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FORUM

YIELD MANAGEMENT

Carlos Alberto Castro Peña

HISTORY

Historically, airlines have operated in a tightly regulated environment. This environment has been regulated by governments and self-regulated through organizations such as the International Air Transport Association (IATA)

The early airline policy for the fare activities was based on offering all the seats on the airplane (or in the coach of the airplane) at the same rate. When the industry entered the 1960s with bigger and faster planes, new types of fares were being approved by the Civil Aeronautical Board (CAB) on certain routes, including lower-night coach fares, and tour-basing fares. There were no capacity controls on these fares. All of the seats were up for grabs and were sold on a first come, first-served basis, provided only that the conditions of the fares were met.

By the end of the sixties, airlines were looking at day-of-week load factor patterns and introduced midweek and weekend fare differentials to stimulate new demand for low load factor flights. High-season and Low-season differential fares were also in place.

At the same time as these new fares were being implemented, the move toward deregulation of the economic aspects of the airline industry was gaining speed. By the mid 1970s the carriers were aware that deregulation was going to happen. Intra state carriers like Southwest Airlines in Texas and Pacific Southwest in California, which were not subject to federal fare regulations, were filling up their planes with a low-cost, low-fare product and making money doing it. This caught the attention of consumers, legislators and regulators alike.

DEREGULATION

A revolution in the airline industry occurred with airline deregulation. Deregulation began a series of events that changed forever the U.S. domestic airline industry and increasingly affects the airline industry worldwide. During the evaluation of this new law or Deregulation as is known, there was a good deal of controversy, Howard W. Cannon, who was a United States Senator, and Alfred E. Kahn former Chairman of the CAB, had strong opinions in favor of Deregulation. Important elements of their testimony are expressed below:

1. The need for competition in the marketplace. The three forces of supply and demand in the market could do a better job of allocating resources than a central authority. Artificial barriers to exit and entry from the market would be eliminated, encouraging new firms to compete and fares to be

established on a competitive basis. Inefficiency would not be rewarded with higher fares to cover marginal routes. Instead, carriers could drop unprofitable routes.

2. Commuter carriers could best serve low-density markets. Smaller carriers with appropriate equipment could better serve low-density traffic points than larger carriers, which received either a subsidy or higher fares to cover the costs of serving such points.

Among the persons against of the Deregulation were George McGovern, former United States Senator and Albert V. Casey, former President of American Airlines, Inc. The following are important aspects of their testimony:

1. Regulation has served the public interest as well as the interests of the carriers. Regulation has checked the forces that might create extreme

Yield Management

competition on the one hand or monopoly on the other. Evidence of success is the fact that the rise in passenger fares over the years has been lower than the rise in the Consumer Price Index.

2. Unbridled competition would result in only temporary allocative efficiency. Carriers would undercut each other's fares with the eventual result that only the larger companies would survive (survival of the fittest). Fares would then rise when few competitors remained in the market.
3. Smaller communities might lose service. Commuter carriers might not be willing or able to serve some markets. Furthermore, the community might not accept them once the established carrier dropped service.

When Deregulation did happen it changed the industry in important ways:

1. Route entry. On January 1, 1982, the CAB lost virtually all of its control over entry into the air transportation business or entry by carriers into new markets. Under the new law, a certificate is still required, but it has generally been freely given, regardless of the statutory fitness standard. However, despite the fact that carriers have picked up a number of formerly dormant and other new certificates in the past five years, very few of these certificates have been utilized. The economic recession in the early 1980s unquestionably, was a major factor.
2. Route exit. The revised law allows the air carriers much greater flexibility in dropping markets than 1958 act. Which mandated and extensive CAB approval process. Under the revised law, a carrier has only to give the CAB 90-days' notice of its intention to exit a particular community. However, during a 10-year transition period, the CAB (and the department of transportation after 1985) has been given the power to require the last carrier serving a community to maintain what is called "essential air service" until a suitable replacement carrier can be found. Congress also guaranteed subsidy to provide service to such communities if needed.
3. Rates and Fares. As of January 1, 1983, the CAB effectively lost all of its authority over airline passenger fares (it already had lost most of its

power over air freight rates by that date) Although the carriers still maintain a private system of passenger and air freight tariffs, the old system of tariff filling and the lengthy approval process have been abolish.

4. Federal preemption. Until the 1978 act, there were no federal statutes preempting state economic regulation of air transportation. The new law provides that no state or political subdivision and no interstate agency may enact or enforce any law or regulation concerning rates, routes or services of any carrier to provide interstate air transportation. The intent here was to preclude the possibility of having 50 CABs.

One of the most tangible results of this revolution was an explosion in the number of fares offered in the marketplace. Fare aspect was a very critical area for airline growth, and the lack of technology had a direct effect on fare policy. For instance, fares were published in books which reservations agents used to identify the appropriate fares for a given markets. Because the pricing of an itinerary was manual, rules and fares had to be relatively simple. Also, because the books had to be printed and distributed, fares could not change very often. With the advent of Computer Reservation System (CRS) and its cousins the Global Distribution System (GDS) tariff books became a thing of the past and prices could change very rapidly.

In this time of period (1970s), the demand for more discount fare products increased dramatically. The Civil Aeronautical Board responded by easing regulations for charter airlines, and opening the way for several new types of charter products. However, discount fares for scheduled airlines were still highly restricted and limited to certain markets. The charter airlines began to offer what were called "public charters" that would enable them to sell seats on what amounted to quasi-scheduled service.

The threat of the public charter was a matter of great concern for all scheduled airlines. When the airlines reached the point where they could no longer reduce costs, they returned to the search for better technology. However, no airline was completely prepared for the scope of changes caused by deregulation to the pricing environment.

The airlines developed new procedures and technology in order to be the largest carrier. Many wanted to become not only a national carriers, but an international one as well. Each wanted to be the airline of the business

traveler. Everyone tried to out-do the other to attract this customer, including frequent flier programs, special privileges for high-mileage travelers and new aircraft. The new aircraft were a critical part of this growth. Customers clearly preferred new to old, or so management hoped. One of the most worried airlines in this new environment was American. Years later, American CEO, Bob Crandall, who was the Senior Vice-president-Marketing for the airline, explained the mood "This was driving us crazy. They were going to fly from New York to California for some amount of money that was a hell of a lot less than we had to charge." He was talking, of course, about the public charter. American had to find a way to compete but they could not possibly produce seats as cheaply as the charter airlines, or so they initially thought.

Their planes were currently flying, on average, half-empty. They were already producing seats cheaper than the charter operators could hope to produce. "If we could figure out a way to sell those empty seats at the prices the charter guys proposed," thought Crandall, "We would make a lot of dough." However, there were huge problems to be overcome. Those were preventing the people who would pay the higher fare from switching to the lower fares and ensuring that only those seats that would otherwise fly empty were sold at the lowest fare level. This was the beginning of modern day Revenue Management.

American's Solution was called "Super Saver Fares," which were capacity-controlled, restricted discount fares. It was introduced to the market on April 25, 1977. This methodology was highly successful. The challenge was just beginning for them as they realized how carefully the availability of the Super Saver seats needed to be controlled in order to maintain profitability.

They started the new system with basic allocations of about 30% of the seats on each flight assigned to Super Saver discount fares, and also to complement the system they implemented new strategies, such as advance purchase. Discount seats required 21-day advance purchase. If they did not allocate enough seats far enough in advance, the planes would depart with empty seats.

Before long, however, American's executives recognized the fact that each flight behaves differently by time of day and day of week. Therefore, they began to study the behavioral characteristics of each flight, on each day of the week. In addition large computer systems were developed to forecast and monitor passenger demand. The objective was to sell the right seat to the right passenger for

the right price at the right time.

The inventory seat method became a system, and it was Bob Crandall who is credited for giving this, the initial inventory management process a formal name. He thought, the term, "yield" was commonly used to measure revenue per passenger mile, so, recognizing that the seat allocations affected the passenger yield, Crandall decided to call it "Yield Management".

YIELD MANAGEMENT

Despite widespread allegations that deregulation resulted in billions of dollars in consumer saving, the truth is that prices were falling faster before deregulation than after it. Inflation-adjusted yields declined 2.5% annually from 1950 to 1978; they fell only 1.7% a year after 1978. In the decade preceding 1978, fuel adjusted real yields fell 2.7% annually; in the decade following promulgation of the Airline Deregulation Act of that year, fuel adjusted yields declined only 1.9% a year.

In addition, the full fare has risen to such prohibitive levels that only those who absolutely must will pay it (only 10% of passenger do).

It is for all these reasons the airlines sought the best way to optimize their profits, developing different methods, and strategies that would allow the companies to maximize revenues. The best option created was the Yield Management. Its philosophy was used by different companies under different names, as is every new technology, or process, but it showed itself to be most effective. It brought the stability needed for the airlines to continue in the aviation business, and to fend off the innovative charter carriers.

Yield Management or Revenue Management as is also known, can be defined as the process of selectively accepting or rejecting reservations requests to maximize revenues. The basic premise behind airline yield management is relatively simple: make seats that are expected to go unsold available at a lower fare to the passenger who would otherwise not travel, while at the same time ensuring that these lower fares are not purchased by passengers who are willing and able to pay a higher fare. The optimal mix of short-haul and long-haul passenger in an airline route network is obtained by selling the right seat to the right customer, at the right price, at the right time to maximize system revenues and profitability. This goal is accomplished by setting reservation availability based on the value of the reservation request.

Yield Management

The success of Revenue Management in the airline fare wars of the early 1980's was the validation of an important new management technique. In 1987, The Massachusetts Institute of Technology awarded a Doctor of Philosophy degree Peter Belobaba for his description of the airline fare optimization issue and the development of the Expected Marginal Seat Revenue (EMSR) model. This was the first widely applied optimization method for controlling the number of discount seats airlines offer.

Effective airline yield management consists of two distinct components (Belobaba 1987a) as follows:

- **Differential pricing:** this is the practice of offering a variety of fare products differentiated in terms of service amenities and /or travel restrictions, at a variety of price levels.
- **Seat Inventory control:** this is the practice of determining the number of seats on a flight to be made available for sale to a particular fare product, limiting low-fare seats and protecting seats for later-booking, by higher-fare passengers, as necessary.

The principal tool used by the airlines for developing Yield Management has been the effective and consistent use of technology. The level of technology is a very important aspect to develop in order to achieve the goals of the system and of course of the company because the level of technology dictates the sophistication of the Yield Management process to generate incremental revenues. It is the reason that many carriers have been gaining revenue advantages (as opposed to cost advantages). This fact has historically been the justification for carriers to spend millions of dollars developing, even more sophisticated yield management systems.

Yield management systems are extremely complicated to set up and maintain. They require complex hardware and software. They demand a constant stream of data. Prices under these systems are set and reset frequently, often many times each day.

Collecting reservations holding data periodically from a reservations system is a relatively straightforward process, since data are already stored at this level of detail. From the demand forecast generated, leg-or segment-based inventory controls are then computed and updated on the airline's host Computer Reservations System (CRS).

Indeed the first phase in the evolution of the Yield Management was the developing of the relatively basic simple database management systems designed to collect

and store historical flight booking data. Periodic (usually nightly) extracts or "snapshots" of the current inventory and booking levels in the airline's reservation system are downloaded and stored in a historical booking database.

The second generation Yield Management systems compare historical booking patterns were generated from the database with actual bookings on future flights, and they issue "exception reports" to the analyst, listing only those future departures that meet a predetermined set of criteria.

The fact is that CRS is one of three key reasons, which have precipitated the growth of the airline industry from a predominantly regional industry to a national and international industry dominated by mega carriers. The other two keys are internal yield management automation, which is clearly represented in the third phase in the evolution of Yield Management systems. It involved the incorporation of mathematical models for forecasting, optimization, and over booking. The third key reason is the developing of the extensive hub system now in place.

OBJECTIVES

What is the purpose of the Revenue Management? How does it work? How should an inventory analyst determine discount seat allocation?

The purpose of the Revenue Management or Yield Management is to maximize the revenue of the airlines. Another goal of this methodology is to reduce the consumer surplus. The consumer surplus is defined as the benefit that a consumer obtains when he or she can get a service or product with a lower price considering that the consumer would otherwise pay a higher price. The yield management also permits the airlines to established their prices strategies and respond quickly to changes in prices of their competitors. Additionally, Yield Management tries to manage the supply/demand relationship for a market controlling the capacity or output and its price. This methodology has been very important for the airlines after deregulation because the price and frequency are the principals indicators for the consumers.

The Revenue Management works as follow. The airlines recollect historical data of the number of passengers that have traveled and how much they paid in each class. With this information, the airline estimates the demand function for every class. The demand estimation is very critical because it permits the airline to know the elasticity or sensitivity of the consumer to the change in prices. The demand function also permits built the

probability that one passenger or group of passenger get this fare. With this information the airline knows how people respond to its prices and the expected number of passengers. After that the airline establishes the capacity and the prices and compares the estimated booking with the real one. When the fare classes are not full and the flight is approaching to the departing, the analysts take the decision about if they have to open a new class or give a bigger discount. This is in a very basic idea of how Yield management works. Some new concepts have been developed such as Virtual nesting. This technique permits the airlines to manage the revenue for a flight that goes

through a network instead of analyzing just one leg or market.

For a better understanding of the Yield Management an example is shown from Northwest airlines.

How can the analyst determine the number of discount seat allocations? Let us, suppose that we have the distribution frequency for the Class Y, Class B and C of certain flight in certain market. The Class Y is the full fare and B and C are discount classes and are nested. It means that the total number of seats equals to Y. The information is presented in the next table.

Table 1 Expected Marginal Seat Revenue

Class Y			Class Y			Class Y		
Fare	200		Fare	120		Fare	100	
Av. #			Av. #			Av. #		
PAX	15		PAX	20		Av. # PAX	35	
SD	7		SD	4		SD	15	
Pax	Acc. Probability	Expected Marginal Seat Revenue	Pax	Acc. Probability	Expected Marginal Seat Revenue			
1	97.7	195.4500	1	100.00%	119.9998			
2	96.80%	193.6700	2	100.00%	119.9995			
3	95.70%	191.3500	3	100.00%	119.9987			
4	94.20%	188.3900	4	100.00%	119.9961			
5	92.30%	184.6900	5	100.00%	119.9893			
6	90.10%	180.1500	6	100.00%	119.9720			
7	87.30%	174.6900	7	99.90%	119.9307			
8	84.10%	168.2700	8	99.90%	119.8380			
9	80.40%	160.8600	9	99.70%	119.6424			
10	76.20%	152.4900	10	99.40%	119.2548			
11	71.60%	143.2300	11	98.80%	118.5330			
12	66.60%	133.1800	12	97.70%	117.2699			
13	61.20%	122.4900	13	96.00%	115.1929			
14	55.70%	111.3600	14	93.30%	111.9831			
15	50.00%	100.0000	15	89.40%	107.3220			
16	44.30%	88.6400	16	84.10%	100.9613			
17	38.80%	77.5100	17	77.30%	92.8047			
18	33.40%	66.8200	18	69.10%	82.9754			
19	28.40%	56.7700	19	59.90%	71.8447			
20	23.80%	47.5100	20	50.00%	60.0000			
21	19.60%	39.1400	21	40.10%	48.1552			
22	15.90%	31.7300	22	30.90%	37.0245			
23	12.70%	25.3100	23	22.70%	27.1952			
24	9.90%	19.8500	24	15.90%	19.0386			
25	7.70%	15.3100	25	10.60%	12.6779			
26	5.80%	11.6100	26	6.70%	8.0168			
27	4.30%	8.6500	27	4.00%	4.8070			
28	3.20%	6.3300	28	2.30%	2.7300			
29	2.30%	4.5500	29	1.20%	1.4669			
30	1.60%	3.2100	30	0.60%	0.7451			

The total of Passenger in class Y is 30. Now the question is the following: using the information in the table how many seats of Y, B and C do we have to allocate? The answer is easy, if we have the demand estimation module that gives us the distribution of the number of people per type of fare. In this case, we know that on average 15 people fly in class Y. Using the concept of Expected Marginal Seat Revenue (EMSR: multiply the cumulative probability for the passenger X by the fare level) we can estimate how many seats of Y we have to sell. In this case is 13' because this is the point where the EMSR is equal to our next fare level in this case is 120. The same logic can be applied to the class B. The next class, fare C, is 100 so we have to sell 16 seats of B and then we can follow the same procedure time after time. In conclusion, we have to sell:

- 13 seats of Y class @ 200 dollars
- 16 seats of B class @ 120 dollars
- 1 seat of Class C @ 100 dollars

Total expected revenue: \$4.260

It is the work developed by the Yield Management analyst, who studying every market movement and collecting daily information to maintain their database completely update, and producing the more responsible and reliable decision for the company.

Yield or Revenue Management is a procedure that looks for maximizing the demand curve in order to obtain the most revenue for the company.

Figure 1 Demand Curve

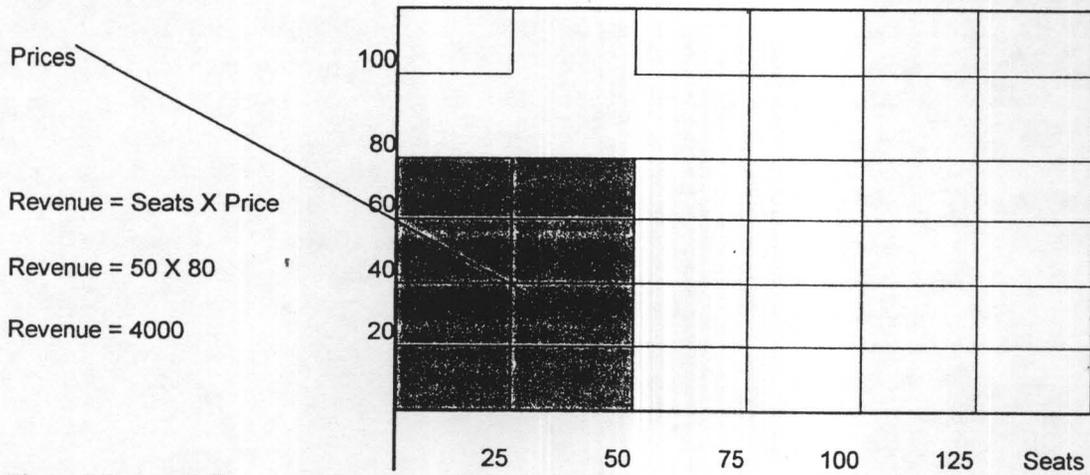


Figure 2 Demand Curve

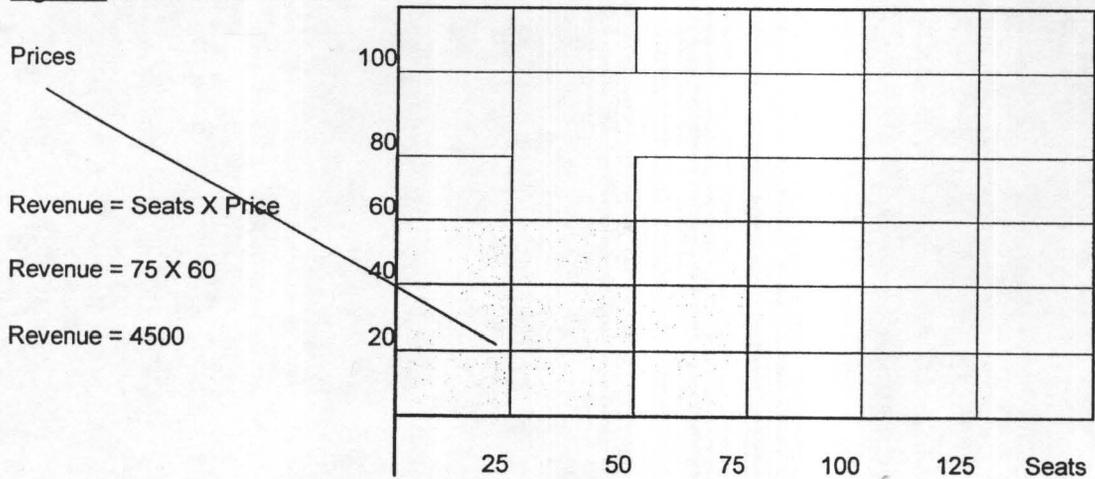
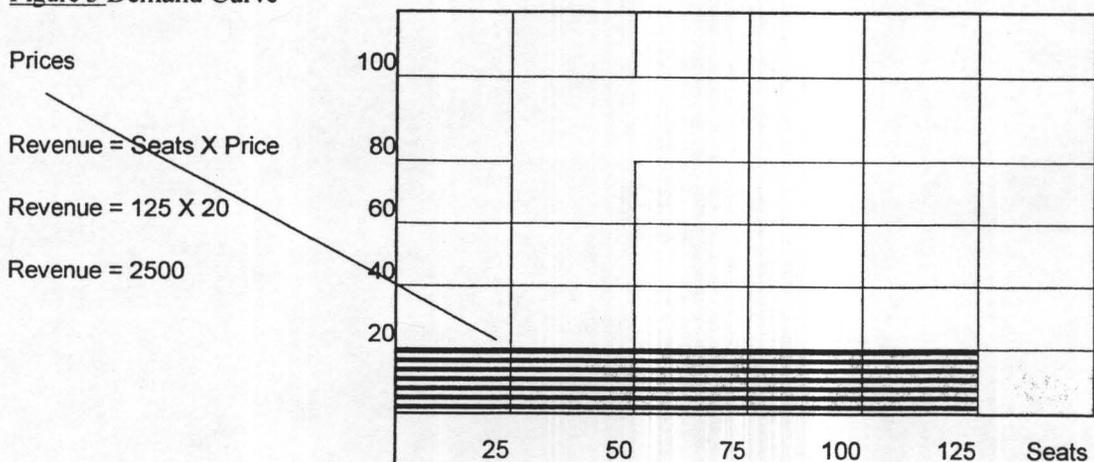


Figure 3 Demand Curve



The revenue is obtained applying a basic mathematical operation, which is based on calculating the area below the curve. In this case, it is that of a geometric figure, a rectangle, and its area represents the calculated by the formula of multiplying base by height.

The initial thought could be to sell all the seats at the highest price, but just a limited quantity of people would be willing and able to pay this fare, and therefore this fare will generate less revenue than selling some seats at reduced cost. However, as it is shown on this graphic the highest quantity of persons willing and able to pay for the seat are found at the lowest price, as the demand laws establish "the demand of a product rises as its prices falls". However, low prices could result in a loss for the airline due to this price will generate a lower revenue than the revenue expected selling part of the seats at the highest price.

The most convenient solution for this flight will be sell the seats at the price B where the more highest quantity of people will be willing and able to pay the fare for the seats. This strategy can also insure that the total revenue for the flight will be the highest.

CONCLUSION

Deregulation has tended to generate a greater number of alternative fares and to increase both fare and schedule volatility. In a volatility environment, airlines have to decide quickly which of their competitor's actions need to be matched and which are of little consequence. An airline also has greater opportunity in such environments to take a proactive approach towards its own pricing tactics.

Yield Management has been one of the most important tools used by the airlines for maintaining the stability of its business. Claims have been made that a good, basic yield management system can boost revenues by up to ten percent. It can also impose management discipline. Traffic is tangible and clearly visible at departure time whereas, in the absence of a YMS, revenues and yields are known only days or weeks later and profits come to light even further into the future. Yield statistics

might not be disaggregated on a segment-by-segment or route-by-route basis. Airlines could not know their behavior on specific market or route. Thus, they could not establish or even change their marketing strategies. The benefits of Yield Management are clear.

Finally, the utility of Yield Management is not limited to getting a few incremental bottoms onto otherwise empty seats. It can form the technological basis underpinning much wider limited-period promotions, combining the advantages of both filling off-peak capacity and raising or reinforcing an airlines market profile.

Yield Management are vital in a competitive market, particularly when the competition has such a system deployed. Nonetheless, it also needs to be treated with caution, for the following reasons.

Yield Management models are simply tools which airlines can use to help them slide up and down the demand curves for individual products. These can control the speed and extent of the slide. What they cannot do is create demand which is profitable in the long run if people are unwilling to pay the prices to ensure profitability, given the nature of the products offered and a particular airline's cost structure. In addition, YMS cannot create demand for a specific market. There are many cases related with airlines which did not develop the system in the best way, such as was the case of the big white and blue American airline "Pan Am". Pan Am flew empty airplanes to places such as, Pago Pago, Rabat, Monrovia, Lagos. "In 1968, Pan Am announced that it would offer nonstop 707 service to Moscow? In the Soviet Union? Who in 1968, other than the odd tourist and few spies, would pay to travel to Moscow?" Why, just "because we are Pan Am, and we supposed to fly exotic places". In the specific case of Pan Am, we can find in the books *Skygods*, comments such as "We built this airline," or from the services director who said "The Pan Am culture was in our blood." Pan Am as well as other airlines showed that it and other companies were not prepared to cope with the challenge of a free market caused by Deregulation. □

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