Case 14

The Boeing 777

The Boeing 777 will set a new standard for aircraft around the world. With the introduction of the 777, we will be able to offer our airline customers a complete family of Boeing airplanes that meets any seating requirement from approximately 100 to 500 passengers. We believe the 777 will allow us to offer the right product for the changing market requirements of the 1990s and beyond.[1]

Shrontz says his mission is raising Boeing's return on equity from the recent average of about 12 percent. Although Boeing makes money while its main competitors don't, Shrontz isn't satisfied. "We've got to enhance our earnings," he says.[2]

It takes a lot of courage to launch an industrial program in this uncertain economic environment.[3]

In October 1990, Frank Shrontz officially announced the launch of the latest addition to the Boeing family, the 777. This plane would fit in a market niche of medium-to-large passenger airframes and would carry 350 to 390 passengers up to 7,600 nautical miles (14,000 kilometers; for instance, from Sydney to Tokyo or Los Angeles to Frankfurt). The first planes were expected to be delivered in May 1995 to United Airlines, which had announced firm orders for the 777 on October 15, 1990. No other orders had as yet been received.

[1]Frank Shrontz, chief executive officer, The Boeing Company, October 29, 1990.

[2]Dorin Jones Yang, "To Frank Shrontz, the Blue Yonder Is Anything but Wild," *Business Week*, July 9, 1990, p. 49.

[3]A quotation of Howard A. Rubel, airline industry analyst with C. J. Lawrence, Morgan Grenfell, Inc., in "It's Fat and Snazzy—and Worth Billions to Boeing," *Business Week*, October 29, 1990, p. 32.

This case was written by Dena Gollish, Henrik Clausen, Niels Koggersvol, Peter Christey, and Professor Robert F. Bruner as a basis for class discussion rather than to illustrate effective or ineffective handling of an administrative situation. The financial support of the Citicorp Global Scholars Program is gratefully acknowledged.

Industry analysts had mixed views on Boeing's decision to go ahead with the 777. Pessimists noted that Airbus Industrie and McDonnell Douglas both had already announced aircraft targeted for this niche and had sizable head starts on firm orders. This competition, they believed, would drive down prices for the aircraft. Furthermore, research-and-development expenditures on the 777—estimated at $4 billion to $5 billion—would be more than twice as high as for the 757 and 767 projects. If this new product failed, the financial loss would substantially deplete Boeing's book value of equity. Finally, Iraq's invasion of Kuwait and the ensuing international crisis had led to a sharp decline in airline travel. Political and economic conditions seemed to have turned against the project.

Optimists believed that the 777 would outperform its competitors and gain at least Boeing's historical 54 percent market share. Boeing believed that air travel would double by the year 2005, creating a large demand for new capacity. Moreover, the aging of large passenger aircraft would mean a replacement demand of 640 new units. Some analysts also pointed to the expected high growth rate on the routes targeted by the 777, resulting particularly from growth in the Asian market. In addition, many analysts believed that Boeing's R&D spending on the 777 could be used to develop other aircraft (for example, a new derivative of the 747) at a much reduced cost. Finally, the 777 offered airlines the most flexibility in designing the interior of the aircraft and the best cost efficiency of all its competitors.

In October 1990, perhaps the prime question was whether the Boeing 777 project remained a sensible investment for Boeing. Two and one-half years had elapsed since the start of the preliminary design effort. Political and economic conditions had worsened. Value Line noted:

> Boeing stock has been pummeled since Iraq's invasion of Kuwait [see graph of share prices], reflecting, we think, the surge in the cost of petroleum and jet fuel, which has sent airline fares rising and weakened global economies. As a result, passenger counts are under pressure and many investors are concerned that the boom in airliner demand will dissipate.[4]

Was the recent slump in Boeing's share price a result strictly of the Gulf Crisis, or was the stock market giving an advance signal of its evaluation of the Boeing 777? The advance orders for competitors' aircraft models to be launched in this segment had proved that demand existed for a new generation of aircraft, but would the new model be profitable at any level of demand? Finally, and most important, would the Boeing 777 project serve Frank Shrontz's ultimate mission of improving Boeing's return on equity?

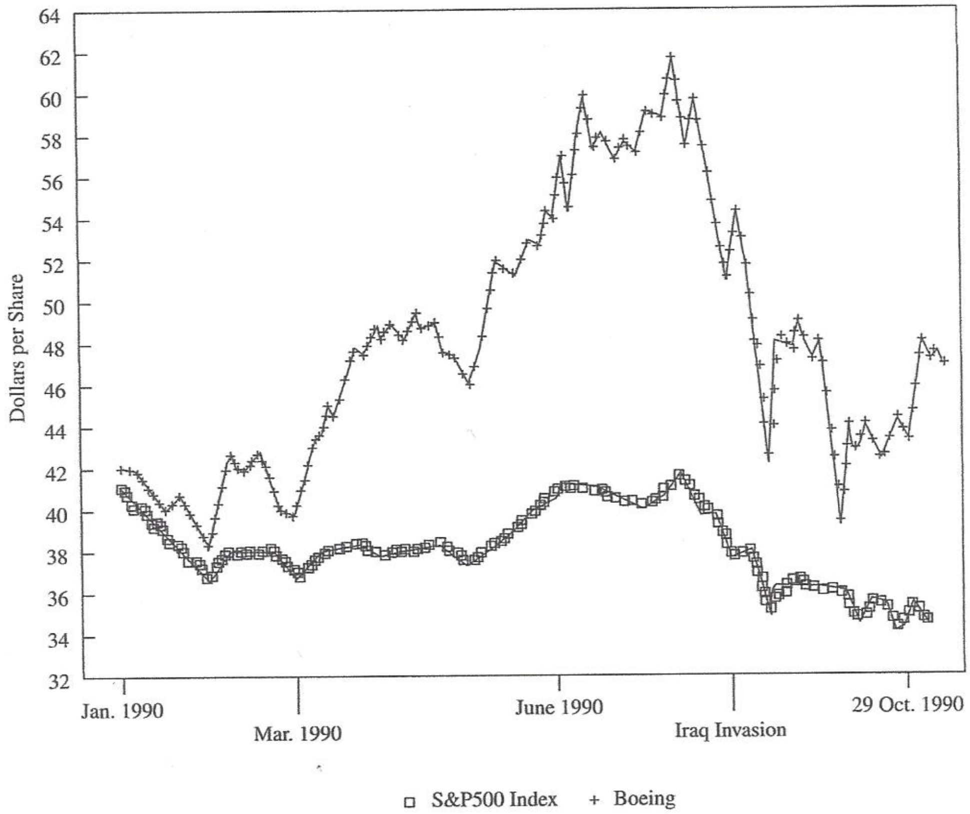
COMMERCIAL AIRCRAFT INDUSTRY

Three companies dominated the large airframe market in 1990, with a combined 90 percent market share: Boeing (53 percent), Airbus Industrie (18 percent), and McDonnell Douglas (19 percent). Boeing was by far the largest player, not only in terms of current aircraft deliveries, but also in terms of revenues, earnings, and aircraft orders.

Airbus Industrie. Established 20 years earlier, Airbus had moved into second place in the world aircraft market, although it had yet to turn a profit. With the introduction of the A330 and A340 models in 1992–93, Airbus claimed it would have a full family of aircraft.

[4]Text quote from *Value Line Investment Survey,* October 12, 1990.

Share Prices, The Boeing Company, Compared to S&P 500



Previously, Airbus competed mainly in the small-to-medium payload and distance segments. The A330/A340 would increase Airbus's offerings on both dimensions. These aircraft would compete directly with McDonnell Douglas's proposed MD-11 and the Boeing 777.

McDonnell Douglas. Historically, McDonnell Douglas (MD) had been primarily a defense contractor, with commercial aircraft producing only one-third of revenues. Consequently, the company's commercial-jet product range was limited and had shown little development. The decline in U.S. defense spending and Airbus's entry into key market segments had severely weakened MD's financial position. Corporate debt stood at $4.9 billion (representing a ratio of book debt to equity of 1.5 times). MD's share of market had fallen over recent years to less than 13 percent of total orders in 1989. In 1989 the company had revenues of $14.6 billion, profits of $219 million, and outstanding orders for commercial aircraft worth $21 billion.

MD competed in the small-payload, short-haul end of the market with the MD-80 and the MD-90 and would compete in the medium segment with the MD-11. In response to the ending of the Cold War, the company planned to increase the commercial-aircraft portion of sales from current levels of 36 percent to 50 percent over the next few years. To meet these goals, it was developing another new aircraft, the MD-12X, to compete with Boeing's 747-400. This project would cost $4 billion to $5 billion.

The Boeing Company. Boeing was the world's leading manufacturer of commercial-jet aircraft. Half of its aircraft sales were to airlines within the United States. Boeing's estimated sales for 1990 were $27 billion (compared with $20 billion in 1989), and profits were expected to be approximately $1.4 billion (up from $675 million in 1989). The company had a record-breaking order backlog of $97 billion, enough to keep its plants operating at full capacity over the next three years.

Boeing had two principal business segments: commercial aircraft and defense (the latter included space and missile products). Exhibit 1 gives a breakdown by segment for sales, assets, and profits for 1987–89. The commercial-aircraft segment produced and sold four main airframes (the 737, 747, 757, and 767) and numerous derivatives of them. Boeing's defense segment was the main contractor on numerous military transportation projects and major missile systems. While the defense division had recorded losses in the most recent years, it provided valuable support to the commercial-aircraft group through the manufacturing of parts and the design and manufacture of electronic systems. Analysts also believed there were significant technology transfers from defense R&D to the commercial-aircraft segment.

Boeing possessed a remarkably strong balance sheet, with book value of debt making up only 4 percent of total capital. Exhibit 2 presents Boeing's balance sheets, and Exhibit 3 presents income statements for 1988 and 1989. Analysts were predicting that Boeing would increase the debt ratio to 14 percent over the next year or so because of future financing needs. Nevertheless, the company had historically shown an aversion to debt financing. Therefore, analysts believed that, in the long run, Boeing's debt capitalization would remain quite low.

DEMAND FOR COMMERCIAL AIRCRAFT

In 1989 world commercial-aircraft revenues exceeded $25 billion; total jet aircraft delivered were 398; orders outstanding were valued at $165 billion. While overall airline traffic was expected to increase by 5.2 percent per year over the next 15 years, traffic in Asia was forecasted to grow at a rate of 10.6 percent a year. At the 5.2 percent overall rate of increase, new aircraft sales would aggregate $615 billion by 2005.

The growth in aircraft demand was a function of increases in passenger air traffic, which in turn was a function of economic growth. Air traffic was highly sensitive to variations in consumer and business confidence. In the brief time since Iraq had invaded Kuwait, fuel prices had risen, passenger air traffic had declined, the inflow of aircraft orders had stopped, and several airlines had canceled existing orders. While the long-term association between economic growth and aircraft orders tended to be quite stable, the health of the commercial airlines tended to be a major determinant of aircraft orders in the short term; airlines could postpone purchases for a year or two, creating havoc in the finances of the aircraft manufacturers.

The demand for aircraft could be segmented along two dimensions: seating capacity and range in nautical miles. As Exhibit 4 reveals, the three major producers of aircraft covered the entire range. Commercial aircraft varied in price from approximately $35 million for Boeing's 737 to $145 million for the 747-400. Boeing produced 21 737s per month, although many models of aircraft had production rates of 5 to 7 per year.

Despite the high up-front costs and the fact that most market segments could support only one model of aircraft, the major manufacturers tried to compete across all segments partly because of the gains expected from derivative aircraft that could be developed to serve selected subsegments or new major segments. Derivatives had design and many parts in common with the original aircraft and thus could be developed and manufactured relatively inexpensively. These derivatives expanded a model's market, extended its lifetime, and led to economies of scale and experience. Incremental development costs of stretching an aircraft design were believed to be usually less than 25 percent of the original cost. Other factors that led the manufacturers to develop a broad range of aircraft included image issues (being a major player), time-based competition (each company trying to preempt the others in a particular segment), and pressure from major customers to fill a market niche.

Boeing was particularly adept at exploiting the advantages of aircraft derivatives. Its 707, 727, 737, and 757 models had similar fuselage shapes, which reduced design costs and allowed them all to be built using common production facilities. These basic shapes were also stretched and shortened into several different models to fill numerous product niches. In addition to development work on the 777, Boeing was also expected to begin working on a super jumbo jet (600+ passengers).

AIRCRAFT DEVELOPMENT AND LIFE CYCLE

Any individual airframe was characterized by huge outlays (for research, development, and tooling) and a long life cycle. The average new airplane in the early 1990s would cost over $4 billion to bring to production and might require 12 to 20 years before breaking even. Substantial negative cash flows would accumulate before an airframe product line broke even. Because of the financial strains a new product line might create, each new airframe was a "bet the ranch" proposition for the aircraft manufacturers. Over time, survival in the industry depended on introducing successful products and having the financial "deep pockets" with which to survive the cash-flow trough. Most analysts concluded, in fact, that few airframes ever yielded positive cumulative cash flows—but the few financial successes were spectacular.

Boeing aircraft tended to follow predictable sales patterns across their lives. Deliveries tended to rise to a peak during the first few years of availability and then decline moderately until a new version of the aircraft (a derivative) was introduced. This pattern was followed by one or more additional cycles of decline and new introduction. Exhibit 5 illustrates these cycles for four of Boeing's aircraft over their first 20 years of delivery.

THE 777

Boeing had been working on a new, revolutionary aircraft since 1988. The aircraft would be the largest and longest haul twin-bodied jet and (according to Boeing) the most flexible and cost-efficient plane ever. The aircraft's most unique feature would be a folding wing tip, which would enable it to fit into the smaller slots in airport terminals. The 777 would also be the first jet to use fly-by-wire technology, an advanced flying system already used on Airbus turbo-prop planes.

Analysts estimated that R&D expense on the 777 had amounted to hundreds of millions of dollars in the 1980s and $200 million in 1990 alone. The new aircraft created a revolution in Boeing's design and manufacturing processes. In terms of the design process, two features were unique:

- *Up-front involvement of the airlines.* Boeing had asked six of its major customers to play active roles in designing the new aircraft in order to ensure that the aircraft would meet customer needs and, Boeing hoped, give it a competitive advantage over the A330/A340 and MD-11.
- *Use of "current engineering."* That is, having 400 or so project engineers work side by side with the aircraft's designers: Until this development, designers worked independently, sent the plans over to the engineers, and then continued to make improvements. Each subsequent change cost upward of $10,000, and hundreds of such changes were made. With the 777, Boeing intended to get the details right before production started. The change in the relationship between design and production was organizational (i.e., the two groups would talk to each other before production began) and technological. Through an advanced computer-aided design and manufacturing (CAD/CAM) system, Boeing engineers could fully simulate production of the aircraft. The bugs could be found and eliminated before the aircraft went into production. Boeing hoped this design/production approach would save as much as 20 percent of the 777's estimated $4 billion to $5 billion development cost.

Despite the many innovations, analysts believed that the R&D costs for the 777 would be higher than for any other plane to date. One analyst forecasted that the R&D expenditures would aggregate to $4.467 billion.[5] In addition to R&D, Boeing would incur major capital expenditures to double the size of the manufacturing facility in Renton, Washington, where the 747 and 767 aircraft were produced. A new facility would be built to produce the major wing components and advanced composite tailplanes. Analysts estimated that these facilities would cost nearly $1.5 billion. Boeing also planned to build a special laboratory for integrating and testing aircraft systems; the 777 and other aircraft would make use of this facility. The company would also increase its spending on employee training to focus on the CAD system used on the 777. Engineers would receive over 350,000 hours of training on this system. Some analysts predicted that all of these new facilities and training programs would increase Boeing expenditures by $2.5 billion over the next few years.

With these large initial outlays, Boeing would need significant revenues to make the 777 program a success. The company expected each aircraft to sell for $130 million on average. Several analysts, however, believed that the A330/A340 and MD-11 would put downward pressure on this price, forcing Boeing to price the 777 at $100 million.

The 777 was targeted to the fastest growing market segment in terms of passenger seats and distance. This segment serviced medium- and long-haul routes. Boeing estimated that over the next 15 years, two-thirds of aircraft sales by value would be in this market segment. If the company maintained its market share of approximately 50 percent, it would achieve unit sales of 1,000 aircraft in the 777's first 10 years of production. Production costs would begin at high levels and rapidly fall as the product moved down the learning curve. Boeing executives believed that the 777 would have a life span of 30 to 40 years.

[5]George Shapiro, Salomon Brothers.

FINANCIAL FORECAST AND ANALYSIS

Exhibit 6 contains a forecast of free cash flows from the Boeing 777 project based on the casewriters' analyses and drawing on numerous assumptions of securities analysts in their published commentaries on the 777 project. The appendix to this exhibit discusses these forecast assumptions in detail. The primary implication of the forecast is that the internal rate of return (IRR) in the base case would be 19 percent.

Numerous sensitivity analyses of the IRR could be made. One important question was the impact of variations in aircraft prices. Another key assumption was the size of demand in the first 10 years. If the recession in the early 1990s were particularly long or severe, planes sold could fall well short of the estimate of 1,000. On the other hand, a resumption of prolonged economic growth could trigger higher sales, not only to replace aging planes, but also to expand overall capacity. The IRRs associated with different unit prices and unit sales volumes in the first 10 years are given in Exhibit 7.

A key determinant of the attractiveness of the 777 project was Boeing's cost of capital. As Exhibit 8 reveals, relatively minor variations in discount rates produced rather large variations in project payback on a discounted-cash-flow (DCF) basis. If the cash flows were undiscounted, the payback would occur in the 10th year. At the other extreme, if cash flows were subject to a 20 percent discount rate, payback would never occur.

COST OF CAPITAL

Boeing's weighted-average cost of capital (WACC) could be estimated using the well-known formula:

$$\text{WACC} = [I \times (1 - t) \times W_d] + (K_e \times W_e)$$

where

I = Pretax cost of debt capital
t = Marginal tax rate
W_d = Proportion of debt in a market-value capital structure
K_e = Cost of equity capital
W_e = Proportion of equity in a market-value capital structure

Exhibit 9 gives information about Boeing and comparable companies to use in the WACC equation. Exhibit 10 depicts five-year stock-price performance relative to the Standard & Poor's (S&P) 500 Index. Boeing had faced a relatively low effective tax rate in the past, but because of changes in tax and accounting regulations, its marginal effective tax rate was expected to rise to 34 percent in the future. In October 1990, the yield on long-term U.S. Treasury bonds was 8.82 percent, and the 64-year geometric average equity-market risk premium was 5.4 percent. At a recent stock price of \$43.00 per share, Boeing's dividend yield was 2.5 percent. Value Line forecasted Boeing's dividends to grow at the rate of 17 percent over the next five years.

Analysts had pointed out that Boeing actually consisted of two separate businesses, the relatively more stable and (in the midst of the Gulf War crisis) thriving defense business and the more volatile commercial-aircraft business. Thus the question arose of whether one should estimate Boeing's cost of capital to serve as the benchmark required rate of return. Would a required return on a portfolio of these two businesses be appropriate for evaluating the 777 project? If necessary, how might it be possible to isolate a required return for commercial aircraft?

CONCLUSION

Within the aircraft-manufacturing industry, the magnitude of risk posed by the launching of a major new jet aircraft was accepted as a matter of course. One observer said,

> Sustained success demands a willingness to gamble regularly, even though the effects of guessing wrong may be fatal . . . The business of making and selling commercial airliners is not for the diffident or faint of heart. It is remarkably difficult and, by anyone's standard, intensely competitive. There are a few industries that consume as much or more capital; certain others rely as heavily on quantities of highly skilled personnel; probably no other is involved with as many advanced technologies.[6]

Other observers worried that the technical challenges might obscure the commercial considerations: "The mystery behind this business isn't building an airplane that flies and is safe. It's building an airplane that is salable and profitable."[7]

Frank Shrontz had indicated that his primary mission during his tenure as CEO of Boeing would be to raise the firm's return on equity. Given that the 777 would be the major new product introduction for Boeing in the 1990s, the prime question was whether it would help Shrontz pursue his objective.

EXHIBIT 1 Revenues, Operating Profits, and Identifiable Assets by Segment for the Boeing Company

	1987	*1988*	*1989*
Revenues			
Commercial aircraft	$9,827	$11,369	$14,305
Defense and other	5,986	5,971	6,318
Total	15,813	17,340	20,623
Operating Profit			
Commercial aircraft	352	585	1,165
Defense and other	306	235	(243)
Total	658	820	922
Identifiable Assets			
Commercial aircraft	5,170	4,558	6,675
Defense and other	7,396	8,050	6,603
Total	$12,566	$12,608	$13,278

Source: The Boeing Company annual reports.

[6] John Newhouse, *The Sporty Game* (New York: Knopf, 1982), p. 92.

[7] A quotation of Wolfgang Demisch of UBS Securities, Inc., in "How Boeing Does It," *Business Week*, July 9, 1990, p. 50.

EXHIBIT 2 Boeing Balance Sheets (dollars in millions)

	1988	*1989*
Assets		
Cash	$ 3,544	$ 1,863
Other current assets	5,017	6,797
Total current assets	8,561	8,660
Customer financing	1,039	822
Net property, plant, and equipment	2,703	3,481
Investments	305	315
Total assets	$12,608	$13,278
Liabilities and stockholders' equity		
Accounts payable	$ 4,697	$ 4,932
Current portion of long-term debt	7	5
Other current liabilities	697	291
Total current liabilities	6,705	6,673
Long-term debt*	251	275
Deferred taxes	205	174
Deferred investment credit	43	25
Stockholders' equity†		
Common shares	1,341	1,736
Retained earnings	4,137	4,452
Treasury stock	(74)	(57)
Total stockholders' equity	5,404	6,131
Total liabilities and stockholders' equity	$12,608	$13,278

*Boeing's long-term debt consisted entirely of two issues: $250 million of 8.375 percent notes due December 31, 1996, and $37 million of long-term notes payable believed to bear floating rates of interest and currently costing 9.31 percent. The market value of the first bond issue was $234.5 million, found by valuing the issue at a discount rate of 9.73 percent, the average yield to maturity of AA-rated debt with five years to maturity. Because the notes payable yielded a floating rate, their market value equaled book value. Thus, the total market value of the two debt issues was estimated to be $271.5 million.

†In October 1990, Boeing had 346,436,214 common shares outstanding. At a trading price of $43 per share, Boeing's market value of equity was $14,896.76 million.

Source: The Boeing Company annual report, 1989.

EXHIBIT 3 Boeing Income Statements (dollars in millions except per share data)

	1988	*1989*
Revenues	$16,962	$ 20,276
Costs and expenses	16,514	19,695
Earnings from operations	448	581
Other income (interest)	378	347
Interest expense	(6)	(6)
Profit before taxes	820	922
Taxes*	206	247
Effect of change in method of accounting for taxes		298
Net earnings	614	973
Earnings per share	2.68	4.23
Cash dividend per share	$1.0333	$1.11666

*Boeing's marginal tax rate was 34 percent

Source: The Boeing Company annual report, 1989.

EXHIBIT 4 Competitive Positioning of Major Jet Aircraft

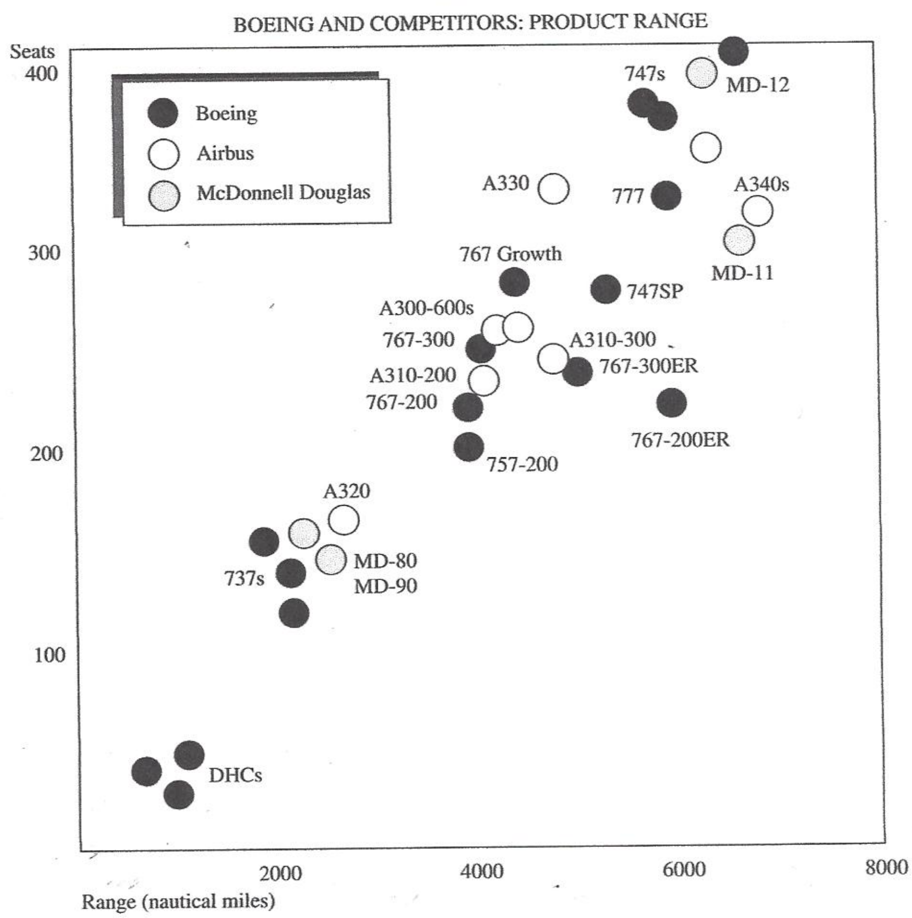
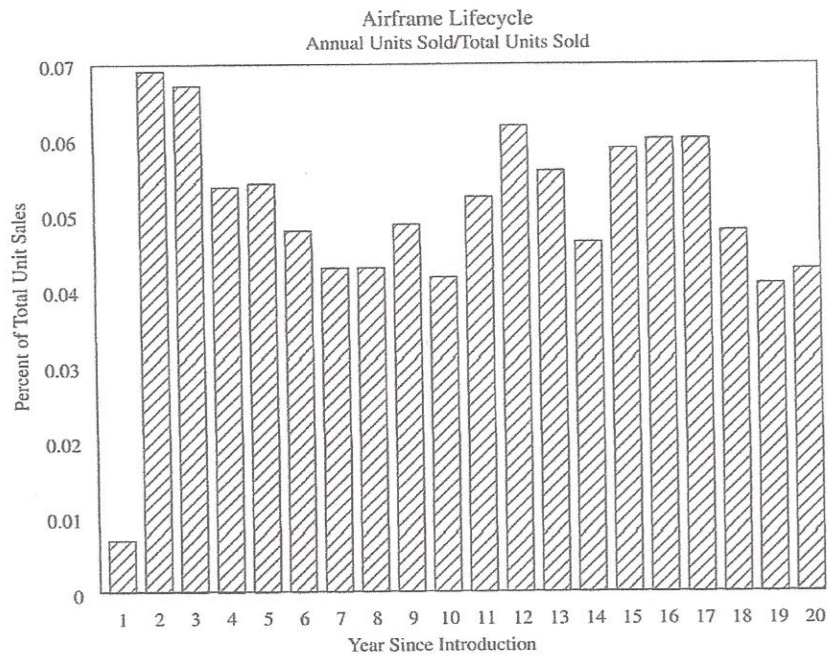


EXHIBIT 5 Life Cycle of Unit Sales (averaged across the Boeing 707, 727, 737, and 747)



Source: The Boeing Company annual reports.

EXHIBIT 6 Forecast of Boeing 777 Free Cash Flows

Assumptions	
Price per plane	130
Working-capital requirement (WCR) as % of sales	9.8%
General, selling, and administrative (GS&A) expense (% of sales)	4.0%
R&D expense (% of sales)	3.0% (excluding 1990–95)
Capital expenditure (% of sales)	0.1% (excluding 1990–94 and years before introduction of derivatives)
Depreciation	Double-digit accelerated method
Total number of planes yrs. 1–10	1,000
Total number of planes yrs. 11–20	1,000
Inflation	3.0%
Marginal effective tax rate	34.0%

EXHIBIT 6 *(continued)*

	1990	*1991*	*1992*	*1993*	*1994*	*1995*
Revenues						
Number of planes delivered						14
Price per plane						$ 130.00
Total revenues						1,847.55
Cost of goods sold						1,662.79
Gross profit						184.75
Depreciation	$ 0.00	$ 40.00	$ 96.00	$ 116.40	$ 124.76	112.28
GS&A expense						73.90
Operating profit (before R&D)	0.00	(40.00)	(96.00)	(116.40)	(124.76)	(1.43)
R&D expense	142.00	865.00	1,340.00	1,240.00	840.00	240.00
Pretax profit	(142.00)	(905.00)	(1,436.00)	(1,356.40)	(964.76)	(241.43)
Taxes (or tax credit)	(48.28)	(307.70)	(488.24)	(461.18)	(328.02)	(82.09)
After-tax profit	(93.72)	(597.30)	(947.76)	(895.22)	(636.74)	(159.34)
Capital expenditure	0.00	400.00	600.00	300.00	200.00	1.85
Depreciation add-back	0.00	40.00	96.00	116.40	124.76	112.28
Change in WCR						181.06
Annual free cash flow	$ (93.72)	$(957.30)	$(1,451.76)	$(1,078.82)	$(711.98)	$(229.97)

	1996	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Revenues							
Planes delivered	145	140	111	111	102	92	92
Price per plane	$ 133.90	$ 137.92	$ 142.05	$ 146.32	$ 150.71	$ 155.23	$ 159.88
Total revenues	19,418.96	19,244.23	15,737.95	16,257.35	15,333.42	14,289.29	14,717.97
Cost of goods sold	16,506.12	15,202.94	12,275.60	12,518.16	11,653.40	10,859.86	11,038.48
Gross profit	2,912.84	4,041.29	3,462.35	3,739.19	3,680.02	3,429.43	3,679.49
Depreciation	101.06	90.95	82.72	77.75	75.63	75.00	75.00
GS&A expense	776.76	769.77	629.52	650.29	613.34	571.57	588.72
Operating profit (before R&D)	2,035.03	3,180.57	2,750.11	3,011.14	2,991.06	2,782.86	3,015.77
R&D expense	582.57	577.33	472.14	487.72	460.00	428.68	441.54
Pretax profit	1,452.46	2,603.24	2,277.97	2,523.42	2,531.05	2,354.18	2,574.23
Taxes (or tax credit)	493.84	885.10	774.51	857.96	860.56	800.42	875.24
After-tax profit	958.62	1,718.14	1,503.46	1,665.46	1,670.49	1,553.76	1,698.99
Capital expenditure	19.42	19.24	15.74	16.26	15.33	14.29	14.72
Depreciation add-back	101.06	90.95	82.72	77.75	75.63	75.00	75.00
Change in WCR	1,722.00	(17.12)	(343.62)	50.90	(90.54)	(102.33)	42.01
Annual free cash flow	$ (681.74)	$ 1,806.97	$ 1,914.06	$ 1,676.05	$ 1,821.34	$ 1,716.79	$ 1,717.27

EXHIBIT 6 *(continued)*

	2003	2004	2005	2006	2007	2008	2009
Revenues							
Planes delivered	105	89	111	130	118	94	123
Price per plane	$ 164.68	$ 169.62	$ 174.71	$ 179.95	$ 185.35	$ 190.91	$ 196.64
Total revenues	17,233.97	15,066.42	19,468.56	23,307.53	21,911.40	17,944.00	24,103.23
Cost of goods sold	12,925.47	11,299.82	16,548.27	18,879.10	17,310.01	13,996.32	20,487.75
Gross profit	4,308.49	3,766.61	2,920.28	4,428.43	4,601.39	3,947.68	3,615.49
Depreciation	99.46	121.48	116.83	112.65	100.20	129.20	96.99
GS&A expense	689.36	602.66	778.74	932.30	876.46	717.76	964.13
Operating profit	3,519.67	3,042.47	2,024.71	3,383.48	3,624.73	3,100.72	2,554.37
R&D expense	517.02	451.99	584.06	699.23	657.34	538.32	723.10
Pretax profit	3,002.65	2,590.47	1,440.65	2,684.25	2,967.39	2,562.40	1,831.27
Taxes (or tax credit)	1,020.90	880.76	489.82	912.65	1,008.91	871.22	622.63
After-tax profit	1,981.75	1,709.71	950.83	1,771.61	1,958.48	1,691.19	1,208.64
Capital expenditure	244.64	244.64	19.47	23.31	21.91	567.22	24.10
Depreciation add-back	99.46	121.48	116.83	112.65	100.20	129.20	96.99
Change in WCR	246.57	(212.42)	431.41	376.22	(136.82)	(388.81)	603.60
Annual free cash flow	$ 1,590.00	$ 1,798.97	$ 616.79	$ 1,484.73	$ 2,173.59	$ 1,641.97	$ 677.92

	2010	2011	2012	2013	2014	2015	2016
Revenues							
Planes delivered	125	125	98	84	89	89	89
Price per plane	$ 202.54	$ 208.61	$ 214.87	$ 221.32	$ 227.96	$ 234.79	$ 241.84
Total revenues	25,316.97	26,076.48	21,133.07	18,550.25	20,321.64	20,931.29	21,559.23
Cost of goods sold	20,506.75	20,600.42	16,483.79	14,283.69	15,444.45	15,907.78	16,385.01
Gross profit	4,810.22	5,476.06	4,649.27	4,266.56	4,877.19	5,023.51	5,174.21
Depreciation	76.84	65.81	61.68	57.96	54.61	52.83	52.83
GS&A expense	1,012.68	1,043.06	845.32	742.01	812.87	837.25	862.37
Operating profit	3,720.71	4,367.19	3,742.27	3,466.59	4,009.72	4,133.43	4,259.02
R&D expense	759.51	782.29	633.99	556.51	609.65	627.94	646.78
Pretax profit	2,961.20	3,584.89	3,108.28	2,910.08	3,400.07	3,505.49	3,612.24
Taxes (or tax credit)	1,006.81	1,218.86	1,056.82	989.43	1,156.02	1,191.87	1,228.16
After-tax profit	1,954.39	2,366.03	2,051.46	1,920.65	2,244.05	2,313.63	2,384.08
Capital expenditure	25.32	26.08	21.13	18.55	20.32	20.93	21.56
Depreciation add-back	76.84	65.81	61.68	57.96	54.61	52.83	52.83
Change in WCR	118.95	74.43	(484.45)	(253.12)	173.60	59.75	61.54
Annual free cash flow	$ 1,886.97	$ 2,331.34	$ 2,576.47	$ 2,213.18	$ 2,104.74	$ 2,285.77	$ 2,353.81

EXHIBIT 6 *(continued)*

	2017	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*
Revenues								
Planes delivered	89	89	89	89	89	89	89	89
Price per plane	$ 249.09	$ 256.57	$ 264.26	$ 272.19	$ 280.36	$ 288.77	$ 297.43	$ 306.35
Total revenues	22,206.00	22,872.18	23,558.35	24,265.10	24,993.05	25,742.85	26,515.13	27,310.58
Cost of goods sold	16,876.56	17,382.86	17,904.35	18,441.48	18,994.72	19,564.56	20,151.50	20,756.04
Gross profit	5,329.44	5,489.32	5,654.00	5,823.62	5,998.33	6,178.28	6,363.63	6,554.54
Depreciation	52.83	52.83	47.52	35.28	28.36	28.36	28.36	16.05
GS&A expense	888.24	914.89	942.33	970.60	999.72	1,029.71	1,060.61	1,092.42
Operating profit	4,388.38	4,521.61	4,664.15	4,817.74	4,970.25	5,120.21	5,274.67	5,446.07
R&D expense	666.18	686.17	706.75	727.95	749.79	772.29	795.45	819.32
Pretax profit	3,722.20	3,835.45	3,957.40	4,089.78	4,220.46	4,347.92	4,479.21	4,626.75
Taxes (or tax credit)	1,265.55	1,304.05	1,345.52	1,390.53	1,434.96	1,478.29	1,522.93	1,573.09
After-tax profit	2,456.65	2,531.39	2,611.89	2,699.26	2,785.50	2,869.63	2,956.28	3,053.65
Capital expenditure	22.21	22.87	23.56	24.27	24.99	25.74	26.52	27.31
Depreciation add-back	52.83	52.83	47.52	35.28	28.36	28.36	28.36	16.05
Change in WCR	63.38	65.29	67.24	69.26	71.34	73.48	75.68	77.95
Annual free cash flow	$ 2,423.88	$ 2,496.06	$ 2,568.60	$ 2,641.01	$ 2,717.53	$ 2,798.77	$ 2,882.44	$ 2,964.44

EXHIBIT 6 Appendix: Discussion of Assumptions Underlying the Estimation of Cash Flows

Revenue Estimation

In order to project revenues for the project, several assumptions were made about market size, market share, units per year, initial 777 price, the rate of price increases, and introduction of derivatives.

Market size: Boeing estimated that, from 1990 to 2005, the total aircraft market would be worth approximately $615 billion.[1] The company predicted that two-thirds of this market would be in the aircraft segment in which the 777 would compete.[2] Because the 777 would not be available until 1995, this forecast uses a total market base from 1995 to 2005, estimated as two-thirds of the 1990–2005 number (i.e., $410 billion). If the 777 segment had two-thirds of this market, it would have a market of $275 billion. The $130 million per aircraft (Boeing's estimate for the 777 price tag) would translate into a market size of over 2,000 planes during the 777's first 10 years of production. The replacement market alone was expected to demand 670 aircraft,[3] and this market was supposed to be the fastest growing in the aircraft industry.

Market share: If Boeing maintained its historical 50+ percent market share, its absolute share of the market between 1995 and 2005 would accumulate to $135 billion. With the 777s expected to sell for approximately $130 million each, the figures translate into a projection of 1,000 units during the 777's first 10 years of production.

Units per year: The number of units sold per year is based on historical trends for other Boeing aircraft for the first 10 years of their lives. The percentage distributions estimated from these other aircraft are then applied to the total 10-year figure (i.e., 1,000 aircraft) to yield annual unit sales. Units per year for years 21 to 30 are estimated to be the same as year 20 to reflect an average of two possibilities: (1) another derivative aircraft is introduced, resulting in higher unit sales, and (2) no new derivatives are introduced and the plane's sales decline.

Initial price: Boeing estimated that the 777 would sell for $130 million—the high end of the aircraft market; analysts' estimates ranged between $100 and $130 million. The forecast presented here assumes a price of $130 million.

EXHIBIT 6 *(concluded)*

Rate of price increases: Aircraft prices are assumed to increase at the rate of inflation. Inflation is assumed to be 3 percent annually for the next 35 years.

Introduction of derivatives: Based on historical trends from other Boeing aircraft, the forecast assumes that Boeing will introduce a derivative plane after 10 years and again after 15 years of 777 production. These moves would lead to temporary increases in sales in the following years.

Expense Estimation

Cost of goods sold: Based on gross-profit-margin experience from other Boeing aircraft models, the forecast assumes that gross profit begins at 10 percent of sales and reaches 25 percent when the company has produced 500 units. Gross profit margin remains at this level until a derivative model is introduced, when the profit margin falls to 15 percent and then recommences the improvement to 25 percent at a faster rate.

General, selling, and administrative expense: Boeing's ratio of GS&A to sales has run historically at about 4 percent. In certain years, the ratio has been as low as 2 percent, and in others, as high as 5 percent.

Depreciation: Boeing depreciated its assets on an accelerated basis. The forecast uses double-declining depreciation with a 20-year asset life and zero salvage value as the base.

Research and development: The forecast uses an analyst's's[4] estimate of up-front R&D expenses of $4.467 billion. The cash flows exclude $200 million that Boeing spent on the project in early 1990, on the principle that the expenditures prior to October 1990 are sunk costs. After this period, annual R&D expense is estimated to be 3 percent of sales, a figure that draws on various analysts' assumptions and historical levels of R&D spending. The forecast assumes that this level of expenditure is sufficient to enable Boeing to introduce two 777 derivatives, in 2005 and 2009. This forecast does not assume Boeing's belief that its development-process innovations will reduce the cost of development by 20 percent.

Tax expense: Boeing has historically had a low marginal effective tax rate. Analysts believed this rate would increase in the future, however, to about 34 percent. The forecast reflects this expectation.

Other Adjustments to Cash Flow

Capital expenditures: The forecast assumes total capital expenditures of $1.5 billion for the original version of the 777 and future capital expenditures for the two derivatives at 25 percent of the original but increased at the rate of inflation. One might use a higher estimate, $2.5 billion, but it is believed to include facilities and systems not incremental to this project.

Working-capital requirement: The forecast assumes the past 5-year average of the Boeing Company ratio of working capital to sales—9.8 percent.

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[1]McDonnell Douglas estimates are significantly higher, but Boeing estimates are used here to be consistent with the expectations of Boeing executives.

[2]"It's Fat and Snazzy," *Business Week,* October 29, 1990, p. 32.

[3]Lawrence Harris, "The Boeing Company, Attractive for Value-Oriented Accounts," Kemper Securities Group, Inc., December 26.1991.

[4]George Shapiro, Salomon Brothers.

EXHIBIT 7 Sensitivity Analysis of Project IRRs by Price, Volume, GS&A, and R&D Expenses

Unit Volume	*Unit Price (Millions)*			
(First 10 Years)	*$100*	*$110*	*$120*	*$130*
700	13.9%	14.8%	15.5%	16.3%
800	14.7	15.5	16.4	17.2
900	15.4	16.3	17.2	18.0
1,000	16.1	17.1	18.0	18.9
1,100	16.9	17.9	18.9	19.8
1,200	17.6%	18.6%	19.7%	20.6%

	R&D Expense/Sales				
GS&A Sales	*1.0%*	*2.0%*	*3.0%*	*4.0%*	*5.0%*
1.0%	23.5%	22.7%	21.8%	20.9%	19.9%
2.0	22.6	21.8	20.8	19.9	19.0
3.0	21.7	20.8	19.9	18.9	17.9
4.0	20.8	19.9	18.9	17.9	16.9
5.0	19.9	18.9	17.9	16.9	15.8
6.0	18.9	17.9	16.9	15.8	14.7
7.0%	17.9%	16.8%	15.8%	14.7%	13.5%

Source: Casewriters' analysis.

EXHIBIT 8 DCF Breakeven by Different WACCs

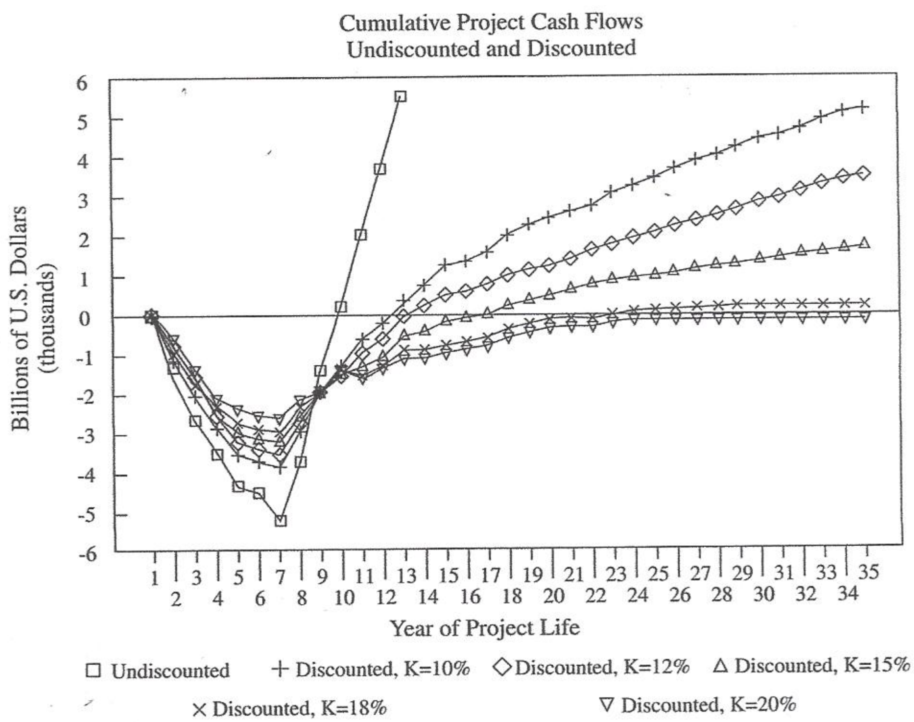


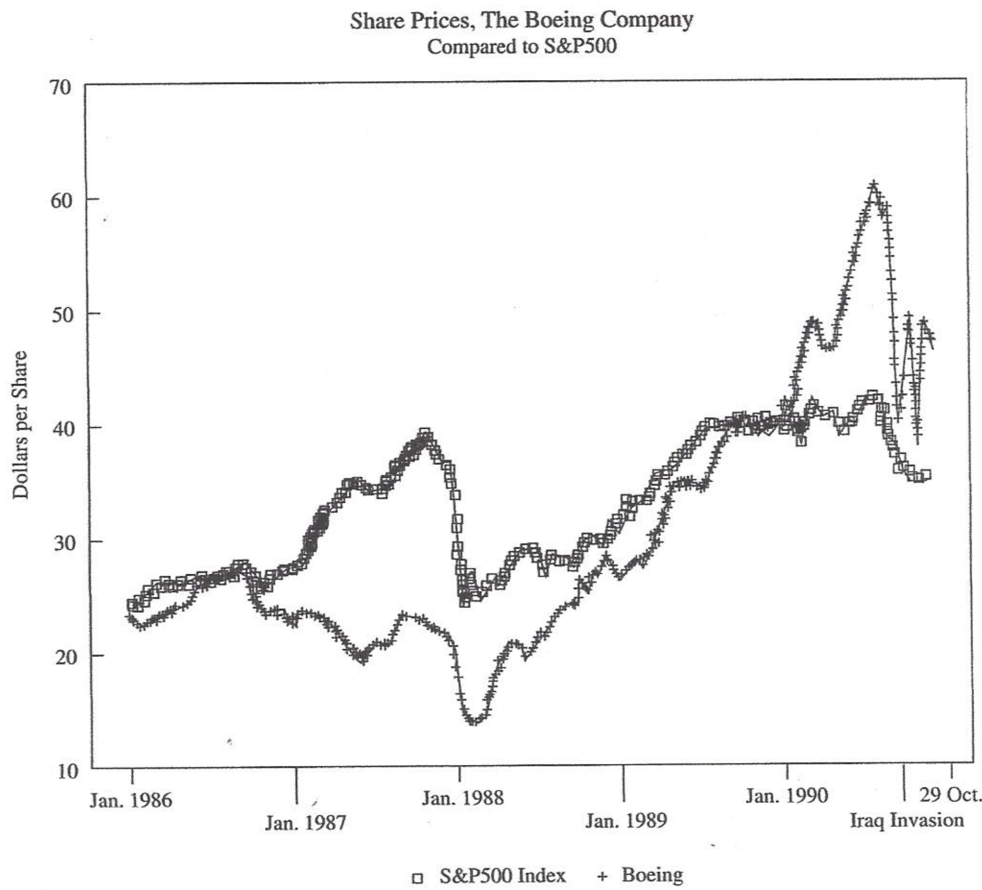
EXHIBIT 9 Information on Comparable Companies (specially calculated betas estimated from *daily* stock returns and market returns over the periods indicated)

	Boeing	*Grumman*	*Northrop*	*Lockheed*	*McDonnell Douglas*
Percentage of revenues derived from defense and U.S. space program	26%	87%	89%	85%	66%
Estimated betas					
1. Statistical services:					
Value Line*	1.00	0.95	1.00	1.10	0.85
Datastream†	1.06	0.53	0.94	0.97	0.51
2. Calculated against the S&P 500 index:					
58 months	0.81	0.80	0.74	0.87	0.60
12 months	1.37	0.73	0.72	0.69	0.63
60 days	1.65	0.68	0.50	0.52	0.64
3. Calculated against the NYSE composite index:					
58 months	0.87	0.86	0.79	0.95	0.66
12 months	1.51	0.80	0.77	0.75	0.71
60 days	1.79	0.73	0.53	0.57	0.71
Market-value debt/equity ratio	0.018	1.756	1.288	1.182	2.714

*Value Line betas are calculated from a regression analysis between the weekly percentage changes in the price of a stock and the weekly percentage changes in the New York Stock Exchange Composite Index. The beta is calculated over the last five years of data.

†Datastream betas are calculated from a regression analysis between weekly adjusted prices of the stock and Datastream's own composite index. The betas are calculated over a four-year-period.

EXHIBIT 10 Daily Boeing Stock Prices Compared with the S&P 500 Index, January 1, 1986, to October 29, 1990



Share Prices, The Boeing Company, DATASTREAM, 1990.