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Welcome to the Transportation Research Forum's 1998 Annual Meeting

These proceedings contain those papers presented at the 40th Annual Meeting of the Transportation Research Forum, held in Philadelphia from October 29-31, 1998, that were received by the deadline publishing date. All papers were reviewed by the Program Vice President to assess their suitability for inclusion in these volumes. Additional papers may be made available by some of the presenters at the time of the Conference.

The Transportation Research Forum (TRF) is an independent organization of transportation professionals providing pertinent and timely information to those who conduct research and those who use and benefit from research. It functions as an impartial meeting ground for carriers, shippers, government officials, consultants, university researchers, suppliers, and others seeking an exchange of information and ideas related to both passenger and freight transportation. The Transportation Research Forum started with a small group of transportation researchers in New York in 1958 and the first national meeting was held in St. Louis in 1960. National meetings have been held annually since 1960 at various cities throughout the U.S. and Canada.

Numerous TRF members and supporters aided in the development of this year's Forum, but it is authors of the papers, the organizers and contributors to the various panels, and the session chairs who make TRF annual meetings so worthwhile and enjoyable. The conference program simply reflects the interests, enthusiasm and commitment of those members of the transportation community. Special thanks go to Patrick and Judy Little who graciously agreed to assemble this year's proceedings for me. Without their help, the job of Program Chair would have been much more of a burden.

A number of other TRF members also assisted in the development of this meeting. Randy Resor and Jim Blaze were constant sources of ideas and encouragement. When help was asked for, they came through repeatedly. Other TRF members provided help with the program in their areas of interest. I want to thank Alan Bender, Michael Belzer, Ken Ericksen, Paul Gessner, Harold Kurzman, Scott Ornstein, Clint Oster, and Peter Smith for their help. Claire LaVaye at the University of Texas assisted with promoting the meeting on TRF's website. Finally, Rick Guggolz provided valuable assistance on the businees arrangements for the conference.

We are also grateful to those companies and organizations who have sponsored awards or made other contributions to the success of the Forum. These include: LTK Engineering, The Metropolitan Transit Association, and RailTex. Among our own members, we are especially indebted to the TRF Foundation, the Cost Analysis Chapter and the Aviation Chapter for their assistance and support.

These proceedings are prepared and distributed at the TRF Annual Forum as a means of disseminating information and stimulating an exchange of ideas during the meeting. Every effort has been made to reproduce these papers accurately. TRF, however, assumes no responsibility for the content of the papers contained in these volumes.

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EXCESSIVE AIRCRAFT ORDERS: A PREDICTOR OF AIRLINE LOSSES

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ABSTRACT

An inverse relationship exists between above-average deliveries of aircraft and airline profits. Five times since World War II, profits declined and losses were incurred as airlines received aircraft at above-average rates. Conversely, when deliveries fell below average, profits were once again achieved. Given the long lead-times between orders and deliveries, it is possible to forecast airline losses and profits one or two years in advance by noting changes in the volume of aircraft orders. While the airline industry will incur losses when absorbing large numbers of aircraft in this cyclical pattern, other firms and individuals may gain by acting in a contrary manner. Examples include: leasing companies able to purchase aircraft at low prices during periods of excess deliveries and airline losses; investors who can buy stock at cyclicly depressed prices when losses occur and then sell when profits reappear; and consumers who can postpone discretionary travel to years when the airlines have a surplus of aircraft and engage in extensive discount pricing. Finally, excessive aircraft orders and deliveries occurred in the U.S. under both regulation and deregulation. Thus, it is a fundamental aspect of the industry that occurs regardless of regulatory policy.

EXCESSIVE AIRCRAFT ORDERS: A PREDICTOR OF AIRLINE LOSSES

INTRODUCTION

Five times since the end of World War II, airlines in the United States and worldwide have ordered new aircraft at much higher than average rates. This happened twice during the propeller aircraft era -- first in 1947-49 and again in 1953-58 -- and Figure 1 shows it has happened three times since jet aircraft were first ordered in the U.S. in 1955. The fifth cycle of excessive new aircraft orders ended in 1991, but a sixth worldwide cycle began in 1995 and record numbers of aircraft were ordered in 1996 and 1997. The first of these recent orders began to be delivered in 1997 and high delivery rates will doubtless continue for several years.

What difference does it make if airlines order large numbers of new aircraft? The problem is that as these aircraft are delivered the airlines' aircraft possession costs increase.[2] Also, in order to utilize these aircraft effectively, the airlines must hire and train more personnel, buy or lease more maintenance facilities and services, expand airport facilities, increase reservations and traffic handling, and also expand all the overhead functions required to support larger operations. In other words, buying more aircraft increases costs in every area of airline operations, and does so by large amounts. Historically, these large cost increases have resulted in the airlines suffering losses while they were digesting their large expansions driven by the purchase of above-average numbers of new aircraft.

This paper will analyze the adverse impact on airline profits resulting from ordering and taking delivery of excessive numbers of new aircraft.

PREVIOUS WARNINGS

Two previous articles on this topic were published in *Air Finance Journal* in March 1989 and June 1992. Even though the U.S. airlines operating jet aircraft in scheduled passenger service had just achieved record nominal profits in 1988, the 1989 article warned:

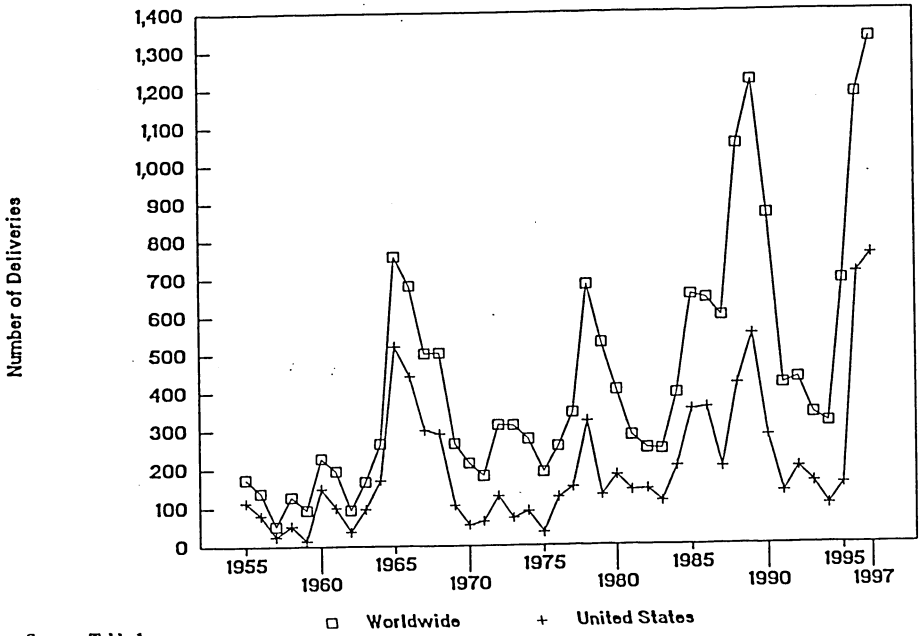
> "(t)he large profit decline that is likely to follow the current period of above-average orders and deliveries makes the present a singularly inappropriate time for airlines to incur unusually large long-term obligations by acquiring or leasing too many aircraft."[3]

Airline managers ignored this warning and continued their buying spree through 1990, six full years after it began in 1984. This resulted in a deluge of deliveries until 1993, and profits before taxes for U.S. airlines operating jet aircraft declined precipitously from their peak of $2.6 billion in 1988 to a record loss of $4.4 billion in 1990.[4] It also shows that large losses

Figure 1

JET TRANSPORT AIRCRAFT NET ORDERS

Western Aircraft Manufacturers, 1955-97



Source: Table 1

among U.S. carriers continued through 1994 with a combined pretax loss of $13.2 billion from 1990 to 1994. Some industry analyst went so far as to assert incorrectly that these losses exceeded the profits earned by all U.S. airlines since the inception of the industry. This, of course, ignored the role of inflation in reducing the value of a dollar in the 1990s compared with previous decades.[5]

The 1992 article, written during the depths of the five-year period of massive losses, provided some modest hope to airline managers when it concluded:

> "Another implication is that until airline managers order aircraft at more stable rates, large losses can be expected when aircraft deliveries peak, followed by periods of profits as aircraft deliveries decline. The airline industry will continue to survive under these conditions, even though individual airlines may fail if their cash flows are inadequate to carry them through the adverse effects of their excessive expansion."[6]

Consistent with this, the low rates of net orders by U.S. airlines during 1991-95 resulted in below-average rates of deliveries in 1994-96 and, as predicted, the resumption of pretax profits in 1995, with record profits in 1997.

One test of a hypotheses is that it accurately predicts subsequent events. The accuracy of the above predictions shows that the "new aircraft orders" hypothesis meets this test.

ORDER AND DELIVERY CYCLES

Table 1 lists the net orders of new jet aircraft worldwide and by U.S. carriers for 1955-97. It excludes jet aircraft manufactured in the USSR/Russia, and it shows net rather than gross orders.[7] The three completed periods of peak orders are indicated by boxed bold numbers, and the fourth peak is similarly indicated, starting in 1995 worldwide and 1996 in the U.S.

Deliveries are also listed in Table 1 for worldwide, U.S. and Canadian airlines. It is obvious that peaks in aircraft deliveries followed peaks in net orders by one or two years, and that the net order cycles had greater amplitudes than delivery cycles since it is easier to take orders than to produce aircraft.[8] It can also be seen that the Canadian carriers had an extra period of above-average deliveries in 1972-75. This was due to a change in government policy in 1969 which allowed smaller regional carriers to operate jet aircraft for the first time. This extra delivery peak in Canada will shortly be used to provide additional evidence regarding the adverse impact of above-average orders and deliveries on airline profits.

It should be recognized that some of the current increase in orders and deliveries are due to policies in the U.S. and elsewhere requiring the phase out of Stage 2 aircraft by the year 2000

Table 1

JET TRANSPORT AIRCRAFT NET ORDERS AND DELIVERIES

Western Aircraft Manufacturers, 1955-97

Year	Number of Jet Aircraft				
	Net Orders		Deliveries		
	Worldwide	US	Worldwide	US	Canada
1955	174	113	-	-	-
1956	139	80	6	-	-
1957	52	25	8	-	-
1958	128	53	15	8	-
1959	93	14	134	87	-
1960	228	149	255	115	7
1961	195	99	208	123	8
1962	93	37	171	82	-
1963	168	96	100	46	4
1964	265	170	206	125	3
1965	758	521	285	172	1
1966	680	441	401	283	9
1967	502	300	522	341	16
1968	503	291	742	467	36
1969	265	105	570	347	16
1970	214	54	333	132	17
1971	182	64	251	70	5
1972	314	128	238	94	14
1973	312	72	312	152	26
1974	277	89	352	102	22
1975	191	34	322	99	19
1976	258	126	271	69	1
1977	345	151	211	88	-
1978	682	323	284	141	9
1979	528	130	412	182	24
1980	404	182	445	164	19
1981	284	142	440	142	26
1982	251	145	302	132	16
1983	249	113	336	156	8
1984	395	204	281	140	6
1985	654	352	360	184	4
1986	644	356	409	207	-
1987	597	201	434	227	3
1988	1,050	418	513	230	22
1989	1,217	548	568	197	19
1990	865	283	675	233	13
1991	417	136	844	246	23
1992	431	199	793	272	23
1993	339	160	652	208	4
1994	316	102	522	152	6
1995	691	156	482	151	21
1996	1,183	708	497	139	12
1997	1,327	757	672	193	26

Table 1 (continued)

Total	18,860	8,827	15,834	6,698	488
Annual Averages: 1955-80	306	148	325*	157*	13*
1981-97	642	293	521*	192*	13*

*Worldwide and US delivery averages for 1959-81 and 1982-97, Canada for 1960-82 and 1982-97.

Sources: Jet Information Services, Inc., World Jet Inventory, Year-End 1997 (March 1998), pp. 12-14.
Air Canada and Canadian Airlines International, Annual Report (1990-97).
Statistics Canada, unpublished reports, (1960-95).

or 2001.[9] Thus, part of the current situation is due to government policy and not management decisions. The adverse effects on profits should be the similar, however, unless the majority of new aircraft simply replace Stage 2 aircraft so that only modest capacity growth results.

U.S. AIRCRAFT DELIVERIES AND PROFITS

The major impact on airline performance and profits occurs when aircraft are delivered, not when they are ordered. Depreciation, rental payments, lease amortization and interest on debt and capital leases, as well as fuel, labor and other operating costs, all begin in earnest with deliveries. Table 2 shows the total operating revenues, operating profit, profit before taxes, and approximate aircraft possession costs for U.S. jet operators from 1960 through 1997.[10]

From Table 1 we see that above-average deliveries of jet aircraft in the U.S. began in **1966, 1979** and **1986** (and started again in 1997), and the three completed periods lasted for three to eight years. Not surprisingly, Table 2 shows that the U.S. carriers enjoyed peak profits before taxes in **1966, 1978** and **1984** (as well as, perhaps, in 1997) -- either during the first year of above-average deliveries, or at the end of a period of below-average deliveries.[11] In each case, pretax profits declined drastically in most subsequent years while large numbers of aircraft were being delivered. When measured from the year before to the year after above-average deliveries, increased aircraft possession costs accounted for at least two thirds of the pretax profit declines).

1969, 1981 and **1993** were the final years of peak U.S. deliveries, while the years of largest pretax losses were **1970, 1982** and **1992** (with large losses continuing through 1993).[12] For the first two cycles, the year of greatest loss was that immediately

Table 2
Operating Revenues, Profit and Aircraft Possession Costs
Scheduled U.S. Airlines Operating Jet Aircraft, 1960-97

Year	Millions of U.S. Dollars					
	Total Operating Revenues	Profit	Profit before Taxes		Approx. Aircraft Possession Costs	
1960-P	$2,884.3	$ 77.6	$ 51.5		$ 365.5	
1961-T	3,063.6	20.1	-47.2		470.1	
1962	3,438.7	190.0	114.8		464.1	
1963	3,759.1	279.8	195.1		476.1	
1964	4,250.8	470.1	395.2		450.6	
1965	4,957.9	671.9	597.0		500.6	
1966	5,745.0	775.5	707.1		591.4	
1967	6,864.7	708.2	644.2		741.4	
1968	7,753.2	504.9	343.1	-954.3	958.7	+875.1
1969-P	8,791.0	387.5	148.9		1,195.7	
1970-T	9,299.7	43.0	-247.2		1,375.7	
1971	10,045.6	328.5	51.1		1,467.6	
1972	11,163.2	584.5	320.4		1,453.9	
1973-P	12,418.8	585.3	361.4		1,596.6	
1974	14,702.6	724.7	539.9		1,696.3	
1975-T	15,356.3	127.7	-99.3		1,695.9	
1976	17,506.0	722.5	633.5		1,685.6	
1977	19,838.3	903.7	932.9		1,766.9	
1978	22,892.0	1,365.5	1,410.2		1,974.0	
1979-P	27,227.0	198.7	156.5	-2,475.9	2,253.7	+1,652.9
1980-T	33,727.8	-221.6	-218.7		2,800.7	
1981-P	35,951.3	-456.0	-698.0		3,292.0	
1982-T	35,944.9	-803.1	-1,065.7		3,626.9	
1983	38,647.1	294.3	-153.5		3,888.0	
1984	42,458.7	1,966.3	1,300.4		4,101.7	
1985	44,972.2	1,304.4	1,003.1		4,533.8	
1986	45,556.3	787.4	-25.9		4,836.1	
1987	51,335.2	1,860.2	932.1		5,263.0	
1988	56,936.8	2,779.4	2,579.1		5,897.7	
1989	60,910.6	1,250.2	791.9	-5,144.5	6,413.9	+4,643.2
1990-P	66,211.7	-2,454.2	-4,358.8		7,169.6	
1991-T	64,981.5	-2,304.5	-2,520.0		7,285.9*	
1992	67,557.2	-2,806.1	-3,844.1		7,832.7	
1993	72,871.7	905.5	-1,836.1		8,436.1	
1994	74,695.4	1,925.7	-683.3		9,177.0	
1995	78,873.8	5,164.9	3,193.8		9,536.5	
1996	84,044.5	5,205.3	3,623.2		9,518.1	
1997	89,871.8	7,511.9	7,168.6		8,779.2	

P/T = Business cycle Peak/Trough

Table 2 (continued)

*Excludes aircraft possession costs of Eastern Airlines ($441.4 million in 1990) and Pan American for the 4th quarter (approx. $118.0 million based on data for the first three quarters). Both terminated service in 1991.

Source: US Civil Aeronautics Board/Department of Transportation Air Carrier Financial Statistics (1960-97).
_____, Form 41, Schedules P-1(a), P-1.1, P-1.2 and P-5.2.

following the last year of above-average deliveries when all of the added aircraft possession, and increased operating costs, were shouldered by the airlines. In the last full cycle, the five-year period of spectacular losses in 1990-94 ended the year after the unprecedented eight years of above-average deliveries.

When measured from the year before to the year after the period of above-average deliveries, increased aircraft possession costs alone accounted for at least two-thirds of the maximum pretax profit decline during each period. Furthermore, during the large profit years of 1995-97, aircraft possession costs were virtually constant, and even declined by about $740 million in 1997.

All of the above happened with little regard to the peaks and troughs in the business cycles. Table 2 specifies the peaks (P) and troughs (T) of the economy and it shows that none of the airlines' peak-profit years coincided with economic peaks. Two of the profit troughs did coincide with economic troughs (1970 and 1982), but the third occurred in 1990 when there was a cyclical peak. This does not mean that economic cycles have no impact on traffic and revenues. However, it is clear that fluctuations in aircraft deliveries, rather than the economy, provide the fundamental basis for the industry's profit cycles.

CANADIAN AIRCRAFT DELIVERIES AND PROFITS

Table 1 shows that the Canadian airlines operating jet aircraft in scheduled passenger service had four complete periods of above-average aircraft deliveries through 1990 rather than the three experienced in the U.S. All but one roughly coincided with the U.S. delivery cycles, but the extra period in 1972-75 (caused by deliveries to the regional carriers) was not duplicated in the U.S. where the airlines received new aircraft in below-average numbers. If above-average aircraft deliveries are related to greater losses, it follows that Canada should have experienced pretax losses in this period while the U.S. carriers did not. Comparing Canadian data in Table 3 with U.S. data in Table 2 shows that this was indeed the case. Canadian carriers experienced declining pretax profits turning into losses between 1972 and 1976 (the year after above-average deliveries ended in 1975) while U.S. carriers had increasing profits in every year except 1975.

Table 3

Operating Revenues, Profit and Aircraft Possession Costs

Scheduled Canadian Airlines Operating Jet Aircraft, 1960-96

Year	Total Operating Revenues	Total Operating Profit	Profit before Taxes		Approx. Aircraft Possession Costs	
1960-P	$ 203.5	$ -3.9	$ -7.2		$ 26.7	
1961-T	221.0	-4.6	-14.6		33.1	
1962	249.7	6.3	-5.0		36.7	
1963	276.8	12.9	0.2		40.8	
1964	298.7	16.7	6.6		43.4	
1965	348.3	21.4	11.4		48.7	
1966	403.1	25.0	16.1		55.0	
1967	475.1	22.6	12.1		66.8	
1968	533.6	35.8	20.6		71.6	
1969-P	598.4	29.1	7.6		89.0	
				-21.4		+63.6
1970-T	714.2	29.5	-0.8		111.4	
1971	769.3	46.6	13.1		118.6	
1972	875.5	69.1	37.3		121.0	
1973	1,038.6	70.5	34.0		129.8	
1974-P	1,318.0	58.4	-6.8		194.7	+123.0
1975-T	1,541.0	46.5	-37.4	-82.5	225.2	
1976	1,681.9	39.7	-45.2		241.6	
1977	1,914.1	124.9	58.3		223.9	
1978	2,167.8	150.8	147.1		206.1	
1979-P	2,568.1	148.3	154.8		230.4	
1980-T	3,080.6	136.4	142.9	-274.9	253.8	+148.6
1981-P	3,593.4	105.9	78.2		314.7	
1982-T	3,610.4	-37.3	-120.1		380.3	
1983	3,615.5	39.8	-23.1		354.7	
1984	3,932.5	108.6	33.0		390.8	
1985	4,623.7	51.6	-58.0		517.2	
1986*	4,958.4	214.4	89.3		544.9	
1987*	5,191.3	257.7	190.6		508.4	
1988*	5,969.8	189.9	114.2		635.6	
1989*	6,316.5	32.4	15.0		826.8	
				-1,029.3		+519.5
1990*-P	6,482.7	-79.6	-201.2		805.6	
1991*-T	5,842.5	-314.1	-603.8		902.2	
1992	6,046.5	-285.2	-838.7		993.3	
1993	6,017.6	-74.1	-600.2		1,027.9	
1994	6,250.1	317.3	151.3		1,039.2	
1995	7,580.8	281.0	-97.1		1,272.6	
1996	8,236.7	177.0	-27.7		1,243.1	

*Excludes Nationair, acharter carrier operating limited scheduled service.

P/T = Business cycle Peak/Trough

Source: Statistics Canada, Catalogues 51-004 (1993-97), 51-202 (1960-69), 51-206 (1970-93) and computer printouts (1994-97).

Roughly the same inverse relationship occurred between delivery cycles and profits in Canada. Above-average deliveries began in 1967, 1972, 1979, and 1988, while pretax profits began to decline in 1969, 1973, 1980 and 1988. Similarly, the final years of above-average deliveries were in 1970, 1975, 1982 and 1992, while the largest pretax losses for each period occurred in 1970, 1976, 1982 and 1992.

Overall, the differences and similarities in the performance of U.S. and Canadian airlines supports the hypothesis that an important inverse relationship exists between above-average aircraft deliveries and decreased profits before taxes.

WHY DO AIRCRAFT HAVE SUCH AN IMPACT ON PROFITS?

Aircraft are expensive. We all know this, but do we really appreciate just how expensive they are? We see dozens of them at airports, and we fly in them as they cover incredible distances in relatively short periods of time, but these contacts really don't convey their true costs. Prices differ by aircraft type, model, quantity purchased, customized equipment and amounts of spare parts ordered, but rough prices can be determined. Next-generation Boeing 737s are currently selling for $35 to $40 million; Boeing 757s for around $65 million; Boeing 767s for up to $100 million; Boeing 777s about $140 million and Boeing 747s up to $200 million.[13] Equivalent Airbus aircraft are priced competitively, and even the 50-seat Canadair CRJ costs around $20 million, with the larger CRJ-700 being priced around $25 million.[14]

Some perspective is provided by comparing aircraft prices with those of office buildings that have much longer productive lives than aircraft. Moderately sized office buildings in the U.S. cost about as much as a Boeing 737, while a new Boeing 747 would be equivalent to a very large office tower. In November 1997, America West Holdings Corp. announced plans to build a nine-story, 225,000 square-feet corporate headquarters building at a price of $37 million. It will accommodate over 700 personnel consisting of all administrative and support functions for America West Holdings and its subsidiaries. That same year American West ordered 34 Airbus A320 and A319 aircraft to add to its 102-aircraft fleet.[15] At a net cost of $1.2 billion, this aircraft order was about 32 times the financial commitment for the corporate headquarters building.[16] Thus, America West with its present and planned fleet of aircraft is equivalent in value to the office buildings comprising the downtown core of a substantial city, one that will grow by about a third in the next few years.

Turning now to the worldwide industry, the annual average 521 aircraft delivered between 1982-97 is comparable to building the downtown cores of, say, five cities each year, with the 192 aircraft delivered to U.S. carriers accounting for just under two of those downtown cores. But these are average figures. In 1991, 844 jet aircraft were delivered worldwide, which is equivalent to the usual five city cores built annually plus those for three more cities. If this

happened just one year it would not be too much of a problem, but it happened again in 1992 (793 aircraft), and an additional one-and-a-half extra "city cores" were built in both 1990 and 1993 -- all this on top of the five built normally each year. With this comparison one can begin to comprehend how ordering and taking delivery of excessive numbers of aircraft on this scale are major economic events that can have serious adverse effects on the airline industry. Furthermore, given the inherent mobility of aircraft, a surplus of aircraft in one geographic region is soon translated to other regions of the world, while real estate is distinctly immobile. Even with the large traffic growth of recent years, in 1997 a total of about 500 aircraft (older "office buildings") were parked, unutilized, including over 200 Stage 3 aircraft.[17]

Obviously, this analogy is only suggestive of the huge scale of resources involved in the commercial air transport industry. Cities need land, roads, water mains, sewers, electricity and communications to support office buildings. Thus, an equivalent utilization of resources in city construction equal to, say, three hundred extra aircraft a year would not all be expended on buildings. But this analogy does provide insights into why airlines incur large losses when they take delivery of too many aircraft in each of several years. The result of too many aircraft is airline losses -- just as constructing too many office buildings results in office vacancies which have adverse effects on real estate markets and the wealth of building owners.

EXCESSIVE ORDERS AS A PREDICTOR OF AIRLINE COSTS

The above analyses demonstrate that excessive aircraft deliveries have consistently resulted in pretax losses for the airlines. Table 1 also makes it clear that excessive deliveries are always preceded by excessive orders. Obviously, keeping track of orders provides a powerful tool to predict airline losses -- above-average orders are invariably followed by above-average deliveries and, then, large losses. Conversely, below-average orders and deliveries yield increased profits. One has to allow for the year or two lead time between orders and deliveries, and normal fluctuations in net orders of aircraft might give a misleading signal, but two consecutive years of excessive orders have always meant that the airline industry will incur losses, and the large swings that have always occurred in the order and delivery cycles generally leave no doubt about what is happening at the time it is happening.

Since individual airlines order aircraft at different rates, not all will suffer the same degrees of losses when too many aircraft are delivered. But, every airline will be influenced to some degree as the industry adjusts to surplus capacity. For example, one result of excess capacity is more intense fare competition as carriers seek to fill their perishable seat capacity. Thus, even airlines who did not order excess aircraft will have to lower fares in competitive city pairs in order to prevent the carrier(s) with excess capacity from diverting traffic, thereby transferring part of their excess capacity to the more restrained airlines.

CONCLUSIONS

This paper does not answer the obvious question about why airline managers have acted as a herd and repeatedly ordered excessive numbers of aircraft. Of course, it takes a strong leader not to follow the pack when the majority of his/her peers are doing the same thing while incurring large profits. 1997 is an excellent case in point -- above-average aircraft orders had been going on for two years in the U.S. and three years worldwide, and profits have been excellent. Therefore, how could managers be sure that ordering more aircraft would bring future losses? One can delay for months, and even a year or so, but shareholders, industry analysts and commentators, and even fellow managers start to wonder why your company is "out of step." It is so difficult to oppose this pressure that it is unlikely that it can be done, even if one knows that once the deliveries begin the profit picture will soon deteriorate.

For many of the same reasons, this kind of excess investment is common in other industries where long-term investment commitments must be made. Given this, it seems likely that the large cycles in airline performance and profits will continue and it behooves those involved in the airline industry to plan accordingly. For example, managers should make sure their airline has sufficient cash reserves to weather several years of losses before ordering large numbers of aircraft, and they shouldn't embark at the same time on mergers or other major activities requiring large expenditures.

Of course, others besides airline managers can use information about the relationship between excessive aircraft orders and airline losses to their benefit. Want to buy a large corporate jet or expand an aircraft leasing company? Wait a few years and purchase aircraft at lower prices from airlines with cash flow problems during periods of excess deliveries and large losses. Want to buy airline stocks? Wait and buy when aircraft deliveries are at a peak, losses are being incurred and aircraft orders are declining. If the airline is basically sound you have good reason to expect that excess deliveries will eventually end, profits will return and stock prices will rise. Want to travel cheaply? Postpone some discretionary long-distance travel until there is again a surplus in airline capacity and promotional fares increase in number and depth. There are always winners and losers in these situations. Airline cycles can mean gains for those who use knowledge about aircraft orders and deliveries to their advantage.

Finally, with regards to public policy, excessive aircraft orders and deliveries occurred three times in the U.S. under regulation, once during the transition from regulation to deregulation, and once under full regulation, with still another period of above-average deliveries starting in 1997. Thus, it is a fundamental aspect of the airline industry that has occurred regardless of economic regulation. As such, it should not be used as a reason to change regulatory policy.

ENDNOTES

1. The support of the Earhart Foundation and the Social Sciences and Humanities Research Council is gratefully acknowledged. The personnel at the Office of Airline Information, BTS, U.S. Department of Transportation (DOT), were of immense help in making accessible public records which provided information on small and obscure airlines, as well as late-filed data that are not included in DOT publications.

2. Aircraft possession costs include rentals, depreciation, amortization of capital leases and interest expenses on the debt used to purchase aircraft.

3. William A. Jordan, "New Aircraft Orders: a Leading Indicator of Airline Profits," *Air Finance Journal*, No. 100 (March 1989), pp. 37-41, esp. p. 41.

4. See Table 2, below. It might be argued that the large loss in 1990 was due in part to the Gulf War crisis that began in August of that year. However, actual combat did not begin until January 1991 and total operating revenues of U.S. airlines experienced a healthy 8.7 percent increase in 1990 compared with a 7.0 percent growth in 1989. In contrast, a significant part of the industry's peak loss in 1990 can be attributed to Eastern and Pan American. Their before-tax losses in that year were $1,115.9 and $637.1 million, respectively (40.2 percent of the industry total), and both carriers went out of business in 1991. Without their large losses, the industry's worst profit year to date would probably have occurred in 1992 (see footnote 12).

5. For example, the $707.1 million profit before taxes in 1966 was equivalent to $2.6 billion in 1990 when adjusted by the GDP implicit price deflator. Calculated from data in U.S. President, *Economic Report of the President, Transmitted to Congress February 1998* (Washington, DC: U.S. Government Printing Office, 1998), p. 284.

6. William A. Jordan, "New Aircraft Orders, Still a Leading Indicator of Airline Profits," *Air Finance Journal*, No. 139 (June 1992), pp. 42-47, esp. p. 47.

7. The importance of this distinction becomes obvious to anyone comparing the net orders for the same year in sequential annual publications. Clearly, orders placed in one year are often canceled or postponed in later years. Between 1955 and 1997, there were 20,942 gross orders compared with 18,864 net orders-- an 11.1 percent difference. Jet Information Services, *World Jet Inventory, Year-End 1997* (Woodinville, WA, March 1998), p. 12.

8. See, for example, Anthony L. Velocci, Jr., "Boeing Finances Hit by Supply Disruptions," *Aviation Week and Space Technology* (October 27, 1997), p. 34; Paul Proctor, "747 Production Resumes, But Delays Mount," *Aviation Week and Space Technology* (November 10, 1997), p. 53; and Paul Proctor, "Boeing Tackles Delivery Delays, Predicts Recovery by Mid-1998," *Aviation Week and Space Technology* (December 1, 1997), p. 50.

9. Christopher P. Fotos, "National Noise Policy Guarantees Quieter Airports by End of Decade," *Aviation Week and Space Technology* (November 25, 1991), pp. 62-63.

10. The data in Table 2 pertain to U.S. certificated route carriers for 1960-80 and, following the elimination of that classification, U.S. airlines operating jet aircraft in scheduled passenger service for 1980-97. Profit before taxes is used as an inclusive measure of airline performance because it is little effected by differing tax policies of various governments.

11. The profit performance of U.S. carriers in 1986-87 was adversely effected by the 20 airline mergers or acquisitions that occurred in those years. This, combined with Pan American's unusually large pretax losses of $471.9 and $274.1 million in 1986 and 1987 makes it difficult to determine the which year would have seen peak profits in the absence of those unusual events. William A. Jordan, "Problems Stemming from Airline Mergers and Acquisitions." *Transportation Journal*, Vol. 27, No. 4 (Summer 1988), p. 29; and U.S. Department of Transportation, *Air Carrier Financial Statistics* (December 1987/1986).

12. Table 2 shows 1990 as the year of greatest pretax losses for the 1986-93 peak delivery period. As discussed in endnote 4, this was probably due to the combined losses of $1,753 million incurred by Eastern and Pan American in their final full-year of operations. This unusual situation prevents an unambiguous determination of whether the largest losses in this cycle would have occurred in 1990 or 1992 under "normal" circumstances. 1992 is used in this paper because excluding Eastern and Pan American in 1990 results in pretax losses for the remaining U.S. carriers of $2,610.5 million in 1990 compared with $3,844.1 million in 1992. Calculated from data in Table 2 and U.S. Department of Transportation, *Air Carrier Financial Statistics* (December 1991/1990).

13. Calculated from data in *Aviation Week and Space Technology* (November 20, 1995), pp. 28-29, and (June 30, 1997), pp. 62-63.

14. Calculated from data in *Aviation Week and Space Technology* (January 27, 1997), p. 21; and (February 24, 1997), p. 30.

15. *Aviation Week and Space Technology* (November 17, 1997), p. 23; and America West Holdings Corp., *Annual Report, 1997* (April 1998), inside front cover, pp. 14 and 22.

16. Ibid., *Annual Report, 1997*, p. 53. America West also purchased six new V2500-A5 spare engines for $42 million -- $5 million more than the cost of its corporate headquarters.

17. Supra note 7, p. 8.