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How Airline Markets Work . . . or Do They?
Regulatory Reform in the Airline Industry

Severin Borenstein and Nancy L. Rose

2.1 Introduction

Government policy, rather than market forces, shaped the development and operation of scheduled passenger air service in almost all markets for the first six decades of the airline industry's history. Intervention in commercial aviation coincided with the industry's inception in the aftermath of World War I, with many governments keenly cognizant of the potential military benefits of a robust domestic aviation sector. During these early days, interest in aviation outpaced the financial viability of fledging airlines. Government support intensified worldwide as financial instability was exacerbated by the global economic depression in the 1930s and military interest in aviation was fortified by increasing geopolitical tensions. Relatively low entry barriers, combined with the lure of government subsidies, led to many small providers of passenger air transportation, and to concern over fragmentation and "destructive competition."

Pressure to rationalize the industry and promote the development of

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strong national air carriers became manifest in subsidies and regulation of privately owned firms in the United States, and in state ownership nearly everywhere else. In the United States, Post Office control through airmail contract awards ultimately gave way to direct economic regulation of prices and entry by an independent regulatory agency in 1938, though both direct and indirect subsidies through airmail rates continued as part of that regulation.[1] In Europe, state subsidies quickly evolved into consolidation and state ownership of domestic "flag" carriers. Restrictions on foreign ownership of domestic air carriers were universal.

International service was governed by tightly controlled bilateral agreements, which specified the cities that could be served and which carriers were authorized to provide service, typically a single carrier from each country. In many cases, these agreements negotiated market allocations across carriers that were enforced through capacity restrictions or revenue division agreements. Prices generally were established jointly by the airlines themselves, under the auspices of the International Air Transport Association (IATA), subject to approval by each carrier's government.

The transition to a more market-based aviation industry began in the United States in the mid-1970s. The Airline Deregulation Act of 1978 eliminated price and entry regulation of the domestic airline industry and provided for ultimate closure of its regulatory agency, the Civil Aeronautics Board (CAB). Subsequent privatization efforts elsewhere transferred many carriers from state-owned enterprises to the private sector, though the United States and most other countries continue to claim a national interest in domestic ownership of airlines operating within their borders. While there has been relaxation of regulation in some international markets, restrictive bilateral agreements continue to limit competition in many important markets and most nations continue to limit foreign ownership of domestic airlines. The notable exceptions are within the European Union (EU), where formal restraints on commercial aviation have been liberalized considerably over the past fifteen years, with the creation of an open intra-EU aviation market, and a limited number of "open skies" agreements.[2] Apart from the

1. The 1938 legislation also provided for federal authority over airline and airport operations. Ultimately, system operations, certification, and safety regulation were concentrated in the Federal Aviation Authority, leaving the Civil Aeronautics Board (CAB) responsible for the economic (price and entry) regulation that is the focus of this chapter.

2. The US State Department lists 107 U.S. Open Skies partners since the first agreement was signed with the Netherlands in 1992, though some agreements are provisional or not yet in force. See http://www.state.gov/e/eb/rls/othr/ata/114805.htm, accessed January 15, 2013. The multilateral US-EU open skies agreement was negotiated following the European Commission's nullification of bilateral open skies agreements between the United States and individual EU member countries, with a substantial liberalization taking effect in March 2008 and modest additional liberalization agreed to in a 2010 extension. Its breadth has been extended as some non-EU countries, such as Iceland and Norway, have since joined the US-EU open skies agreement. Continued US limits on foreign ownership of domestic air carriers and denial of EU carrier rights to cabotoge within the United States remain contentious, however.

EU market, however, carriers continue to be prohibited from competing for passengers on flights entirely within another country (so-called cabotage rights).

In this chapter, we analyze government regulation and deregulation primarily in the context of US. domestic airline markets. This choice is dictated by three considerations. First, intervention in passenger aviation took place through an explicit formal regulatory system in the United States, rather than through the more opaque operation of state-owned enterprise as elsewhere. Focusing on the United States enables a clearer discussion of government policies, their changes, and effects. From the inception of air travel, the United States has led the world in incorporating market incentives into its airline policies. While nearly every other country operated one or two state-owned airlines that dominated service, the United States relied on privately owned carriers and even under regulation allowed the airlines substantial autonomy in their operations. Second, until the EU changes in the late 1990s, policy reform has taken place primarily within domestic aviation markets. As the United States has had the largest domestic passenger aviation market in the world, it provides a substantial "laboratory" for observing the effects of policy changes. The United States also was the first to deregulate airline pricing and entry, leading nearly all other countries by more than a decade, thereby providing a longer postreform period in which to study the transition across regimes. Finally, and perhaps most importantly, the US government has collected and published detailed financial, operational, and market data at the individual-carrier, and in many cases, carrier-route, level from the regulated era and continuing through to the present. These unique data resources facilitate detailed econometric analyses that typically cannot be duplicated with the data that are publicly available on airlines in other countries. The availability of these data over much of the past thirty or more years has facilitated a wealth of analysis of regulatory reform and its impact.[3]

In this chapter, we first describe briefly the inception, institutions, and operation of US airline regulation. We then turn to a discussion of the events leading to deregulation of the industry and evaluate the impact of those reforms. A brief discussion of international aviation regulation and reform follows. Finally, we study the key issues of ongoing contention in the industry and assess their implications for the continuing debate over government intervention in passenger aviation markets.

3. These data are now used to study aspects of firm behavior not directly related to regulation, but of broad interest to industrial organization economists, firms, and policymakers. See, for example, studies of entry determinants and incumbent responses (e.g., Berry 1990, 1992; Whinston and Collins 1992; Goolsbee and Syverson 2008) and price level and structure determinants (e.g., Borenstein 1989; Hurdle et al. 1989; Borenstein and Rose 1994; Gerardi and Shapiro 2009; Morrison 2001; Berry and Jia 2010).

2.2 Airline Regulation

The US federal government began using private air carriers to supplement military airmail carriage in 1918, with early payloads devoted primarily to mail, not passengers. The Kelly Air Mail Act of 1925 (43 Stat. 805, 1925) established a competitive bidding system for private air mail carriage, and subsequent amendments provided explicit subsidies by enabling the Post Office to award contracts with payments exceeding anticipated air mail revenues on the routes.[4] These subsidies, along with Ford Motor Company's introduction of a twelve-seat aircraft in 1926, facilitated the expansion of passenger air service in the nascent US air carrier industry. By the 1930s, reports of the postmaster general's efforts to "rationalize" the route system and encourage the "coordination" of vertically integrated, national firms in the bidding process led to congressional censure and 1934 legislation to establish regulatory oversight by the Interstate Commerce Commission (ICC). This was soon replaced by the Civil Aeronautics Act of 1938, in which the industry succeeded in establishing a system of protective economic regulation under what eventually became the Civil Aeronautics Board, and operational and safety oversight under what was to become the Federal Aviation Administration (FAA).[5] Our analysis focuses on economic regulation and deregulation.[6] FAA operational and safety functions have not been deregulated, and there is little evidence of significant interactions between economic and safety regulation in this setting (see Rose 1990, 1992; Kanafani, Keeler, and Sathisan 1993, and the citations therein).

As in many other industries during the Great Depression, airline policymakers and executives alike were eager to trade the "chaos" of market determination of pricing and network configuration for government "coordination" across air carriers, elimination of "unfair or destructive competitive practices," and restriction of entry to that required by the "public convenience and necessity."[7] Perceived national defense interests in a robust

4. See Wolfram (2004) for an analysis of the performance of the early airmail contract award process.

5. Civil Aeronautics Act of 1938, 52 Stat. 977 (1938), amended in 1958 by the Federal Aviation Act of 1958, 72 Stat. 731, 49 U.S.C. §1341 (1958). In addition to economic regulation, these acts extended government oversight to aircraft certification, safety regulation of airline operations, airport development, and the air traffic control system. The safety functions were unaffected by changes in economic regulation, and are beyond the scope of the present analysis. We discuss infrastructure policy in section 2.5.

6. This section is not intended to duplicate the many excellent treatises on the history of airline regulation. See Caves (1962) and Levine (1965) for detailed discussions of the early airline industry and its regulation in the United States. These sources, along with Jordan (1970), Eads (1975), Douglas and Miller (1974a), Bailey, Graham, and Kaplan (1985), and many others, provide excellent analyses of the regulated era. See Rose (2012) for a discussion of some lessons from airline regulation highlighted by Fred Kahn.

7. 49 U.S.C. §1302, 1371 (1958). The exchange of government coordination and regulation for the "destructive competition" of the market was echoed in the origin of trucking regulation under the Motor Carrier Act of 1935, for example. See Kahn (1971, vol. 2, chap. 5).

domestic airline industry added to the appeal. To this end, the CAB was charged with "the promotion, encouragement and development of civil aeronautics," and given authority to accomplish this through control of entry, rate levels and structures, subsidies, and merger decisions.[8]

Economic regulation of the US airline industry persisted over the subsequent four decades in largely unchanged form. Two elements of regulation are most salient for this analysis: entry restrictions and rate determination.

When the CAB was formed in 1938, existing carriers were given "grandfathered" operating authority over their existing markets, as is typical in regulatory legislation. The CAB interpreted the public interest in avoiding destructive competition as implying a high hurdle for proposed new entry, effectively ruling out de novo entry of any new national ("trunk") scheduled passenger service carrier after 1938. During World War II and its immediate aftermath, the CAB bowed to pressure to authorize entry by carriers providing service to and from smaller communities. These "local service" carriers were sparingly certified and restricted largely to "feeder" routes that avoided competition with existing trunk carriers. By 1978, they still accounted for fewer than 10 percent of domestic revenue passenger miles (RPMs).[9] Mergers led to gradual consolidation in the market, with eleven of the sixteen original grandfathered trunk airlines and a dozen local service and regional carriers still operating in the late 1970s (Bailey, Graham, and Kaplan 1985, 15). This consolidation occurred against a backdrop of explosive traffic growth, with compounded annual growth rates of 14 percent to 16 percent in passenger enplanements and revenue passenger miles between 1938 and 1977 (see figure 2.1).

Expansion by incumbent carriers was similarly subject to strict oversight. As the Federal Aviation Report of 1935 argued: "To allow half a dozen airlines to eke out a hand-to-mouth existence where there is enough traffic to support one really first-class service and one alone would be a piece of folly" (in Meyer et al. 1981, 19). Trunk carriers wishing to expand onto routes served by an existing airline were required to show that their entry would not harm the incumbent carrier. The CAB only gradually allowed expansion of the trunk carriers to erode the highly concentrated route structure preserved in the grandfathered route networks. Growth of the local service carriers was largely stifled until the mid-1960s, when political pressure against the rising subsidies they were receiving convinced the CAB to allow them to enter into some profitable higher-density trunk markets. This system resulted in no more than one or two carriers authorized to provide service in all but the largest markets. In 1958, for example, twenty-three of the hundred largest city-pair markets were effectively monopolies; another fifty-seven were

8. 49 U.S.C. §1302 (1958).
9. A revenue passenger mile is one paying passenger flying one mile on a commercial flight.

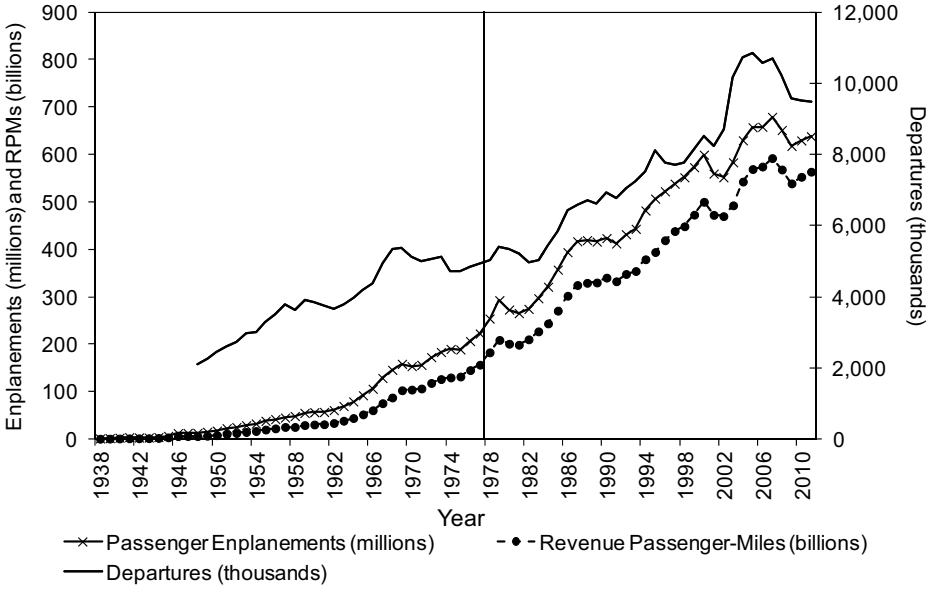

Fig. 2.1 US airlines domestic passenger traffic, 1938–2011

Sources: Data for 1938 to 1995 are from Airlines for America, Inc., "Annual Traffic and Ops: US Airlines," last modified June 7, 2008, accessed September 16, 2008, http://www.airlines.org/economics/traffic/Annual+US+Traffic.htm. Data for 1996 to 2011 are from Bureau of Transportation Statistics, RITA BTS, "US Air Carrier Traffic Statistics through September 2012" (Customize Table-Operating Statistics-System Scheduled Passenger Services), accessed January 15, 2013, http://apps.bts.gov/xml/air_traffic/src/index.xml.

Notes: Domestic scheduled revenue passenger miles and passenger enplanements, system-wide departures (includes international operations).

effectively duopolies; and in only two did the three largest carriers have less than a 90 percent share.[10]

The CAB's authority over route-level entry gave it control over airline network configurations. Over time, the CAB used this authority to generate implicit cross subsidies, awarding lucrative new routes to financially weaker carriers and using these awards as "carrots" to reward carriers for providing service on less-profitable routes (Caves 1962, chap. 9). Thus, carrier networks were optimized to maintain industry stability and minimize subsidies, but had no necessary connection to cost-minimizing or profit-maximizing design. Though there were concentrations of flight activity in airports at large population centers, the resulting networks were generally "point-to-point" systems, as illustrated in trunk carrier route maps (see figure 2.2 for an example). Moreover, the regulatory route award process largely

10. Caves (1962, 20). This defines monopoly markets as a single carrier with 90 percent or greater market share; duopoly as two carriers with a combined 90 percent or greater market share.

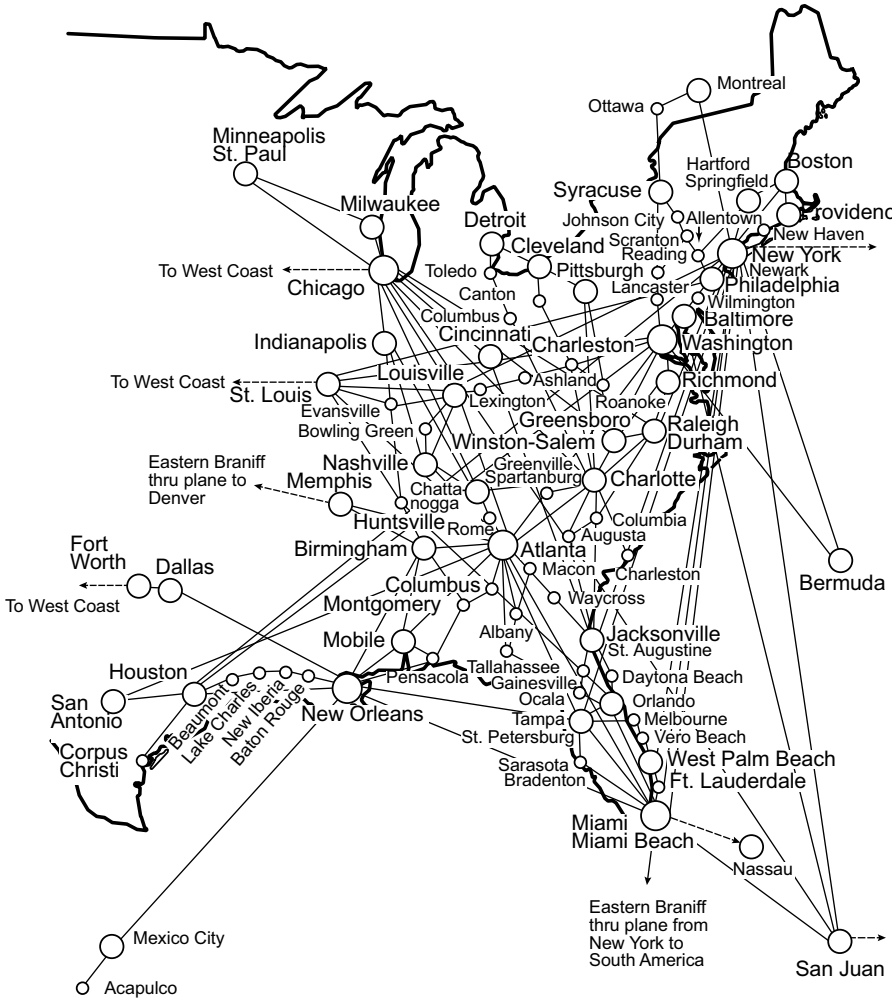

Fig. 2.2 Sample regulated era route map, Eastern Airlines, 1965

Source: www.airchive.com (http://airchive.com/html/timetable-and-route-maps/-eastern-airlines-timetables-route-maps-and-history/1965-june-1-eastern-airlines-timetables-route-maps-and-history/6842, accessed January 15, 2013).

prevented airlines from reoptimizing their networks to reduce operation costs or improve service as technology and travel patterns changed.

Rate regulation was the second key component of government control. The CAB was authorized to restrict entry in order to prevent destructive competition, but monopoly routes raised the specter of monopoly pricing, another concern of legislators during the 1920s and early 1930s. Authority over rates was therefore deemed essential. An interesting transition occurred between the 1934 act, which focused on maximum rates and elimination of

excess profits, and the 1938 act, which gave the CAB authority over minimum, maximum, and actual fares, at its discretion. Attention shifted from restraining market power in rate setting toward ensuring profit adequacy. Control over fares was one tool given to the Board; another was authority to set airmail rates "sufficient to insure the performance of such service, *and together with all other revenue of the air carrier*, to . . . maintain and continue the development of air transportation to the extent and of the character and quality required for the commerce of the United States, the Postal Service, and the national defense" (italics added, 72 Stat. 763, 49 U.S.C.A. 1376, in Caves 1962, 129).

In keeping with this focus, the Board approved general fare increases initiated by carriers and used the level of airmail rates and selective route awards to adjust profits toward implicit, and later explicit, target levels. Proposed discounts were viewed with skepticism and typically disallowed on the grounds that they disadvantaged competitors or were unduly discriminatory across passengers, even if the discounts were associated with lower quality service characteristics. Over time, the fare structure across markets became increasingly distorted in its relationship to cost structures, and resulted in fares substantially above efficient levels in many markets.

Not until the 1970–1974 Domestic Passenger Fare Investigation did the Board develop a formal cost-based standard for judging the reasonableness of fares. The resulting Standard Industry Fare Level (SIFL) formula provided a nonlinear distance-based formula for calculating fares based roughly on industry-level costs, a "reasonable" 12 percent rate of return, and target load factor of 55 percent. SIFL-based fares were intended to better align the cross-market fare structure with the distance-based economies of modern jet aircraft and mitigate the escalation of regulated fares as airline competition eroded profits through reduced load factors. The Board also returned to its historic preference for relatively level fare structures within markets, opposing a variety of promotional fares within markets on grounds of both discriminatory pricing and administrative complexity.

A starkly different industry structure developed in some intrastate markets, which were exempt from federal economic regulation by virtue of not crossing state lines and therefore provided a glimpse of the possibilities of unregulated air travel.[11] California became the poster child for advocates of regulatory reform, as large "lightly regulated" intrastate California markets could be compared to CAB-regulated interstate markets of comparable distance and density on the East Coast.[12] Similar comparisons ultimately were drawn for markets in Florida and, following the certification of Southwest

11. The CAB attempted various legal arguments to bring intrastate markets under its jurisdiction, most creatively and successfully in the case of intra-Hawaiian markets.

12. The California Public Utilities Commission had oversight authority for intrastate airline markets, but until mid-1965 could not regulate entry and exercised little control over fares. See Levine (1965).

Airlines in 1971, in Texas as well. Michael Levine (1965) and William Jordan (1970) focused attention on California. Levine argued that the scale of the air market between Los Angeles and San Francisco-Oakland—the largest market in the world at that time—was attributable in large part to the higher growth rates stemming from dynamic competition among a number of carriers that kept frequencies and load factors relatively high and fares remarkably low: "Although the lowest fare between Boston and Washington, served only by CAB-certificated trunk carriers, is $24.65, [the intrastate carrier] Pacific Southwest Airlines, using the same modern turbo-prop equipment, carries passengers between Los Angeles and San Francisco, only 59 miles closer together, for $11.43. The jet fare is only $13.50" (Levine 1965, 1433).

Keeler (1972) reached a similar conclusion based on his estimates of long-run competitive costs for airline service. His structural model, which predicted observed prices on unregulated intrastate routes to within about 3 percent of actual fares, suggested that regulated fares were substantially above competitive long-run costs—with 1968 margins ranging from 20 percent to nearly 100 percent over costs, generally increasing with distance.

High CAB-regulated fares did not translate into supranormal profits for the industry, however. This contrasted to the experience in regulated sectors such as interstate trucking.[13] Keeler (1972, 422) argued that high fares in conjunction with apparent normal rates of return to capital for airlines suggested that "airline regulation extracts high costs in inefficiency on high-density routes." Carriers responded to high margins with behavior that increased costs, reduced realized returns, and raised the cost of meeting a given level of demand for air service. As Kahn (1971, 2:209) argued: "If price is prevented from falling to marginal cost . . . then, to the extent that competition prevails, it will tend to raise cost to the level of price." Carriers continued to compete for passengers; with the suppression of price competition, they focused on schedule competition and other aspects of service quality.

Recognizing the potential significance of quality competition, the CAB over its history attempted direct control of some nonprice dimensions of competition. These included enforcement of connecting flight requirements on many route awards (to restrict nonstop competition) and limits on the use of first-class and sleeper-seat configurations (or imposition of fare surcharges for such configurations). Largely unregulated dimensions of service quality included a litany of amenities: interior aircraft configuration including seat spacing, inflight amenities including food and beverage service and entertainment, even flight attendant appearance and services.[14]

13. See Caves (1962) and Keeler (1972). Rose (1985, 1987) estimated rents for regulated less-than-truckload motor carriers in the range of 15 percent of total revenues.

14. See Braniff's "Air Strip" advertising campaign built around its designer flight attendant uniforms, viewable on Mary Wells Lawrence's "author's desktop" at http://www.randomhouse.com/knopf/authors/lawrence/desktop.html\hb, accessed January 15, 2013.

The most costly forms of nonprice competition, however, focused on aircraft type, capacity, and scheduling. Here, regulatory action was mixed. Competition through new aircraft introduction was explicitly encouraged by the Board. The CAB consistently refused to allow airlines operating older, slower, and less comfortable aircraft to charge lower fares than competitors offering service on newer aircraft, even when these lower fares were argued to be necessary to preserve demand for the lower-quality service. This policy pushed carriers toward faster adoption and diffusion of new aircraft.

Capacity costs were further increased by airline scheduling responses to fixed prices. With passenger demand a function of price, schedule convenience, and expected seat availability (the latter also increasing in-flight quality by raising the probability of being next to an empty seat, and hence, more interior space), suppression of price competition encouraged carriers to increase flight frequency and capacity to compete for passengers. The intensity of flight competition was exacerbated by the apparent S-curve relationship between passenger share and flight share: a carrier with the majority of capacity on a route received a disproportionately high share of passengers (Fruhan 1972; Douglas and Miller 1974b; Eads 1975).

As Douglas and Miller (1974a) pointed out, however, competing in flight frequency is largely a zero-sum game across carriers. Given fixed prices and rivals' flight schedules, most of a carrier's expected increase in passenger volume from adding another flight comes from business stealing, not demand expansion. With high price-cost margins and the CAB legally prohibited from restricting carriers' flight schedules, the equilibrium of the noncooperative game is greater flight frequency and capacity, lower load factors (seats sold divided by seats available), and higher average costs per passenger mile. For example, average load factors in unregulated California intrastate markets exceeded 71 percent over 1960 to 1965, more than 15 percentage points higher than overall average load factors for trunk airlines in regulated markets over the same period (Keeler 1972, 414). Load factors in regulated airline markets not only decreased with the number of competitors on a route, but also declined with distance (Douglas and Miller 1974a; Eads 1975, 28–30). Observed load factors appeared to be lower than optimal load factors based on reasonable estimates of passengers' time valuations for all but relatively short monopoly markets (Douglas and Miller 1974a, 91; Eads 1975, 30).

Moreover, when the CAB attempted to increase rates of return by increasing prices, as it did at various points in its history, service competition intensified, leading to even lower load factors and higher average costs. As Douglas and Miller (1974a, 54) argued, "the fare level and structure, instead of determining or controlling profit rates, should be viewed principally as determining . . . the relative level of excess capacity and the associated level of service quality." Board efforts to raise carrier profits by increasing fares led to what became known as the "ratchet effect," as airlines responded to

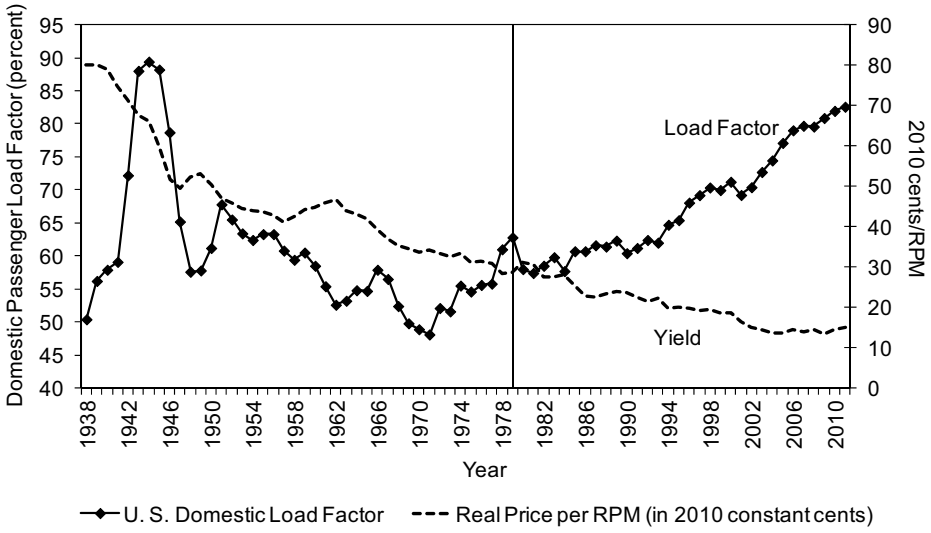

Fig. 2.3 Airline industry average domestic load factors and real yield, 1938–2011

Source: Domestic passenger yields are from Airlines for America, Inc., accessed January 10, 2013, http://www.airlines.org/Pages/Annual-Round-Trip-Fares-and-Fees-Domestic.aspx. For the domestic passenger load factor, see figure 2.1 sources.

Notes: Yields are scaled to include additional fees (primarily baggage and booking fee revenue) using authors' calculations. Adjusted to 2010 constant dollars using the CPI all-urban annual price deflator.

higher fares with increased flight frequency and declining load factors, and ultimately raised average costs rather than profitability.[15] By the early 1970s, average load factors had fallen below 50 percent for the first time since CAB regulation (see figure 2.3).

While rent dissipation through scheduling competition is well documented, there is less clear evidence on whether labor also extracted a share of the profits. In some industries, regulatory rents were shared with labor, either through increased employment, increased wages, or some combination of both (e.g., see Rose [1987] for estimates of labor rent sharing in the regulated trucking industry, and Hendricks [1994] and Peoples [1998] for cross-industry comparisons). There is some reason to think airline workers would similarly benefit from regulation: airlines were heavily unionized and union relations often were contentious. Dependence on key occupations such as pilots, FAA certification requirements that made it difficult or impossible for airlines to replace flight operations personnel during strikes, interunion rivalry for members of a given occupation class across firms, cooperation across unions representing different occupations within a firm,

15. See Paul Joskow's chapter in this volume for a discussion of the general phenomenon of strategic responses to regulatory incentives.

and CAB limits on airline entry and price competition all tended to enhance labor's ability to capture rents. But not all factors tilted in the direction of labor strength: labor union gains were limited by the ability of firms to use the Railway Labor Act provisions to delay or block strikes stemming from contract disputes, the lack of national bargaining units, and the 1958 creation of the Mutual Aid Pact, under which airlines agreed to cross-firm strike insurance payments.[16] In addition, while regulated prices prevented airlines with lower labor costs from capturing market share by underpricing higher-cost rivals, regulated prices were set on the basis of industry rather than firm-specific costs, implying possible high-powered profit incentives for firms to reduce costs relative to industry norms.[17]

Empirical evidence suggests that pilots, in particular, were effective in negotiating pay and work rule agreements that captured a significant share of productivity enhancements due to adoption of larger, faster aircraft (Caves 1962, 110). Comparisons of pilot wages and productivity levels between regulated carriers and intrastate carrier PSA are consistent with this pattern, although much of the productivity difference may be attributed directly to differential scheduling and fleet use resulting from PSA's focus on price rather than quality competition (Eads 1975). Empirical estimates of the extent of regulatory labor wage gains based on wage responses to airline deregulation suggest relatively modest effects, on the order of 10 to 15 percent of wages (Card 1997; Peoples 1998; Hirsch and Macpherson 2000; Hirsch 2007). Hendricks, Feuille, and Szerszen (1980) argue that estimates based on wage declines after deregulation may understate rent capture. They point out that deregulation increased the airlines' cost of strikes due to mandated elimination of the Mutual Aid Pact and the greater competitive disadvantage of firms that faced strikes in deregulated markets, while providing little immediate change in unionization rates or in market structure. Some support for their view is provided by Hirsch and Macpherson (2000) and Hirsch (2007), who find larger relative airline wage declines over time, and some evidence that wages follow firm profitability cycles.

16. The Mutual Aid Pact established a system of strike insurance among participating airlines. By 1970, amendments to the pact elicited participation by all trunk airlines but nonunion carrier Delta. The initial pact provided that "each party will pay over to the party suffering the strike an amount equal to its increased revenue attributable to the strike during the term thereof, less applicable direct expenses" (Unterberger and Koziara 1975, 27). Revisions over time specified guaranteed minimum payments at a specified fraction of the struck carrier's "normal air operating expenses." Unterberger and Koziara (1975) argue that the terms made some airlines more profitable during a strike than they were under normal operations, increasing the number and duration of observed strikes.

17. Setting prices independent of an individual carrier's cost would seem to yield high-powered incentives for cost minimization and technical efficiency by individual carriers (Laffont and Tirole 1993). This incentive was undermined, however, by the CAB's implicit policy of assigning profitable new routes to struggling carriers and unprofitable new routes to carriers that were highly profitable.

2.3 Airline Deregulation in the United States

In the mid-1970s, airline regulation began a drastic transformation.[18] Hearings held by Senator Edward Kennedy's Judiciary Committee in early 1975 dramatized the costs and inconsistencies of CAB regulation, and seem to have pushed airline regulation onto the national agenda.[19] Over the next three years, congressional hearings on the industry paralleled administrative reforms.

The appointment of pro-reform chairmen to the CAB heralded a dramatic departure in the Board's attitude toward regulation. The CAB became increasingly receptive to reform, approving discount fares and expanded charter operations under chair John Robson in 1976. This accelerated with the appointment of economist Alfred Kahn as chair in 1977 and Elizabeth Bailey as CAB member. Kahn—whose 1971 book remains today the preeminent analysis of the origins, principles, and effects of economic regulation—led the Board through a series of administrative reforms that reversed the agency's traditional preference for regulation over market determination of outcomes.

Political forces coalesced around legislative deregulation in 1978, with industry opposition splintering and eventually giving way with the passage of the Airline Deregulation Act by Congress, signed into law by President Carter in October 1978. The act provided for a phaseout of regulatory authority by January 1983, and elimination of the CAB itself by 1985. The most significant regulatory legacy was a continuing program of subsidies and oversight of service to small communities under the "Essential Air Service" program. The EAS was supposed to phase out in the 1980s, but political forces have kept it alive to this day. For service to all but these very small airports, however, the transition to deregulated markets occurred quite rapidly.

The confluence of several factors in the mid-1970s contributed to this reexamination and eventual repudiation of federal airline regulation in the United States. These included the contrast of CAB-set fares with fares in the intrastate California, Texas, and Florida markets; an increasing body of research documenting the problems with federal airline regulation; and political concern with rising price levels economy wide and stagnant eco-

18. Hundreds, if not thousands, of books and articles have been written on the politics and economics of airline passenger deregulation, with detail we cannot begin to replicate here. For a brief introduction, see Breyer (1982); Bailey, Graham, and Kaplan (1985); Kahn (1988); Borenstein (1992); Joskow and Noll (1994); Morrison and Winston (1986, 1995, 2000); and the references cited therein. Much less studied was the deregulation of air cargo, which preceded air passenger deregulation in the United States (see Bailey's [2010] discussion).

19. Breyer (1982, chap. 16), who was instrumental in focusing Kennedy's attention on airline regulation, provides a superb history and analysis of these events, and argues for Kennedy's role as a catalyst for eventual reform.

nomic growth, exacerbated by the 1973 and 1974 OPEC (Organization of the Petroleum Exporting Countries) oil price shock.[20] None of this, however, provides an entirely satisfactory explanation for why the airline industry was deregulated, or why it happened in 1978 and not earlier (or later). Though an important role must be assigned to political entrepreneurship by Senator Ted Kennedy and administrative reforms implemented by Alfred Kahn, these were probably not the only determinants, particularly given the coincidence of airline deregulation with regulatory reform across such disparate industries as trucking, natural gas, and banking, among others (Joskow and Rose 1989; Joskow and Noll 1994). Peltzman (1989) argues that changing economic interests in regulation were an important contributor (but see the comments on his paper in the same volume); Joskow and Noll (1994) and their commentators argue for a more multifaceted political economy interpretation. With few such deregulatory events, however, it is difficult to disentangle the complex interactions that lead to such major changes in the role government plays in the business economy.

The CAB moved quickly to implement provisions of the Airline Deregulation Act of 1978 and accelerated the shift from government to market decision making in the industry. Many entrepreneurs were quick to respond to the new opportunities—new entrants proliferated and some incumbents expanded rapidly—while management at some of the "legacy" airlines proved to be much less nimble. The impact of deregulation became evident in several areas: removing regulatory price controls was followed by lower average prices, a substantial increase in price variation, and efforts to soften price competition through differentiation and increases in brand loyalty. Lifting entry restrictions altered market structure at the industry, airport, and route levels, and led to reorganization of incumbent airline networks. The industry also developed new organizational forms, including code sharing and alliances across airlines, particularly in the aftermath of tighter merger policy. Shifting from nonprice to price competition reduced many aspects of service quality, although the quality declines of most concern to customers are most likely attributable not to deregulation but to government infrastructure policy, as we discuss later. While some of these impacts were anticipated during the debate over deregulation, others were quite unexpected (see Kahn 1988).

2.3.1 Price Levels, Dispersion, and Loyalty Programs

The aftermath of US airline deregulation seemed to confirm the forecasts of academic economists and others who predicted substantial fare reductions and concomitant traffic growth. In the first decade of deregulation, between 1978 and 1988, average domestic yield (revenue per passenger mile), as shown in figure 2.3, declined in real terms at an average compound rate

20. See the discussion by Bailey (2010).

of 2.0 percent per year, while domestic revenue passenger miles, shown in figure 2.1, increased at an average compound rate of 6.1 percent per year. In the subsequent twenty-three years, real yields declined at 1.9 percent per year, and traffic grew at an annual compounded rate of 2.4 percent.

Such figures are often presented to argue the success of airline deregulation. A comparison to the pre-deregulation era, however, demonstrates that the argument for deregulation must be made much more thoughtfully: in the decade *prior* to the onset of deregulation, 1968 to 1978, real domestic yield declined at a rate of 2.1 percent per year and traffic growth outpaced the post-deregulation decade, at an annual rate of 7.6 percent. Thus, attribution to deregulation requires a more carefully constructed counterfactual.

Price Levels

In examining airline prices, one appealing counterfactual is the regulatory cost-based Standard Industry Fare Level (SIFL) formula created by the CAB to determine fares just prior to deregulation. The Department of Transportation (DOT) continues to update this formula based on input cost and productivity changes in part for use in US-Canada fare negotiations.[21] Figure 2.4 presents a comparison of passenger mile weighted average yields and SIFL-based yields for tickets in Databank 1A's 10 percent sample of all airline tickets.[22] Actual fares were about 26 percent lower than SIFL-formula fares in 2011, suggesting a consumer welfare increase in the range of $31 billion in that year.[23]

Even this comparison merits closer scrutiny, however. Three underlying assumptions are critical. First, the SIFL calculation takes productivity gains in the industry as exogenous. If deregulation brought about some of these gains, and they would not have occurred under regulation, then the SIFL is understating the counterfactual fares and understating the benefits of deregulation.[24] Second, the SIFL assumes a 55 percent load factor, while planes are much more crowded than that, with domestic load factors hitting 83 percent in 2011. If, for a given schedule of flights, 80 percent of costs are

21. See US Department of Transportation Standard Industry Fare Level at http://www.dot.gov/policy/aviation-policy/standard-industry-fare-level accessed January 15, 2013.

22. The calculation reported here includes free travel tickets in the DB1A, most of which are frequent flyer bonus trips. Excluding all tickets with fares of $10 and below raises the actual yields by about 4 percent. Dollar savings are scaled up from the 10 percent sample in the DB1A. Baggage and ticket change fees are also included in the scaled calculation of average ticket prices. DB1A data are not available prior to 1979.

23. We arrive at this number by assuming constant quality and a constant elasticity demand with long-run elasticity of –1, then calculating the difference in consumer surplus from the actual 2011 average yield and domestic RPMs and the counterfactual SIFL price level and associated quantity along the same demand curve.

24. Morrison and Winston (1995, 12–14), performing a similar analysis of actual to SIFL fares for 1976 through 1993, argue that deregulation increased productivity, and therefore adjust the SIFL index upward by 1.2 percent per year over 1978 and 1983, and by a constant 8.7 percent thereafter, to remove estimated deregulation-related productivity gains.

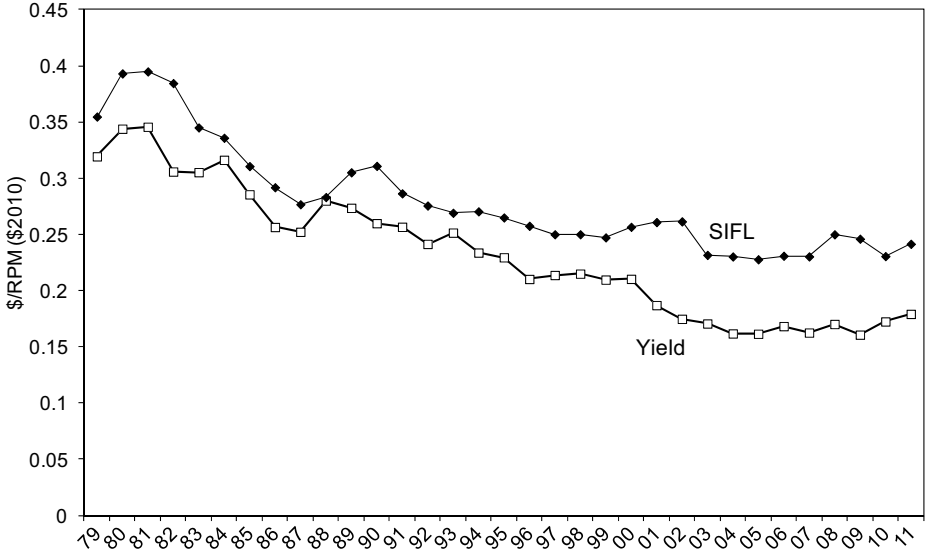

Fig. 2.4 Real yield (rev/passenger mile) versus DOT standard industry fare level, 1979–2011

Notes: Authors' calculations are from DOT Databank 1A/1B. The SIFL formula is available at http://www.dot.gov/policy/aviation-policy/standard-industry-fare-level (accessed January 15, 2013).

assumed to be invariant to changes in the load factor (i.e., to the number of passengers flown) over this range,[25] then adjusting for the change in load factor would spread those costs over 51 percent more passengers (83 percent divided by 55 percent). The effect would be to lower the SIFL for 2011 by 27 percent (1 – (0.2 + 0.8/1.51) and the change in consumer surplus from deregulation would be slightly *negative*. Third and finally, the SIFL formula was for full-fare coach tickets, but even prior to deregulation limited discounting was permitted. Richards (2007) presents evidence that actual average coach fares were about 15 percent below SIFL in 1977, just prior to deregulation, though significant relaxation of fare controls had already occurred by then. Obviously, if actual average coach fares would have been 15 percent below SIFL under regulation, that alone would eliminate about half of the benefits typically calculated.

These potential changes highlight the difficulty in calculating a true counterfactual against which to judge airline deregulation. Much more important than these technical corrections, however, is the underlying assumption

25. This number comes from assuming that all costs are invariant to number of passengers except 25 percent of labor costs, 50 percent of advertising costs, 100 percent of food costs, and 100 percent of passenger commissions, all of which are assumed to increase linearly in the number of passengers.

that airline regulation would not have changed. For example, it is quite possible that incentive mechanisms, as have become common in electricity regulation, would have been adopted under continued airline regulation and led to some of the productivity improvements that have occurred under deregulation. On the other hand, the continuation of regulatory control would have made it easier for politicians, or even the airlines themselves, to subvert the regulatory process to their own advantage.[26] Similarly, more than three decades of deregulation has taught lessons about antitrust and consumer protection that would likely influence and, one hopes, improve public policy toward a less regulated airline industry.

Regardless of exactly how one calculates the fare declines attributable to deregulation, it is clear that the gains from those lower prices have not been distributed uniformly across customers. While deregulation advocates argued that the CAB may have allowed too little variation in fares—failing to account for difference across carriers in their service amenities, not permitting off-peak discounts in order to align fares with variations in the shadow costs of capacity, and not recognizing differential costs across leisure and business customers—few, if any, people predicted the resulting enormous range of prices, both across and within routes.[27] Relative to the SIFL (and pre-deregulation prices), fares have fallen more on long routes than on short routes. Fares have also remained higher in concentrated markets and on flights in and out of airports dominated by a single carrier, all else equal. And although average fares were 26 percent below SIFL in 2011, nearly one-third of economy class passengers paid a fare greater than the SIFL for the route on which they were flying.

Variation in Prices across Routes

There is considerable variation in average price levels across routes, and this variation has not been stable over time. The lower line in figure 2.5 shows the coefficient of variation of route average fares after controlling for route distance.[28] Cross-route price variation peaked in 1996 at a level that was nearly twice the variation in 1979 and 66 percent higher than in 2011.

The identity of competitors, in addition to the presence of competition,

26. An interesting and unknowable question is how a regulator would have handled the airlines' post–9/11 financial crisis. Would, for instance, the airlines have been able to push through regulated fare increases to compensate for weak demand even though the industry had massive excess capacity?

27. Through most of the regulated era, fare structures typically consisted of a standard coach and first-class fare on each route with very limited exceptions, such as a youth or family discount fare. A significant deviation from this policy was the Board's 1966 approval of "Discover America" excursion fares for leisure markets and off-season transcontinental flights.

28. This calculation is done by dividing all routes into fifty-mile distance categories. The coefficient of variation of route-averaging fares is calculated for each distance category, where each route is weighted by revenue passenger-miles. The measure shown in figure 2.5 is the weighted average of these measures across all distance categories, where the weights are total revenue passenger miles in each distance category.

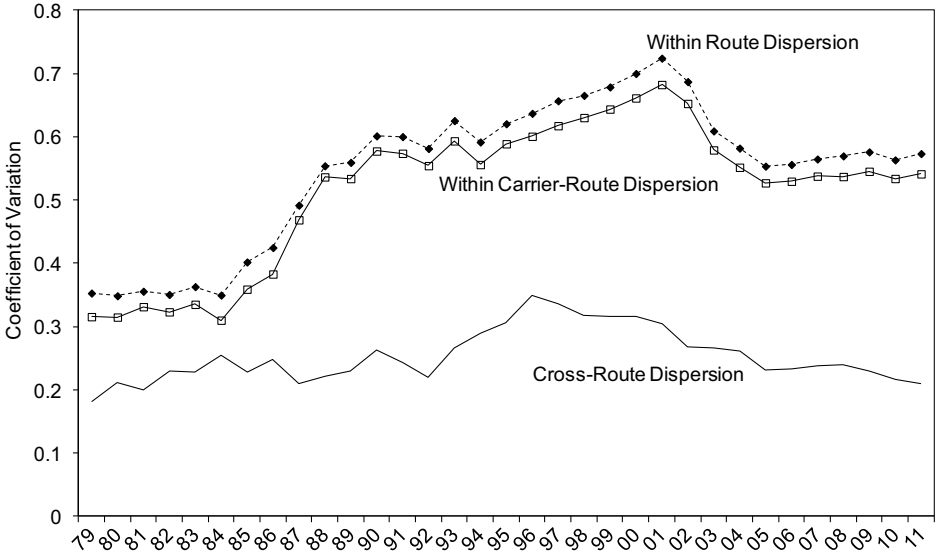

Fig. 2.5 Within-route and cross-route price dispersion, 1979–2011

Notes: Authors' calculations are from domestic tickets in Databank 1A/1B using only tickets of 4-coupons or fewer. (See "Translation of Domestic DB1A into More Usable Form," http://faculty.haas.berkeley.edu/borenste/airdata.html.) This analysis drops all fares less than zero and greater than four times SIFL for observed route, and drops all fares labeled first-class except for Southwest, Jet Blue, Spirit, Frontier, and ATA, which report all or nearly all seats as first-class during some quarters. Cross-route dispersion excludes 1980 data from the fourth quarter because Eastern and Delta massively underreported to the DOT 10 percent ticket sample. Annual data are the average of quarterly calculations, weighted by revenue passenger miles.

appears to be an important determinant of route average price levels. Since before airline deregulation, there have been "no-frills" or "low-cost" carriers that have operated with much lower costs than the regulated legacy airlines, though they operated solely intrastate before 1978. The best known of these today is Southwest, but many others have entered and most have exited over the thirty-five years since deregulation. This failure rate is puzzling given the enormous cost advantages they seemed to maintain. Figure 2.6 tracks the standard industry cost measure of cents per available seat mile (ASM),[29] in constant 2010 dollars, for the legacy carriers (and their successor companies) and for the largest low-cost entrants that have operated since deregulation, many of which did not survive or have made trips through bankruptcy court.[30] The presence of these low-cost competitors

29. An available seat mile is one seat flown one mile on a commercial flight.

30. The figure does not adjust for average flight distance, which is inversely related to cost per ASM. Adjusting for flight distance expands the cost advantage of the low-cost carriers, because most fly shorter flights than industry average.

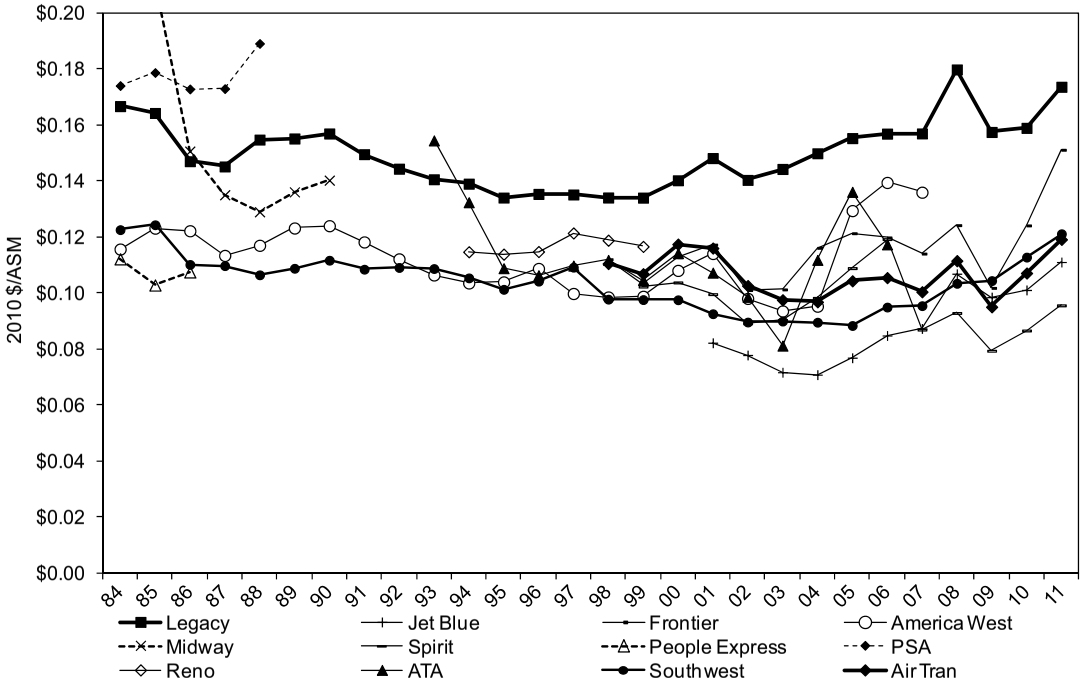

Fig. 2.6 Real operating cost per ASM for legacy carriers and start-ups, 1984–2011

Note: Authors' calculations are from DOT Form 41, Schedule P6.

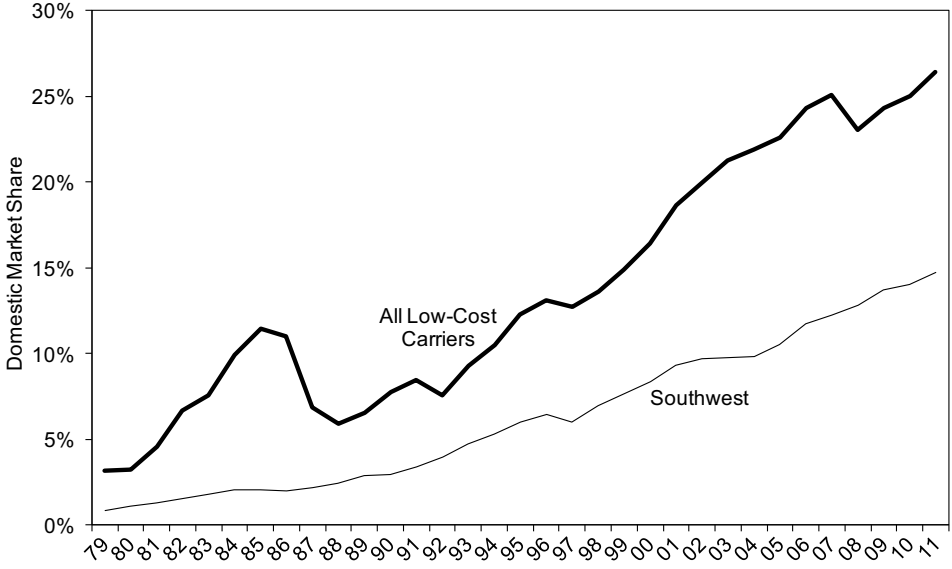

Fig. 2.7 Domestic market share of Southwest and all low-cost carriers, 1979–2011

Notes: Authors' calculations are from DOT Form 41, Schedule P6. Low-Cost Carriers are defined as Air Tran, America West, ATA, Frontier, Jet Blue, Midway, People Express, PSA, Reno, Southwest, Spirit, and ValuJet. Share based on domestic revenue passenger miles.

on a route substantially dampens average fare levels (e.g., for analyses, see Borenstein 1989, 2013; Morrison 2001; Goolsbee and Syverson 2008). Low-cost carriers have expanded substantially since the late 1980s, due in part to continued expansion of Southwest and in part to the rapid growth of some other low-cost airlines (see figure 2.7).

Variation in Prices across Passengers on the Same Route

Despite the CAB's historic reluctance to deviate from very simple fare structures, some price variation is undoubtedly efficient in the airline industry. With fixed capacity, a nonstorable product, and demand that varies both predictably and stochastically, efficient prices will vary intertemporally with demand realizations. Even tickets on the same flight purchased at different times may efficiently carry different prices (see Prescott 1975; Salop 1978; Dana 1999a, 1999b). Moreover, Ramsey-Boiteux prices yield differential markups across customers based on relative price elasticities of demand as the constrained welfare-maximizing solution to compensating firms with substantial fixed costs. While these considerations suggest deviations from the relatively level regulated fare structure, however, few observers were prepared for the often-bewildering array of fares available (and prices actually paid by different passengers) on any given airline route.

The CAB's "administrative deregulation" push over 1976 to 1978 encouraged airlines to experiment with pricing. Airlines were quick to use pricing flexibility to introduce fare variation. In 1977, American Airlines took advantage of the CAB's new push toward fare flexibility to introduce a menu of "Super Saver" fare schedules. These were targeted at increasing air travel among leisure travelers, with ticket restrictions that included both advanced purchase (fourteen or twenty-one days) and minimum stay (seven days or longer, generally). With deregulation in 1978, discount fares flourished. Airlines soon recognized that Saturday-night stay restrictions were nearly as effective as minimum-stay requirements in excluding low-elasticity business travelers from discount fare purchases, and imposed lower costs on the high-elasticity discretionary customers at whom the low fares were aimed. The Saturday-night stay restriction replaced minimum stay on discount tickets in most markets, and became the standard self-selection device for major airlines over the next twenty-five years.

The effect of this was an almost immediate boost in fare dispersion. The highest (dashed) line in figure 2.5 shows the average within-route coefficient of variation of fares. Such a measure of dispersion aggregates within carrier-route dispersion with variation in average prices across carriers on a route. The slightly lower solid line (with boxes) in figure 2.5 shows the average within carrier-route dispersion, demonstrating that most of the price variation is due to individual airlines charging different prices to different customers on the same route (and on the same flight).

Average levels of fare dispersion mask significant differences across carriers and routes, however. Some carriers, particularly among the low-cost and entrant airlines, have relatively few ticket categories, and relatively low gradients of fare increases as restrictions are removed. Others may have twenty or more different ticket restriction/price combinations available for purchase on a given route. Moreover, there appear to be substantial differences across routes in dispersion. Borenstein and Rose (1994) analyze the determinants of price dispersion, with particular attention to the impact of competition, using a cross-section of carrier routes in 1987. That work suggests that dispersion increased with the move from monopoly to duopoly to more competitive route structures. This finding is consistent with price discrimination based not only on customer heterogeneity in their overall elasticity of demand for air travel (e.g., across business and leisure travelers), but also on heterogeneity in cross-brand price elasticities, such as might result from differences in airline loyalty. Gerardi and Shapiro (2009) argue that relationship is not robust to alternative identification strategies, and evidence on the relationship between price dispersion and competition varies across studies in both the US and EU markets (e.g., Stavins 2001; Giaume and Guillou 2004; Gaggero and Piga 2011; Orlov 2011).

Over time, however, fare structures grew even more complex, with an increasing variety of advanced purchase durations (three, seven, fourteen,

and twenty-one days being most common), discounts for low travel-demand days or times, temporary price promotions, negotiated corporate discounts, upgradeable economy tickets, and more recently, web-only, auction-determined, and "buyer offer" prices. The spread between the top unrestricted fares and lowest discounted fares also increased. This was accompanied by the development and increasing sophistication of management systems that monitor the evolution of demand relative to forecast demand, set overbooking limits, and allocate seats to each fare "bucket" to maximize expected revenue for the airline (Belobaba 1987). American Airlines, which was in the vanguard of developing these systems, reported that yield management systems added approximately $500 million, or roughly 5 percent, to annual revenue for the airline in the early 1990s (Smith, Leimkuhler, and Darrow 1992). This is an enormous effect, of the same order of magnitude as the total net income/sales ratios for the industry. Revenue management systems have become an important management and strategic tool, with simulation estimates suggesting "the potential for revenue gains of 1 to 2 percent from advanced network revenue management methods, above and beyond the 4 to 6 percent gains realized from conventional leg-based fare class control" (Barnhart, Belobaba, and Odoni 2003, 383).

As illustrated by the closeness of the two higher curves in figure 2.5, cross-carrier variation in mean prices contributes relatively little to within-route dispersion; most is attributable to the enormous variation in prices any one carrier charges in a given market. The pattern illustrated in this figure is consistent with increasing concern over fare structure complexity and price dispersion through the 1990s. Price dispersion within carrier routes more than doubled between 1979 and 2001. The 2001 coefficient of variation of 0.72 implies a standard deviation that is nearly three-quarters of the mean fare. Since 2001, within-route dispersion has declined to levels not seen since the late 1980s, though still much higher than in the earliest years of deregulation. This has been accompanied by declines in cross-route price dispersion; as discussed later, both may reflect the impact of greater penetration by low-cost carriers.

Loyalty Programs

American Airlines led the industry into the use of loyalty programs with its introduction of the first frequent flyer program in 1980. Other airlines quickly followed. Since then, airlines have offered loyalty programs not only for individual customers in the form of frequent flyer programs, but also for travel agents who steer clients their way, and to corporations in the form of quantity-based discounts. Frequent flyer programs evolved into businesses on their own in the late 1980s as airlines began to sell frequent flyer points to other retailers—hotels, supermarkets, and credit cards, for example—to then be given to customers. While other retail sectors have followed suit with

their own loyalty programs, airline frequent flyer programs remain by far the most successful.[31]

Loyalty programs typically reward travelers or travel agents with a nonlinear schedule of potential rewards, generating an increasing return to incremental purchases. The programs for individuals and travel agents also take advantage of an incentive conflict that may exist between the entity paying for the ticket (often the individual's employer or the agent's customer) and the person receiving the loyalty bonus (the traveler or travel agent).[32] Loyalty programs soften price competition across carriers, as they induce a switching cost for travelers (or travel agents) by raising net cost if travel is spread over several airlines rather than concentrated on a single airline over time.[33] The programs also link service across markets, basing rewards on the total amount purchased from the airline in all markets, not just one city pair, and providing greater redemption opportunities on airlines with substantial service in a passenger's home market. In this way, they potentially further insulate large network carriers from competition on individual routes, particularly out of their hubs (see Lederman 2008). Over time, refinements to the programs leveraged the effect by offering enhanced access to benefits such as preferential boarding, seating, upgrades, and free travel availability to the highest volume travelers flying 50,000, 100,000 or more miles on the airline within a calendar year.

During the 1980s, policymakers became concerned that some airlines used distribution systems to unfairly insulate themselves from price competition. Until the late 1990s, travel agents issued more than 80 percent of all airline tickets, with the bulk of the remainder issued directly by the airlines. In the 1980s, agents started using computer reservation systems (CRSs) that allowed them to directly access airline availability and fare information. CRSs grew out of airlines' internal computer systems and were originally owned by the airlines. This raised the potential for airline owners to bias the systems' response to information queries in a way that advantaged them and limited price competition. Concern about bias of information displays in favor of one carrier became a competitive issue for much of the 1980s and

31. Changes to these programs have greatly devalued the frequent flyer points as flight currency over the past several years, increasing the miles needed to redeem award travel and reducing the number of seats available for those awards. This strategy seems to have reduced the concerns some analysts have voiced about the airlines' liability represented by the billions of outstanding points. For many frequent flyers, the chief value of loyalty programs now lies in the preferential boarding and upgrades accorded to the high mileage elite tier cardholders.

32. The most obvious manifestation of agency problems were short-lived promotions in late 1988 and 1989, such as the Eastern shuttle promotion—they handed passengers $50 American Express gift checks as they boarded—and Continental's promotion—they gave a $50 bill (distributed at the airport) to customers traveling on high-fare tickets.

33. Borenstein (1996) presents a model of repeat-buyer programs in network industries and discusses their use in many industries throughout the twentieth century.

1990s, ultimately leading to formal regulatory restrictions on CRS display criteria in 1984 and 1992.[34]

This concern has faded with the second major innovation in the distribution: use of the Internet. As users of sophisticated electronic reservation and ticketing interfaces with travel agents, the airlines were well prepared to move into Internet sales of their product, and airline and independent travel agencies were early adopters of Internet marketing and sales. This had particular appeal to airlines, who saw the Internet as a way to bypass the traditional sales channel—travel agents—in favor of lower-cost electronic ticketing methods. For years, airlines had complained about inefficiency of travel agency distribution and the high cost of travel agent commissions, at 10 percent or more of ticket prices. No single airline was willing to reduce their commission rate unilaterally, however, fearing that travel agents would "book away" from them. With the diffusion of Internet sales, carriers saw an alternative.

In the last fifteen years, online ticketing has skyrocketed, comprising more than 30 percent of sales in 2002 and an estimated 40 to 50 percent as of 2006 (GAO 2003; Brunger 2009; Barnes 2012). Airlines have gradually eliminated travel agent commissions on domestic tickets and reduced commissions on international tickets. They now generally charge higher distribution fees for tickets not sold electronically, even for those booked directly with the airline over the phone. While reduced travel agency commissions and online ticketing have dramatically reduced airlines' distribution costs, the Internet also has made it easier for customers to shop for low fares, find alternative airlines and routings, and generally become better informed about travel options and their costs. Some have argued that the greater transparency of airline fare structures to final consumers may have contributed substantially to reduced bookings for full-fare, unrestricted tickets, and explain at least part of the collapse in intracarrier price dispersion. This also may be an important factor in the dramatic rise of ancillary fees for services that began with reservation changes and checked baggage and now may include advance seat reservations, preferred boarding status and seating, onboard food and entertainment, and even carry-on bags. While online travel search engines could be susceptible to display bias of various kinds (an issue that has attracted considerable attention with respect to their hotel listings, for example), the largest systems claim to present neutral airline displays, and allow consumers to re-sort search results according to a variety of criteria.

34. These restrictions were lifted in 2004 based on the argument that there are now many more competing sources of fare, schedule, and seat-availability information.

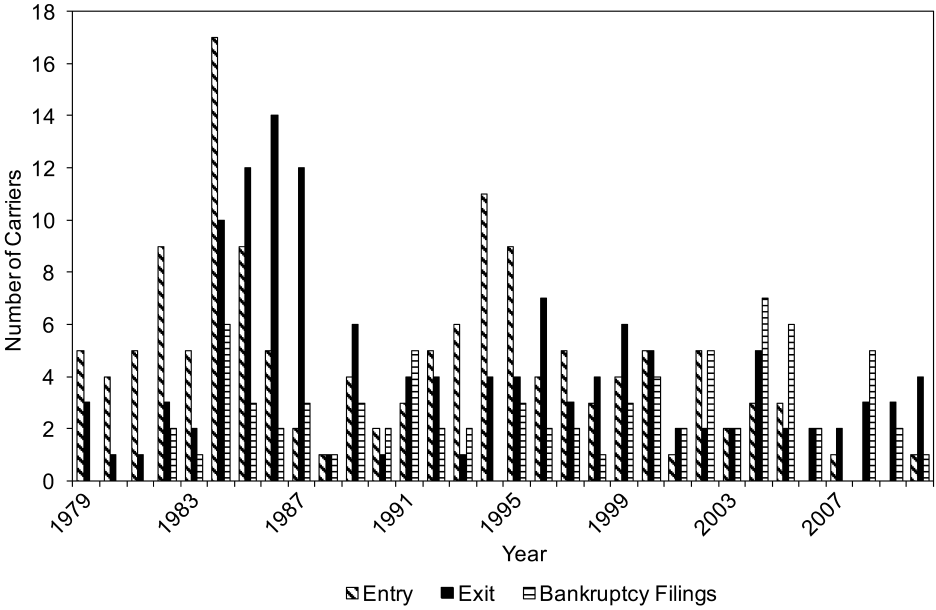

Fig. 2.8 Airline entry, exit, and bankruptcy filings, 1979–2011

Notes: See Jordan (2005) for events through 2003. Carrier entry and exit after 2003 updated from BTS carrier annual carrier reporting groups, see, for example, http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/subject_areas/airline_information/accounting_and_reporting_directives/pdf/number_304a.pdf. Bankruptcies updated with information from Airlines for America, Inc., http://www.airlines.org/Pages/U.S.-Airline-Bankruptcies-and-Service-Cessations.aspx.

2.3.2 Entry and Exit, Airline Networks, and Market Structure

Entry and Exit

Expansion by existing carriers and entry by new firms dramatically altered industry structure in the immediate aftermath of deregulation. The eleven trunk and dozen local service/Alaska/Hawaii "legacy" carriers authorized to provide regulated jet service prior to 1978 were joined by forty-seven new entrants by 1984. Most of the new entrants and some of the legacy carriers left the industry through acquisition or liquidation over the subsequent decade; forty-eight carriers exited between 1984 and 1987 alone. Figure 2.8 records the number of airlines entering or exiting the industry, as well as the number of airline bankruptcy filings, each year.[35] Of the carriers who began interstate service through 1984, only seven operated in 1990, and only two

35. A common finding in many industries is that entry rates and exit rates are highly temporally correlated (see Dunne, Roberts, and Samuelson 1998).

remain in operation today.[36] This appears to reflect more than transitional uncertainty in the aftermath of deregulation. Entry peaked again in the mid-1990s, with eighteen independent new entrants between 1993 and 1995, only two of which remained in operation through 2012.[37] By the end of 2011, thirty-three years after deregulation, six of the twenty-three legacy carriers continued to serve the domestic market, with a combined domestic market share of 59 percent.[38]

Financial distress, reorganization, and exit have been as much a part of the industry as new entry since deregulation. Of the six airlines that carried at least 5 percent each of domestic US traffic in 2011, five (Continental, USAir, Delta, United, and American) have filed Chapter 11 bankruptcy at least once. Only Southwest has not gone through bankruptcy reorganization. We discuss the causes of this financial volatility in section 2.5, but emphasize here that Chapter 11 bankruptcy filings do not equate with an airline shutting down. Although some of the carriers that have entered bankruptcy have been liquidated, the majority have emerged to operate as publicly held companies or been merged into another airline, generally with operations disrupted for little or no time.

While bankruptcies are costly for the affected firms' shareholders and their workers, and are broadly disparaged by politicians and industry lobbyists, there is little evidence that they harm competitors or consumers. Borenstein and Rose (1995) found that airlines tend to lower their fares before entering bankruptcy, but healthy competitors do not follow and the fare declines are generally short lived. When bankrupt carriers do reduce service, other airlines generally are quick to jump into their abandoned markets. Borenstein and Rose (2003) find no statistically discernible effect on the service to small and large airports when a carrier with operations at the airport declares bankruptcy. Even at medium-sized airports, where they do find a statistically significant effect, total service to the airport declines by less than half the number of flights that the filing carrier offered before bankruptcy.

Airline Networks

Incumbent airlines responded to elimination of regulatory restrictions on routes they could serve by restructuring as well as expanding their networks. The almost immediate transformation from the point-to-point systems created by the CAB entry policies into hub-and-spoke networks was perhaps

36. Southwest Airlines and America West, which was renamed USAir after its purchase of that rival.

37. Those two are AirTran, which in 2013 is being merged into Southwest, and Frontier, now owned by Republic Airways Holding.

38. As of 2012, survivors included three former trunk airlines, American, Delta, and United; local service carrier USAir (though now owned by a new entrant); and former Alaskan/Hawaiian carriers Alaska and Hawaiian Airlines. The late 2013 approval of the American Airlines and USAir merger further reduces this number.

the most unanticipated result of deregulation, and fundamentally altered the economics of airline operations. The new networks served passengers traveling to and from the central hub airports with nonstop service, and passengers traveling between two points on the spokes with change-of-plane service through hub airports.

The hub-and-spoke configuration provides cost, demand, and competitive advantages. Hubs generally increase available flight options for passengers traveling to and from hubs and facilitate more convenient service on routes for which demand is not sufficient to support frequent nonstop service at relatively low prices. Operating cost economies arise from the increased density of operations, allowing the airline to offer frequent service on a segment while maintaining high load factors. At the same time, because very few airports have the logistic or economic capacity to support more than one large-scale hub operation, competition at the hub airports typically is quite limited, yielding substantial market power for airlines at their own hubs. In addition, the frequent flights and extensive destinations available on the hub airline tend to give that airline a demand advantage versus its competitors on routes out of the hub (Borenstein 1991), arising from fundamental consumer preferences and substantially enhanced by the development of airline loyalty programs subsequent to deregulation. These effects have been reflected in less competition on routes to/from hub airports compared to other markets.

Examining concentration for trips to and from the twelve major hubs that existed for a significant share of the thirty-three years since deregulation[39] reveals an interesting pattern. These routes were slightly less concentrated than the national average until the mid-1980s, but diverged markedly by 1989, with hub-route Herfindahl-Hirschman Indexes (HHIs) averaging 0.48 versus 0.40 for nonhub routes. Since then, the difference has gradually narrowed. In the most recent data, average concentration is nearly the same on hub and nonhub routes.

Market Structure

While the early entry wave substantially reduced concentration in deregulated airline markets, merger activity in the mid-1980s acted as a substantial counterweight. Mergers peaked in the mid-1980s, when antitrust policy was relatively lax and greater credence was given to the view that potential competition could discipline prices as effectively as actual competition. By 1990, as antitrust policy became stricter in general and concerns about airline competition and hub dominance increased, merger activity slowed considerably, and most subsequent successful merger proposals involved at least one airline that was in extreme financial distress. Until the spate of mergers following the 2008 financial crisis—Delta/Northwest, United/Continental,

39. These are ORD, ATL, DFW, DEN, STL, DTW, MSP, PIT, IAH, CLT, SLC, and MEM.

and Southwest/Air Tran—others, such as the USAir/United merger proposed in 1999, met with sufficient threat of antitrust opposition that they usually were withdrawn.

As mergers declined, alternative forms of linkages were introduced. In the 1980s, major US airlines had pioneered partnerships with small commuter airlines that allowed each carrier to sell tickets for trips that use the commuter airline to bring the passenger to the carrier's hub and then the large carrier to fly between major airports. These partnerships allowed coordination of schedules and "code-sharing," which presented the product as a single-airline ticket. Other carriers, most notably American, chose instead to vertically integrate into the commuter airline business, buying some commuter carriers and expanding their fleet to form American Eagle, which is wholly owned by American Airlines.[40]

Code-sharing alliances between major carriers began with agreements between US and foreign air carriers as a response to regulation of entry on international routes.[41] By the late 1990s, these were extended to relationships among many large US airlines. Northwest and Continental, for instance, formed an alliance that allowed each to sell tickets under its own brand name that included flights on the other airline. These alliances, domestic and international, now generally include cooperative arrangements for frequent flyer plans, joint marketing, facilities sharing, and scheduling, though prices are required to be set independently.

Economic analyses suggest that alliances create value for customers, by converting interairline connections to apparent online connections and by allowing airlines to coordinate schedules to improve the quality of those connections. Bamburger, Carlton, and Neumann (2004) analyze the Continental/America West and Northwest/Alaska alliances, and conclude that prices declined in markets where the alliance created an "online" code-shared flight from an interline connection across the two carriers. They find a significant increase in traffic in those markets for the Continental/America West alliance. Armantier and Richard (2006) report similar findings for code-shared connecting itineraries in the Northwest and Continental alliance, but report higher prices for nonstop flights by alliance carriers. Armantier and Richard's (2008) analysis of net consumer welfare effects suggests that surplus gains by connecting passengers were offset by surplus losses of nonstop passengers.[42] Lederman (2007) finds evidence of an additional con-

40. Some airline decisions on organizational form were undoubtedly influenced by expected operational and labor costs associated with ownership of commuter carriers. See Forbes and Lederman (2009). American Airlines twice has announced plans to sell American Eagle, but these were postponed as a result of the 2008 financial crisis and American's bankruptcy filing in 2011.

41. Frustrated by restrictions on entering international routes, major US carriers began to create "alliances" with foreign carriers that followed the same model as their partnerships with commuter airlines.

42. Bamburger, Carlton, and Neumann (2004) do not separately analyze these markets.

sumer benefit in her analysis of international alliances: an airline's domestic demand appears to increase as a result of travel opportunities created by a new international alliance. This has mixed implications for consumers in equilibrium, however. If, as seems plausible, this results from demand spillovers through a more attractive frequent flyer plan, the loyalty effect of the frequent flyer plan may provide incentives for ultimately raising prices.

The net effect of these various changes in the industry was a decline in average concentration at the route level in the immediate aftermath of deregulation. From an average route-level HHI of about 0.55 in 1980, the HHI declined on both hub and nonhub routes through the early 1980s (see figure 2.9) with the national average HHI hitting its lowest point of 0.41 in 1986. Concentration, particularly on hub routes, rose from the late 1980s through the late 1990s, before declining somewhat in the 2000s. In the 2008 to 2011 period, concentration levels for all routes averaged about 0.46. How much of the reconsolidation through the 1990s was inevitable in an unregulated market and how much was the result of ancillary government policies including liberal merger policy continues to be debated. That debate was invigorated by the post-2007 mergers among the handful of remaining large carriers. Two unanticipated developments—reconfiguration of airline route

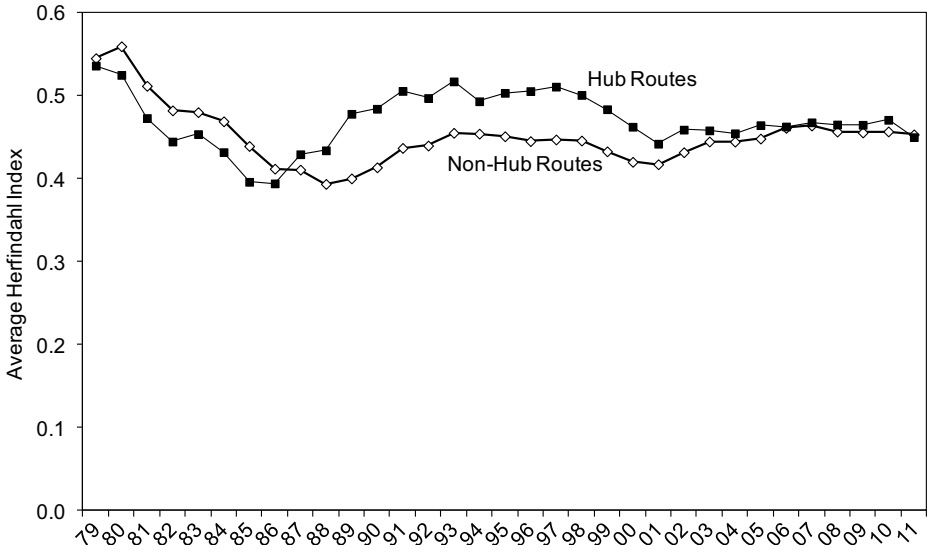

Fig. 2.9 Route-level concentration, 1979–2011

Notes: Authors' calculations are from domestic tickets in Databank 1A/1B using only tickets of 4-coupons or fewer. (See "Broadened Market Dataset," http://faculty.haas.berkeley.edu/borenste/airdata.html). The airports counted as hubs are ORD, ATL, DFW, DEN, STL, DTW, MSP, PIT, IAH, CLT, SLC, and MEM. Excludes data from the fourth quarter of 1980 (see figure 2.5 notes). Annual data are the average of quarterly calculations, weighted by revenue passenger miles.

networks into hub-and-spoke systems, and strategic innovations in loyalty programs that differentiated airlines' services and dampened competition—contributed to increases in route-level concentration. Government policies, however, particularly with respect to antitrust, exacerbated any latent tendencies toward concentration. The question of whether market power concerns require something more than antitrust attention continues to surface; we address it in section 2.5.

2.3.3 Service Quality

Once carriers were free to compete on price, the nature of competition required reevaluation. Historically, airlines have found it easier to differentiate price across passengers on a route than quality (apart from premium class service—business or first—with its own cabin), though over time there has been greater use of access to priority security lines and boarding, upgrades, and preferred seating for an airline's most valued customers. These historically were based on frequent flyer status and undiscounted fare tickets, but more recently are often available for à la carte purchase at additional fees. Some quality attributes associated with network reconfiguration and increased density, such as flight frequency and online connections, were maintained or improved following deregulation. Others, such as safety levels, which continue to be regulated, were unaffected. Many, particularly those associated with onboard amenities, have been reduced. Airport congestion and flight delays, which are among the most visible and significant declines in service quality, may be attributed more to the success of deregulation in increasing traffic and to the failure of infrastructure policy to keep pace with traffic growth than to altered carrier decisions under economic deregulation. Reduced levels of service quality overall do not imply that consumers as a group are worse off, though quality-loving, price-inelastic consumers may well be. We turn next to deregulatory impacts on service quality with respect to some of the key service quality metrics.

Flight Frequency and Connections

The reorganization of airline networks following deregulation led to increased frequency for service to and from hub airports and reduced nonstop service between smaller airports, all else equal (see Bailey, Graham, and Kaplan 1985, 83–86). There is a common view that deregulation led to a significant increase in the share of passengers that had to change planes. The change, however, was actually quite small. The dashed line in figure 2.10 presents the share of domestic passengers who changed planes from 1979 to 2011. These raw data, however, do not account for another change that was occurring at the same time: the average trip distance (nonstop origin to destination) was increasing—from 873 miles in 1979 to 1,067 in 2011—so more people were flying longer distance trips on which changing planes is more common. The solid line in figure 2.10 presents the same data adjusted

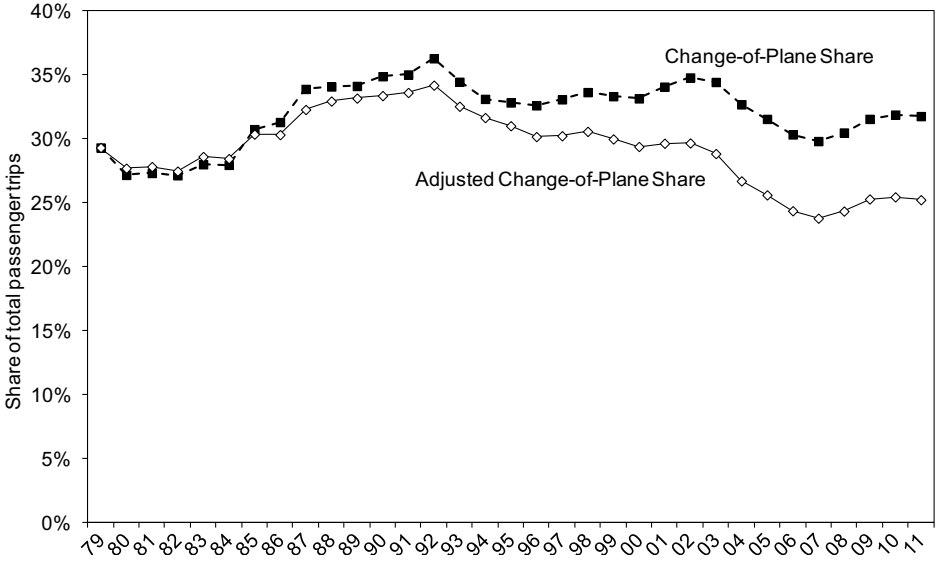

Fig. 2.10 Change-of-plane share with and without distance adjustment, 1979–2011

Notes: Author calculations from domestic tickets in Databank 1A/1B using only tickets of 4-coupons or fewer. (See "Translation of Domestic DB1A into More Usable Form," http://faculty.haas.berkeley.edu/borenste/airdata.html). Excludes 1980 data from the fourth quarter (see figure 2.5 notes). Change-of-plane (COP) share is the total number of directional trips (a round-trip is two directional trips) that include a change of planes divided by all directional trips. Adjusted change-of-plane (ACOP) share is set equal to COP share for 1979. For all successive years, ACOP share is the previous year's ACOP plus the weighted average change in COP share in all fifty-mile distance categories, where the weight is the previous year's passengers in each fifty-mile distance category.

for trip length.[43] Controlling for trip distance, a substantially smaller share of customers changed planes in 2011 than in 1979.[44]

Some studies of airline deregulation have also noted the drastic decline in interline connections—those involving a connection between two different airlines—after deregulation. Because online connecting service (change of aircraft but no change of airline) is associated with improved connections and better baggage handling, this improved the estimated net quality of service. In fact, the share of connections that were interline fell from 45 percent in 1979 to 8 percent in the early 1990s. It began to rise again in 1996, however, with the spread of code-sharing arrangements. It is more difficult to interpret interline statistics now, because some code sharing is between carriers

43. We adjust for trip length by calculating the change in change-of-plane share in 100-mile trip distance categories and then creating an overall change in change-of-plane share by taking a weighted average of the change within each category.

44. Berry and Jia (2010) argue this reflects changes in passenger demand for direct travel after 9/11.

that share some or all ownership, while others are between companies with only weak affiliations. In any case, by 2011 the share of connections reported in the DOT's Databank 1B that are interline had risen back to 44 percent.

Greater passenger volume has facilitated in many markets an increase in flight frequency, relative to the high price, low volume regulatory model. Figure 2.11 records changes in domestic service levels between 1984 and 2011. Not only has the number of flights nearly doubled in the past twenty-seven years, the number of markets with nonstop service is up more than 60 percent, even after the post-2008 service cutback.

Figure 2.11 shows a dramatic increase in the number of cities with nonstop service beginning in the late 1990s. This change corresponds to the widespread introduction of regional jets (RJs), jet aircraft with capacities of less than 100 passengers that can be efficient for routes previously served by propeller aircraft or by larger jets. RJ flights increased from 41 per day in 1997 to 8,805 per day in 2007, comprising about one-third of all domestic commercial flights. The number declined slightly in succeeding years, standing at an average of 8,182 flights per day in 2011. In 2011, the median

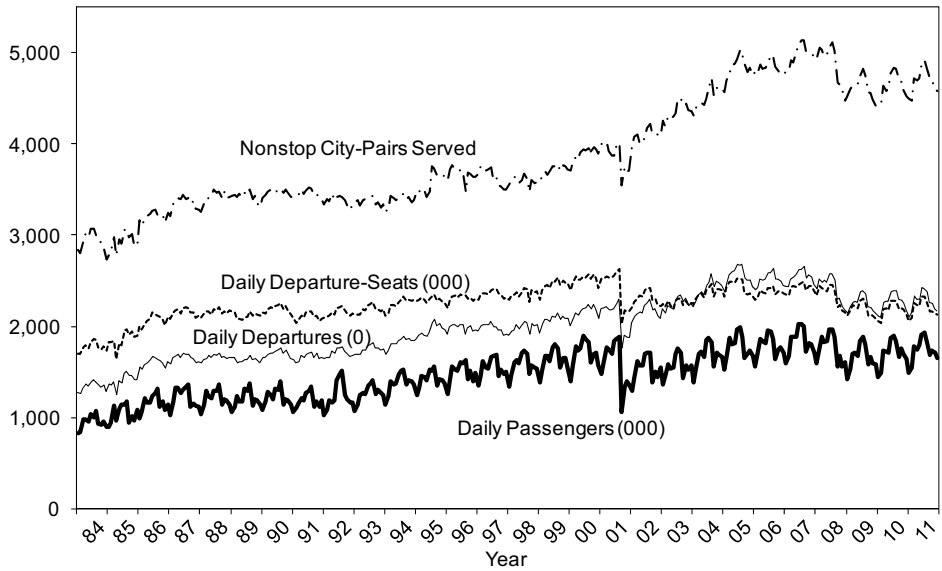

Fig. 2.11 US domestic airline service, 1984–2011 (monthly)

Notes: Authors' calculations are from the DOT T-100 service segment data set. An airport pair is defined as "served" if it averages at least one nonstop flight and ten seats per day during the month. Note that there was a change in October 2002 to the T-100 that added a number of small carriers (carrier codes added were 3C, 5C, 8C, 9E, 9J, 9K, 9L, BMJ, BSA, CHA, CMT, DH, ELL, EM, EWA, F8, FE, FI, FX, GBQ, GCH, GLA, GLF, HNA, HRZ, JX, KAH, KR, MIW, NC, NEW, NWS, PAM, PFQ, RYQ, SEA, SHA, SI, SKW, SLA, SMO, TCQ, TRI, USQ, VEE, VIQ, VPJ, WI, WP, WRD, WST, YTU, YV, ZV). These carriers are dropped in order to maintain comparability.

distance of an RJ flight was 419 miles, with 25 percent of flights less than 258 miles and 10 percent of flights over 866 miles, so these new aircraft clearly can play a variety of roles. One of those roles is introduction of nonstop service on routes that previously had none. Of the 2,053 airport pairs that gained nonstop service between July 1997 and July 2011, about 37 percent received at least some of that service with regional jets. Overall, 26 percent of RJ flights in July 2011 were on routes that had no nonstop service in July 1997.

Load Factors

Given the tendency toward inefficiently low load factors during the regulatory period (Douglas and Miller 1974a, 1974b), it is not surprising that load factors generally have increased since 1978, as shown in figure 2.3. Average load factors for domestic scheduled service climbed from lows of under 50 percent prior to deregulation, to over 60 percent in the mid-1980s, and have remained above 70 percent since the late 1990s, hitting 83 percent in 2011. While much of this increase is due to carriers' ability to compete on price in addition to flight frequency, it has been facilitated by the increasing sophistication of airline booking systems. These systems manage dynamic demand forecasts and seat allocation to the myriad fare classes, enabling airlines to fill seats that would otherwise go empty with a low-fare passenger, while reserving seats for likely last-minute high-fare passengers.

Since most costs do not vary with the number of passengers on a flight, higher load factors have contributed to lower costs per revenue passenger mile. But they have also led to lower quality flight experiences for consumers. With high load factors, late-booking travelers may not find a seat on their preferred flight, in-flight experiences are less likely to be comfortable, and rebooking to accommodate missed connections or canceled flights becomes increasingly difficult. Gone are the days of almost being assured an empty middle seat on most cross-country flights. While many travelers complain about crowded planes, it is important to recognize that airlines have the option of offering higher price, less-crowded flights. That virtually none choose to do so suggests that passenger demand is not sufficient to justify the price/cost trade-off.[45]

In-Flight Amenities

Quantifying the provision of in-flight amenities is difficult, but it seems clear that this area has experienced perhaps the greatest decline in quality

45. Indications of consumer dissatisfaction with the ability of airlines to recover from schedule disruptions during the summer of 2007 led some airlines to conclude that they undercut even the minimum service quality passengers are willing to pay for (see McCartney 2007). It is difficult to say whether improvements in delays and cancellation rates since then reflect intentional actions take by airlines or reduced congestion resulting from the fall in demand associated with poor macroeconomy.

since deregulation. The days of piano bars in 747s and gourmet meals are long past for most domestic travelers. More significant for many passengers has been the decrease in their space on board. Coach class seat width and pitch has decreased, even while Americans' girths have increased, and high load factors make empty middle seats less and less common. The decline in amenities has not been monotonic or universal, however. In recent years, airlines have abandoned the headset or movie charges they previously imposed for in-flight entertainment, and some, like Jet Blue and Virgin America, promote their service with in-flight entertainment options. As of 2013, most legacy airlines offer a section of the coach cabin with greater legroom, at least on longer-distance flights, allocating these seats to customers with high status in their frequent flyer programs and others who are willing to pay an extra fee. However, carriers that have differentiated themselves primarily by offering plusher onboard service for all customers have not been particularly successful, suggesting that when passengers vote with their wallets, low prices beat higher quality for many customers.

Oversales and Denied Boarding

With fixed capacity, uncertain demand, and last-minute cancellations or no-shows among passengers, airlines generally have found it optimal to offer more tickets than there are seats on a given flight. In the instances in which more passengers than anticipated show up for an oversold flight, some passengers will be denied boarding. The CAB addressed this concern in 1979 with a rulemaking on denied boarding compensation. Rather than ban oversales (one proposal that was not adopted), the Board attempted a market-based solution, which has persisted through today. Airlines are required first to seek volunteers to give up their seats, for some compensation that is at the discretion of the airline. Airlines may have some "standard offer" compensation, though many conduct informal auctions, increasing offered compensation (usually in the form of free travel, booking on the next available flight, and perhaps food or hotel vouchers) until the requisite number of volunteers are obtained. In more than 90 percent of the cases, this solves the problem.[46] In the remaining cases, passengers are to be boarded in order of check-in times, and those involuntarily denied boarding are awarded compensation determined by the regulation.[47] In 2011, the

46. The overall denied boarding rate increased from 0.15 percent in the early 1990s to a peak of 0.22 percent in 1998, and has varied within a narrow band of 0.10 to 0.13 percent since 2005. Voluntary denied boardings account for 91 to 96 percent of the total. See the US Department of Transportation, Bureau of Transportation Statistics, National Transportation Statistics 2011, table 1-64, at http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications\national_transportation_statistics/html/table_01_64.html, accessed January 14, 2013.

47. Denied boarding compensation is not mandated if the oversale is due to substitution of smaller aircraft than originally scheduled or a result of safety-related weight limits for flights operated by aircraft with sixty or fewer seats, the passenger has not complied with check-in requirements, or the delay is less than one hour.

risk a passenger faced of being involuntarily "bumped" was less than 1 in 10,000, so it appears that this is not a significant quality issue.

Travel Time and Delays

One of the most contentious issues in the deregulated airline environment has been increased travel time, particularly due to congestion and delays. Substantial increases in flight operations (see figures 2.1 and 2.11), with limited increases in infrastructure capacity and few changes in infrastructure deployment, have led to dramatic increases in congestion at key points in the aviation system. This has not only increased scheduled travel time in many markets, but increased mean delay beyond scheduled travel time and increased uncertainty around expected arrival times. The Bureau of Transportation Statistics On-Time Performance database reports that in 1988 (the first full year of statistics), roughly 20 percent of all flights arrived more than 15 minutes after their scheduled arrival (including cancellations and diversions). Despite increasingly "padded" scheduled flight times, this had increased to 27 percent in 2000,[48] when flight delays at some airports reached unprecedented levels. While there was some improvement in delays following the reduction in demand after 9/11, by 2007, delays and cancellations had once again climbed to 27 percent. It is difficult to say whether post-2008 delay and cancellation rates of roughly 20 percent reflect changes in operational procedures or are simply the byproduct of reductions in aggregate flight activity and lower congestion associated with the poor macroeconomy over recent years.

Flight delays have numerous causes. Some disruptions, such as severe weather, are beyond an airline's or airport's direct control (though the magnitude and severity may be affected by an airline's scheduling policies and availability, or lack, of redundant equipment and personnel). Incentives to set schedules based on favorable, or even average, conditions (Mayer and Sinai 2003) make some delays inevitable. The existence of delays at hub airports, where congestion *externalities* for the dominant carrier are relatively small, suggests that airlines may optimize their networks with some expected delay built in (Mayer and Sinai 2003). But a significant portion of delays appear due to inefficient infrastructure investment and utilization policies, as we discuss in section 2.5.

Safety and Security

The level of airline safety has been a focus of government policy since the infancy of the industry, when Post Office airmail contracts were shifted from military aircraft to civilian contractors after a series of fatal accidents involving military pilots. Despite economic deregulation, the Federal Avia-

48. See the discussion of LaGuardia airport's 2000 experience in section 2.5 and by Forbes (2008).

tion Administration has maintained authority over all aspects of air carrier safety, from certification of new aircraft, to airline maintenance, training, and operating procedures, to airport and air traffic control system operation. Even though safety regulation was not reduced, some opponents to the Airline Deregulation Act warned that the competitive pressures resulting from economic deregulation would reduce the level of safety provided by commercial airlines. Economic theory is not dispositive on whether such an effect would be expected (Rose 1990).

There is no evidence that airlines have reduced their provision of safety since deregulation. While research finds some evidence that carriers' safety records may be influenced by their financial condition, particularly for smaller airlines (Rose 1990; Dionne et al. 1997), and Kennet (1993) finds that engine maintenance cycles lengthened somewhat after deregulation, analyses do not suggest lower levels of safety following deregulation. This is consistent with a range of other work (e.g., Oster, Strong, and Zorn 1992; Rose 1992; Savage 1999), and with continuing declines in overall and fatal accident rates for US commercial airlines. This is not terribly surprising. Not only does safety continue to be directly regulated, but airlines also perceive strong safety reputations to be a prerequisite to attracting any passengers. The impact on carriers, such as ValuJet, who fail to maintain such reputations lends some credence to that view.[49]

Since 2001, there has been an increased emphasis on securing air travel against terrorist attack. Passenger screening that was first introduced in the 1970s in response to aircraft hijackings was shown to be inadequate, so security measures were stepped up. There have been no successful attacks since 2001, but there have been reports by the US and UK governments of interrupted plans to stage attacks. The screening raises the cost of travel, discouraging people from traveling by air. Using cross-airport variation in implementation dates of security changes, Blalock, Kadiyali, and Simon (2007) estimate that the hassle of increased passenger screening after September 11, 2001, reduced demand by about 6 percent overall and by 9 percent at the nation's fifty busiest airports.

2.4 Airline Markets outside the United States

The development of the airline industry outside the United States differed in two significant ways from the previous description. First, with relatively

49. Most airline accidents have modest impacts on the affected firm's capital market value and little or no measurable impact on subsequent demand (see Borenstein and Zimmerman 1988). As Borenstein and Zimmerman point out, this may be "due to very limited updating of prior beliefs [about an airline's safety] or to a low *marginal* valuation of safety" (1988, 933) at current levels of safety provision. Dillon, Johnson, and Pate-Cornell (1999) argue that some accidents may contain more information and therefore generate greater responses, such as ValuJet's loss of one-quarter of its market value in the month following its 1996 Everglades crash and its subsequent decision to rebrand as AirTran following its acquisition of that firm in 1997.

few exceptions, non-US carriers' fortunes were substantially dependent upon international routes due to their relatively small domestic markets: for example, international traffic accounted for 90 percent of major European carrier traffic in the 1970s, compared to 28 percent for comparable US carriers (Good, Röller, and Sickles 1993).The terms of competition in international markets have been governed by negotiated bilateral treaties that generally limited rivalry and often encouraged collusive behavior, as discussed in greater detail following. Second, while the US industry was characterized by privately owned firms subject to government regulation, the norm elsewhere was one or two scheduled passenger service "flag carriers," operated as entirely or majority state-owned enterprises. Many of these received significant continuing state subsidies.[50] This combination of protected markets, state ownership, and soft budget constraints created a tendency toward high costs of service and high fare levels, particularly relative to comparable US routes in the aftermath of their deregulation. Estimates of these effects suggest that they were substantial. Cost and production function-based estimates suggest relative inefficiencies of 15 to 25 percent of US carrier costs (e.g., Good, Röller, and Sickles 1993; Ng and Seabright 2001). Much of this appears linked to labor costs in a manner strongly suggestive of rent sharing. Neven, Röller, and Zhang (2006) estimate a model that explicitly endogenizes wage costs through union negotiations, and conclude that labor cost inflation ultimately led to average prices close to monopoly levels despite noncooperative markup behavior given those higher costs.

Despite these inefficiencies, the movement toward more market-based airline sectors considerably lagged US reforms. This cannot be attributed entirely to the need for international coordination. There was little progress even on actions requiring no coordination, such as privatization of airline ownership and relaxation of entry restrictions to reduce monopoly, until the mid-1980s or later. For example, Swiss Air was the only European flag carrier with no state ownership until the decision to privatize British Airways in late 1986. While entirely state-owned carriers have become less common today, many governments continue to have significant ownership shares in their national airlines. Similarly, even among countries large enough to have potentially significant domestic markets, competitive restraints remained the norm through the 1980s. In Australia—home to one of the

50. The focus on national "flag carriers" persists today, although private investors have replaced state ownership in most countries. Most jurisdictions, including the United States, limit foreign national ownership of airlines. Only a handful of countries—Australia, Chile, and New Zealand—have eliminated foreign ownership restrictions for domestic airlines. For airlines within the EU, nationality limits have been replaced by a 49 percent limit on foreign ownership applying only to owners outside the EU. The US statutory limit of 25 percent of voting shares in foreign ownership is now one of the most severe, and its enforcement has been aggressive. See, for example, the adjudication of Virgin America's request for certification beginning in 2006. This has been a particular source of disagreement in negotiations over international routes between the United States. and countries in the EU.

largest domestic airline markets during the industry's infancy—the tightly regulated domestic duopoly between state-owned Trans Australian Airlines (TAA) and privately owned Ansett Australian National Airlines (Davies 1971, 1977) was not relaxed until 1990. Qantas, Australia's state-owned international flag carrier and, with the purchase of TAA in 1992, domestic carrier, was not fully privatized until 1995 (see Forsyth [2003] for a discussion of the post-deregulation Australian experience).

In international markets, the need for government renegotiation of changes in air service agreements added further constraints on the pace of deregulation. The framework, but not terms, of international air service agreements was established with the 1944 International Convention on Civil Aviation, referred to as the "Chicago Convention" for its location. Despite some early pressure for multilateral agreements, the framework that was adopted focused on bilateral negotiations. The convention enunciated the possible "freedoms of the air" to be granted to commercial carriers, which were expanded over time to include nine possible "freedoms." The first two were by default granted to all signatory states, and provided for the right to fly over another country without landing and to land without picking up or discharging passengers. The third and fourth freedoms, which comprised the core of bilateral agreements, provided for rights to transport traffic between a carrier's home country and an airport in the second country. The fifth and sixth freedoms involved extensions of service to a third country through continuing or connecting service, respectively. The seventh freedom permited international service between two countries entirely outside an airline's home country; the eighth and ninth freedoms permited an airline to offer domestic service within a country other than its home country, either as a flight continuation from its home country (eighth) or as an independent service (ninth, also referred to as "pure cabotage.").[51]

Over the first three decades following the Chicago Convention, most air services agreements followed the traditional form set out in the US-UK 1946 "Bermuda I" agreement. These agreements generally restricted international scheduled passenger service to one designated carrier from each country providing service on a limited set of specified airport routes between the countries. Fares required approval from each government, though this approval usually was automatic for fares set by the participant airlines under the auspices of the International Air Transport Association (the international airline trade association), which also set service standards intended to limit nonprice competition across carriers. Capacity limits and revenue-sharing agreements were common, ensuring that neither country's airline had the ability or incentive to dominate passenger flows on the routes.[52] The result

51. See Doganis (2006) and Odoni (2009) for a more complete description of the convention and its freedoms.

52. Revenue-sharing agreements were not permitted in US bilaterals, as they were viewed as a violation of US antitrust policy. In addition, the CAB, on behalf of the US government, frequently protested fares set by IATA as too high.

was little or no competition and high fares on most international routes. Traffic was limited not only by high fares, but also by passenger diversion. The convention focused on regulation of scheduled passenger air service; nonscheduled charter or tour operators took advantage of the regulatory breach to expand their operations, particularly in markets with significant potential leisure traffic. This resulted in substantial passenger shifts away from scheduled passenger airlines in many markets: for example, by 1977, 29 percent of the North Atlantic market passengers flew on charter or nonscheduled services (Doganis 2006, 31).

Liberalization of international agreements began in the late 1970s (see Doganis 2006). The first major shift was toward "open market" agreements, modeled after the 1978 US–Netherlands agreement. These introduced greater flexibility into air service—the most liberal eliminated capacity and service restrictions, allowed each country to designate multiple airlines for international service, facilitated more competitive pricing, and expanded the set of airport routes flown between the two countries. They fell far short of transforming international travel in the way the 1978 US Airline Deregulation Act transformed the US domestic airline market, however. Entry and pricing flexibility were expanded, but not competitively determined. Bilateral agreements ignored the fundamental network aspect of air travel, impeding efficient network operation. Implementation for agreements that involved the United States was asymmetric: for example, while US airlines might be granted access to all airports in the foreign country, foreign carriers were restricted to a relatively small set of US gateway cities, generally defended by arguing that the large US airline market was not matched by similar opportunities abroad. The emphases tended to be more on the welfare of each country's carriers than the welfare of consumers.

A second shift, to "open skies" agreements in the 1990s, further reduced government impediments to competition in selected international markets. The US–Netherlands 1992 agreement was the first to mark the transition. This and other "open skies" agreements allowed unlimited market access on all routes between the two countries for all carriers designated by either country, as well as unlimited fifth freedom rights, competitively determined pricing, and authorization of code sharing and strategic alliances between carriers. Even open skies agreements typically were negotiated on bilateral basis, however.[53]

The most dramatic transformation in international air service took place in Europe. By the mid-1980s, the United Kingdom had begun to negotiate more flexible intra-European bilateral agreements, and several other European countries followed suit. These were similar to the agreements the United States had signed with many countries, which the United Kingdom

53. A few multilateral agreements eventually opened common aviation areas to competitive service, such as the Asia Pacific Economic Community agreement between the United States, Brunei, Singapore, Chile, Peru, and New Zealand.

had heretofore rejected, and continued to reject in negotiations with the United States. This, with the movement toward integration of the European Community, led to three successive airline liberalization packages in Europe in 1987, 1990, and 1992. While the early reforms were modest, the full implementation of the final package in 1997 was as revolutionary for international air travel within Europe as the 1978 Airline Deregulation Act was for domestic US air travel. This comprehensive multilateral agreement created a single, largely unregulated airline market throughout the twenty-five European Union (EU) member states, Switzerland, Norway, and Iceland, roughly commensurate with the US domestic market in passenger volume. It allows full and open access to any routes by any EU carrier (eighth and ninth freedoms), eliminates price controls, sharply constrains state subsidies, and replaces national ownership restrictions with liberal EU-wide ownership requirement (allowing up to 49 percent ownership by foreign nationals outside the EU, and any ownership patterns by EU member state nationals).

These reforms have led to a substantial increase in entry by "no frills" (primarily point-to-point) carriers, though two no-frills carriers, Ryanair and easyJet, account for more than half of their segment's total traffic. The Association of European Airlines (AEA) reported that by the summer of 2006, AEA members (primarily "full service" or network carriers) accounted for 56 percent of weekly seat capacity; no-frills carriers accounted for 18 percent, and other carriers (primarily charter and tour operators) accounted for 26 percent. This average masks much greater no-frills shares in markets with an endpoint in the United Kingdom (close to 50 percent) and lower shares (less than 15 percent) in remaining intra-EU markets. These carriers tend to operate out of satellite or regional airports, providing regional or city-pair, but not airport-pair, competition.

The EU "Third Package" goes far beyond the largely bilateral "open skies" agreements negotiated for some markets, and has placed the EU in the vanguard of the movement for more fully deregulated international aviation markets. As dramatic as these changes have been, however, their impact has been moderated by continuing constraints. Many of the largest EU airports have capacity constraints that limit or preclude entry at the airport level, protecting incumbent carriers through administrative rules for allocating access (see Odoni 2009) and constraining direct competition. Reaching the full potential of relaxed ownership restrictions was also severely impeded by the continued governance of extra-EU international service by bilateral agreements between individual countries: service between the United States and France was limited to French- and American-owned carriers, service between Japan and the United Kingdom to Japanese- and British-owned carriers, and so forth. Carriers that consolidated across national boundaries within the EU risked losing access to lucrative international markets outside the EU. This ensured that the EU carrier network remained more fragmented than might be expected in equilibrium.

Eliminating these restrictions has been a key objective of ongoing EU-wide negotiation of air service agreements with non-EU countries. At the top of the EU agenda is replacing bilateral agreements between its member states and non-EU countries with multilateral open skies agreements. Renegotiation of these agreements was effectively forced by a 2002 European Court of Justice decision invalidating substantial portions of bilateral agreements. The court objected on two key grounds: first, that the agreements concerned some terms that were in the purview of the EU, not the member states, to negotiate; and second, that they discriminated across EU airlines based on the nationality of their ownership, violating Article 43 of the European Community Treaty. Over the past several years, the EU has pushed for greater deregulation, and the United States has dragged its heels. EU negotiators have targeted relaxation of the US statutory limit of 25 percent foreign ownership of US domestic airlines, nondiscriminatory access to US–EU markets for any EU carrier, and relaxation of the US government "Fly America" policy. US negotiators insisted on greater US carrier access to London's Heathrow airport (the existing US-UK bilateral agreement restricted US carrier access to Heathrow to United and American airlines), and had been unable to deliver prospective Congressional approval of a number of EU demands—most notably relaxation of ownership restrictions.[54] A first-stage agreement that moves partway toward these goals was approved in 2007, with implementation effective in March 2008. This expanded access to Heathrow airport, allowed EU- and US-owned carriers to fly between US and EU cities regardless of national ownership, and waived nationality clauses for EU ownership of airlines in twenty-eight designated non-EU countries (primarily African). A second stage agreement was reached in 2010, with the United States promising to seek legislation to relax foreign ownership restraints; Congress has not as of this writing taken any action.

Despite liberalization of many international aviation agreements over time—incrementally with the push toward "open skies" bilateral agreements and most significantly with the transformation of European Union markets over the past ten years—competition in many international markets continues to be limited, encouraging higher prices and rent-seeking activities.[55] Protection of domestically owned carriers through ownership restrictions that preclude foreign acquisitions or mergers and continuing prohibitions on cabotage (international or domestic service that lies entirely outside a carrier's home country) preserve inefficiencies and reduce the benefits of

54. Congress has articulated national security, operational, safety, and labor concerns over foreign national ownership of US carriers. While most of these concerns could be addressed through less restrictive means (see the discussion of the Brattle report on these issues by Doganis [2006, chap. 3]), the political environment in the United States seems resistant to significant change.

55. See, for example, the lobbying by US carriers over the availability of new US-China routes (Torbenson 2007).

competitive markets. There continues to be a considerable distance between current policy and a competitive international aviation market.

2.5 Continuing Issues in the Deregulated Airline Industry

Airline deregulation has likely benefited consumers with lower average prices, more extensive and frequent service, and continued technological progress in both aircraft and ticketing. The industry continues to attract considerable attention from economists and policymakers, however, in part because its business practices have been so dynamic and differentiated across firms while airline earnings have been tremendously volatile. If the fundamental question of industrial organization is the degree to which unfettered markets achieve efficient production and allocation of outputs, and the extent to which government intervention can improve such efficiencies, the airline industry may illustrate those issues as well as any.

After more than three decades of experience with airline deregulation, some observers continue to call for renewed government intervention in the economic decision making of the industry. The concerns divide somewhat imperfectly into three areas. First, is the current organization of the industry economically sustainable? US airlines have lost billions of dollars during demand downturns that occurred at the beginning of the 1980s and 1990s, during 2001 to 2005, and post-2008. Also, several large carriers have exited through mergers in recent years. Do these losses indicate that fundamental change in the organization of the industry—for example, to a tight oligopoly—is necessary before the sellers will be able to sustain a competitive rate of return over the long run? Or, alternatively, are the losses the result of investor exuberance and management weakness that led to excess capital and inflated costs during high-demand periods, setting the companies up for extreme earnings downturns when demand weakens? Put differently, will firms' self-control of capacity and labor cost growth during good times be enough to reduce the cyclicality of the industry, or is the instability of this industry fundamentally different from most others?

Second, should market power be a significant public policy concern in this industry? Mergers and use of loyalty programs may raise barriers to entry by new firms and barriers to market expansion by existing firms, but how large are these effects, and can they be moderated through application of antitrust policy? Does the poor earnings record of the airlines demonstrate that market power is not a significant issue? Conversely, does the enormous apparent cost advantage of smaller airlines—which still have only about one-quarter of the US market—indicate just the opposite, that the market power of incumbents has allowed them to impede the loss of market share to much more efficient rivals. If this is the case, then the market power may create not only the usual static deadweight loss from underconsumption, but also production deadweight loss from exclusion of a more efficient firm.

Finally, much of the air travel infrastructure remains in government hands, and there remain questions about the efficiency of the interaction between government resources, including airport facilities and air traffic control, and the private air transport sector. Congestion and delays soared prior to the collapse of traffic following 9/11, and reemerged as critical issues with the return of passenger volume in 2006 and 2007 and exacerbated by the growth of smaller aircraft such as regional jets in many markets. These suggest that government-run airport and air traffic control systems may have lagged behind the industry's dramatic expansion since deregulation. While higher jet fuel prices and reduced demand may have mitigated congestion since 2008, this reprieve, like that in the early 2000s, may be temporary. Does imperfect coordination of government-controlled support activities lead to significant inefficiencies in the industry? And, would privatization of these government services be likely to improve performance?

2.5.1 Sustainability of Airline Competition

Airline nominal net profits over the post-deregulation period have fluctuated wildly, with a high of nearly $5.4 billion in net income in 1999 and a low of over $27 billion in net losses in 2005. Two different, but related, theories have been argued to show that competition in the airline industry is not sustainable. These are versions of the "destructive competition" concerns that were raised in early discussions of the need for airline regulation in the 1920s and 1930s. Their basic idea is that unconstrained competition leads to prices too low to sustain viable firms. The outcome may be evolution into a monopoly or tight oligopoly, though supranormal profits associated with this structure may then set off another round of "excessive" investment and competition.

The first theory tends to be popular with the media and with some industry lobbyists pursuing a regulatory-relief or tax-relief agenda. Proponents of this theory note that the airline industry has substantial fixed costs and very specific assets used to produce a homogeneous good, and at the same time is subject to highly cyclical demand and frequent shocks to variable cost. In such an unregulated environment, it is argued, boom/bust cycles are inevitable and will lead to underinvestment, or, in the extreme, a complete collapse of funding for the industry.

While the description of industry-specific fixed costs and cyclical demand is reasonably accurate, it should be noted these are not unique to airlines. Moreover, the conclusion of inevitable collapse is difficult to reconcile with the history of this industry, or that of other capital-intensive industries that face unpredictable demand. Like those in other industries—steel, autos, semiconductors, oil refining, and telecommunications, among others—airline earnings are likely to be volatile, which can lead to bankruptcies. With long-lived industry-specific capital, failures tend to change the identity of its owners with little effect on the overall capital stock. This can depress returns

for extended periods of time, as occurred in oil refining for most of the 1980s and 1990s and in telecommunications infrastructure in the early 2000s.

These conditions present a problem in the economic or industrial organization sense only if the unpredictability results in returns insufficient to generate investment in the industry. In the airline industry, however, inadequate industry investment is virtually never mentioned as a problem. Over the last three decades, the far more frequent complaint from the airlines and industry analysts has been that there has been too much capital pouring into the industry; this complaint often is accompanied by a plea from the industry to limit entry and expansion in order to "rationalize" capacity and ensure adequate returns to investment.

The second theory appeals to the existence of scope and network economies in production of air transportation. Proponents argue that the efficient configuration of production implied by these economies suggests that the number of viable firms may be quite small in equilibrium. A nuanced version argues that there may be an "empty core" to the competitive game, if, for example, costs of producing a large set of air travel services among many cities are lowest if provided by one firm, but costs are not locally subadditive. That is, if subsets of those routes could be served at a cost below the incumbent's fares, an entrant serving just those routes could be profitable while rendering the reduced system of the incumbent unprofitable. The entrant's set of city-pair markets might, in turn, be vulnerable to further attack by entrants serving other subsets of markets, leaving groups of markets that are not break-even on a stand-alone basis.[56] Periodic upheavals in the industry might follow the breakdowns and reforming of coalitions.

There is little empirical support for either an empty core or natural monopoly characterization of the airline industry. There is widespread agreement among researchers and industry participants that economies of scale and passenger density may exist, but empirical estimates of their magnitude have found fairly modest advantages of size. Returns to density in airline networks typically have been estimated as the change in total cost of increasing passenger traffic (e.g., passenger miles) while holding constant network size (e.g., airports or routes served) and structure (e.g., average stage length). Estimated elasticities of total cost with respect to density tend to cluster around 0.85.[57] That is, doubling passenger traffic on a given network reduces average costs by roughly 15 percent. Estimated returns to scale, generally measured by the increase in expected costs from doubling output and network size, tend to be roughly constant at the scale of major

56. For a discussion of the general theory of sustainability, see Baumol, Panzar, and Willig (1982).

57. See, for example, Caves, Christensen, and Tretheway (1984); Ng and Seabright (2001); and Basso and Jara-Diaz 2005. Brueckner and Spiller (1994) estimate substantially larger returns to density, with an elasticity of marginal cost with respect to spoke density out of hub airports of –0.3 to –0.4 from their structural model of demand and profit maximization.

airlines. Moreover, across major US airlines, there seems to be little correlation between overall size of operations and unit cost, though it is quite difficult to adjust such calculations for quality and the different array of products offered. After more than twenty-five years, there is no evidence that cost advantages are giving the largest airlines increasingly dominant positions, as indicated by figures 2.6 (costs) and 2.7 (market share). Borenstein (2011) documents the airline losses on domestic service since deregulation and examines four common explanations: high taxes, high fuel costs, weak demand, and increasing competition from low-cost carriers. He finds no evidence that taxes are a significant factor, but plausible evidence that each of the other three factors has contributed significantly.

We would note, moreover, that complaints of inadequate returns on investment are not unique to the deregulated environment, nor to the airline industry. Prior to 1978, regulators faced ongoing claims of profit inadequacy, although economic analyses suggested that returns generally covered the industry's cost of capital (Caves 1962) and that attempts to increase returns through higher fares generally led to increased capacity investment rather than to increased profitability (Douglas and Miller 1974a, 1974b). While it is true that the level of profits in current dollars exhibits substantially greater fluctuations post-deregulation, this is to be expected given price inflation and the rapid increase in the overall scale of the industry. Figure 2.12 ad-

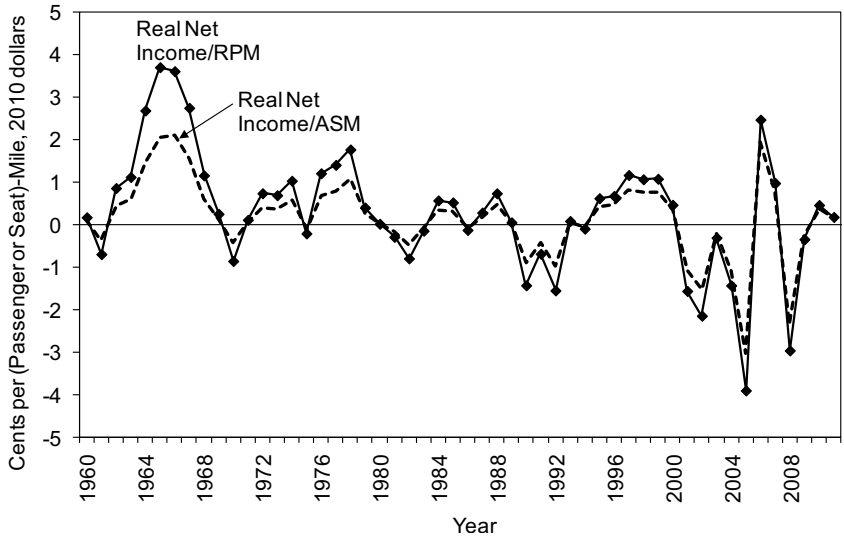

Fig. 2.12 Airline scaled net income, 1960–2011

Sources: Financial results are from Airlines for America, Inc., http://www.airlines.org/Pages/Annual-Results-U.S.-Airlines.aspx, and authors' calculations of net income deflated by urban CPI deflator, 2010 = 100. For system-wide RPM and ASM, see figure 2.1 sources.

Note: In constant 2010 cents.

justs for both of these factors, scaling industry aggregate constant dollar net income by available seat mile and by revenue passenger mile from 1960 to 2011.[58] Cyclicality in income is not new, though the losses following the demand shocks of 9/11 and the 2008 financial crisis and the fuel price shocks in 2005 make the 2000s a particularly volatile period.

Two classes of explanations go a long way toward explaining the volatility in the industry. First, the fundamental economics of the industry—volatile demand, high fixed costs, and slow supply adjustment—combine to create an environment in which profits are likely to change quickly and drastically. Second, the industry has undergone and continues to undergo a very high level of business-model experimentation, in pricing, logistics, competitive strategies, and organizational form. With companies still quite uncertain about major aspects of operations and market interactions, it would not be surprising that significant strategic errors and successes occur with negative and positive profit impacts. We consider these two areas in turn, focusing on data through 2007, prior to the most recent downturn.

Market Fundamentals

The first factor contributing to earnings volatility is volatile demand. To illustrate the demand volatility carrier's face, suppose airline demand reflected only proportional shifts in an otherwise unchanging constant elasticity demand curve. For a given elasticity, ε, we can associate observed quantities (measured by aggregate domestic revenue passenger miles) and prices (measured by real average revenue per domestic revenue passenger mile) with a demand curve of the form $ln(Q) = \alpha + \varepsilon \cdot ln(P)$. Shifts in α needed to keep observed price and quantity pairs on a demand curve can be interpreted as demand shifts. Figure 2.13 illustrates the resulting implied domestic demand shifts (changes in a normalized α) over 1960 to 2007, for assumed constant demand elasticities of –0.8, –1.0, and –1.2.[59] These are broadly within the range of industry short-run demand elasticity estimates in the literature.[60] While somewhat artificial, this captures the rapid demand changes that occurred, not just following the attacks on September 11, 2001, but also around the recessions of the early 1980s and 1990s, and at other times. Figure 2.14 presents the year-to-year changes in α for the midelasticity case of –1. The implied demand changes are quite substantial and volatile. In the early 1980s, for instance, 9 percent growth in demand one

58. The profit information we discuss here covers only domestic operations. U.S. carriers are required to report separate financial statements for domestic and international operations, though obviously all of the typical transfer pricing and revenue sharing issues arise in such financial breakouts. We carry out the analysis in this section only through 2007 in order to avoid concerns that the analysis is driven entirely by the extreme fuel price spike and crash in 2008 as well as the financial crisis and Great Recession that followed.

59. Many other factors may have changed over this period—most notably, demand elasticity—so the graph should not be read as literally measuring exogenous demand shifts.

60. Gillen, Morrison, and Stewart (2004) survey estimates of air travel demand elasticities.

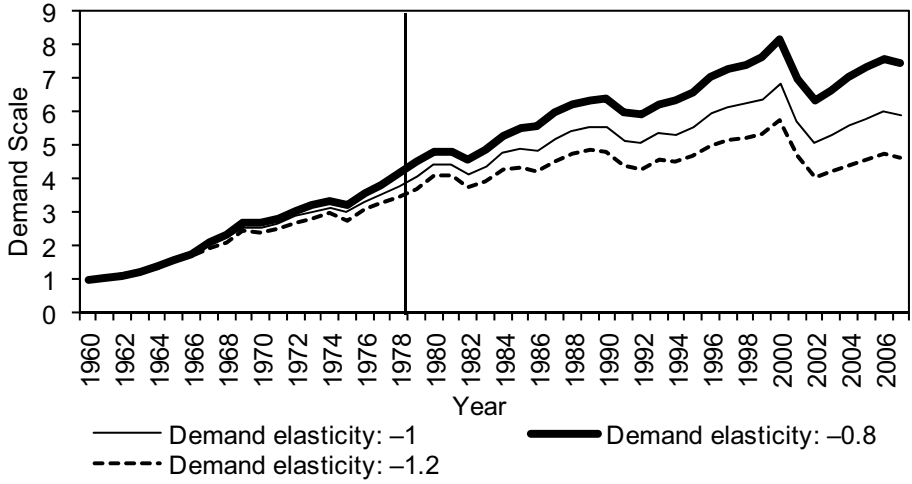

Fig. 2.13 Implied normalized demand, 1960–2007

Notes: Authors' calculations are based on domestic industry revenue passenger miles and average domestic yield (revenue per revenue passenger mile); see figures 2.1 and 2.3. Yield deflated by urban CPI deflator, 2010 = 100.

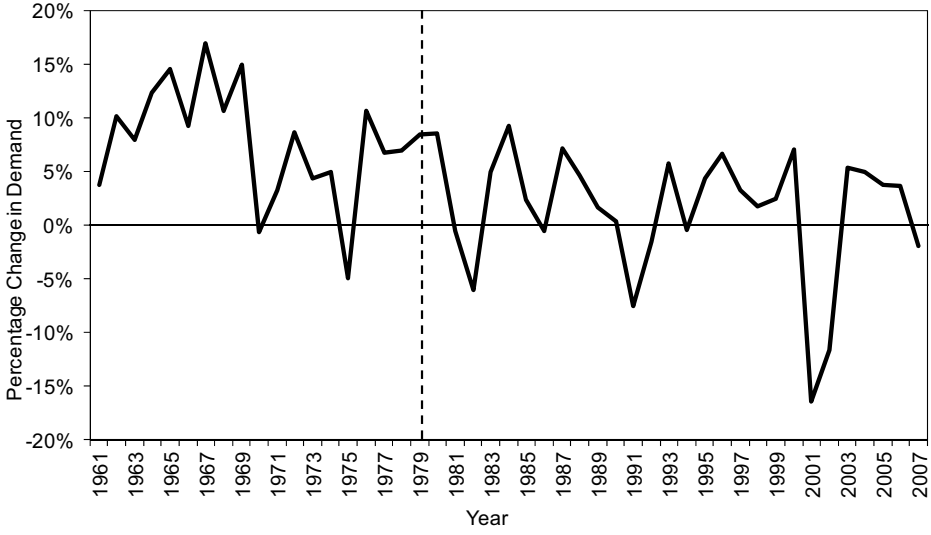

Fig. 2.14 Year-to-year changes in implied demand for air travel, 1961–2007

Note: See figure 2.13 and explanation in text.

year reverted to a 6 percent decline just two years later and back to 9 percent growth two years after that. Volatility of demand is, of course, especially challenging for producers when the good is not storable and production is characterized by strict short-run production constraints, as in the case with air travel.[61]

Volatility in demand creates even greater earnings volatility if firms are not able to resize production quickly, reducing inputs and costs when demand slackens and expanding rapidly when demand picks up. Fixed capital costs make this difficult in the airline industry, but capital costs (lease, depreciation, and amortization costs for aircraft and other capital) averaged only 15 percent of total costs from 1990 to 2007. These capital costs are actually not fixed in the usual economic sense. There are active resale markets for aircraft and other equipment, and the transaction costs are considered to be low. But their economic value fluctuates with demand and is highly correlated across firms. Moreover, financially distressed firms may be disadvantaged in "forced" asset sales (see Pulvino 1998). So, for instance, a carrier cannot generally recoup the original cost of an aircraft by selling the plane when it faces a demand downturn. In economic terms, the demand downturn creates a capital loss for the carrier because it is holding aircraft at the time the value of aircraft has declined. In accounting terms—which drive reported profits—the firm continues to recognize the financing cost and depreciation of the asset each year. Thus, for instance, a huge capital loss that carriers incurred from holding aircraft on September 11, 2001 showed up in accounting terms through depreciation of the original aircraft cost over the ensuing years.

Labor costs (wage and benefits) are a much larger cost factor for airlines, averaging 35 percent of total airline operating costs between 1990 and 2007. Figure 2.15 reproduces the implied domestic demand changes from figure 2.14 for 1989 to 2007 and adds changes in labor costs (comparable data are not available for earlier years). Changes in labor cost, total wage, and benefits bill are clearly much smoother than demand changes. This demonstrates a fundamental cause of earnings volatility in the airline industry: not just capital costs, but also labor costs, are slow to respond to demand changes.

Labor agreements in this industry generally cover both the compensation and work rules. While labor costs generally are thought of as variable costs, in the highly unionized airline industry, they are certainly not easily or quickly changed. They are not accurately characterized as fixed costs either,

61. As a point of comparison, we carried out similar exercises with gasoline, coal, and electricity demand using elasticity estimates from published demand studies. Over 1961 to 2005, the standard deviation of the growth rate of airline demand was 6.6 percent. For gasoline, coal, and electricity, the standard deviations of demand growth rates were 2.2, 3.2, and 2.8 percent, respectively. We also examined the serial correlation in demand changes, which was 0.21 for air travel demand changes over this period, while it was 0.57 for gasoline, 0.12 for coal, and 0.58 for electricity. This suggests that the demand growth for gasoline and electricity changes much less sharply than demand for air travel or coal.

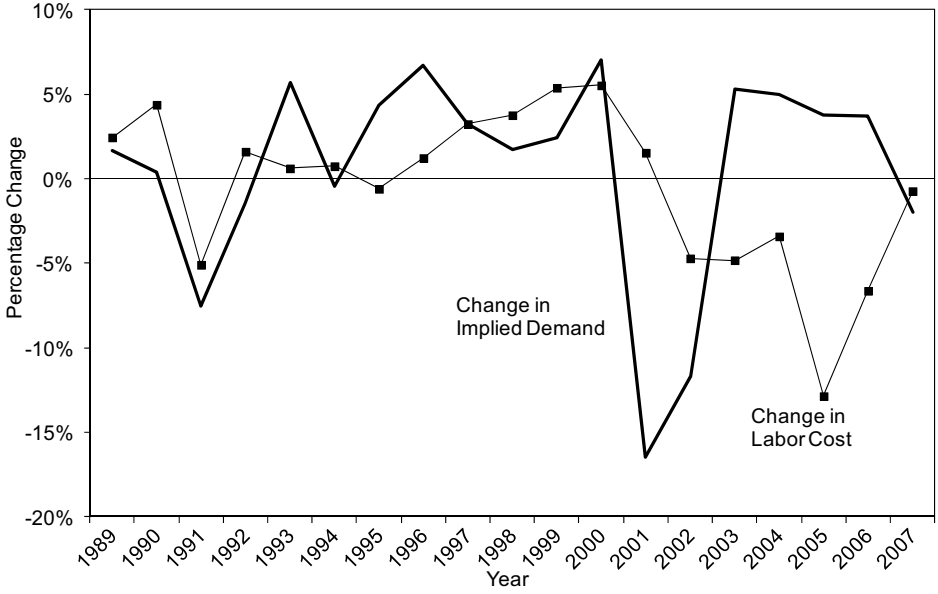

Fig. 2.15 Changes in labor cost and implied demand, 1989–2007
Note: Labor cost is total domestic salaries and benefits from DOT Form 41, Schedule P6.

however. Typically, the quantity of a fixed input can only be changed with a lag, but its purchase price is set exogenously. From statements by both airlines and labor, it is clear that wages of pilots and other high-skilled workers are endogenous to air travel demand and, it appears, to airline profits (see Hirsch 2007; Neven, Röller, and Zhang 2006). Changes in an airline's financial health affect both the quantity of the semifixed input it wants to buy and the wage it pays.

Labor relations in this industry are somewhat more complex than in most others, both because of the specialized skills and government safety certification required of some workers and because of the nonstorability of the good. The former implies that input substitutes for highly skilled workers may not be available on short notice.[62] The latter makes labor actions particularly costly to the airlines in terms of both lost business and reputation damage.

The power of the airline workforce has made it a quasi shareholder in the airlines. During high-profit periods, labor has been able to negotiate attractive compensation packages, while periods of sustained losses often

62. In a notable exception, Northwest Airlines trained 1,900 replacement workers in anticipation of an August 2005 mechanics strike. The strike failed and many of the mechanics were permanently replaced by workers receiving substantially lower wages.

lead to negotiated reductions. Changes in compensation packages, however, typically lag earnings changes. There is now a well-established pattern at many legacy carriers.[63] An airline's earnings decline, whether from adverse industry shocks or competitive disadvantages unique to the firm. The airline may pursue cost-saving initiatives, but labor is by far the largest cost category, and the second largest, fuel, is priced exogenously. Management therefore claims that it needs concessions from labor to remain viable. Labor unions are resistant to wage or benefit cuts, or restructuring of work rules; they express skepticism about the airline's financial difficulty and blame losses on poor management. If the financial distress of the carrier continues, labor is faced with the possibility of carrier bankruptcy—which brings the bankruptcy court into the labor negotiations with its powers to impose wage and work rule changes, merger into a stronger airline, or even possible liquidation of the company. Generally, at this point, labor representatives become more accommodating and some sort of compensation reduction is agreed to. Between 2002 and 2005, however, USAir, United, Northwest, and Delta each entered bankruptcy even after negotiating significant compensation reductions and then proceeded to negotiate for further givebacks. American Airlines, which avoided a bankruptcy filing during this period, struggled with higher labor costs than its competitors, likely setting the stage for its Chapter 11 filing in 2011.

Similarly, during strong financial periods, labor attempts to extract some of the profits. Multiyear collective bargaining agreements, however, mean that airlines can have extended periods of high earnings before the pressure to distribute some of those profits to labor alters wages. In both cases, the wage bill stickiness means that labor cost changes may be out of sync with profit changes, exacerbating the profit swings.

Among the costs that contribute to earnings volatility, fuel cost is probably the one that has received the most attention in the press and policy discussions. The exogenous price of jet fuel can been very volatile: from 1990 to 2007, fuel costs averaged 15 percent of total operating expenses, but varied from 11 to 25 percent, and was over 30 percent for the first half of 2008.[64] Airlines can make incremental operating changes to affect the amount of fuel they use for a given flight schedule—flying at slower speeds and using their most fuel-efficient aircraft—but their fuel cost per available seat mile is driven primarily by oil price fluctuations. Fuel price volatility can be large and is only somewhat correlated with the demand that the airlines face. Figure 2.16 shows the annual change in fuel cost per available seat mile (ASM). Note that the scale is different from the previous two graphs.

63. See Hirsch (2007) for an analysis along these lines.

64. Other than capital, labor, and fuel expenses, the largest airline cost category is service (including commissions, advertising, insurance, and nonaircraft equipment rental), which averaged 19 percent over this period, while the remaining costs include maintenance materials, food, landing fees, and other.

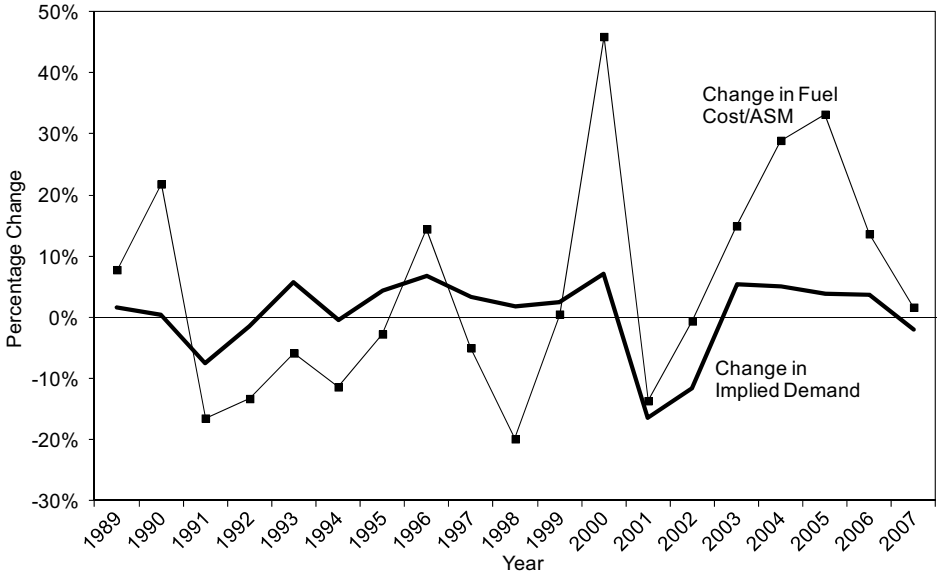

Fig. 2.16 Changes in fuel cost per ASM and implied demand, 1989–2007
Note: Fuel cost is total domestic aircraft fuel expense from DOT Form 41, Schedule P6.

As in nearly all other industries, producers complain that they are unable to pass along energy price increases as quickly as they would like. The production technology of the airline industry explains some of the difficulty in this case. For a given flight schedule, the increase in fuel consumption from carrying an additional passenger is quite small,[65] so fuel is close to a fixed cost until the carrier is willing to change the number of flights it offers. If the industry were to adjust rapidly to fuel cost changes, the number of flights would decline and load factors would likely rise whenever fuel prices increased. Airlines are reluctant to make rapid schedule reductions in response to fuel price increases, in part for logistical reasons—it requires complex rescheduling of all the carrier's aircraft and rebooking of passengers who have already bought tickets—and in part for competitive strategic reasons—concern that a reduced schedule will make them less attractive relative to competitors.[66] Empirically, it is hard to see any tendency toward adjustments in capacity flown or load factors in response to fuel price shocks during the post-deregulation data.

Figure 2.17 shows the implied demand next to the changes in output sold, measured by revenue passenger miles, and capacity, measured by available

65. On a fully loaded commercial jet, passengers and their baggage comprise about 15 percent of the takeoff weight of the aircraft.

66. This can arise from an empirical S-curve distribution of passenger share as a function of flight share on a route, discussed earlier.

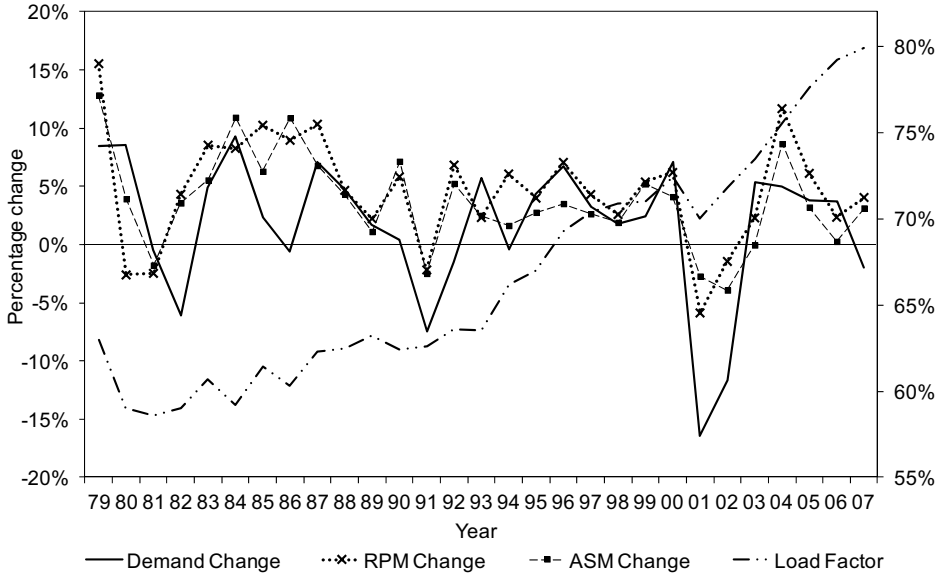

Fig. 2.17 Changes in RPMs, ASMs, load factor, and implied demand, 1979–2007
Note: See figure 2.1 sources for RPM, ASM, and load factor.

seat miles. This indicates some degree of short-run supply inelasticity; perfectly elastic supply would result in no price adjustment and quantity that would change by the full demand shift. Reductions in demand do not trigger equally large reductions in input costs; instead, price adjusts downward in the short run, so quantity falls less than the demand shift.

In addition, the common perception that planes fly very full when demand is strong and mostly empty when demand weakens is not supported by the data. The lowest line on the left side in figure 2.17 (utilizing the right-hand axis) shows the load factor, the proportion of seats filled.[67] Load factor does not seem to be affected much at all by demand shocks; even in 2002, the domestic average load factor was 70 percent, the same as in 1998 and just 1 percentage point lower than in 2000. None of the major post-deregulation demand downturns—1982, 1991, 2001 to 2002, (and 2008 to 2009, as shown in figure 2.3)—was accompanied by a significant drop in load factors. This suggests that airlines have managed their capacity and prices to keep the proportion of seats filled roughly constant in the presence of demand shocks. Fuel price shocks also do not seem to drive load factors: large fuel cost increases in 1980, 1990, 2000, and 2005 are not associated with unusual load factor increases and the plunge in fuel costs in 1986 and somewhat

67. More precisely, load factor is revenue passenger miles divided by available seat miles.

smaller drop in 1999 do not seem to have driven load factors down. Over the deregulation years, however, there has been a clear trend toward higher load factors, as shown in both figure 2.3 and figure 2.17.[68]

The demand shock following September 11, 2001 illustrates the dynamic of the interaction between demand, supply, and costs that causes earning in the industry to be so volatile. Between 2000 and 2002, demand fell 26 percent (using an assumed –1 price elasticity), real price fell 17 percent, output (RPMs) fell 6 percent, capacity (ASMs) fell 5 percent, and load factor declined from 71 to 70 percent. Real labor expenses declined only 2 percent. Yet, over the following four years, real labor expenses declined 28 percent while demand grew 13 percent.

While these data suggest that volatile demand, sticky labor and capital costs, and fluctuating fuel costs all contribute to volatile earnings, it is hard to know the magnitude of these effects from the discussion thus far. In an attempt to calibrate the effects of these factors on profits, we have created a fairly simple model of airline profits that attempts to capture these factors and roughly gauge the size of their impacts on earnings.[69]

We start from the recognition that if production were constant returns to scale even in the short run, if all cost changes were fully and immediately passed through to price, and if all demand shifts were absorbed completely by quantity changes with no price adjustment, then earnings per customer (or, more precisely, earnings per revenue passenger mile) would not vary. Then we introduce (a) some fixed component to costs, (b) the actual fuel price volatility and the assumption that it is only partially absorbed in price adjustment, and (c) short-run adjustments to demand shifts that are partially in quantity and partially in price.

We examine data for the entire domestic US airline industry for 1990 to 2007. We first calculate "low volatility" earnings, assuming airline costs per unit output, load factors, and prices are constant at their mean (in real terms) over this period. In this case, earnings fluctuations would be due entirely to shifts in demand that would shift earnings by exactly the same proportion.

The nearly flat line with hollow diamonds in figure 2.18 represents this fluctuation. The large demand fluctuations we discussed earlier are, not surprisingly, dwarfed by the actual fluctuations in industry operating profits, which are represented by the line with dark squares.

We then make a set of assumptions of incomplete industry adjustment. We assume that in any one year, as demand growth and fuel costs deviate from their average over this sixteen-year period, carriers can only adjust incompletely. In particular, only 50 percent of deviations from mean fuel

68. Over this time, until 2005, the real price of jet fuel has declined fairly steadily, which by itself might suggest a decline in equilibrium load factors.

69. The model is implemented in a spreadsheet that is available from the authors.

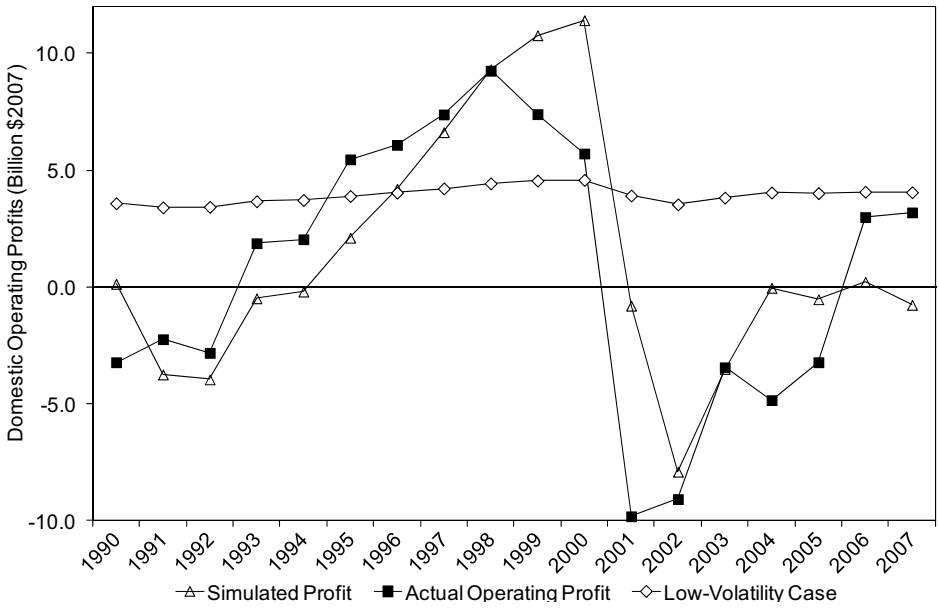

Fig. 2.18 Actual, low-volatility, and simulated domestic operating profits, 1990–2007

Note: Data sources are listed in the simulation spreadsheet, available from the authors.

cost are passed along through price changes. Similarly, when demand growth deviates from its mean level, quantity changes by only 30 percent of the horizontal demand difference between the expected and actual demand shift. The remainder of the shift is absorbed by price adjustment, as would be the case with short-run supply inelasticity, regardless of whether it is due to steep marginal costs, concerns about competitive position, or some sort of oligopoly adjustment process. We also assume that costs are not completely flexible. Of the nonfuel costs, we assume that 30 percent are fixed with respect to passengers or flights. We assume 20 percent are proportional to passengers (RPMs), and the remaining 50 percent are proportional to flights (ASMs). Finally, we assume that flight schedules adjust nearly, but not quite completely, to changes in passengers; that is, that deviations from mean quantity are associated with a 90 percent deviation from mean capacity in the same direction, so load factor exhibits minimal variation.

We do not claim that these assumptions are precisely accurate, but we would argue that they are plausible in the context of the airline industry. The model also does not capture any serial correlation due to *lagged* adjustment, as opposed to just the partial adjustment from mean levels that we model here. And the model ignores the endogeneity of input prices, such as labor. Nonetheless, even this simple model of partial adjustment to demand and

cost shocks generates earnings volatility—represented by the line with hollow triangles—that is nearly the magnitude we have observed in the industry over the last decade and a half. The point is not that this is an exact model of the adjustments in the airline industry, but that demand and fuel cost fluctuations combined with sticky adjustment on the supply side can easily generate the observed magnitude of earnings volatility, without any appeal to "empty core" or destructive competition arguments.

Innovation

While the airline industry has more than three decades of experience in a deregulated environment, it would be a mistake to assume that firms have had that much time to adjust to a new but stable business environment. Technological innovation in this industry has been relatively slow compared to telecommunications, electronics, media, or a number of other industries, but the post-deregulation airline industry has been one of the leaders in experimentation with alternative production processes, pricing models, and organizational forms. It takes time to determine the success of a given experiment, and as one would expect, some of the experiments have not been successful.

Network Configuration. The hub-and-spoke network is probably the best-known innovation attributed to airline deregulation. Though hubs existed prior to deregulation, their use expanded tremendously in the immediate aftermath of deregulation. However, while there are clear advantages of a hub system due to density economies and demand advantages, there also are costs, which have become more apparent over time. In the late 1980s, hubs were thought to be so powerful—both as an efficiency enhancement and protection from aggressive competitors—that a race to develop as many hubs as possible ensued. Many of the new hubs that airlines set up ultimately proved unprofitable and were abandoned.[70] Over the past decade, developments in the industry, including the consistent profitability of Southwest Airlines, which does not operate a formal hub system,[71] have raised further questions about the competitive advantage of hub-based airline networks.

After initial focus on cost and competitive advantages of hubs, airlines have become more cognizant of their limitations. Hubs may increase aircraft operating costs, particularly when "tightly banked," that is, when coordinated groups of flights arrive at very close intervals and then all depart 45 to

70. Former hub airports include those in Nashville, Raleigh-Durham, Kansas City, and Columbus, Ohio. Some airlines even considered opening "pure hubs," airports located in remote areas in the middle of the country with no local demand, used just for passengers to change planes, but the idea was never pursued.

71. Though Southwest does not schedule operations in a traditional hub model, as of 2011 it operated small scale hubs at Dallas Love Field, Chicago Midway, Salt Lake City, Phoenix, Las Vegas, and Baltimore, and 22 percent of its passengers traveled on connecting itineraries in 2011.

75 minutes later. These operations increase delays and congestion costs and reduce aircraft utilization (see Mayer and Sinai 2003). As delays increase, traveler inconvenience and missed connections also increase, reducing passenger demand (Forbes 2008; Bratu and Barnhart 2005). Some airlines have experimented with "de-banking" their hubs or introducing rolling hubs, in which flight operations are smoothed over the day. For example, Figure 2.19 illustrates the evolution of American Airlines' hub operations at Dallas-Fort Worth airport between 2001 and 2003, from the tightly banked hub schedule first developed during the 1980s to a rolling hub schedule with a smoother pattern of arrivals and departures. While de-banking hub operations may reduce some of the cost of hubs, rolling schedules also tend to increase passengers' expected travel time, reducing their demand for connecting flights. Further experimentation with network configuration is undoubtedly ahead.

Pricing and Distribution. Many industries have learned from the sophistication airlines have developed in peak-load pricing, price discrimination, and revenue management. But the airlines themselves remain uncertain, and often in fundamental disagreement, over how much price segmentation is optimal and precisely how to accomplish it.[72] As shown in figure 2.5, within carrier-route price dispersion peaked in 2001. A decline in business travel beginning in late 2000 and accelerating in early 2001 led to a sharp decline in unrestricted ticket sales. This, combined with the perceived slow return of high-fare passengers following September 11, 2001, led many in the industry to argue that price dispersion had exceeded profit-maximizing levels.[73] As evident in figure 2.5, price dispersion has declined sharply from that peak. The unprecedented gap between unrestricted and discount fares in the late 1990s may have significantly altered purchasing patterns. This may have been exacerbated by changes in airline distribution methods: the difference in fares is readily apparent to travelers using online travel search engines, and travelers with some flexibility in their schedules can take advantage of search tools that readily provide potential cost savings from small schedule shifts. Fare search engines may have encouraged diffusion of a wide range of ancillary fees that airlines now charge for services that may include telephone reservations, seat reservations at time of booking, checked and carry-on baggage, priority boarding, exit-row seating, in-flight food and entertainment, and more. Concern about the increasing prevalence and opacity of ancillary fees prompted the Department of Transportation to announce a rulemaking on fee disclosures, but has postponed any action in the face of ongoing industry opposition.

72. For example, the costly price war that erupted after American Airlines' 1992 introduction of its "simplified" value pricing plan illustrates the intense divergence of preferred price structures across airlines.

73. See Trottman (2001) and Zuckerman (2001) on the decline in unrestricted ticket sales following the tech crash in 1999 and 2000.

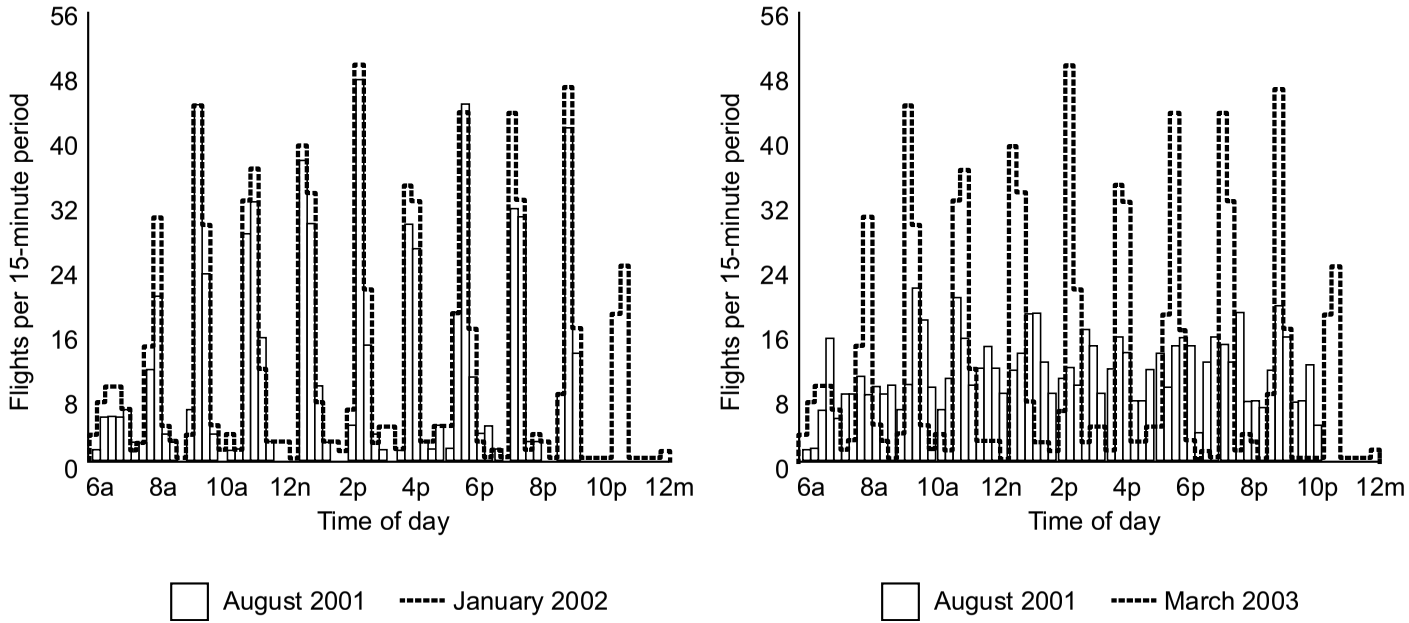

Fig. 2.19 Conversion of American Airlines DFW hub to rolling hub schedule, 2001–2003
Source: Tam and Hansman (2003), figures 4-12 and 4-13.

Legacy carriers have not only been losing formerly high-fare passengers to restricted fares on their own networks, but also appear to be losing an increasing fraction of business travelers to low-cost carriers such as Southwest and Jet Blue, contributing to the increased market shares of those carriers. This defection is ascribed in part to generally lower unrestricted walk-up fares on low-cost carriers, and in part to perceptions that their service, while no-frills, may be more reliable and consistently on time, a valuable attribute for business travelers.[74] Airlines have also experimented with changing the kinds of restrictions they impose on discount tickets. The penetration of Southwest and other low-cost airlines with simpler pricing structures and no Saturday-night stay requirements have led many legacy carriers to drop Saturday-night stay restrictions, at least on competing routes, relying instead on advanced-purchase requirements and nonrefundability for their discounted fares. Uncertainty about the optimal ticket restrictions and level of price dispersion surely contributes to the volatility of the airlines operations and financial returns.

Organizational Form. Perhaps the most important ongoing business innovation in the airline industry is in organizational form. In the early 1980s, an airline was a stand-alone entity that sold tickets for travel on the routes it served. During the 1980s, most major airlines formed code-sharing partnerships with small commuter airlines providing feed traffic for their hubs. Though strategic alliances have since expanded greatly in number, geographic scope, and the dimensions of activities on which partners coordinate, their role remains somewhat unclear. Alliances are not mergers, and most do not have antitrust clearance to cooperate on pricing. Rather, they are a hybrid organizational form in which firms may compete in some markets, while cooperating and jointly selling their product in other markets. These agreements can be very complex, both to be beneficial to both partners and to clear antitrust scrutiny (see Brueckner and Whalen 2002; Bamberger, Carlton, and Neumann 2004; Lederman 2007, 2008; Armantier and Richard 2006, 2008; Forbes and Lederman 2009).[75]

This certainly is not an exhaustive list of the business changes the industry has seen since deregulation, but it illustrates how dynamic the airline business model has been and continues to be. The managerial skills necessary to run an airline are constantly changing. Airlines continue to experiment with alternative approaches to flight operations and scheduling, pricing, orga-

74. Southwest is frequently at or near the top in on-time performance among the major carriers and Jet Blue, until its Valentine's Day 2007 winter storm meltdown, had maintained a policy against discretionary cancellations on the theory that passengers preferred late arrivals to nonarrivals.

75. Though alliances have become a mainstay of operations among most of the large carriers, Southwest and the other low-cost airlines generally have not pursued them. Southwest's only alliance or joint-marketing agreement was with ATA (formerly known as American Trans Air), which ceased operation in April 2008.

nizational form, distribution, and many other aspects of the business. The feedback process is slow and extremely noisy, making it difficult to determine which experiments are successes and which are failures. These issues are not unique to airlines, but combined with the demand volatility and cost stickiness discussed earlier, they suggest that industry volatility in itself is unlikely to indicate a structural need for renewed government intervention.

2.5.2 Market Power Concerns

Attention to market power concerns in the airline industry has waxed and waned considerably over the post-deregulation period. It heightened during the mid- to late-1980s, as airline exits and consolidations led to dramatic increases in concentration, and again in the late 1990s, as profitability soared. Amid the recent financial distress of the industry, concerns about industry concentration and pricing power have abated. While it may be natural to worry more about market power when profits are high, the profit level tells us little about its extent. Market power does generally raise profits relative to the competitive level, though the size of this effect depends in part on the rent extraction accomplished by labor and other input suppliers. Still, given the factors discussed in the previous section—volatile demand, sticky costs, and repeated disruptions from business innovations—it is difficult to know whether airlines are making higher profits than would be the case if they were simple price takers. With the potential for inefficient production, labor rent sharing, and poor or unlucky timing of fixed investment, profit levels shed little or no light on the degree of market power that airlines present.

At the time of deregulation, it was recognized that most routes might be able to support only one or two firms and that market power could be an issue. The theory of "contestability"—that potential competition would discipline firms, forcing them to keep prices at competitive levels in order to deter new entry—was put forth in support of deregulation.[76] Through the 1980s, however, contestability theory as applied to airlines took repeated blows from studies that found the number of actual competitors significantly affected price levels on a route.[77] Potential competition in general had a modest effect disciplining pricing.[78] Fares are markedly higher on routes served by only one airline than they are on routes with more active competitors, and tend to decline significantly with entry of a second and third competitor. By the end of the 1980s, the theory was seldom raised in the context of airlines.

In the late 1980s and early 1990s, the focus of market power analysis expanded to include airport shares. The basis for this concern, first laid out by Levine (1987), was that an airline could use its dominant position at

76. See Bailey and Panzar (1981) and Baumol, Panzar, and Willig (1982).

77. See Borenstein (1989, 1990, 1991, 1992, 2013); Hurdle et al. (1989); and Abramowitz and Brown (1993).

78. Some studies suggest a greater effect when the potential competitor is Southwest Airlines (see Morrison 2001; Goolsbee and Syverson 2008).

an airport to deter entry. A number of economic analyses have found significantly higher fare associated with concentration at the airport level (see Borenstein 1989; Evans and Kessides 1993; Abramowitz and Brown 1993). This airport dominance effect may reflect the impact of market power exercised through loyalty rewards programs in which the value of the rewards—to travel agents, corporations, and individuals—increased more than proportionally with the points earned.[79] By inducing travelers to concentrate their business with just one or a few airlines, these programs make it difficult for a new airline to successfully enter a small subset of routes at an airport dominated by another carrier. Airport dominance could also impede entry by giving the incumbent control over scarce gates, ticket counters, and (at some airports) landing slots.

Some airlines and researchers have disputed the existence of a "hub premium," arguing that studies finding such price differences across airports fail to control for differences in the business/leisure mix of travelers (see Gordon and Jenkins 1999; Lee and Prado 2005). The argument, however, has two serious flaws. First, the critique suggests that a finding of higher prices in markets with less elastic demand—more business travelers—should not be attributed to market power. While some have suggested that there are higher costs in serving business travelers, the magnitude of these cost differentials cannot explain the price differences across airports (see Borenstein 1999). Second, in practice, most of these studies have determined the share of leisure traffic at an airport by examining the proportion of customers who purchase discount tickets. While a "leisure share" variable constructed as the proportion of passengers paying low fares goes a long way toward explaining where average prices are lower, especially in an industry with significant self-selective price discrimination, this sheds little light on the cause.

It is important to recognize that these patterns do not imply that passengers at dominated airports are necessarily worse off. Large airports with one or two dominant carriers generally are hubs and, as such, schedule a disproportionate number of flights compared to the *local* demand for air service. Improved service quality may offset part or all of the loss from higher prices resulting from airport dominance. Nor do these concerns necessarily demand regulation. Even if prices are above competitive levels, they may be no less efficient than are regulated prices. Rather, the relevant question is whether appropriately executed competition policy could enable customers to receive the benefits of greater service without having to pay higher fares associated with trips to and from the hubs.

Some of these concerns may be mooted by recent market developments. Figure 2.20 illustrates a trend toward convergence in prices across airports that is documented by Borenstein (2005, 2013). One can calculate an average fare premium at an airport in a given year by comparing the prices paid for

79. See Borenstein (1989, 1991,1996) and Lederman (2007, 2008).

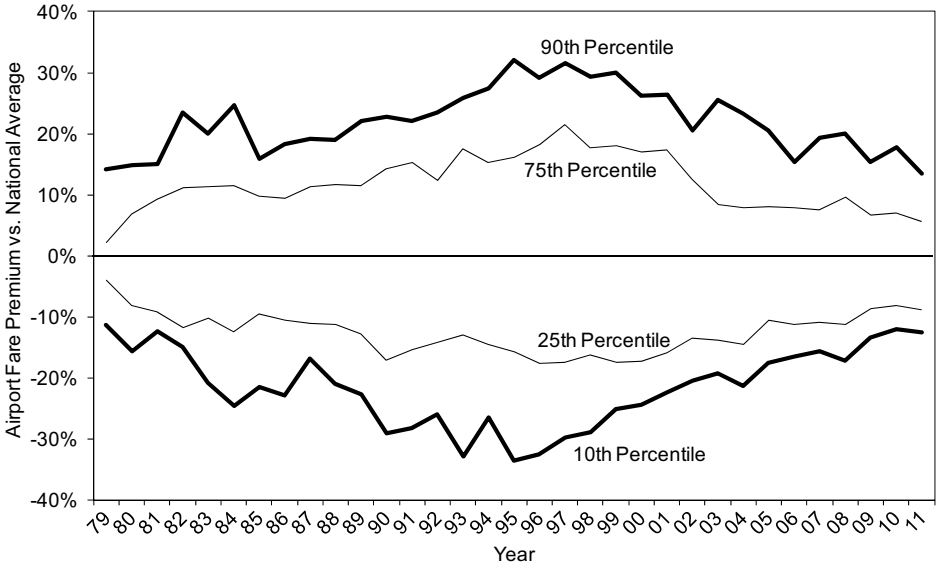

Fig. 2.20 Dispersion in airport premia across all US airports, 1979–2011
Notes: Weighted by passengers' departures at airport. Authors' calculations are from the same source and inclusion criteria as figure 2.5. See Borenstein (2013) for exact details of calculation.

trips to/from that airport to national average prices for all similar distance trips.[80] For the average fare premium across US airports (weighted by passengers at the airports), figure 2.20 presents tenth, twenty-fifth, seventy-fifth, and ninetieth percentiles during 1984 to 2011. Cross-airport price variation peaked in 1996 and has been declining since. Relative to national average, the majority of the most expensive airports have seen prices fall, and fares at most of the cheapest airports have risen. The standard deviation of the fare premium measure across US airports has fallen from 24 percent in 1996 to 13 percent in 2011, a level virtually identical to the extent of cross-airport dispersion in fare premia that existed in 1980. Borenstein (2013) examines these changes in more detail and finds mixed evidence that market power from airport dominance is declining.

The continued decline in fare disparities across airports despite recent mergers among large legacy carriers coincides with the expansion of low-cost airlines in the United States. Many low-cost or "no-frills" start-up airlines appeared in the 1980s, People Express being the most widely known, only to liquidate before the decade was over. With the exception of Southwest, they have until recently had difficulty gaining sufficient presence to ensure profitability and their continued existence. Southwest appears to

80. The exact method of airport premium calculation is presented by Borenstein (2013).

have avoided their fate through relentless attention to employee relations and productivity, careful control over operating costs, and judiciously paced expansion plans that until relatively recently avoided head-to-head competition at dominated airports.

There clearly is a significant "Southwest effect" in the current airline industry, in terms of its increased market share, expansion into more markets, and price impact in markets it serves or may credibly begin to serve (Morrison 2001; Goolsbee and Syverson 2008). Whether this is unique to Southwest, and hence nonreplicable, or is poised to diffuse across other airlines, may be a significant determinant of the future saliency of market power concerns in this industry.

2.5.3 Infrastructure Development and Utilization

Airport congestion was not a significant issue at most US airports during the regulated era. Most airports operated well below their technical capacity and it was rare that air traffic controllers were required to impose more than minor delays due to excess demand for ground or air space. Four airports—National (now Reagan) in Washington, DC, La Guardia and JFK in New York, and O'Hare at Chicago—were subject to significant excess demand. Under the so-called High Density Rules, the FAA imposed limits on aggregate hourly operations (takeoffs and landings) at these airports. Initially, takeoff and landing "slots" at these airports were allocated through a negotiation process among incumbent carriers. As demand grew rapidly after deregulation, the problem of congested airports worsened substantially. By 2000, fewer than three-quarters of all flights arrived at their destination airport on time, defined by the FAA as landing within 15 minutes of scheduled arrival time.[81]

Some operational delays are within the control of air carriers (see, e.g., Mayer and Sinai 2003). But an increasing share appears linked to inadequate infrastructure in the airport and air traffic control system. The airline industry in the United States and throughout the world, regardless of the degree of economic regulation, relies on an infrastructure that is largely government controlled. The US air traffic control system, which directs all aircraft flight operations, is operated by the Federal Aviation Administration. This control extends to airport runway traffic management, but not to the airport facilities. Airport terminals are managed, and usually owned, by a local government entity, which can be a city, a county, or a special government entity established purely to oversee an airport. After September 2001, security at US airports was turned over to the Transportation Security Administration, an agency within the US Department of Homeland Security.

Unfortunately, the track record of these government-controlled compo-

81. A significant contribution to delay in 2000 was a surge in delays at a single airport—LaGuardia—resulting from AIR21 legislation that overruled the FAA's High Density Rule constraints.

nents of the air transport system has not been particularly impressive. A preference, or in some cases, requirement, for administrative allocation of resources often has trumped any attempts to understand and employ market incentives in order to improve efficiency. Besides slow adoption of economic innovations that could improve economic welfare, technological innovation has also been slow in some areas.

Airport Access

In 1985, the federal government addressed a small part of the problem by establishing limited property rights for takeoff and landing clearance at four highly congested airports. Most of these tradeable "landing slots" were then given to incumbents based on their prior level of operations at the airports. Some were held out for allocation to new entrants at below-market prices. A market for these slots has developed and has supported thousands of trades since the beginning of the program. The slot allocation program, however, has been extended to only six US airports. Moreover, while this system has improved the allocation of scarce operational slots at these airports relative to negotiated allocations, it faces an uncertain future.

In 2000, Congress decided that small communities did not have sufficient access to service at slot-controlled airports, and it enacted legislation ("AIR 21") to suspend the High Density Rule (HDR) slot limits. LaGuardia was immediately opened to service using regional jets. The surge in scheduled service resulted in a 30 percent increase in operations, to almost 1,400 daily, at an airport that was previously ranked as the second-most delayed airport in the country. The result was predictable. In September 2000, one-third of the flights at LaGuardia were delayed, with an average delay of more than 40 minutes. LaGuardia-related delays accounted for one-fifth of all delays in the country (Maillet 2000). Forbes (2008) analyzes the effect of these delays on travelers' willingness to pay for air travel. The FAA ultimately responded with a temporary cap on total flight operations per hour and a lottery system to allocate these across carriers. In 2002, landing slots were to be abolished system wide. A similar story replayed at Chicago O'Hare airport, where both American and United substantially increased scheduled service in anticipation of the elimination of slot constraints, leading once again to egregious delays and imposition of administrative solutions. A 2008 administration proposal for landing slot auctions for LaGuardia, Kennedy, and Newark airports was met with fierce opposition by the New York Port Authority and the airlines, and amendments to ban slot auctions were introduced in Congress. In the meantime, operational caps at these most congested airports continue to be extended periodically, on a "temporary" basis. With Congress unwilling to recognize operational constraints,[82] and

82. While the FAA continues its "temporary" capacity caps on NYC airports, in 2012 Congress mandated sixteen additional long-distance flights to be allowed at Reagan National Airport as part of its 2012 FAA reauthorization.

airport authorities unable or unwilling to expand physical capacity to meet demand at current access prices, the future of this system remains uncertain.

The remaining (more than 300) airports that support commercial jet flights operate under a system known as "flow control," which is essentially queuing. Despite the success of market incentives in other parts of the industry, and growing interest in congestion pricing applied to some transportation segments,[83] there has been tremendous resistance to use of congestion pricing to allocate scarce runway capacity. In one case, a plan to use peak-load runway pricing at Boston's Logan airport was struck down by a federal court as being unduly discriminatory, because the system imposed higher per-passenger costs on small general aviation and commuter aircraft. Much of the opposition to runway pricing has been led by general aviation and small commuter aircraft operators who use the same airports and nearly as much scarce runway capacity as much larger commercial jets. Thus, it is not unusual for a fully loaded wide-bodied jet to be delayed in taking off by a small plane carrying just four or fewer people. Though general aviation has been discouraged at many highly congested slot-controlled airports, the slot program legislation established special categories to allocate rights to smaller commercial aircraft. The growth in corporate and private jet usage only exacerbates this problem.

Market-based airport facilities allocations are not without problems. Economists studying the possibility of pricing solutions to airport congestion have pointed out two potential concerns.[84] First, a dominant airline at a slot-constrained airport could buy excess slots in order to deter entry. It is straightforward to show that a competitive entrant could be outbid by an incumbent that intended only to withhold the slot from use. There have been some accusations of this behavior by small airlines attempting to enter a slot-controlled airport, though these arguments have been undermined somewhat by the accompanying claim that the small airline should receive the slots at no cost. Still, the incentive of a firm with market power to restrict output is real and it turns out in practice to be very difficult to monitor for such behavior.[85]

A second concern is the complexity of determining efficient congestion prices. Conventional models of congestion pricing, such as highway congestion tolls, assume atomistic users. In that case, each user imposes the same congestion externality on all other users, and symmetric tolls can enforce

83. Note, for example, the growth in private toll roads in states including California, Texas, and Virginia, and positive responses to London's congestion tolls on automobiles driving within the center city.

84. For example, see Borenstein (1988); Brueckner (2002, 2009); Brueckner and Van Dender (2008); and Morrison and Winston (2007).

85. A "use it or lose it" rule imposed at slot-constrained airports required that each slot be used on 80 percent of all days. In practice, this means that a firm could restrict output by 20 percent without being in violation of the rule, because they own many slots for each hour and can "assign" a given takeoff or landing to a different slot on different days.

efficient use of the scarce resource. For airports, such an assumption is clearly violated. Moreover, if airlines differ in their scale of operations, they will internalize the congestion externality of an additional flight to different degrees. Large carriers with many flights will internalize more of the externality; small carriers, less (see Brueckner 2002; Fan 2003; Brueckner and Van Dender 2008). For instance, if one airline has 60 percent of the flights at an airport, it will recognize that adding another flight at a peak time incrementally delays all of its existing flights. It will not fully internalize the congestion since 40 percent of the flights are operated by other airlines, but it will have more incentive to avoid further congesting peak periods than does an airline with 1 percent of all flights. This would argue for higher congestion tolls on carriers with smaller airport shares, all else equal, and apart from any market power concerns. If airlines also exercise different degrees of market power, optimal toll design becomes even more complex—it is possible that optimal tolls would be zero or negative for large carriers with considerable market power. Designing such a system would be difficult; implementing it politically would likely be impossible. It seems crucial, however, to measure the potential costs of an imperfect market-based system to the status quo, not the first-best system. Greater use of market incentives could almost surely improve economic welfare relative to the current system, which is driven by a combination of historical property rights, administrative rules of thumb, and political clout.

In addition to inefficient access to scarce infrastructure resources, the current system provides no mechanism to tie investment in that infrastructure to scarcity signals. Airport regulation typically limits fees and prices to levels that provide a fair return on historic investment costs. This may restrict landing fees to levels too low to promote efficient scheduling of scarce capacity and preclude any price signals that might guide efficient investment in future capacity. At some airports, geography or neighborhood limits may effectively preclude expansion of capacity at any reasonable cost. At others, capacity expansion may be feasible. Allocating scarce capacity through a price system and using revenue collected through that system to finance investment, may better discriminate between these two conditions.

Many of the market power concerns in congestion management of runways also arise in airport facilities management. The local authorities that operate airport terminals face the standard set of local development issues and financing concerns. They lease space to airlines and retail shops in order to finance operations. When they want to expand the facility, incumbent airlines are often the primary purchasers of the local bonds sold to finance the projects. In many cases, they have negotiated preferential access to terminal space in exchange for financing commitments. These may be necessary in order to secure financing for airport facility expansions, but they can lead to inefficient exclusion of new competitors. The airport authority must balance financial constraints against the longer-run goal of attaining competitive

air service that benefits the surrounding community. Snider and Williams (forthcoming) find evidence that a change in airport financing that reduced preferential terminal space access at some airports had the effect of increasing competition at those airports.

Infrastructure Technology

A more difficult area to analyze is that of technological innovation in government-controlled infrastructure. Many industry participants have bemoaned the technology lag in the country's air traffic control system. The government has long admitted that the system is out of date and overburdened, but plans to overhaul the system and install modern technology for air traffic control have chronically failed to meet targets. The current air traffic management systems modernization effort, launched in 2004 under the umbrella "NextGen," targets completion in 2025 with significant component milestones along the way. While the FAA Modernization Act of 2012 provided longer-term FAA funding commitments than had been available in recent years, there presently is ongoing disagreement between FAA administrators and the Department of Transportation Inspector General on the likelihood of meeting near-term targets. Some critics argue that a private company would not have made the same mistakes or delayed new technology adoption so long (see Hausman and Sidak's discussion of government impediments to technological innovation in the telecomm sector in chapter 6 in this volume). The airline industry is subject to a variety of government fees and taxes. While some of these are earmarked for aviation investment, there has been no direct link between the collections and infrastructure investment, and the government has at times used the surplus in the Aviation Trust Fund to meet other budget goals. This situation has led some to call for privatization of the infrastructure system, with fees and taxes flowing to the privatized entity.[86] A privatized monopoly air traffic control system, while perhaps increasing efficiency relative to its objective function, would present a new set of concerns. We suspect that regulatory issues similar to those presented by a private monopoly electric grid operator, as discussed in Joskow's chapter, would pose considerable challenges.

2.6 Conclusion

Airline regulators attempted to assure a stable, growing industry that benefited consumers and the economy. The result was relatively high fares, inefficient operations, and airline earnings volatility. The problems with economic regulation of airlines prompted a pathbreaking shift in 1978, as the United States became the first country to deregulate its domestic airline industry. Fares have declined since deregulation and efficiency has improved,

86. See the discussion by Winston and de Rus (2008).

but it is difficult to know what counterfactual with which the current state of the industry should be compared thirty-five years after deregulation. The volatility in industry earnings has continued and average earnings have declined since deregulation.

Still, the continuing upheaval in the industry shows no signs of impeding the flow of investment in airlines or the benefits to consumers. Though the attacks of September 11, 2001 resulted in a major setback to the finances of the industry (even after the $5 billion in cash gifts the federal government bestowed upon the airlines in the following weeks), their effect on the level of air service was very short lived. More domestic routes had nonstop service in the summer of 2002 than in the summer of 2001 just prior to the attacks, and the daily number of domestic flights was nearly identical across the two years. Real fares continued to decline into 2005 and remained low through 2011. Measured by US city pairs that were connected by nonstop service or seats available on commercial flights, the level of service was better in 2007 than in any previous year, though it subsequently declined slightly, as might be expected given the 2008 financial crisis.

The post–9/11 rebound and growth in service and traffic came with a heavy price, however. As passenger volume expanded, and flight operations increased more than commensurately with the movement toward smaller aircraft and more frequent service in many markets, congestion and delay costs also reached record levels; the present reprieve may well last only until the macroeconomy strengthens. Moreover, this problem is far from unique to the United States. Efffectively managing aviation infrastructure—efficiently allocating access to current resources, investing in technology and physical capacity improvements at airports and in the air traffic control system, and ensuring efficient provision of airport security—is likely to be one of the greatest challenges facing the global aviation industry over the decades to come.

The average returns that the airlines have earned since deregulation would be insufficient to sustain the industry prospectively, although this conclusion might have been different in the late 1990s. That does not imply that competition in the industry is inherently unsustainable. The natural volatility in the demand for air travel probably will always cause earnings to be less stable than in other industries, but other factors that have depressed earnings are potentially controllable. Slow adjustment of labor costs is an institutional feature of the industry that may change either through new labor agreements at legacy carriers or through shift in market share to airlines that can adjust more nimbly. Much of the instability since deregulation has resulted from experimentation with flight scheduling, pricing, loyalty programs, distribution systems, and organization forms. Though clear, permanent answers to these management issues are unlikely to emerge, one would expect some learning to result from the experimentation and the range of both strategies and outcomes to narrow.

For most consumers, airline deregulation has been a benefit. For many airlines, it has been a costly experiment, though a few have prospered in the unregulated environment. Both the companies and economists studying the industry continue to learn from the industry dynamics.

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