instead they were viewed as mavericks hell-bent on maximizing their share of the world market through fierce price-cutting.

The rise of Chinese exports played a key role in several of the vitamins cartels. Chinese exports were increasing before most of the B complex cartels were formed in 1990-1991, but their greatest rate of growth began from 1991 to 1995. In those four years, the real value of Chinese vitamin exports rose by 250% and the quantity tripled. Doubtless, the increase in the prices of the vitamin C and the B complex vitamins was a major factor that encouraged that explosive growth.

After the cartel was formed, vitamin B1 prices in Europe did rise 5 to 6% in the first two years. However, by late 1992 Chinese imports into the EU had reached 18% of supply, and those imports had begun to restrain EU price increases. In the U.S. market for vitamin B1 prices rose

15% from January 1991 to late 1992. Vitamin B1 prices peaked in early 1993, but fell rapidly thereafter. EU feed-grade prices fell by 26% from mid 1993 to the second half of 1994. U.S. prices tumbled 20 to 30% during the same period. At a meeting in June 10, 1994 Roche and Takeda abandoned price fixing. By 1996-1999, the prices of both grades of vitamin B1 had declined by more than 50% from the 1993 peak.

At three and one-half years, the vitamin B1 cartel was the second-most fragile of all the vitamins schemes (Figure 11.2). Although it died the kind of natural death that true believers in perfect competition expect to be the norm, it did in fact turn out to be a profitable venture while it lasted. Whether the cartel could have made more money through a strategy of slowly *lowering* prices and thereby extending the collusive period is doubtful.

Vitamin B2

The history of this cartel parallels that of the vitamin B1 cartel in several respects. Roche, BASF, and Takeda were the three dominant sellers in 1990, with 87% of the world market under their control. Takeda, which had entered the industry only in 1990, was the smallest member of the cartel established in 1991. The fringe producers in the vitamin B2 industry were: Eastern European producers, which accounted for about 10% of the European market for vitamin B2; the Japanese manufacturer Tanabe in Asia; and the U.S. company Coors in North American market. Unlike vitamin B1, Chinese entry was no long-term threat to the cartel.

From 1988 to 1990 the EU price of vitamin B2 fell by 12%. In the United States, the price of feed-grade vitamin B2 fell about 15% at the same time, but human grade was unchanged. In response to falling prices, Roche and BASF executives met in Bottmingen, Switzerland in July 14-15, 1991 to discuss a vitamin B2 cartel.[13] The two companies accounted for 84% of global supply. At the Swiss meeting they agreed to raise prices and to fix volume quotas for the top three sellers for the years 1992 to 1996 at levels equal to actual 1990 levels. Roche and BASF also agreed to set up the four-tier system of cartel management with quarterly meetings that was being used in the vitamins A and E cartels.

Soon thereafter senior Roche and BASF representatives separately traveled to Japan to convey the cartel's market-share proposal to Takeda Unlike vitamin B1, Takeda was in a relatively weak third place in

[13] It appears likely that earlier discussions about a vitamin B1 cartel may have taken place in Tokyo in January 1991 when Roche senior executives visited Takeda. It is possible that Takeda wanted to delay talks about a cartel because it was expanding its vitamin B1 plant in Japan at the time.

the industry, with only 3% of global output. So by late 1991 or early 1992 it accepted the Roche-BASF offer of a 12% global share.[14] Roche and BASF both gave up considerable market shares in 1992 to allow Takeda's share to rise. Roche and Takeda met in Basel on April 13, 1992 to finalize some details on the cartel's policy of continuous increases in prices. Subsequently, Takeda met quarterly with Roche and BASF, but always bilaterally. The three conspirators exchanged sales data on a regular basis for five global regions: Europe, North America, Latin America, Japan, and the rest of Asia.

Takeda officials kept detailed minutes of their many meetings with Roche and BASF officers, even though some of them were headed by a warning: "Destroy after reading." These notes contain items that indicate constant bickering about shading of prices by Takeda, sales to specific customers, and concerns about market shares of various grades of Vitamin B2. Takeda found its initial agreement to accept a constant 12% global share hard to live with. Takeda complained that the rising prices of vitamin B2 kept its volume of sales virtually constant from 1990 to 1992. In late 1992, Takeda demanded an increase in its 1993 volume of sales to 500 tonnes, about 30% more than it had previously agreed. Roche representatives angrily rejected the demand, but Takeda's stubborn insistence on a larger volume of sales eventually had its intended effect. In the interests of cartel harmony, Roche and BASF agreed to yield some of their shares to Takeda. Takeda's global share would grow from 13% in 1992 to about 17% in 1994, almost all at the expense of Roche.

The vitamin B2 conspiracy is an interesting illustration of one in which repeated annual renegotiations were needed to maintain pricing discipline. In 1991 when the cartel was initiated by Roche and BASF alone, they agreed to a 64:36 split. To entice Takeda to cooperate Roche gave up 9.7 percentage points of intra-cartel share and BASF a proportional 5.0 points as a reward to Takeda for joining. Then to satisfy Tanabe's further demands, the two leaders ceded another 4 percentage points of the cartel's total production to Tanabe from 1992 to 1994. Finally, the two leaders needed to accommodate a fourth member. Rhone-Poulenc began selling vitamin B2 in 1994; by the next year it had been generously granted a 10% share of cartel production, which was carved out of the two leaders'

[14] Tanabe had a 7% global share in 1990 but dropped out of the market at the end of 1990 or beginning of 1991. It seems that Tanabe must have sold or leased its Japanese production capacity to Takeda by early 1992. This is consistent with many other acts of deference shown by the smaller Japanese vitamin makers to Takeda in the 1990s. Tanabe was dependent on supplies of vitamin B1 from Takeda.

quotas. After less than five years of collusion, Roche had gone from a 64% intra-cartel quota to a mere 45%

Despite the evidence of continuing disagreements over market shares, the minutes of the cartels meetings also show a continuing commitment to the overarching principle of "Price before quantity." That is, prices were continuously, even experimentally raised despite the fact that quantity growth was being adversely affected. Like the earlier cartels, the vitamin B1 conspirators agreed to two sets of prices: list (or target) and lowest. The minimum prices were about 5% below the target prices. Moreover, feed-grade prices were kept in a nearly constant ratio to the human grade – feed grade was priced about 80 to 83% lower than human. Following these customary discounts made the process of arriving at a consensus on prices quite manageable. In effect, the cartel needed only to agree on a target price for human-grade vitamin B1; deriving all the other prices was a mere arithmetic exercise.

While the vitamin B1 cartel negotiated a solution to an internal threat to its stability, it was less successful in dealing with an external threat. The external threat did not come from China this time, but rather from the United States. In 1991 and 1992 the three members of the cartel believed that only two significant rivals remained outside the cartel: Coors in the United States and the GUS group in Russia. The outsiders were believed to hold about 4.6 to 4.8% of the global market in 1990 and 1991 – a share small enough to be safely ignored for collusion purposes. However, in 1993 the cartel discovered that the U.S. brewing company Coors had built a vitamin B2 biotech plant with 230 tonnes capacity, about twice as large as they had estimated in 1991. To protect prices outside the United States, Roche contracted to purchase half of Coor's capacity, an amount sufficient to prevent Coors from exporting vitamin B2. Roche then sold a portion of its purchased product to BASF in an amount that preserved their relative quotas. This was a cunning, if expensive solution to foiling large-scale entry into the cartel's market.

The vitamin B2 cartel unraveled in 1995 because of two events. First, Takeda was caught cheating on its volume agreement. At a meeting with Roche and BASF on March 16, 1995 the Roche representative confronted Takeda with evidence of its perfidy. Roche had discovered from Japanese government trade statistics that Takeda's sales in Japan and its exports amounted to an annual sales volume of 580 tonnes, which was 40

to 50% above its agreed quota. At that meeting, the Takeda representative made an obscure reply to Roche's accusation that was tantamount to admission. Later, Takeda told Roche that it was operating at close to its production capacity, but that it would not reduce its sales volume. This episode shows the importance of information-sharing. Overt collusion works best when transparency is complete among cartel participants, and third parties do not have access to facts that cause surprise.

Second, in 1995 the Coors vitamin B2 plant was sold the large agribusiness firm Archer Daniels Midland (ADM). Furthermore, ADM signed a marketing agreement with Rhône-Poulenc to sell part of its U.S. production in Europe. As usual, ADM decided to expand its vitamin B2 production rapidly. By offering vitamin B2 at a lower price, ADM quickly garnered a 9% share of the European market by the end of 1995, up from 2% at the beginning of the year. Moreover, ADM's global share rose from about 13% in 1995 to 23% in 1998. Roche's global market share plunged from 56% in 1990 to 41% in 1996.

Prices of vitamin B2 declined in the U.S. market, slowly in 1996 and then rapidly for four years thereafter. Feed-grade prices fell from $62 per kilogram in 1995 to $26 at the end of 2000 – an astonishing 58% plunge; human-grade fell by 41%. Prices of both types in Europe reached their peak in 1995 at €60.6 ($76) per kilogram and fell to €37.6 in 2000, less than in the United States but still an impressive 38%.

In the fall of 1995, Roche unilaterally informed the others that it would terminate the failing vitamin B1 cartel.

Folic Acid (Vitamin B9)

Collusion in the market for folic acid, the smallest of the bulk vitamins markets, began as early as the January 30, 1991 meeting in Tokyo between senior officers of Roche and Takeda. Both sides had come prepared to exchange confidential sales data and were primed to deal.

The folic acid industry consisted of four major players: Roche, Takeda, Kongo, and Sumika/Sumitomo. In 1990 these four manufacturers controlled 96% of world production. Roche asked Takeda, the largest of the three chemical firms, to coordinate cartel decisions with the two smaller Japanese manufacturers. The structure and organization of the cartel was copied closely from the vitamin A and E cartels: multi-tiered quarterly meetings, market shares frozen at 1990 levels, a compensation mechanism to reward under-quota members, and target prices with minimum prices at most 5% lower set each autumn for the following year. Prices and market shares were set for four regions: the USA, Europe, Japan, and the rest of the world. The Japanese members of the cartel met

quarterly simultaneously with the Yosankai Trade Association, a creation of Japan's Ministry of International Trade and Industry.

Information provided by Takeda indicates that Roche had dual objectives in forming the cartel. Roche desired to profit from the sale of straight folic acid but also wanted to raise the prices of bulk folic acid in order to improve its market position in the downstream market for feed premixes. Because Roche could supply its own growing premix business with bulk vitamins at the cost of production, it could keep its premix products low in price and squeeze rival premixers out of the market. The Japanese members of the cartel did not benefit from the premix objective, so Roche's dual objectives caused some tensions early during the cartel's life.

Events in the cartelized folic acid market unfolded in a manner reminiscent of vitamin B1. Folic acid prices took off from the first year of the agreement until mid 1994. U.S. prices rose by 40% in that three-and-one-half-year period. The cartel's downfall began in late 1993. Until that year Chinese production had never accounted for more than 3% of global supply. However, like a few of the other water-soluble vitamin cartels, Chinese manufacturers had in the early 1990s solved technical production problems and were rapidly scaling up output and exports. From 1992 to 1993 Chinese production exploded, increasing by 700%. By 1994, Chinese producers accounted for more than one-third of global production.

At its meeting on September 24, 1993 the three Japanese firms identified growing Chinese exports as the main cause of falling folic acid prices. In Europe, Chinese imports had reached a level that amounted to 28% of the cartel's planned 1993 volume. Prices began to decline in mid 1994, so the folic acid agreement was formally abandoned at a meeting in Tokyo on June 10, 1994. Five years later U.S. prices had dived by nearly 60%.

Vitamin B6

This cartel also began with the January 30, 1991 visit of Roche executives to Tokyo. In 1990 Roche, Takeda and Daiichi controlled 72% of global sales, the second smallest initial degree of control of any of the vitamins cartels. The pricing pressures facing the three firms in this market were especially severe. From mid 1988 to 1990 the EU price of vitamin B6 declined by 15 to 20%; in the United States, the decline was more than 20%. The major reason prices had declined so precipitously is that a previous cartel that had operated in the 1980s had ended in 1989.

As was the case with so many of the vitamins cartels, the agreements were patterned closely after what had been working so well in vitamins A and E. The three members of the vitamin B6 cartel met pair-wise:

biennially in Basel (Takeda and Roche) and biennially in Tokyo (Takeda with Daiichi). They agreed to raise minimum prices at least four times: in January 1991 (increase unknown), October 1991 (by 3.5%), and April 1992 (by 2.3%), and July 1992 (by 5.6%). In April 1993 the remnants of the cartel lowered its minimum price by 5.6%.

During the cartel's first 15 months prices rose dramatically faster than the agreed prices. In Europe the price rose from DEM 51 in the first quarter of 1991 to DEM 85 by March of 1992, an increased of 67%. In the United States, the comparable increase was 60%. However, most of the price rise is attributable to two fortuitous events. First, two significant suppliers (BASF and E. Merck) withdrew from the industry in early 1991.[15] Second, Daiichi closed an old plant in August 1991, and its new plant did not start up until March 1992. After Daiichi's new capacity came on stream, EU transaction prices continued to rise by only about 2% to the peak in early 1993. Prices held steady until July 1993, after which they fell precipitously.

Internal dissention and Chinese production ended the cartel. Roche wanted to meet directly with Daiichi in the spring of 1993, but Takeda said that Daiichi would not comply. When Takeda and Roche met in Basel on May 25, 1993, Takeda reported that Daiichi was trying to maximize the amount it could sell, disregarding the cartel's share agreement. Takeda's role as the intermediary reeks of double-dealing, because it had actually grabbed much more market share in 1993 than had Daiichi. Roche and Takeda decided to punish Daiichi by matching its prices. The prices being offered by Chinese companies were even lower, though events in the late 1990s would show that Chinese production was not based on low-cost technologies.[16] Prior to the start of collusion in 1991, Chinese production had languished at below 3% of the world's total. During 1991-1993 Chinese production value rose to 48% of the global total.

The last meeting between Roche and Takeda concerning vitamin B6 occurred in Japan on June 10, 1994; Roche met with Daiichi for the last time on June 15th. However, all the participants had recognized earlier that year that the cartel agreement had been ineffective for quite some time. In July 1994 Roche signaled the end of collusion by lowering its minimum

15 The shut-downs of the BASF and E. Merck plants look suspiciously timed. Both companies had produced vitamin B6 since 1982, reaching global shares as high as 11 and 16%, respectively. When their production ended, as if by prior arrangement Roche absorbed all of their production the next year. Their simultaneous withdrawals could have been part of a side agreement with another cartel.

16 When in 1996-1998 selling prices fell permanently 50% below peak collusive prices, Chinese production withered to a mere 10% of world output and the shares of the three former cartel members rose to heights not seen for more than 15 years.

DEM price by 28% to meet Chinese competition in the EU; in October 1994 price was cut another 13%. EU transaction prices fell 60% in 1996 from their 1993 peak and remained at less than half the 1993 level through 2003. The U.S. market displayed the same post-cartel price movements.

Vitamin B5

Despite the fact that Daiichi was one of its three members, the vitamin B5 (cal pan) scheme was the most durable of the B complex cartels. Like vitamin B6, the vitamin B5 cartel was a rebirth of an earlier conspiracy in 1985-1989. However, participants agreed that the earlier cartel did not approach the sophistication of its 1991-1999 successor. The disbanding of the first cartel in 1989 caused prices to decline so low that Roche was selling vitamin B5 at cost in 1990.

Roche made overtures to Daiichi about reviving collusion at a Tokyo meeting in late December 1990, proposing to adopt the mechanism and rules used in the vitamins A and E cartels. Implementing the cartel took about six months of negotiations. The first formal meeting among Roche, BASF and Daiichi took place in Basel in the first quarter of 1991; a few months later the firms were exchanging sales data. Using 1990 production as the basis of the agreement, the three companies agreed to set market shares within narrow ranges in Europe and worldwide for the 86% of world supply that they controlled. The decision to adopt quota *ranges* of about four percentage points was unique among the vitamins cartels; it was a substitute for the compensation sales used in most of the other cartels. In all other respects, the vitamin A model was imitated closely.

The vitamin B6 cartel had a small fringe of firms outside the cartel from Eastern Europe and Japan. The fringe's share rose and fell slightly during the cartel, but averaged only 14% of global sales; sales by fringe firms were kept to even lower levels in Europe and North America. Within the cartel, the three members carefully observed their agreed quota ranges. Except for a blip in 1996, Roche held on to a 41 to 45% intra-cartel share and BASF to 21 to 25%. Daiichi too was an exemplar of self-restraint.

The vitamin B5 cartel was highly effective in raising prices. EU prices rose by 50% from 1991 to 1993; at the peak in early 1998, prices were 75% higher than the year before the cartel was underway. Similarly, U.S, transaction prices reached a 1996-1998 plateau that was 80 to 85% above the 1990 price. As with other cartels, the members of the vitamin B5 cartel were active in countering the deleterious effects of international geographic arbitrage. The rule of thumb was to keep prices in one currency zone less than 10% above or below prices in other currency zones.

Roche and BASF at times caused dissent within the cartel because of their strategy of using price increases to squeeze rival premix sellers out of business. Daiichi, which did not make premixes, objected to a proposed 10% price increase in the spring of 1998 because it judged that fringe producers in Eastern Europe would flood Western Europe with vitamin B5. This would reduce the cartel's market share in straight vitamin B5, but would have benefited the premix operations owned by Roche and BASF.

Meetings of the B6 cartel persisted even after the U.S. vitamins investigation intensified in 1998.

Vitamin C

In terms of annual sales the vitamin C market was the biggest of the 15 straight vitamin markets. Global sales were 50% higher than second-ranking vitamin E and were about 85% larger than all five of the B complex vitamins just described. The short history of vitamin C collusion resembles that of vitamin B1.

In 1975, Roche and Takeda controlled about 84% of the global market, but 15 years later they shared only 71%. In 1990 E. Merck and BASF sold about one-eighth of world sales. However, the two leaders were not in direct competition with their two smaller rivals. Roche and Takeda emphasized the production of the dominant segment of the market, human-grade product, whereas E. Merck and BASF specialized in animal-grade. The remaining 13% of the 1990 world market consisted mainly of fast-growing Chinese manufacturers of feed-grade vitamin C.

With about 90% of world production, the same four top producers had carried off a moderately successful cartel in 1995-1989. Prices of human vitamin C had risen by 30% in the United States in the late 1980s, but prices of feed grade had not been so responsive.

The establishment of the second vitamin C cartel was explored a meetings of top executives of Roche and Takeda in Basel on April 7, 1990 and on September 4th in Zurich. Prices in Europe had declined by 10% from the previous year and had also weakened slightly in North America. Negotiations must have been difficult, because two more sessions were required to nail down the details: a Swiss meeting among Roche, BASF, and E. Merck in early January 1991 and a final one in Tokyo between Roche and Takeda officers on January 30th and 31st.

The finalized agreement incorporated a familiar set of features: freezing the four producers' 1990 global shares of the "available market" (i.e., the 87% they controlled), four tiers of management and control, and setting target and minimum prices. In vitamin C the minimum price spread was 7 to 9% below the target, which is an indicator of the relative weakness

of this cartel. Meetings occurred quarterly, alternately in Basel and Tokyo. Takeda met bilaterally with Roche, as was its habit in four other cartels, until a May 1993 meeting at Zurich Airport.

One aspect of the vitamin C arrangements that set it apart from the other cartels was the extensive attention paid to several large customers. Buyer concentration was higher in this market than the other vitamin markets. The purchases of these "key clients" were individually allocated, sometimes exclusively and sometimes jointly, to one or two of the cartel members. Examples of such "key accounts" are Coca Cola, Pfizer, Kellogg, and Bayer. The cartel managers indicated that their rigged prices for Coca Cola should be carefully calibrated across countries so that the company could not engage in international *intra-firm* geographic arbitrage. "If this were not done, Coca Cola would always attempt to conclude all of its contracts at the lower market price" (EC 2003: p. 409).

The vitamin C cartel engineered a 30% increase in prices from 1990 to the late 1993 peak. Already keen on expanding their world shares, Chinese producers found the higher prices an added inducement to expand sales at a furious pace. Several capacity expansions in Chinese plants that used a new low-cost all-fermentation technology had been ongoing for a few years. Most of the product was feed-grade vitamin C, so E. Merck and BASF were especially hard hit by Chinese expansion. The cartel seems to have underestimated the pace of Chinese competition. Already in 1992 the two smallest members of the cartel had sold about 13% less than had been planned in 1991. By 1993 the cartel had lost 29% of the global market to fringe producers, and the difficulties of coping with the Chinese challenge became a major irritant at cartel meetings. Worse, the Chinese manufacturers had begun to make human-grade vitamin C, which began to hurt Roche's sales.

At an early 1993 session, the cartel considered purchasing a large enough portion of Chinese-made vitamin C to stabilize prices. Instead, consistent with the general policy of "price before quantity," Roche proposed price increases of about 4% for each quarter of 1995 and an immediate 5% cut in cartel production; the others agreed to the plan. In April Roche announced the planned price increase.

Despite the stress on the cartel from fringe entry, its internal market-sharing agreement proved to be remarkably robust. Throughout the 1991-1995 cartel period, Roche strictly adhered to its 51 to 53% share of cartel production, Takeda never wavered from a 29 to 31% share range, and the two smaller members stood by their quotas.

Chinese incursion intensified later in 1993, and by the end of the year prices began to drop quickly. In their August 1993 meeting, the European members of the cartel renewed their call for a 5% across-the-board

reduction in sales volume. Over Takeda's vociferous objections, the plan was adopted. The adjusted quotas for 1993 assumed that the cartel would command only 74% of global production. Takeda returned to its complaint about equal percentage reductions in a November 1993 cartel meeting, but was once again rebuffed. Although it ostensibly remained an active cartel member until the end, Roche began to see more and more evidence of Takeda's cheating in 1994. The combination of price cutting by Takeda and the Chinese producers caused EU transactions prices of vitamin C to decline by 33% from the end of 1993 to 1995 and by 45% in 1996-1999.

The vitamin C case illustrates the difficulty of identifying precisely when a cartel ends. Although Takeda only pretended to adhere to the cartel agreement from about late 1993, the three European members observed their relative quotas throughout 1994. The last formal meeting of the vitamin C cartel took place in Hong Kong on August 24, 1995. Roche claims that it renounced its involvement in the conspiracy at about that time, but this assertion cannot be verified. The four companies continued to exchange sales information and set regional prices at the August meeting, and market projections were updated through December 1995. Guilty pleas registered in U.S. courts assert that the end of the conspiracy was the fall of 1995; pleas in Canadian courts admit to December 1995; and the European Commission was only certain that the cartel had ceased affecting prices by mid 1996.

Biotin (Vitamin H)

In the early 1980s, the global biotin industry consisted of one dominant firm, Roche, and two others, Sumitomo and E. Merck. This pattern suggests that the technology of production was a formidable barrier in the early 1980s. In 1980 Roche had a near monopoly of 86% of global production, but Sumitomo's expansion in the early 1980s had brought about a precipitous decline in biotin prices of nearly 60% in 1985. By 1985 Roche's share had slipped to 79%.

During the first three years of collusion, prices rose 45%, but this rise only recaptured about one-third of the 1980-1985 loss of price. The cartel of 1985-1990 was a weak one with no strict market quotas. Not only did Sumitomo's market share expand during the collusive period, but Tanabe entered on a large scale in 1986 and doubled its global share to Sumitomo's level by 1990. A fifth firm, South Korea's Il Sung opened a plant in 1988 that would eventually supply up to 8% of the world's biotin. The last company to enter the industry, Lonza of Switzerland, opened a plant in 1990 capable of supplying 9% of world demand in the 1990s.

This onslaught of new capacity drove down the biotin price from mid 1988 to early 1990.

Thus, in 1990 the world industry consisted of six good-sized manufacturers. When the cartel of 1991-1995 was formed, Roche had 47% of market sales, but there were four other companies each with global shares that averaged 12%. These five participants controlled 95% of global sales throughout 1991-1995, but comprised the largest number of conspirators of any of the vitamin cartels. Moreover, BASF became a sixth member of the biotin cartel by proxy. Unlike most of the other vitamins cartels, new-firm entry was never a problem at any time from 1991 to 1998. Yet, with six participants the biotin cartel was quite unstable.

The decline in biotin prices in 1988-1990 was the major motive for reestablishment of overt collusion. Initial contacts were made by Roche and Tanabe in March 1991. This bilateral meeting in Japan principally concerned technical matters, but the idea of setting target prices was also broached in an indirect fashion for the first time. A similar meeting occurred in Japan in May 1991 and biennially for four more years thereafter.

In Europe, Roche organized a summit for five firms (Roche, Lonza, Sumitomo Chemical, Tanabe, and E Merck) in Lugano, Switzerland on October 14, 1991. The world's fifth largest producer, Il Sung of South Korea, did not attend and did not cooperate with the cartel. Another seller of biotin was absent. Under a co-production agreement with E. Merck, BASF obtained all its biotin only from E. Merck. Roche ordered Merck to represent BASF's interests in the cartel.

At Lugano the first order of business was to exchange each firm's previous year's sales volume, all expressed in 100%-biotin equivalents. Shares were broken down for Europe, North America, and the rest of the world. The figures were communicated orally so that there would be no written record. Then, the companies' 1990 production shares were adopted as quotas for the 1992 marketing year with only a few small adjustments. As a sweetener the two largest manufacturers, Roche and Sumitomo, agreed to cede about 3% of the 1992 market to the three smallest firms, most of the increase going to Tanabe. Because of a "significant degree of mistrust" among the participants, it was understood that renegotiations might have to be rescheduled every quarter or every six months. Merck in particular threatened to keep its production high if it detected deviations from the agreed shares.[17] These quota arrangements were a significant departure from the vitamin A blueprint.

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[17] A confidential note kept by BASF referring to agreements made at the Lugano summit states: "*MERCK + BASF will nicht zurückfallen, wenn andere steigen*" ("Merck and BASF will not cut back if others increase") (EC 2003: ¶493). While called "the principle

Although the market-share agreement seemed to be makeshift, it turned out to be quite stable in practice. The intra-cartel share of Roche from 1991 to 1995 barely wavered from its original 47% allocation. The combined shares of the two expansionist Japanese firms also barely moved; from 38% in 1991, it climbed gently to 40% in 1993-1995. Only E. Merck's share slid to accommodate the Japanese firms' expansion.

At Lugano, the participants also agreed to raise target and minimum prices for biotin to be made effective January 1, 1992 and to raise them again on April 1, 1992 (*ibid.*). List and minimum prices were also set for both a diluted (2%) feed-grade product and a 100%-pure pharmaceutical version. As in other cases, the principle was "price before tonnage."

Besides the usual bickering about other members selling at low prices or stealing customers, new price levels and quotas were negotiated about every six months at meetings in luxury hotels in Zurich, Geneva, Nara, Osaka, Tokyo, and similar cities. Sales data were gathered in advance by means of telephone calls. In a departure from the pattern in the other vitamins cartels, the multi-tiered management structure was abandoned. For biotin meetings all the participants were from the top reaches of the companies' management structure. Roche sent its head of worldwide vitamins marketing. The engagement of top-level executives may have been prompted by an unusually high degree of mistrust.

From the start transactions prices were below targets. In early 1992 Lonza was charging biotin prices that were 8% below the January targets, and the two Japanese firms were 11% below. Although the evidence is sketchy, it appears that by early 1994 the cartel was achieving a weak but positive effect on prices in Europe. Using the prices being offered by the maverick Korean manufacturer Il Sung as a benchmark, members of the biotin cartel were selling at prices inflated by 7 to 8%.

In the U.S. market the price of feed-grade biotin barely budged in the 1991-1995 period. This was no doubt disappointing to the biotin conspirators because feed-grade biotin accounted for 73% of U.S. commerce. However, the cartel had more success with the human grade product. Its prices rose by 15 to 20% from 1990 to 1992-1995. Thus, weighting the two grades together, U.S. prices of biotin also increased by 7 or 8% from more competitive levels. Compared to most of the other vitamin cartels, the biotin agreement produced a weak result, but compared to the prices that had preceded the cartel, the profits may have been satisfactory.

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of fair burden sharing," in game theory this promise of retaliation is a "trigger mechanism."

Like the vitamin C cartel, it is unclear when the biotin cartel ceased to function. The European Commission comments that after April 1994 "contacts may have been desultory" (EC 2003: p. 514). Tanabe says that it continued to apply the cartel's target prices until January 1995 and that it was given target prices by telephone in December 1994. At a meeting organized "sometime in 1995" by Roche at its new headquarters in Basel, both Merck and Lonza announced that they were no longer prepared to meet. This fact suggests that two of the members thought that the agreement was still in force at least through the end of 1994. In the United States, plaintiffs filing private suits claimed that the biotin conspiracy lasted until the fall of 1995.

Even assuming the longest collusive period of 55 months, the biotin cartel was the briefest of the 16 vitamin cartels. Unlike most of the B complex cartels, the threat to cartel was internal cohesion rather than external price competition. The participants were unable to construct the kind of elaborate management structure that contributed to the effectiveness of the other cartels. Despite the unusual dependence of the biotin cartel on the involvement of top executives, the records of its meetings suggest a high level of discord. Because its price effects were relatively weak, it seems to have generated small, if positive profits for its six members. The small size of the competitive fringe was in the end unable to compensate for the strong centrifugal forces associated with large collusive groups.

The determination of the termination date for formal collusion was critical in this case because under EC rules there is a five-year time limit from the date the violation stopped to the date of the EC's first "action." The relevant action date is the day the Commission begins its formal investigation (the day it sends out written requests for information). The biotin investigation began on August 20, 1999 – about three months after U.S. guilty pleas were made public. In fact, all six companies were guilty, but the time limit was exceeded by *four months,* thus sparing them significant EU fines. Had the Commission decided on December 1994 as the date of cessation of collusion, six fines could have been imposed.

Summary of Vitamins B1 to B9, C, and H

This section discussed the cartel conduct of European and Japanese manufactures for seven of the class of water-soluble vitamins: B1, B2, B5, B6, folic acid, C, and biotin. Five vitamins cartels (A, E, B12, and two carotinoids) had been initiated in late 1989 and early 1990 the seven conspiracies just discussed comprised the second wave of cartel building by the three founding members of Vitamins, Inc.

Like the vitamin A and E cartels, the second-wave cartels were part of the family of schemes initiated and dominated by the biggest manufacturer, Hoffmann-La Roche, ably assisted by its two willing partners, BASF and Rhône-Poulenc. Each of the seven cartels was constructed from the vitamin A and E templates, but each was designed with subtle differences to accommodate variation in environmental or compositional variation.

Vitamin D3

It appears that the Roche-Solvay duopoly operated a vitamin D3 cartel from 1985 to 1988. There was no third producer. Prices in the late 1980s display the classic hump shape seen in all successful cartels periods. However, pricing discipline broke down in the year before a new collusive episode began, though this dip in price was modest and confined to the larger feed-grade segment of the market. One reason that prices weakened in 1989 was the impending entry of a third producer, BASF, which practically overnight went from zero to a 13% global production share. BASF's rapid ascension corresponded almost exactly to Roche's decline in share. This suggests that Roche transferred capacity to its friendly rival BASF and that little or no *new* capacity was created in the industry.

The formation of the second cartel is a bit opaque. A Roche document discovered in an EU raid dated March 1991 states that vitamin A pricing was to be done in conjunction with vitamin D3 pricing, but Roche denies having originated the D3 cartel. Solvay, on the other hand, blames Roche for instigating collusion.

Around 1990 a number of structural changes took place in the industry. Belgian chemical manufacturer Solvay was and remains the dominant global producer of vitamin D3. Solvay stopped making vitamin A before 1990. At about the same time BASF, then colluding with Roche in the market for vitamin A, began to manufacture vitamin D3. BASF's entry into D3 caused Solvay to lose 25% of its sales in 1990. Moreover, Roche had, after years of doing so, refused to supply Solvay with vitamin A beginning in 1991. Thus, Solvay became unable to sell the vitamin A and D3 compound that many of its customers would want. To all appearances, Roche and BASF were squeezing Solvay.

Plaintiffs in the civil suit in the United States tell a different story about the origins of the D3 cartel. They claim that the second cartel began in January 1990. Two bits of circumstantial evidence support the earlier date. First, despite BASF's large-scale entry in 1990, U.S. prices rose dramatically in 1990 and 1992, by 30% in the feed-grade market and by 25%

in human grade. While prices rose from time to time during 1993 to 1998, none of the later increases were close to the earlier ones. Second, market-share stability was almost as high during 1990-1993 as during 1994-1998.

According the EC, the three companies initiated their collusion on January 11, 1994 in Basel, Switzerland. At that meeting, Solvay, Roche, and BASF agreed to split the feed-grade market in the ratio 41:38:21. This split was not much different from the actual shares in 1993. In the much larger feed-grade segment, Roche and BASF agreed to shares of about 30% each. Target and minimum prices were set for three regions: Europe, the United States, and the rest of the world. With control of about 100% of world supply, the prospects for a durable cartel were rosy.

The D3 conspirators met only twice each year in February and September. Solvay acted as Rhône-Poulenc's agent at the meetings. Rhone-Poulenc gave Solvay its sales data in advance of the biennial tripartite meetings. Thus, the cartel had four members, one that participated by proxy. The EC decision states that the cartel raised prices only twice, in April 1994 and in August 1997. BASF was the designated the "price leader" for the first price adjustment and Solvay for the second. U.S. prices hardly reacted to the first announcement and not at all to the second. The anemic price response suggests that the January 1994 meeting was a renegotiation of a much earlier agreement.

As is generally the case with the oil-soluble vitamins, the vitamin D3 cartel expressed no worries about fringe firms, and in fact the degree of cartel control was 100% for the conspiracy's five to eight years. It did, however, discuss concerns about grand-jury investigations in the United States. Roche representatives brought up the topic at the cartel's August 1997 meeting, telling the others that Roche's management had instructed employees to stop regular meetings. Nevertheless, the four conspirators continued to meet at least three more times bilaterally (Rhône-Poulenc with Solvay, Solvay with Roche, and Roche with BASF) until at least June 1998. Collusion may have persisted to February 1999.

Cartels without Roche

Niacin and Choline Chloride

Relatively few details have surfaced about the origins and operation of the niacin price-fixing conspiracies. What little is known must be pieced

together from court documents containing only minimal facts filed in U.S. and Canadian courts. However, much more is known about the inner workings of the choline chloride cartel because of a trial held in the United States in 2004 and the decision of the EC released in late 2005.

These two cartels were different in several ways from the others that have been discussed. The participants in the niacin (B3) and choline chloride (B4) conspiracies were almost a completely different set of companies from those in the "Roche cartels." In both cases only one company was a member of both the Vitamin B3 or B4 cartel and simultaneously one of the Roche cartels. In addition, both cartels are unique in having had participation by manufacturers that were headquartered in North America. The vitamin B4 conspiracy began having market effects in 1988. No other vitamins cartel began on this date.

Niacin

The ringleader of the global niacin cartel was the Swiss firm Lonza, which is loosely part of the Alusuisse conglomerate. Lonza had captured two-thirds of global production in the early 1980s. In the early 1990s Lonza still dominated global sales from its single plant in Switzerland that supplied almost 60% of global production and had a 70% share of European sales. The German metals and specialty chemicals company Degussa had a strong and growing second position in the niacin market. Degussa's share of world wide production of vitamin B3 grew from only 8% in 1981, to 21% in 1990, to 27% in the late 1990s.

It is possible that Lonza and Degussa began colluding on European sales and exports to North America in 1985. While the U.S. guilty plea agreements are vague on this point, U.S. prices trace the characteristic hump shape associated with an effective collusive period from 1985 to the end of 1988 followed by a pause in collusion from early 1989 to mid 1990. From 1985 to 1988, the two leading firms enjoyed a nearly constant 80% global share that was certainly sufficient to support overt collusion. However, the U.S. private plaintiffs did not claim damages from a late 1980s cartel in vitamin B3, and no U.S. or EU convictions have been forthcoming. Therefore, the evidence concerning the existence of an earlier cartel is mixed.

A global cartel of four firms certainly operated in global market for vitamin B3 through most of the 1990s, but there is some uncertainty as to the starting date. It appears that Lonza and Degussa initiated discussions to establish the vitamin B3 cartel in mid 1990 and later pulled two smaller U.S. companies into the conspiracy. The U.S. companies, Reilly Industries and Nepera, joined the two European companies to form the cartel

sometime between mid 1990 and early 1992. Price data favor the earlier date. U.S. prices of feed-grade vitamin B3 fell by 25% in the 18 months prior to July 1990 and then climbed 35% in the 18 months following July 1990. No other steep price changes of that kind occur in the 1990s.

Reilly Chemical ran two vitamin B3 plants, a large one in Indianapolis and a smaller one in Belgium. Sometime in the early 1990s Degussa and Reilly became co-owners of a niacin joint venture known as Vitachem, but when the partnership began is not exactly known. Until late 1994, the pricing of vitamin B3 was Degussa's responsibility while Reilly's management confined itself to production decisions. However, in September 1994 Degussa pulled Reilly into the conspiracy.

Nepera is a small chemical maker headquartered in New York State; it sold most of its niacin in North America. Nepera held a North American share approached 30%. From the U.S. guilty pleas, it is clear that Nepera had an active role in the conspiracy beginning by at least January 1992. In July 1995, about the time it was acquired by Cambrex Industries, Nepera withdrew from the U.S. conspiracy. Cambrex was never charged with any wrongdoing. So, from July 1995 to March 1998, Lonza, Degussa, and Reilly continued with U.S. price fixing on their own. Without Nepera's support, U.S. prices did begin a slow slide from 1995 until the end of collusion in 1998.

There are few signs of stress in the B3 cartel. The cartel was protected by technological barriers and operated in a highly concentrated industry. From 1990 to 1998 the four top vitamin B3 manufacturers controlled 86 to 95% of global supply. During the three-firm stage of the cartel, intra-cartel market shares were quite stable. Lonza maintained a 65 to 67% cartel quota in most years, Degussa-Reilly 24 to 26%, and Nepera 10%. Lonza and Degussa loosely coordinated the vitamin B3 conspiracy with the main group of vitamin price fixers associated with Hoffmann-La Roche (Barboza 1999). Even after Nepera left the cartel, the remaining three conspirators held on to 84 to 86% of global supply and maintained their 1991-1995 production quotas. Fringe firms did not expand during the collusive period.

Choline Chloride in North America

There were three distinct price-fixing episodes in the markets for choline chloride (vitamin B4).

The first choline chloride cartel began at a meeting in Toronto, Canada in January 1988. There the longtime vitamin B4 sales manager for Chinook, Ltd. (Russell E. Cosburn, employed from 1967-1992) hosted a meeting of the other two manufacturers of the vitamin in North America:

the Cleveland, Ohio firm Bio-Products (owned by Mitsui of Japan) and DuCoa of Illinois. DuCoa was formed in 1987 as a joint venture of DuPont and ConAgra. DuCoa's principal line of business was choline chloride. ConAgra was assigned principal management responsibility over DuCoa.

North America was the locus of the largest vitamin B4 supply in the world. The three manufacturers controlled 47 to 49% of global production in the mid 1990s, and before the global cartel was formed in 1992, their exports to Europe accounted for 9% of European demand. The five European producers shipped little choline chloride to North America in 1991, so it appears that the three U.S. and Canadian firms were more efficient than their European counterparts.

At the Toronto meeting, the three North American companies agreed to raise the North American list price of choline chloride, to allocate specific customers, to rig bids, and to share the market equally. By the spring of 1989, market prices of choline chloride began to rocket upward – by 40% above 1987 levels in the first year. Thus began the "North American branch" of the global choline chloride cartel. In general, U.S. prices of choline chloride remained 40 to 65% above 1987 levels for the entire ten years of effective collusion. Prices did decline modestly from the 1995 peak through 1998, but they remained well above pre-cartel and post-cartel levels.

In 1997 DuCoa was acquired by a company named DCV. Based on the convictions in the United States and Canada, it appears that DuCoa's mid level sales managers continued to collude before and after DuCoa's acquisition without the knowledge of DCV's management. Neither DuCoa's old parents nor its new one were charged with price-fixing violations, but as the managing partner of DuCoa, ConAgra was held responsible for DuCoa's damages in U.S. civil suits. Except for Chinook, lack of involvement of top executives of parent companies is another feature of the choline chloride cartel that sets it apart from the Roche cartels.

The only criminal trial involving an individual participant took place in U.S. District Court in Dallas, Texas in 2004 (Barnett 2005: 6-16). The defendant was Daniel T. Rose, former President of DuCoa, who was found guilty by a jury and sentenced to 30 months in prison in March 2005. Five of Rose's co-conspirators testified against Rose. The trial record provides some tantalizing insights into cartel conduct.

The cartels held 20 to 30 face-to-face meetings in the Midwest from 1988 to 1998. The agendas usually involved reviewing market sales trends, planning to rig bids and thereby allocate major customer accounts, raising or maintaining list prices, and assigning one of the three to make the first price announcement to the trade press. A former president of DuCoa testified that:

> "The conspiracy was our way of life….that's what we had to do to sell the product and make the money we were making."(Barnett 2005:16).

The three companies "had a spat from time to time," frequently trading accusations of poaching particular customers (*ibid.* p.9). However, poaching was not a sign that their agreement was in jeopardy; rather it simply signaled the desire for a meeting to renegotiate the "protected customers" list. Each supplier's customer portfolio would be reconfigured on a regular basis to maintain the agreed sales quotas.

For example, in the fall of 1997 DuCoa and Chinook were concerned about Bio-Product's rising market share. In response, their representatives decided to implement a "Trojan Horse strategy." DuCoa would sell a large amount of choline chloride at a favorable price to a chemical wholesaler, South Central Products. In late 1997 Chinook and DuCoa bid high on a tender for one-third of Tyson Food's substantial choline chloride needs, and this allowed South Central to win the Tyson contract. That business had been previously allocated to Bio-Products, so the Bio-Products manager angrily insisted on a meeting. In January 1998, officers of the three companies met over dinner on the fringes of the Southeast Poultry Convention in Atlanta to discuss the engineered rift. At a follow-up meeting at the O'Hare Airport Hilton Hotel in Chicago, DuCoa and Chinook and DuCoa offered compensation to Bio-Products for the loss of its Tyson business. DuCoa offered to turn over its Roche account to Bio-Products, and Chinook offered its account with Cagle's. Rose's lieutenant Antonio Felix later testified that "…[T]he idea was to see how we can compensate …the balance that Bio-Products had lost with our takeover of Tyson" (*ibid.* p.13). Bio-Products apparently accepted the trade, thus ameliorating the brief tempest.

At the end of the Chicago meeting the conspirators decided to raise list prices by 4 to 5 cents per pound for liquid choline chloride and by 3 cents for dry product. This price increase of about 6% was to be effective on April 1, 1998. One of the companies was assigned to contact *Feedstuffs* magazine with the news. After the meeting, the attendees were careful to cover their tracks. The Bio-Products manager falsified his travel-expenses report by saying that he met with customers; similarly, the Chinook representative claimed in his expense report that he had met with Continental Grain; and the DuCoa president ordered his assistant to report that they were in Tennessee rather than Illinois.

At a third meeting at the TWA Ambassadors Club at the St. Louis Airport on March 9, 1998, the conspirators met to confirm that the proposed

customer trades had been carried out and that prices had been duly raised by all. Both changes had gone off smoothly and effectively. Despite the stated objective to fix North American shares equally, there were some fairly large shifts in intra-cartel positions. Bio-Product's share nearly doubled and DuCoa's was cut by more than half.

The St Louis meeting was one of the last to be held by the North American branch of the choline chloride cartel. In June 1998, Bio-Products suddenly withdrew from the cartel, and in September FBI agents raided the offices of the remaining companies. The post-cartel plunge in choline chloride prices was the most dramatic of all the cartels; from July 1988 to January 1989, prices fell 40% (equivalent to an 80% annual rate).

The Global Choline Chloride Cartel

Fast-rising European imports of choline chloride in 1989-1992 alarmed the North American manufacturers. However, the event that that triggered the formation of the global cartel was an aggressive move by DuCoa into the Mexican market.

The three big European makers of choline chloride were BASF (a plant in Germany), Akzo Nobel (the Netherlands and Italy), and UCB (Belgium). In the mid 1990s these three companies supplied 35% of global demand and 78% of EU consumption. In the 1990s they built plants abroad: BASF in Mexico, Brazil, and Thailand; and Akzo and UCB each built plants in China. The first choline chloride plant built abroad by a North American producer was DuCoa; it began production in Mexico in early 1992 even though BASF already had a plant there. DuCoa goaded BASF further by announcing that it intended to take 40 to 50% of the Mexican market. BASF retaliated by arranging to sell under favorable terms 400 tonnes of choline chloride to the United States from its plant in Mexico in early 1992. The effect would be to reduce the North American cartel's high prices.

To address this problem, DuCoa and Bio-Products officers met with BASF managers in Mexico City in October 1992, in order to "…complain about [BASF's] pricing and to suggest setting limit prices in the US" (EC 2004: 25-26). A month later, at a second meeting in Mexico City, BASF agreed to stop exports to the United States, close its Mexican plant, and purchase its entire local supply from DuCoa's new plant. The *quid pro quo* for BASF's capitulation became clear at a summit of the big six manufacturers at the third Mexico City meeting in October 1992. There they all agreed to cease exporting from the United States or Canada to Europe and *vice versa.* To finalize the details of the global cartel, the six met again in November 1992 at the headquarters of BASF in

Ludwigshafen, Germany. The six companies affirmed their intentions to stop exporting to each other's continents, to allocate exclusive world sales territories, and to raise the price of choline chloride all over the world.

The Ludwigshafen protocol was quite specific (*ibid.:* 28-34). North America exports to Western Europe would cease by June 1993 and exports to Eastern Europe by June 1994. The three European members would stop all exports to North America by June 1993, and BASF would close its Mexican plant by the same date. By 1994 each sub group would have hegemony over its respective continent. In Latin America BASF would be compensated for its losses in Mexico by permitting it to open a new Brazilian plant and use that plant to capture all future demand growth in that region. The remaining five manufacturers agreed to freeze all exports to Latin America at 1992 levels. In Asia, the plan was to allow Chinook and Bio-Products to capitalize on all future growth in that continent. The other four producers would hold annual exports to Asia to no more than 375 tonnes. Production quotas were expected to stay roughly constant, but no precise market shares were specified. Production levels were to be audited by CEFIC, the large European chemical trade association. As for prices, three EU increases were planned for January of 1993, 1994, and 1995 to $0.66, $0.73, and $1.05 for full container loads, respectively; U.S. prices were expected to be about 5% less than those targets.

The six continued to meet as a group from January 1993 to April 1994 in Atlanta, Amsterdam, Toronto, Bruges, and Malaysia. At the last meeting in April 1994 Chinook announced that it would no longer attend meetings of the big six. After April 1994, DuCoa and some of the other companies no longer met about the global arrangements (*ibid. p.* 35). However, to monitor the territorial-exclusivity agreement continuous bilateral contacts were maintained throughout the 1990s. UCB and Chinook in particular met frequently to ensure the smooth operation of global partitioning.

Several indicators began to reveal the global cartel was not fully living up to expectations. Global price increases were less than had been hoped. Prices in the United States averaged about $0.73 per pound (100% basis), which was the cartel's planned price target for 1994, but apparently versions on silica or grain bases. Control of the converters' selling prices small companies that purchased liquid choline chloride and prepared dry versions on silica or grain bases. Control of the converters selling prices was proving difficult. Considerable dissention arose when Chinook opened a new plant in Singapore in April 1994. In late 1994 DuCoa itself started to undermine the prohibition against exporting from North America to Europe; Mexican exports grew from 66 tonnes in 1994 to 1000 tonnes in 1997-1998.

Although there were no more six-party talks after April 1994, smaller groups and some bilateral meetings were held between members of the North American and European branches until as late as December 1996. This date may be taken to mark the end of cooperation between the two branches. Choline chloride prices slipped a bit from 1995 to 1997, but plunged by 40% from 1997 to 1999. By the early 2000s prices were so low that BASF and probably other producers were suffering from negative operating profits on chlorine chloride sales.

Choline Chloride in Europe

The "European branch" of the choline chloride conspiracy was the last to be formed. It was far more tightly organized than the two others that preceded it. The three leading European manufacturers stated to the EC that they began agreeing to *global* price-fixing at a meeting in Ludwigshafen, Germany in November 1992, but at the European level the cartel may have been launched as late as a meeting in Schoten, Belgium on March 14, 1994. Thereafter, meetings were held in various cities in Belgium, Germany, and the Netherlands every three months and telephone calls every week or two. The specific locations and persons attending the 16 meetings are known from minutes supplied by the three companies (EC 2004: 35-36). Most of them were scheduled immediately before or after the regular meetings of CEFIC, the European chemical-industry trade association. Target contract and spot prices were specified in local currencies for various grades of choline chloride. Prices were set for four quarters in advance. Besides raising prices, the European branch allocated specific customers to one of the vitamin makers. Shares in the EU were set at 35% for Akzo, 28% for UBC, and 15% for BASF; actual shares tracked these allotments closely. A compensation system was implemented to punish cartel members that exceeded their quota. At the meetings confidential business information was shared about customers, sales, and prices.

The European branch of the choline chloride cartel was apparently still colluding effectively until its last meeting in October 1998. It disbanded only after prosecutions of the vitamins cartel erupted shortly thereafter in the United States. A Dallas, Texas grand jury had begun investigating the choline chloride market in late 1988. Moreover, the largest U.S. manufacturer began cooperating with DOJ investigators in June, and the other two North American members of the cartel had been raided in September 1998. The fact that a European meeting took place at all in October is testimony to either risk-loving behavior or to the wide separation of the two branches of the chlorine chloride cartel.

Meeting Challenges to Collusion

Like the I.G. Farben cartel in the 1930s, the vitamins cartels employed almost every trick in the price-fixer's book. 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 show that conduct of the vitamins cartels addressed these problems.

Renegotiating Agreements

It is virtually impossible to write a contract that can foresee 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 reestablishment 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 two contracts became the models for the others, but in some cases with significant alterations of details.

Quarterly meetings were standard for most of the cartels. At these face-to-face meetings complaints about the division of the spoils could be expressed, prices and quotas could be adjusted and other 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 market share. 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.

The cartelists showed flexibility in other ways. 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 sales 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 be sufficiently reliable, and they would be supplemented with third-party data. The members knew the location of each member's plants and frequently a country would have only one producer for a given product, so national exports could serve to 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. Thus, increases in interfirm, intra-industry sales are indicators of cartel activity.

Punishing Cheaters

Roche frequently took upon itself the role of the bully. The EC decisions frequently refer to displays of anger directed by Roche representatives toward alleged cheaters or arbitrageurs. A punishment strategy suggested by cartel theorists 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 (by E. Merck in biotin), but it was not particularly credible. 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 are observed. If prices were sometimes used to punish deviants, they were applied with finesse. For example,

when evidence of cheating surfaced in the vitamin B5 cartel in 1993, Roche and Takeda decided to punish Daiichi by matching the latter's price cuts.

Dealing with Arbitrageurs

The managers of Vitamins Inc. were well aware that international geographic arbitrage was capable of causing prices to fall below an optimal level in one of its regions. Vitamins are storable commodities, cheaply transported, and subject to uncontrollable 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 because of its centralized procurement policy.

Containing Aggressive Fringe Producers

The record is rather incomplete, but various tactics were employed to try to inhibit the expansion of fringe production.

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. Fringe production often was initially of low quality suitable only as feed grade, and there are occasions when 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 to premix makers because these buyers would then be at a price disadvantage in premixes compared to Roche and BASF. Indeed, there are statements in the record that suggest 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 1981acquisition 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.

However, the vitamin conspirators were feckless in the face of some fringe producers. ADM's refusal to play ball in the vitamin B2 market is one example. In several markets the cartels were unable to quash 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 prearrangement 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 be 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

The vitamins agreements resemble 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, but the 14 Roche cartels were overlapping and intermeshed. The difference between these 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 prosecuted international cartels,

could only impose fines if a cartel has been previously warned, and meted out only modest fines in any case. Japan's Fair Trade Commission operates in a similarly shy 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 begin investigating until after the U.S. DOJ made collusion 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 activities.

Causes of Death: Natural or Legal?

The 16 vitamins conspiracies ended in one of two ways. Some 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 or expansion by 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 likely 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.

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 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 relatively untested Corporate Leniency Program. This program offered practically 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.

It is noteworthy that none of the vitamins cartels ended because of a breakdown in internal cohesion. Disagreements among cartelists are inevitable, but the dissention 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. Absent legal intervention the majority of the cartels might have continued indefinitely.

Short-Lived Cartels

Six of the vitamin conspiracies ended relatively soon. 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. Except for Vitamin C these cartels were quite small. In terms of affected sales, the six short-lived conspiracies accounted for only 21% of the 16-cartel total. Five fell apart because producers outside the cartel cut prices and captured large shares of the market. The sixth brief cartel, biotin, seems to have been fragile because it had too many participants.

Chinese producers had a profound impact on the termination of four cartels (Connor 2006c: Table 11). In the vitamin C market they already had a 3% global share in 1980 that grew to 8% by 1990. As the vitamin C cartel was getting underway in 1991, Chinese manufacturers were adopting a new low-cost fermentation technology that put them in a formidable price position. Chinese production tripled between 1991 and 1994, the peak year for vitamin C prices. Moreover, during the last difficult year of the cartel as prices plummeted, China's vitamin C manufacturers added an unprecedented 10 percentage points to their global market control.

In the case of vitamin B1 Chinese incursion into this market was already significant in the 1980s (global shares ranged from 9% to 14%). When collusion began in 1991 the high prices prompted Chinese manufacturers to ramp up output very quickly. From 1990 to 1994, the last year of the cartel, China's production grew an average of 35% per year. However, when prices plunged by 40% from early 1993 to 1998, China's share fell back to below 30%. This seems to indicate that costs of production in China were not much lower than those of Roche and Takeda.

In the folic acid (vitamin H) industry China's share of world production in the 1980s languished in the 2 to 3% range. Collusion began in 1991 and by the time the cartel reached its apogee of pricing effectiveness in 1993-1994, the Chinese had captured one-third of global production. However, when prices crashed by 55% over the next five years, the share of Chinese factories stabilized at around 20%. The folic acid industry is one of the few in which Chinese expansion was paralleled by long term growth of small Indian vitamin manufacturers.

In vitamin B6 Chinese firms did not enter until 1986 and achieved only a 4% share of world production by 1990. However, as soon as the cartel raised prices in 1991, the Chinese fringe increased that share by 250%. In the cartel's last year (1994) Chinese producers accounted for an astounding 43% of world supply. This impressive tenfold surge in share of supply was the largest of the four markets discussed in this section. With the end of high prices the Chinese industry fell back to a mere 10% of global production by 1998.

There were a few vitamin industries in which non-Chinese vitamin makers had significant shares, but only one of them hastened the demise of a cartel in the 1990s. Archer Daniels Midland Company grew quickly in the vitamin B2 market through the application of a new fermentation technology. ADM's 5% share at the end of the vitamin B2 conspiracy in 1995 grew to 12% three years later. In all other vitamins industries, non-Chinese fringe firms with significant market shares appear to have been passive followers or constrained by capacity.

Another common feature of these five product markets was the participation of Takeda or Daiichi. Perhaps these companies were less committed to the cartel agreements and more troublesome about their assigned quotas.

The End of the Durable Cartels

The ten other vitamins cartels endured for six to ten years in the 1990s. 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 vitamin B2 and biotin (vitamin H). 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. 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 making premixes] 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.

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. It would be more than one year before the government indicted Hoffmann-La Roche, BASF, and others for those crimes.

These 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, it could not provide details 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. 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. That summer, the company began competing for customers the old-fashioned way, by offering lower prices. 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. In effect, Rhône-Poulenc became an FBI mole.

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.