Troublesome trends in U.S. air transportation

The ups and downs of the nation’s airline industry have ripple effects throughout the U.S. economy. Since deregulation in 1978, decisions on fares and regions of service are left up to the carriers. But a changed economic picture may call for a larger government role and some dramatic innovations.

by Lance Sherry and George Donohue

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The U.S. airline transportation system is a critical cog in the U.S. economic engine. By providing affordable, rapid intercity travel, the system is instrumental in bringing about the productivity gains experienced by the U.S. economy.

Economists and governments have generally taken these economic benefits for granted. Recent trends, however, cast doubt on the validity of this complacency and raise questions about whether the laissez-faire government approach is strategically
sound. An examination of trends in the U.S. domestic airline industry and the phenomena driving these trends may offer the government a roadmap for reversing them.

TRENDS

Since deregulation of U.S. airlines in 1978, there have been three distinct phases of growth in U.S. domestic service. In the first phase, from 1978 to 1987, the expansion of airline service was faster than the growth of the gross domestic product. In the second phase, from 1987 to 1997, expansion of service kept pace with growth in GDP. However, in the third phase, from 1997 to the present, airline service has expanded more slowly than the GDP.

The result is that during the past decade, in the presence of a net growth in GDP, airlines are serving fewer markets with lower frequency of service and smaller aircraft than estimates would have pre-
Since deregulation of the nation’s airline industry in 1978, U.S. domestic airline service (measured in available seat miles, or ASMs), has grown faster than the GDP (1978-1987), at the same rate as GDP (1987-1997), and then more slowly than the GDP (1997-2011).

The net effect is that U.S. domestic airlines are now configured to provide domestic service to fewer, higher paying passengers. Like the proverbial boiled frog, the public has been slow to perceive these gradual, subtle changes, which also have been masked by the effects of two recessions (in 2001 and 2007). The changes are real, however, and have significant economic and social implications.

**IMPACTS**

The increased prices and reduced geographic accessibility of air travel have had a direct effect on the economy through the multiplier effect of transportation. For businesses, the cost of travel is now significantly higher, affecting how much and how quickly companies can expand activities that generate innovation and productivity. In the tourism industry, another significant component of the U.S. economy, many leisure destinations rely on air transportation to compensate for small regional customer catchment areas. Thus the reduced affordability of air travel is having a significant effect on this sector as well.

Total revenues generated by air transportation have also directly affected income from federal excise taxes. These are collected by the airlines in the form of taxes applied to tickets and are used to fund the operation of the government-run air traffic control system. Shortfalls in such revenues also affect funding of the proposed National Airspace System modernization initia-

tives, including NextGen and the Airport Improvement Program.

Why did all this happen, and what, if anything, can the U.S. government do to reverse these trends? Researchers at George Mason University and MIT have been studying this phenomenon by mining historical data and developing simulations of the industry. Their findings are fascinating—and also counterintuitive.

**FACTORS THAT SHAPE SERVICE**

Prior to airline deregulation in 1978, the Civil Aeronautics Board strongly influenced the markets served, the frequency of service, and airfares. During that period, the airlines competed primarily by selecting the type of aircraft and amenities they provided passengers. In this way the government influenced how widespread and how affordable airline services were.

Since the industry’s deregulation, all of the factors that determine the level of service (markets served, frequency, and airfare) are determined exclusively by the airlines, based upon the economics of the market. When the economics of the industry have failed to meet societal needs—leaving gaps in service to rural areas, for example—the federal government has subsidized airline service through the Essential Air Service (EAS) program.

**AIRLINE ECONOMICS 101**

In this deregulated market, publicly traded airline companies must make decisions to ensure the profitability of their networks. Profitable ‘economic operating points’ for service between two markets are determined by a complex interaction between nonlinear revenue and cost functions. The nonlinearities and asymmetries in these functions create several internal ‘tipping points’ that result in nonintuitive airline choices. For example, fewer passengers will be lost than will be gained, for the same increase/decrease in airfare.

A similar nonlinearity occurs when costs increase (fuel prices, for example). Instead of causing a shift to larger aircraft that (in theory) transport the additional passen-
gers at lower cost, the interaction between revenue and cost functions shifts the maximum profit point to a new economic operating point where the revenues for excise taxes are lower.

This is exactly what has happened in the past decade. Inflation-adjusted, hedged jet fuel prices, which had hovered around $0.50 a gallon for the previous two decades, increased above $1 a gallon in 2004, peaking at $2.73 in the second quarter of 2008. This higher cost dictated that airlines respond by shifting to flying fewer, higher paying passengers on smaller aircraft. The average aircraft size for U.S. domestic flights decreased from 118 seats in 1997 to 96 seats in 2011. The inflation-adjusted average airfares decreased from $283 in 1997 to $582 in 2011.

This is not a transient effect. Because of rising demand for fossil fuels from developing countries and increasing exploration and extraction costs, the DOE's Energy Information Agency (http://www.eia.gov/) forecasts that jet fuel prices will remain above $2 a gallon and increase over the next two decades to between $3 and $5 a gallon. This shift is a long-term structural change. Unless actions are taken to confront the phenomenon directly by addressing the control levers, this situation is here to stay.

**COMPENSATING FOR HIGHER FUEL COSTS**

To overcome the air transportation network contraction caused by higher fuel prices, the costs of operating a flight must be decreased. Traditional thinking has focused on improving fuel burn to compensate for the higher costs. However, analysis of empirical data on the costs experienced by U.S. airlines operating aircraft from 2005 to 2010 show there are marginal economies-of-density in aircraft seats for nonfuel costs and fuel costs.

Compensating for an increase in fuel costs from $1 a gallon to $4 a gallon, for example, would require an estimated improvement in nonfuel costs per seat-hour and fuel burn per seat-hour, to 41% of the existing performance for a 100-seat aircraft. Individually, this is a change in the nonfuel costs per seat-hour equivalent to three times the fuel burn per seat-hour, and a reduction in fuel burn per seat-hour to 25% of existing levels. This magnitude of change is greater than that of historical trends in technology. The only way forward is through a combination of improvements in nonfuel and fuel costs.

**WHAT CAN THE GOVERNMENT DO?**

With the existing technology and fleet mix, at $4 a gallon, maintaining affordability levels of $1 a gallon requires significant improvements in both nonfuel operating costs and fuel burn rates. A two-pronged approach is proposed: regulatory incentives and technological innovation.

- **Regulatory incentives.** Corporate average operating efficiency (CAOE) standards for new aircraft designs. CAFE (corporate average fuel economy) standards are regulations enacted by Congress in 1975 to improve the fuel economy of cars and light trucks sold in the U.S. These regulations require manufacturers to design a fleet of vehicles that in aggregate meet a fuel efficiency standard. A similar approach could be adopted to incentivize aircraft manufacturers to meet operating cost standards. These standards would apply not just to fuel efficiency, but to total aircraft operating costs.

- **Technology innovation.** Performance-driven comprehensive aeronautics research program. To ensure that the proposed CAOE standards for commercial airliners can be achieved, the federal government
The decline in ASMs per GDP is correlated with the rise of jet fuel prices above $1 a gallon, and the maximum flight density migration to smaller sized aircraft flying fewer, higher paying passengers.

The proposed single-crew/ground-monitored flight deck would include a pilot on board the aircraft, assisted by an automated pilot associate as well as a ground-based monitoring pilot serving multiple flights simultaneously.

The ground-based monitoring pilot, with capabilities similar to those used for UAVs, might have responsibilities for crew resource management, checklist, data and communication, and system monitoring. This pilot would also be responsible for assuming control of the flight if the onboard pilot became incapacitated. The ground-based monitoring procedures, technology, and human factors would dovetail with ongoing research projects for UAVs. This research would leverage advances in ‘pilot’s associate’ technologies and U.AV ground station technologies that have been funded by NASA and DARPA.

Long lead times require an immediate start. Establishing the target performance requirements and the detailed research roadmap will be challenging, but it is critical to get started now. The lead times for technology development and fleet insertion are on the order of decades. For example, it took the intervention of a presidential task force in 1981 to facilitate the transition from a three- to a two-crewmember flight deck.

**AMTRAK OF THE SKIES?**

Failure to act decisively could lead to the same problem that U.S. passenger rail transport experienced half a century ago. As railroads found more profit in moving freight than in transporting people, they abandoned passenger service. To maintain desirable levels of commerce, the government was obliged to step in and subsidize passenger trains, namely Amtrak.

Given the future probability of government budget austerity, the Amtrak mode for air service (such as expansion of the Essential Air Service program) is unlikely to be adopted. The result: reduced air commerce, with all the negative implications for the greater economy. A