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A welfare analysis of subsidies for airports☆

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ABSTRACT

The welfare of residents and profitability of business in many medium-sized MSAs would be improved if their airports had a higher level of service, for example reflected by more frequent flights serving more destinations. The level of service at such airports may rise with the number of enplanements, making total enplanements and the level of service subject to a positive feedback effect. Using a new annual data set put together by combining five sources for the years 2002 through 2012, we find evidence for such a positive feedback effect. We argue that subsidies at smaller airports may be welfare-enhancing in the presence of such an effect.

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1. Introduction

Analysts agree that the Airline Deregulation Act of 1978 resulted in lower fares and more frequent departures, though with the lower fares flying has become a less pleasant experience for many passengers. Importantly for many small and medium metropolitan areas, those with a population from, say, 100,000 to 750,000, the hub and spoke system the airlines created after deregulation has deprived them of much of the service they would have enjoyed otherwise. Their passengers now face less frequent departures and fewer point-to-point flights and may pay higher fares (Reynolds-Feighan, 1998).

The lower level of service at these smaller airports may have a feedback effect, especially for airports within reasonable driving distance of hubs. A first feedback component is substitution with the nearest hub (and perhaps other hubs as well). If more potential passengers drive to the hubs the flights from the smaller airports may become still less frequent, to fewer destinations, and more expensive. That could induce still more passengers to drive to the hub, and so on. A second feedback effect can occur if worse service at a local airport induces people not to fly who otherwise would have. The importance of the substitution effect relative to the induced demand effect probably declines as the distance to the nearest hub airport increases.

If there is such a feedback effect, it could work in reverse as well. Subsidies to the airports in smaller MSAs (metropolitan statistical areas, our basic unit of analysis) aimed at increasing their level of service could keep more passengers from driving to the hub and thus result in more frequent flights, more destinations, and more competitive fares. The higher level of service could induce still more to avoid the drive to the hub.

If a feedback effect caused by a positive relation between the number of passengers and the level of service at smaller airports exists, it offers the potential for welfare-enhancing subsidies. Subsidizing smaller airports might increase the welfare of their potential passengers, net of the subsidy, while also reducing congestion at hub airports. Adding to the importance of reducing hub congestion is the difficulty of gaining permits for adding or lengthening runways in large urban areas. Smaller airports, in contrast, are usually uncongested or nearly so. Waits for take-off and landing are typically non-existent or brief.

2. A model of air travel demand with feedback effects

Direct demand for enplanements per capita (n^d) in a particular MSA may increase with total enplanements (N) because more enplanements may lead to more frequent departures or a wider array of potential destinations, for example, increasing the level of

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service. Per capita direct demand includes demand from visitors flying out of the MSA, and so exceeds resident demand per capita. We employ a constant elasticity approximation of direct demand per capita,

$$n^d = e^{\alpha} f^{\eta} N^{\theta}, \tag{1}$$

where f is the fare charged, η is the own price elasticity of direct demand, θ is the elasticity of direct demand with respect to total enplanements, and α represents, for now, the combined impact of all other factors, for example the distance to a larger airport, per capita income, or the ratio of demand from visitors leaving the MSA to resident demand.

We assume local population, P, is not a driver of per capita direct demand. This assumption is crucial for our measurement of feedback effects. There is no apparent reason a typical individual would choose to fly from or to an MSA more or less frequently simply because the MSAs population is a bit higher. If there are more businesses just like existing businesses, they should attract a similar number of visitors and generate a similar number of trips to other destinations. If there are more families just like other families, they should generate the same number trips into and out of the MSA as current families. This does not mean higher levels of population may not be associated with other factors that impact direct demand. For example, more populous MSAs may, on average, have a richer set of recreational opportunities which attract more visitors per capita.

Letting P denote the local population, total enplanements are$N = Pn^d$, or $N = e^{\alpha} f^{\eta} N^{\theta} P$. Holding N, and all else, equal, the direct effect of doubling population should be to double enplanements. Solving for N gives

$$N^D = e^{\frac{\alpha}{1-\theta}} f^{\frac{\eta}{1-\theta}} P^{\frac{1}{1-\theta}}. \tag{2}$$

The capital D superscript in equation (2) denotes that it includes both the direct and indirect, or induced, effects of changes in fares or any individual demand shifter—it is final demand.

The elasticity of total enplanements with respect to population, holding per capita demand constant, is 1. But, the elasticity of final demand with respect to population is $\frac{1}{1-\theta}$, which is greater than 1 in the presence of positive feedback effects ($\theta > 0$). The population elasticity of final demand reflects both the proportional effect of increasing population holding per capita direct demand constant, and the further increase in demand induced by that increase in enplanements.[1] The price elasticity of final demand, including direct and induced effects, is $\frac{\eta}{1-\theta}$. We assume $\theta < 1$ so final demand slopes down. Moreover, in general, the total elasticity of demand for any demand shifter (captured for now in α) is the direct elasticity of per capita demand with respect to that variable divided by $1 - \theta$.

Dividing equation (2) by P gives final demand in per capita terms,

$$n^D = e^{\frac{\alpha}{1-\theta}} f^{\frac{\eta}{1-\theta}} P^{\frac{\theta}{1-\theta}}. \tag{3}$$

The two notions of demand are illustrated in Fig. 1. At a fare of f_0, per capita quantity demanded is n_0. Now imagine lowering the fare to f_1. The lower fare directly increases direct demand, n^d, holding N constant at $N_0 = Pn_0$, to n'. The increase in N through the feedback effect further increases demand, with final quantity demanded ultimately increasing to n_1.

Both direct and final demand are important for understanding the potential for subsidies to increase welfare. If we focus only on final demand, n^D, we miss something crucial—with a positive feedback effect the value of inframarginal enplanements to consumers is higher with more enplanements. Subsidies, by increasing total enplanements, increase consumer surplus not only through increasing the number of enplanements, but also through increasing the value of each enplanement. If this effect is large enough to overcome the excess burden of raising public revenue to fund the subsidy, subsidizing air travel, at least at uncongested small and medium airports, is welfare enhancing.

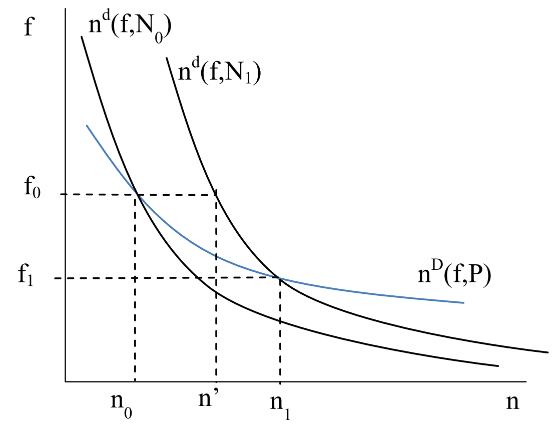

Fig. 1. Direct and final demand per capita.

We can gain insight into the potential economic importance of positive feedback effects and air travel subsidies by evaluating the optimal subsidy—which maximizes consumer surplus net of the cost of the subsidy—and its impact on welfare for ranges of reasonable parameter values. The crucial parameters are the own price elasticity of direct demand, the elasticity of direct demand with respect to total enplanements, and the excess burden of taxation per dollar of revenue raised. Estimates of the excess burden of taxation and the price elasticity of demand may be drawn from the literature. Our empirical work, to which we now turn, estimates the elasticity of direct demand with respect to total enplanements.

3. Empirical analysis

3.1. Data

We combined five sets of annual data for the years 2002 through 2012 to compile the following five variables.

1. Enplanements (N) for all airports with 10,000 or more passengers from the FAA Passenger Boarding and All-Cargo Data for U.S. Airports
2. Distance in miles (D) from the MSA to the nearest hub airport
3. Population (P) by MSA from the United States Census Bureau
4. Per capita income (y) by MSA from the Bureau of Economic Analysis, converted to constant 2009 dollars using the GDP deflator
5. The share of MSA GDP in the leisure and hospitality sector (h) from the Bureau of Economic Analysis Regional Economic Accounts

These were merged into a database indexed by MSA name. To permit uniformity, a canonical list of MSA names had to be established. This was necessary, as the precise definition and name for the MSA changed slightly from year to year. For example, the data for population from the United States Census Bureau Population Estimates defines the MSA containing Atlanta, GA as

[1] Net congestion effects would be reflected by $\theta < 0$.

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