



Seeding growth at airports and airport cities: Insights from the two-sided market literature

Stephen J. Appold*, John D. Kasarda

Kenan Institute of Private Enterprise, University of North Carolina at Chapel Hill, 27599–3440, United States

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ABSTRACT

Airports are evolving from simple infrastructure providers to complex multiproduct, multiservice enterprises wherein consumption of one product cross-subsidizes the provision of others. Nowhere is this better seen than in the airport cities which are evolving around many mid and large sized airports. Rather than separate portfolio businesses which can smooth or augment airport revenue, these developments raise the prospect that airports are platforms for two-sided markets.

Therefore after defining two-sided markets this paper will consider the concept's applicability to airports in a more extensive manner than has previously been the case, and use the theory to understand airport area growth processes. Our main focus will be on examining the business models of selected airport cities for the lessons that can be learned for contemporary airport and regional development strategy.

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1. Introduction

The rise of internet-based commerce where consumers can often obtain expensive information and services without direct payment has revived interest in business models. Business models provide an explicit conceptual link between the benefit provided to consumers, the costs incurred in delivering the benefit, and the revenues received. The basic business model describes a direct stand-alone, arms-length exchange of a unit of good or service provided for a payment which is equal to the cost of providing that unit. That is a powerful model with wide applicability but frequently it does not fully capture economic behavior. For example, businesses often attempt to lock in customers with volume discounts, decreasing demand uncertainty by rewarding customers either for reduced sales costs or for the reduced unit cost manufacture and distribution.

Businesses also attempt to lock in customers with multiple linked products. Safety razor handles and blades were an early example of this strategy. Handles were given away or sold at a loss while the blades were sold with a high premium. In the long run, all costs need to be covered but reducing the price on the handle reduces the threshold for adoption while also creating an incentive for brand loyalty. Similar multiproduct pricing business models are said to be employed to increase total sales in marketing laser printers and toner cartridges, iPods and iTunes, and other products (Parker & van Alstyne, 2005; Rochet & Tirole, 2003).

The two-sided market business model discussed later builds on that multiproduct strategy but entails linking distinct types of customers (for example, as discussed later: airlines and travelers), rather than products, possibly charging each other differently – and neither according to the costs incurred in providing service.¹ The nature of multi-sided markets implies particular business strategies which have implications for regulation and business development.

Two-sided markets have become an important area of business strategy and the concept being adopted by airports. Airport managers are beginning to see themselves as operating platforms in two-sided markets (e.g., Gatwick Airport, 2010). Our contribution in this paper is to 1) explain the mechanics of two-sided markets with an emphasis on “seeding” non-recursive (chicken-egg) growth processes, 2) following on the initial work of Gillen (2011), briefly review existing applications of the two-sided framework to airport non-aeronautical revenue, refining the concept by placing two-sided markets within the context of a transportation demand model, and 3) using five selected case studies of airport city business development strategies, extend the application of the theory to airport real estate and economic development issues. Our primary interest is in the application of two-sided market pricing policy to accelerate airport area growth.

We will not argue that the theory of two-sided markets offers the best approach to airport or airport city business strategy. Such an assertion would be premature. The value of the approach will be seen as the literature grows and the nuances of commercial aviation are incorporated into models.

* Corresponding author. Tel.: +1 919 962 8201; fax: +1 919 962 8202.
E-mail addresses: appold@unc.edu (S.J. Appold), John_Kasarda@unc.edu (J.D. Kasarda).

¹ Terminology is still unsettled in this field. “Two-sided markets,” “two-sided platforms,” and “two-sided platform markets” each finding usage. “Multi-sided” may be a more accurate term but we use the more common term.

Our approach is conceptual and exploratory, rather than econometric, relying largely on stylized facts. The basic mathematical models are included in literature cited below and the literature continues to develop. We will suggest that the theory of two-sided markets does provide a coherent strategic framework for understanding the challenges and opportunities facing airports and airport cities.

Two-sided market business models are relevant to airport management because they can provide a guide to business development strategy wherein airports may add value through active engagement in matchmaking, rather than acting as passive infrastructure providers, as mere extensions of airline strategy, or as local monopolists.

2. Two-sided markets

A market can be considered two-sided if there are two sets of agents, and if an agent from one side of the market can be matched only with an agent from the other side (Gale & Shapley, 1962). Two-sided markets are “characterized by the presence of two distinct sides whose ultimate benefit derives from interacting through a common platform (Rochet & Tirole, 2003: 990).” There are three elements to the structure of two-sided markets: the two sides and the platform which allows them to find each other and interact. Two-sided platforms are sometimes categorized into market-makers as just described, audience-makers which allow advertisers to access audiences gathered for another purpose, and demand coordinators such as the payment systems discussed later (Evans, 2003a).

Two-sided markets are frequently characterized by “network economies.” That is, the larger the number of participants, the greater the benefit to each, thus an increase in the number of participants leads to a further increase in the number of participants. In contrast to the basic case of network economies where the larger the number of users, the greater the benefit (e.g., telephones), the network effects are indirect. In two-sided markets, the larger the number on the one side, the greater the benefit on the other (e.g., larger passenger volumes create greater opportunities for terminal retail sales).

In technical terms, the theory of two-sided markets can be seen as “a cross between network economics, which emphasizes [un-internalized] externalities and the literature on multiproduct pricing, which stresses cross-elasticities (Rochet & Tirole, 2003: 991).” Accordingly, “a market is two-sided if the platform can affect the volume of transactions by charging more to one side of the market and reducing the price paid by the other side by an equal amount; in other words, the price structure matters, and platforms must design it [the price structure] so as to bring both sides on board (Rochet & Tirole, 2006: 665).” Conversely, if that is not the case, the market is one-sided. The charges can include either fixed registration charges or usage fees or both. The key business insight, which also impacts regulation, is that platform managers may be able to increase the number of participants on one side by manipulating the prices the other must pay to participate in the platform.

Singles bars are a favored concrete example in the literature on two-sided markets (e.g., Evans, 2003b). In fact, the models sometimes have been termed “marriage models.” In order to be successful, a heterosexual singles bar needs to draw males and females in appropriate proportions and qualities. In such circumstances, it might make sense to charge women, the side which is generally more difficult to attract, less for drinks or provide special benefits for them in order to attract sufficient men who, in turn, would pay a premium for their drinks (analogous to a usage fee) and possibly pay a cover charge (analogous to a registration payment). Further segmenting the market, by targeting influential people, such as celebrities, within each group, might also help attract a larger clientele. Of course, neither males nor females are attracted mainly by the drinks. They are generally looking for each other and, up to a point, a larger crowd would facilitate better matches.

Much recent research on two-sided markets has been oriented towards understanding the information technology industry and the

process by which one electronic format (e.g., VHS), operating system (e.g., Windows), gaming system (e.g., Playstation), or credit card (e.g., Visa) may come to dominate the competitors. Many consumers use Visa cards because many stores accept them. Correspondingly, many stores accept Visa cards because many consumers have them.

Pricing structure is often held to be a critical strategic policy tool. Customers are actually subsidized for using most Visa cards (as long as they pay the bill when due) while merchants need to invest in specialized equipment and pay a fee for each purchase. On the other hand, the ease of payment may encourage shoppers to make purchases and it also relieves many smaller stores from the costs of providing credit to consumers. Skewed pricing is one of the common central features of two-sided markets.

While the logic of differential pricing is often easy to understand for going concerns, the process of “seeding” a two-sided market – solving the implicit “chicken-egg” problem – is a key concern for business development strategy (Caillaud & Jullien, 2003). Microsoft’s DOS emerged as the dominant personal computer operating system during the competitive era of the late 1970s and early 1980s. Two-sided pricing strategy is sometimes claimed to have been their main initial competitive advantage. Microsoft distributed developer kits to programmers at little or no cost while its competitors charged programmers for them. The result was that Microsoft was able to attract more programmers to its platform and thus had a larger number of available applications earlier than their competitors. It was therefore able to attract a larger and more rapidly growing number of users, even if, as critics complain, DOS was an inferior product compared to others available on the market at the time.²

Similarly, singles bars succeed not because they serve the best drinks or offer the best hospitality, although they may, but because they allow males and females to find each other more efficiently than alternative venues. Similarly, the implication is that Microsoft succeeded in becoming the dominant provider, not because DOS was technically the best personal computer operating system, but because it allowed users to connect to the greatest number of applications they found useful.

There are many varieties of two-sided markets. Several characteristics may affect the optimal business strategy for platforms. Labor markets, for example, are two-sided markets in which each side seeks the other and participants on both sides are often willing to invest substantial effort into finding the best possible match (Roth & Sotomayor, 1992). Labor and marriage markets entail one-to-one matchings while software platforms, such as those described above, lead to many-to-many matches. That is, in the former, one person has one job and one spouse each with significant lock-in costs to the match while, in the latter, each person uses many applications and each software application has many users affecting the pricing structure and level.

The level and object of lock-in may affect the propensity to “multi-home.” That is, men and women may use multiple platforms (visit several different bars) in seeking matches. Research on dating patterns suggests that the nature of the platform can affect the success and quality of matching between sides with church socials more often leading to marriage than singles bars (Laumann, Ellingson, Mahay, Paik, & Yim, 2004). The nature of the platform may affect the feasibility of multi-homing with those requiring specific investments inspiring more loyalty but possibly also greater resistance to “buy-in.” The high lock-in costs may have doomed the B2B web portals which

² Some observers claim that these were not the critical factors in Microsoft’s success. Bill Gates has stated that such inducements were insufficient for programmers to create Windows applications; apparently applications developers were waiting for larger rewards. However, the Microsoft experience can be compared with the contrasting experiences of the Apple II where outside applications developers were welcomed and the Macintosh where they were not.

were set to revolutionize corporate sourcing a decade ago (Evans & Schmalensee, 2010).

The costs associated with expansion are often negligible in virtual markets. Additional Visa card users and merchants impose little burden and generates benefit, possibly creating a “winner-take-all” market in which a single dominant platform attracts the large majority of merchants and shoppers or developers and users. The direct and indirect network effects may be limited in bricks and mortar businesses. Real world markets, such as singles bars, can suffer from congestion and searching costs which rise with usage. Such factors may lead to smaller, more numerous platforms.

Industry maturity may be a key factor determining start-up strategy. An initial entrant may need to develop a market, starting out by addressing a limited market segment. E-Bay reportedly began as a place to exchange collectables before scaling up to larger markets. Facebook began as a way to find dates at a single university. On the other hand, new entrants to established markets may feel it is necessary to use a costly and risky “boil the ocean” strategy – using all means and options available to get something done – in order to build up a threshold market share on both sides of the platform quickly (Gerstner, 2002). From that point of view, the drinks pricing policy outlined earlier may describe the strategy of successful singles bars but be of limited use to those attempting to start new ones. In order to enter a crowded market, a new singles bar may consider including a celebrity or entertainment blitz in its launch. The literature on two-sided markets suggests late entrants may need to acquire customers on both sides en masse (Evans, 2003a). Failure rates appear to be high for new two-sided market platforms.

Several findings have emerged from the burgeoning literature on two-sided markets. The first is that pricing specific goods or services below marginal cost is not necessarily an indication of predatory pricing. Therefore, regulators should not immediately assume anti-competitive behavior. That finding emerges from the possibility that prices will be different for each of the two sides in order to achieve and maintain the optimal balance. Pricing, thus, may be critical to business strategy. Finally, “chicken-egg” start-up problems can be thorny, especially when a certain scale of operations is needed before customers on both sides, and the platform itself, are able to benefit. Before discussing airport cities, we extend the existing literature applying two-sided market theory to airport management by placing the theory in the context of structured transportation decisions. The dimensions of two-sided markets discussed above are relevant to the application of theory to airports.

3. The application of two-sided markets to airports

In the broadest sense, two-sided markets are quite common. For example, retailers can be seen as platforms linking consumers and wholesalers. Gillen (2011) and less directly Starkie (2001) and a number of others have suggested that the two-sided market framework can provide insights into airport management and public policy. Such discussions view the airport as a platform linking airlines on the one hand and passengers on the other. Consonant with the literature on two-sided markets, airlines search for and benefit from large passenger pools, just as passengers search for and benefit from a large choice of airlines and routes. The emphasis has generally been on regulatory issues with the central points being that pricing below marginal costs is not necessarily predatory and that, properly understood, market forces may lead airports to minimize aeronautical charges so that only a light regulatory touch is needed.

Airline service, passengers, and cargo do tend to concentrate at a relatively small number of airports globally and locally. Based on recent ACI data, the busiest 36 airports capture one-third of global passenger traffic. Seventy capture half while 43 airports account for half of the international passenger traffic. For cargo, the busiest 12 airports in the world capture one-third of the traffic. Twenty four are

responsible for half and 15 capture half of the international freight. Locally, in those cases in which a metropolitan region is served by multiple airports, a single airport dominates air service unless certain, relatively rare, circumstances hold. Ground distance from pockets of high demand and frequency of service appear to be the main factors determining the position of an airport in multi-airport regions. Especially the latter, local, pattern suggests that airports act as platforms in two-sided markets in a manner consistent with the relevant theory.

In discussing airports and other forms of transportation infrastructure as platforms in two sided markets, the differences from the software and other examples outlined earlier may affect the effectiveness of two-sided pricing strategy in determining volume. First, airports support a many (passengers)-few (airlines) matching which may be intermediate between the many-many matches of internet portals and the one-one matches for labor markets. At hub airports, a single airline often captures a large portion of the passenger population and may internalize many of the positive externalities. Airport pricing policy may be stronger at busy non-hub airports. Second, the nature of the matching along with the costs involved affects the ability of each side to multi-home – and thus their decisions to participate at all. It is expensive for airlines to multi-home, partially explaining their generally conservative strategies, but significantly less so for passengers. Third, unlike in the software industry where the economies of scale are considerable but the diseconomies negligible, the absence of economies of large airports in the form of longer trips to gates, longer taxi times to runways, and sometimes congested airspace, is often apparent (e.g., Doganis & Thompson, 1974; Jeong, 2005). According to Rochet and Tirole (2003), network economies are critical to several key findings. Fourth, in contrast to the electronic payment sector which only supports a few platforms, there are many platforms (airports) in the air transportation sector. Many of these hold partial geographic monopolies which limit competition among platforms.

Finally, much of the literature on two-sided markets studies how leaders emerged from an uncertain set of poorly developed competitors. The air transportation sector is a, by now, mature industry and the “chicken-egg” problem facing new entrants is how to find a niche among well-established competitors. Modified gravity models, using population weighted by income at origins and destinations, appear to explain the level and pattern of air traffic fairly well. As is the case in the broader literature, the impact of pricing policy on seeding or maintaining airport traffic has yet to be firmly demonstrated. Nevertheless, the theoretical findings are suggestive for those airports seeking to expand market share, particularly from a zero base.

3.1. Aeronautical and non-aeronautical revenues

Much of the discussion of airports as platforms in two-sided markets centers on how aeronautical and non-aeronautical revenues could be managed to cross-subsidize each other to both increase the level of traffic and total revenue for airports. The most relevant portions of non-aeronautical revenues may be that due to the unbundling of airline services, with food and drink and reading material less commonly provided by airlines now than in the past. Hotels and conference venues supported by air passengers are also important. In addition, air traveler specialty retail purchases can add to non-aeronautical revenues. While parking fees are often an important source of non-aeronautical revenue, they are less relevant to the argument because they are central components of passenger travel budgets and thus may pose a direct challenge to airline revenues.

The central component of the two-sided argument is that reducing aeronautical charges for airlines – in other words – operating the aeronautical side as a loss leader will help increase air service at an

airport. Costs would be recovered by higher returns on non-aeronautical investments. That is, the possibility of earning high returns on non-aeronautical investments, such as terminal retail, hotels, and cargo facilities, might encourage airports to make investments in the regulated aeronautical sector where returns are sometimes constrained to below market rate returns on the capital invested. Because aeronautical revenues are sometimes required to cover costs of runways, taxiways, aprons, and the portion of terminals directly tied to aviation at dual till airports, the argument may have even greater validity for single till airports where non-aeronautical revenues may subsidize airline costs to a greater degree in order to maximize total financial returns.³ In either case, optimal airport strategy would be to subsidize airline operations in order to gain access to a desired customer base. (Following the same logic, some airports also minimize parking charges, which often constitute a significant portion of non-aeronautical revenues, in order to remove impediments to additional travel.)

Commentators have long quipped that terminals are essentially expensive shopping malls with runways (Sudjic, 1992). Just as shopping centers provide free parking in order to attract customers and subsidize anchor tenants in order to attract specialty shops (Brueckner, 1993), airports may subsidize travel in order to do the same. An airport customer base can be quite moneyed, as the exclusive shops at some large airports suggest. Retailers, hoteliers, and others may be willing to pay a premium for privileged access to this elite clientele and this can be reflected in the rents paid for terminal retail space.

The key regulatory policy question is whether such cross-subsidization of aeronautical expenses by non-aeronautical revenue amounts to anti-competitive behavior. Prices, in that situation will not meet the marginal cost Lerner condition of an inverse relationship between price-cost margin and demand elasticity for competitive pricing. However, neither consumers nor competitors necessarily suffer from the cross-subsidization. In fact, consumer welfare arguably increases in many such cases.

Arguments based on the theory of two-sided markets are still controversial with respect to airports, as they are in the broader literature. The finding that socially optimal prices may not equal marginal costs does not require two-sidedness as commonly defined (e.g., Morrison, 2009). Moreover, a clear consensus concerning the desirability of cross-subsidization has yet to emerge (e.g., Zhang & Zhang, 2010). Nevertheless, over \$1 billion in annual sales at Dubai airport terminal shops suggests the plausibility of the two-sided strategy, at least in specific cases.

3.2. Seeding airport growth

While regulatory issues are important, the key business strategy issue is whether cross-subsidization can “seed” or accelerate the chicken-egg process, increasing airline and consequently passenger or cargo traffic and ultimately airport revenue. Airlines are clearly sensitive to airport costs. Minimizing aeronautical charges has long been the Holy Grail of airport management. From the beginning of the air age, airports have used financial inducements in order to lure airlines and increase air connectivity. Airports have frequently sought non-aeronautical revenue to subsidize aeronautical costs (Hubbard, McClintock, & Williams, 1930). That practice may have reached its peak in the 1930s with the so-called “LaGuardia leases” used by the City of New York to lure air service away from nearby Newark Airport (Doig, 2001).

³ Under the single till principle airport activities (aeronautical and commercial) are taken into consideration to determine the level of airport charges. By contrast, only aeronautical activities are taken into consideration under the dual till principle (IATA, 2007).

As it turns out, an exclusive reliance on non-aeronautical revenues has not proven to be a viable airport business strategy. Love Field, near Dallas TX, was one of the first major U.S. airports to give up on a full reliance on non-aeronautical revenue to support aviation activities (Bednarek, 2001). Similarly, when the Port Authority took over the management of La Guardia and Newark Airports in the late 1940s, it renegotiated the leases. As a point of perspective, few, if any, singles bars – a commonly cited example of a two-sided market – provide drinks at no cost to women.

Placing airport pricing policy in the context of a transportation demand model helps refine the application of two-sided market theory to airport business strategy. The standard four-step transportation demand model posits an equal number of travel decisions: 1) trip generation (whether to travel or not), 2) trip distribution (where to go), 3) mode choice (by what means of conveyance), and 4) route assignment (how to get there geographically). While the four decisions are not necessarily strictly nested, climbing up the decisions tree and at the same time backing away from the airport to examine progressively broader geographic scales focuses on the strengths and limitations of pricing policy.

Research has examined air transport route choice most closely. Specifically, given that a person has already decided to travel by air, which origin/destination airport should be used (in regions with multiple options) and which transfer hub should be employed? Much of the cost of using a particular airport for both airlines and air passengers are in operational costs and the value of time, respectively. In multi-airport regions, ground access time may be the critical factor determining airport choice for passengers, with destination choice and ticket price also having an impact (Hess, Adler, & Polak, 2007; Pels, Nijkamp, & Rietveld, 2001). Because airlines seek access to passengers, service quality tends to correlate with ground access time also. Since ground access time appears to be particularly important to high-yield passengers and since high and low cost service is frequently offered on the same aircraft, the opportunity for airports to act as mediators may be limited. Any reduction in airport charges could be countered by a rise in airline charges, assuming that the trip, rather than the flight, has a fixed value to passengers.

Airports sometimes have been able to attract primarily leisure-oriented, low-cost airlines to new destinations by offering low landing fees. The pricing policy on the part of these low cost airports appears to be most effective in attracting airlines when primary airports are capacity constrained and the airport in question is not far from centers of established air travel demand. Ironically, the airports attempting to recruit airlines are sometimes considered deficient in the services which would increase non-aeronautical revenues. Accordingly, although the practice sometimes runs afoul of competition laws, local governments or the local business community are sometimes willing to subsidize low aeronautical costs in order to increase passenger flows or tourism. Such behavior suggests the efficacy of airport-based two-sided market strategy in a wider context.

The success of such pricing strategies appears to be heavily dependent upon the market entry strategies of particular airlines. The alliances between low cost airlines and low cost airports may prove to be unstable as the airlines grow and are sometimes able to access more centrally located airports on an attractive basis, as Southwest increasingly does. Some large airports are in the process of creating separate low-cost terminals with minimal services and retail offerings. Therefore, it is unclear whether the concessions to airlines are compensated by higher non-aeronautical revenue or simply by more effective use of infrastructure and by increased aeronautical charges over time.

Airport pricing, along with geographic centrality within a broad region and the size of the local customer base, does appear to be a significant factor affecting the outcomes of airline hub competition. If airport aeronautical cost influences airlines (and they most likely do at hubs), airport terminal retail and leisure offerings may influence air

travelers with a choice of intermediate hub. Particularly in an era of declining service differentials among airlines, the quality of the airport experience may become a factor in hub (and thus possibly airline) choice in addition to transfer time and total travel time. Hub airport business development strategy may therefore include low aeronautical charges combined with well-developed terminal facilities.

A pricing policy difficulty arises in that some of the features most valued by travelers, such as short transfer times and an absence of crowds, do not directly generate revenue. Therefore, the airport needs to consider the volume-revenue trade-offs. Accordingly, as USAir consolidated its operations, Pittsburgh lost its airline hub despite its excellent reputation as an airport and its acknowledged leadership in developing non-aeronautical revenues through its AirMall retail innovations. The relatively high per enplaned passenger airline costs necessitated by the construction of the terminal containing the AirMall is said to have contributed to the withdrawal decision which was also affected by the size of the regional market. Optimal airport pricing strategy is then not necessarily to subsidize one side over another but to find the overall optimal mix of prices and services to get, and keep, both sides on board. For hub airports, that might imply somewhat high fixed costs but relatively lower landing fees to encourage (or at least not discourage) volume.

In contrast to the software industry where one operating system (platform) supports a large number of applications, most hub airports are heavily dependent upon one airline. Selecting a particular hub also advantages a specific airline and airport competition is frequently tantamount to airline competition. This co-dependency alters the incentives and therefore the nature of the relationship between the airport (platform) and airline (one side) from that found in the software industry, making it perhaps more similar to the “Wintel” relationship than to the Windows-Word relationship. First, a large number of air routes are uncontested and the geographic segmentation of air transportation markets means that airlines have been more successful than actors in other sectors in establishing quasi-monopolies. Second, carrier survival appears to be the determining factor in hub survival. As based carriers cease operation, new airlines often do not rush in to fill a service void. Airports, as platforms, have less leverage over airlines than, say, operating systems have over applications developers. The relative position of airports is suggested by the debates over peak pricing to relieve congestion and in the relative success of airline and airport loyalty programs.

The costs and convenience of using airports are likely to influence mode choice and, consequently, decisions about whether to travel or not. Influencing these decisions is the likely rationale behind airport amenity offerings including ease of use and the more intangible benefits of design and signature architecture. Airlines could absorb the costs of those amenities but passengers often pay for these amenities directly through passenger facility charges. Airport practice in this regard suggests the efficacy of a pricing strategy based on two-sided market theory.

Not all differential pricing to develop business relies on the two-sided framework, however. Airports sometimes offer to subsidize new routes by reducing aeronautical charges for a limited period of time or by contributing to marketing and promotion in order to generate additional passenger flow. Because survey evidence suggests that airline executives generally believe that airports can offer such support for only a few months, these incentives are generally based on information asymmetries (Gardiner, Ison, & Humphreys, 2005). Airports are sometimes aware of a market potential not visible to airlines and are willing to signal their confidence by investing in start-up costs which will be recouped over time. The use of limited funds for such purposes enhances the credibility of the signal.

Airports are not the only type of transportation infrastructure to apply strategies based on two-sided market thinking. In the late 1940s, when the Port Authority of New York and New Jersey realized that bus companies would be unwilling to pay the full cost of

constructing a needed bus terminal, they included retail space in the design in order to fill the revenue gap. Similarly, train station retail offerings in Japan, the Netherlands and other countries, help underwrite the infrastructure costs.

4. Airport city case studies

The theory of two-sided markets may also inform strategy to address chicken-egg issues to benefit at a larger geographic and economic scale — developing airport areas or even whole regions. Historically, transportation infrastructure and the accessibility it can provide have had impacts on urban and regional development. A century ago, real estate developers realized that providing streetcar service from center cities to specific land parcels increased the value of their holdings. Earlier, railroads were granted land holdings along the lines they constructed through the American mid and far west in order to encourage development.

Capturing the value generated by the transportation infrastructure has long been a component of infrastructure finance and the investor value proposition. Real estate value capture continues to support the Hong Kong metro system as public transportation and public housing cross-subsidize each other. Similarly, aviation infrastructure may create value which is captured either in land rents or in the incremental tax revenues brought about through the employment generated by the air traffic, helping to justify the large capital expenditures needed.

Tourism destinations, such as those along the Mediterranean or Caribbean Seas, are often heavily dependent upon aviation. An integrated multiproduct or two-sided market strategy may increase overall revenues above that possible by independent airline, airport, and resort business development strategies. Second tier cities in China and India and air-dependent export regions, such as Kenya's rose-growing district, may also benefit from a two-sided market strategy. The actors in these example situations do not necessarily have the management tools required to implement a strategy based on two-sided market theory but in some cases, the tools are available to airport management or their sponsors.

We explore five selected airport regions which have explicitly attempted to use airports as vehicles for regional economic development in order to investigate how the chicken-egg seeding problem was (or is) being addressed in well-developed aviation markets. The cases are at differing levels of maturity and have met with varying levels of success thus far. The selected cases are the Amsterdam Airport Area, Alliance Texas, the new airport in Panama City, Florida, the Detroit Region Aerotropolis, and the North Carolina Global TransPark. These cases do not cover the entire landscape of airport-based interventions but they do provide useful contrasts and they begin to illustrate the parameters of airport-centered regional development strategies. Because the application of the theory has been less explored at this level, our style is descriptive but our aim is to uncover the elements of seeding strategy in order to make preliminary assessments about the efficacy of two-sided pricing policies under specific circumstances.

4.1. Amsterdam airport area

Amsterdam Schiphol is perhaps the leading European airport city and has an acknowledged role in growing the regional economy. By devoting a significant portion of on-airport land near the passenger terminal to non-aviation use, Schiphol in many ways pioneered value capture through real estate development inside and outside the airport fence. Control over land has allowed Schiphol the possibility to exercise strategies based on two-sided markets. Aside from extensive retail offerings serving passengers inside security, Schiphol has used low-traffic areas of the terminal for recreational and cultural uses. The city's Rijksmuseum maintains a gift shop in such an area with a dozen

or so Dutch Masters' paintings located in a space above the shop. The airport has recently added a 1200 volume library with books in two dozen languages for the use of terminal passengers.

The retail offerings, including well-appointed shopping and entertainment arcades, continue outside the security zone in an area which is also open to non-passengers. By combining terminal design with mall design, Schiphol has substantially increased revenues through concession rents and consumer purchases.

More importantly, Schiphol Real Estate has been able to develop a 4 million sq. ft. (372,000 m².) World Trade Center, including meeting and commercial facilities and the regional headquarters of such firms as Thomson-CFS and Unilever, directly across from Schiphol's passenger terminal. A Sheraton and a Hilton hotel complete the complex and all are connected to the airport terminal and its underground train terminal by enclosed walkway and travelator. Office rents in this on-airport complex are among the highest in the Netherlands. A large office park is located on the older, city side of airport grounds for the use of KLM and other aviation-related businesses.

As a major European cargo gateway, a portion of the airport has been developed as a cargo center. A large logistics park spills over the airport fence to the south and the east with flex-space extending into nearby municipalities. As the airport-related real estate development extended beyond the airport, Schiphol created Schiphol Area Development Corporation in cooperation with other parties to capture value from such demand. Industrial space in the airport area also commands high rents. Several other airport area business and industrial parks have been planned. Approximately 62,000 people are employed on airport grounds.

In recent years, non-aeronautical revenue has contributed as much as 70% of Schiphol's operating surplus. As Schiphol faces increasing competition for hub traffic, stemming in part from KLM's 2004 merger with Air France and from competition from Middle Eastern airlines on profitable Asian routes, the role of non-aeronautical revenues in supporting the air accessibility which supports regional prosperity may increase.

Schiphol's real estate value capture is aided by fortuitous geography and by national investments in surface infrastructure. The region's history helped in the chicken-egg seeding process. Amsterdam has long been a global center of trade and, along with nearby Rotterdam, which has one of the world's busiest and most strategically-located seaports at the mouth of the Rhine River, anchors one end of the European "blue banana" which reaches into Germany and is near the economic centroid of continental Europe. This meant that the airport was immediately supported by well developed trade and business institutions and by transport infrastructure which was already supported by surface transportation.

In addition, the airport is near the center of the poly-centric Dutch Randstad giving it a regional centrality advantage not enjoyed by many other airports. This advantage increased as the Dutch national government made substantial additional investments in highways and rail lines. Two major expressways (the A4 and the A9) link the airport to downtown Amsterdam and the broader urban area. Since the Dutch national government relocated the main national trunk rail line under the airport terminal in 1995, a modern train station has efficiently connected travelers to the city center, the rest of the Netherlands, and, with the continuing construction of high-speed rail lines, Belgium, France, and soon, Germany. The highways and rail lines help make the Schiphol area, beginning with a 10 million square foot (930,000 m²) edge city which has emerged on the city's south side six minutes by expressway or train from Schiphol's passenger terminal, reaching through the terminal office area described earlier, and terminating in an office and industrial flex space area to the airport's south a major site for internationally-oriented firms, particularly those which require large floor plate office and industrial space.

Other factors have had impacts, seeding Schiphol Airport Area development. Although it is nominally the national carrier, KLM is a traded private company. Based in a small country with a limited home market area, KLM was motivated to expand internationally from an early date and is reputed to have been one of the earliest European adopters of the hub and spoke pattern. In order to survive, it needed to compete successfully against national carriers in protected markets, providing an early boost to airport growth. More recently, as producer service sector growth began to accelerate in Europe, Amsterdam may have been able to benefit from escalating real estate and labor costs in London where office rents are approximately twice what they are in Amsterdam.

The airport and the air service provided is held to be a significant factor in the decisions of over 1000 international companies to locate in the greater Amsterdam region. Accordingly, the Dutch national government has taken an active interest in the airport's development strategies. In Amsterdam's case, geographic centrality which continues to attract surface cargo appears to be a major factor in seeding the traffic in the Amsterdam Airport Area. The proficiency of the based airline, KLM, in providing service to an emerging passenger market may have also played a role in the growth of the Amsterdam Airport Area. At the same time, growing capacity constraints impinging upon expansion at other hubs may have helped fuel air service growth at Amsterdam. The chicken-egg problem has been addressed incrementally, with gradual small additions on each side, in Amsterdam. The airport's direct involvement in on and off-airport real estate development has allowed its government owners to larger capture a portion of the value emanating from air transport and possibly accelerate its growth through coordinated two-sided pricing strategies.

4.2. Alliance Texas

Alliance Texas is a well-known example of real estate development linked to infrastructure provision, with the airport being the most prominent aspect of the infrastructure investment. The airport was used to enhance real estate returns. These have also generated significant tax returns for North Texas localities. From the start, Alliance's development process followed the two-sided market shopping center model discussed earlier.

Fort Worth Alliance Airport is a city-owned public-use airport located 14 miles (23 km) north of the central business district of the City of Fort Worth, in Tarrant County, TX. Opened in December 1989, the airport covers 1198 acres (485 ha) and offers two parallel runways. Planned as a cargo airport, Alliance has served as a regional hub for FedEx Express since 1997 and as a maintenance base for American Airlines since 1989. The airport is owned by the City of Fort Worth and managed by Alliance Air Services, a subsidiary of Hillwood Development Company, a real estate development company owned by H. Ross Perot, Jr. The airport is, in effect, a joint venture between the City of Fort Worth, the Federal Aviation Administration, and Hillwood.

Fort Worth Alliance is not so much a transportation facility as a real estate development. Former U.S. Presidential candidate, Ross Perot, Sr., and his son had begun acquiring land north of Fort Worth during the early 1980s along Interstate 35, part of what is now sometimes called the NAFTA Superhighway. A slowdown in the Texas economy in the late 1980s postponed development plans. Hearing about the FAA's plans for a new reliever airport for Dallas-Fort Worth International Airport (DFW), the Perots recruited Jim Wright of Fort Worth, then the Speaker of the U.S. House of Representatives to champion in Congress a far larger project than the Federal Aviation Administration had recommended.

Because the airport needed to be publicly-owned and to have a government sponsor, the Perots donated the land to the City of Fort Worth, the city annexed the property, which then became the ten percent city contribution to the airport required by the FAA. The city

also committed to bring water service to Alliance, which effectively opened up between 40,000 and 50,000 acres of land for development. The City of Fort Worth also funded construction for a crash, fire, and rescue facility. The initial city commitment has been estimated to be approximately \$60 million. Federal, state and local governments provided more than \$375 million in cash and tax incentives for the airport and real estate development.

AllianceTexas, a 17,000 acre (3885 ha) master-planned development, surrounds Fort Worth Alliance Airport, stretching across four cities (Fort Worth, Haslet, Roanoke and Westlake), two counties (Denton and Tarrant) and two school districts (Keller ISD and Northwest ISD). The airport is just a part of a large multi-modal logistics hub that includes an inland port, Interstate highway connections, and two Class I rail lines with a Burlington Northern Santa Fe inter-modal hub. Handling more than 400,000 containers each year, the Burlington Northern Santa Fe rail yard receives goods from the ports of Los Angeles and Houston.

AllianceTexas is in the Dallas-Fort Worth northward development path. As the suburban frontier approached, the development thrived. The development now encompasses 29 million ft² (2,700,000 m²) of building space, 200 corporate residents (including 14 international firms and more than 65 premier U.S. companies), 28,000 employees and more than 6700 single-family homes. AT&T, Nokia, BFGoodrich Aerospace, Bell Helicopters, Gulfstream, Zenith Electronics, Nestle Distribution, and Dell Inc. are among the firms located at AllianceTexas. Less than one-third of the available land has been developed. The complex is estimated to generate \$150 million in local property taxes annually.

As suggested earlier, in a classic two-sided market strategy, the platform – the airport itself – was proposed to accelerate take-up in the real estate development. Donating the land made the airport possible, a key consideration in attracting aviation. Ironically, although Alliance Airport now processes approximately one-third as much cargo as nearby Dallas-Fort Worth airport and several tenants are thought to be dependent upon the FedEx hub, it is unclear whether air connectivity has been an important factor in Alliance's growth. As in several other cases, the inter-modal rail facility is said to work as a traffic generator and provide a strong location incentive. These surface facilities allow for separate seeding strategies based on two-sided market theory which anchor freight forwarders and distribution facilities, possibly generating additional air cargo business in turn.

4.3. Panama City, Florida

A relocation of the Panama City-Bay County International Airport which was closed, the Northwest Florida Beaches International Airport is a new facility located north of Panama City Beach, Florida approximately equidistant between Pensacola and Tallahassee. The airport serves the growing resort areas on the Florida panhandle and is also flanked by two nearby Air Force bases. Opened on May 23, 2010 for commercial flights, Delta and Southwest serve the airport with 19 scheduled arrivals and departures daily.

The initial phase of the new airport includes a 10,000-foot (3000 m) primary runway with ramp access to a 1400-acre (560 ha) industrial complex as well as a planned 5000-foot (1500 m) crosswind runway. Land is reserved for a second-phase 8400-foot (2500 m) parallel runway and additional aviation-related commercial uses. The 112,000 ft² (10,400 m²) reconfigurable terminal opened with 7 gates and will likely become the first Leadership in Energy and Design (LEED)-certified passenger terminal in the United States. Plans are also in the works to make both the airport and the surrounding real estate development carbon neutral.

Like Alliance Texas, Northwest Florida Beaches International Airport is an anchor for real estate development, although with a somewhat different public sector motivation than in the former case.

The previously existing airport was hemmed in by urban development on one side and a bay on the other. Environmental concerns precluded expansion even as regional traffic increased. The runways were too short for large aircraft and did not meet Federal safety standards. Fortunately, the St. Joe Company, a former paper company, had a nearby 75,000 acre (30,350 ha) tract of timberland which, with increasing regional population growth, it hoped to develop for residential and commercial uses. At 10 miles from Panama City and the desirable beachfront, the property was far beyond the development frontier, however.

As in the Alliance case, St. Joe donated 4000 acres (1600 ha) at the center of this tract for the new airport. The company also agreed to encumber an additional 10,000 acres (4050 ha) for environmental mitigation associated with the new airport. This donation addressed the airport expansion problem and immediately increased the value of the tract, making development feasible. Initial airport development is on just 1300 acres (525 ha), leaving a significant amount of land for future infrastructure expansion and inside-the-fence commercial development. Strategically located commercial and residential developments will eventually cover about 30% of the remaining 71,000 acres (28,700 ha) on the tract beyond the airport property.

St. Joe is planning 4.4 million ft² (409,000 m²) of commercial space immediately surrounding the airport with airport-related businesses such as rental car outlets and hotels clustered to the south. The area east of the airport is designated for office buildings and, further east, an intermodal truck/rail facility will be linked to the airport area and the Port of Panama City. The area west of the airport is slated to be a regional employment center for time-sensitive goods-processing industries. As in other airport-related real estate developments, a higher education cluster is being pursued in order to further anchor commercial and residential real estate development. At full build-out, the St. Joe real estate development plan envisions 27,000 residential units and 37 million ft² (3.4 million m²) of industrial and commercial space. The West Bay initiative is the largest planned mixed-use development in the United States and it would be significantly less likely to succeed without the public infrastructure anchor.

Attracting and maintaining a threshold level of air service will continue to be a challenge and the airport authority is hoping that regional air traffic can be consolidated at the new airport. Incentives are being offered to airlines in order to support that effort, allowing the new airport to build on an existing passenger market. The prospect of real estate returns has prompted the St. Joe Company to guarantee Southwest Airlines a profit for serving the airport for the first three years of its operation. Passenger traffic has been substantially greater than at the old airport but perhaps less than anticipated (Nelson, 2010).

Northwest Florida Beaches International Airport's chicken-egg process has been primed by the airport's replacement of an existing airport. A strategy based on the two-sided market framework was fundamental to building the new airport. With the airport just opening, it is too early to assess residential and commercial absorption rates. Given the current collapse of the Florida real estate market, real estate revenues and the related tax flow will likely be more modest than hoped.

4.4. The Detroit Region Aerotropolis

The Detroit Region Aerotropolis differs from the preceding cases because, although the Detroit airport, as a Delta hub, is the sixth-busiest in the U.S. in terms of aircraft movements and serves 145 nonstop destinations in the U.S., Europe, Asia, and Latin America, the airport area has not attracted a significant amount of real estate development. Moreover, despite on-airport improvements including refurbished runways, renovated terminals, and an on-site hotel, the critical land development was to be off-site, on land transferred to

Wayne County in the process of airport upgrading. Therefore, the County is the central strategic actor. Despite the region's well-publicized employment decline, the Detroit area also boasts one of the largest and most skilled labor forces in the United States. The central problem for Detroit and surrounding Wayne County is that both population and employment have tended to move away from the city, the airport, and the central county.

The cornerstone of the Detroit Region Aerotropolis was to have been the Pinnacle Aeropark of Wayne County, originally proposed by Ed McNamara, former Wayne County Executive. When it was originally envisioned, Pinnacle Aeropark was to comprise 1200 acres (486 ha) with a planned direct link to the south side of the Detroit-Wayne Airport. A commercial cluster of 83 acres (34 ha) would form the heart of the complex with over 500 acres (200 ha) devoted to flex-tech facilities for the metalworking and plastics industries. Logistics operations were allocated another 109 acres (44 ha). Office development received 67 acres (27 ha). Another 430 acres (175 ha) were given over to rights-of-way and open space. The commercial cluster was to have included three business class hotels and a conference center along with a full range of business and personal services. An 18-hole championship golf course and biking and pedestrian trails would be located nearby. An integrated system of new or upgraded roads and communications infrastructure was planned.

A master plan was completed in 2000. Project management and operations were to be the responsibility of a public corporation. A local development financing authority and a foundation promoting development were formed with \$3 million in county funds. Nearly \$50 million was set aside for land acquisition and basic infrastructure provision. The park was expected to be the site of \$1.6 billion in investments and generate 25,000 permanent jobs by the end of the 10 to 15-year development process. The developer was to have petitioned the state of Michigan for as much as \$45 million in state grants and transportation funds to help offset road and infrastructure installation and improvements and to have invested an equivalent of \$1.5 million of its own funds annually. While the public costs were significant, the project was forecast to generate \$350 in tax revenue annually, promising an attractive regional return.

A consortium of two developers was chosen in mid-2000 to begin construction but they could not reach a working agreement with each other. Neither broke ground. In August 2006, seven years after competitive bids were received and after being without a developer for six years, a firm was finally selected for a much scaled-back 150 acre office and warehouse plan. The developer was to invest \$5–\$10 million of his own funds but again construction did not begin.

The project was given a restart in early 2006 with a student charrette sponsored by the University of Michigan School of Architecture and Design. The design charrette became a vehicle for promoting a significantly larger 25,000 acre area stretching from the airport area west into the neighboring county crossing several jurisdictions. This marked a major shift in strategy for the County. Although a race track was developed on the county's Pinnacle property as a demonstration project, the potential for integrating aviation and real estate pricing policy through a two-sided market strategy has shifted into the background as development focus shifted away from county-owned land to the wider region.

4.5. The North Carolina Global TransPark

The North Carolina Global TransPark (GTP) encompasses 5,000 acres (2025 ha) in rural eastern North Carolina, 70 miles (115 km) east of the Research Triangle Park and 40 miles (55 km) from the Atlantic coast. Like Alliance, it was planned as a multi-modal industrial airport designed to support manufacturing, distribution, agribusiness, and transportation-related companies fully integrating air, rail, road, and nearby sea transportation capabilities to serve the logistics requirements of industrial and distribution tenants and users.

The GTP is perhaps the polar opposite of the Amsterdam Airport Area in that while the latter region had all ingredients necessary for being a major airport region before the first flight took place early last century, the GTP had few. Consequently, it has been saddled with start-up problems it struggles to solve.

Two-sided market strategy is visible at two levels. Combining infrastructure and industrial land under common ownership gives management the power to implement a pricing strategy which could be adjusted as needed on either side to attract industrial tenants and air service providers. More broadly, as a state-sponsored economic development, capital investments could be recouped not only through service charges and land rents but through tax revenues generated by the employment created.

The Global TransPark Authority chose an underutilized airport (the Kinston Regional JetPort) in an economically lagging part of the state for development in May 1992 and completed a master plan in 1994. At full buildout, 15,300 acres (6200 ha) would be developed (roughly three times the present size) with two parallel runways of 11,500 ft (3500 m) and 13,000 ft (4000 m). For the initial phase, an existing 7600-foot (2300 m) runway was extended to 11,500 ft (3500 m). A second runway was to be added as demand dictated. Extensive provision was made for a road and rail network to serve the Global TransPark and provide distribution links to deep-water ports. Thousands of acres within the GTP are currently available for private, industrial, manufacturing and distribution facilities. The entire Global TransPark was designated as a Foreign Trade Zone to allow companies to defer, reduce or eliminate payment of some tariffs and duties.

By 2002 the needed approvals had been secured, investments had been made, and the runway extension was complete. By 2007, approximately US\$80 million had been allocated from federal and state governments with an expected total investment of US \$250 million required for full development. Despite attracting some tenants, development lagged.

In July 2010, Spirit AeroSystems, a Boeing spin-off headquartered in Wichita, Kansas, opened a 500,000 square foot (46,000 m²) manufacturing plant at GTP to manufacture fuselage components for Airbus. It is slated to employ more than 1000 people within the next several years while investing \$570 million in the project over the next six years. The facility, still gearing up for production, now employs over 150. External financial incentives were instrumental in attracting Spirit. Estimates of total public development costs for the Global TransPark range from \$300 to \$500 million.

Political realities and the perceived need to stimulate economic development in the state's most impoverished region, rather than commercial opportunity or a need for capacity, drove the GTP siting decision. As a consequence, The GTP continues to grapple with a serious chicken-egg problem. The GTP lacks the tenants necessary to attract sufficient air service providers. On the other hand, the GTP lacks air service, so that logistics firms and manufacturers have not found a strong attraction to the site. These realities have strained the two-sided market strategies which the direct involvement of the state government and the linked land development could potentially provide.

5. Conclusion

Airport business models, like business models in general, have been given increased attention over the last several years (e.g., Mercário, 2008). Airport charges, non-aeronautical revenues (Graham, 2009), airport area real estate development (Golaszewski, 2004) and monopoly and locational rents (Forsyth, 2004) have been analyzed with growing rigor. The literature on two-sided markets provides a powerful, but not all-encompassing, lens for understanding these business models by formally tying the different aspect of airport business together in a strategic business model that implies closer

linkages than portfolio revenue streams or passenger service offerings.

Two-sided thinking is critical to airport business strategy. Transportation customers and airlines often seek each other. As platforms for such two-sided markets, airports need to attract both airlines and passengers (or cargo customers) in order to be successful. Because access to the other “side” is important in two-sided markets, pricing policy can be an important component of business development strategy. Under those conditions, optimal prices may not reflect the marginal cost of providing service. The most critical implication of the theory of two-sided markets for airport management may be in addressing the chicken-egg problem in airport and regional trade development.

Airports have been important components of regional economic development strategies since the 1920s. Air service has long been seen as a driver of economic development just as economic development is a driver of air service. Airports, then as now, faced significant finance challenges and have often wrestled to meet costs. For decades, the economic development problem has been combined with the infrastructure finance problem in theory and strategic plan, whether in the form of cultivating non-aeronautical revenues or in the form of promoting real estate and regional economic development.

Strategically, airports themselves may be able to address on-airport chicken-egg problems through manipulating the structure of airport pricing. Our initial review suggests that such a strategy is theoretically sound but that, as in other applications of the framework, there are constraints limiting its application. In several cases where the pricing structure could be applied to address recognized imbalances in air traffic among regional airports, the requisite tools have either not been applied or have had modest leverage. In several other cases, the evidence reviewed suggests that the level of pricing has an impact on behavior but the evidence on the effect of the structure of pricing (a determinant feature of two-sidedness) is still unclear.

At a somewhat larger scale, transportation and land use decisions influence each other. The theory of two-sided markets provides insights into airport city business strategy. A few tentative conclusions can be drawn about the ability of air service and local economic development in the form of real estate development or employment growth to seed each other in a chicken-egg process.

First, it is easier to capture regional growth than it is to generate it. Being located in a region of exogenously growing real estate demand appears to help airport cities grow. The Global TransPark and Detroit have been faced with difficult development challenges. The airport cities in growing regions, Alliance and Panama City, were able to create a leapfrog effect, steering spatial development to preferred properties. In these two cases, the platform itself – the airport – was used to prime a real estate development pump. The Panama City and Alliance development strategies were derived from the same multi-product playbook that motivates real estate developers to donate land for schools, playgrounds, and museums. Schiphol's central regional location may have helped Amsterdam Airport City and the greater Amsterdam area capture a greater portion of the Randstad growth than otherwise might have been the case.

Second, air traffic itself does not appear to have a significant effect on seeding regional real estate or employment development. Other factors may also be required. Despite excellent connections within North America and to overseas destinations, the Detroit Aerotropolis has struggled to establish itself. Theory would predict that Detroit would be in the strongest strategic position of the five case studies. To date, the airport has yet to be able to leverage its traffic to create airport area land rents. Similarly, the Saint Louis, Pittsburgh, and Baltimore regions were not able to use their (former) airline hub status to protect their employment bases.

Third, transferring traffic from another platform, as was the case in Panama City, is tremendously helpful in negotiating the initial

threshold which has stalled places like the Global TransPark which have needed to begin from a dead start. Similarly, Alliance has used a rapidly expanding intermodal rail yard to attract cargo customers and anchor freight forwarders, even if there is no direct air to rail transfer.

Fourth, a stepped, zig-zag approach to business development, shifting recruiting emphasis from side to side, as in the Amsterdam case, may be more effective than an intense, “boil the ocean” development strategy. Unlike in the software industry where costs increase very little with scale, airport and airline costs increase roughly proportionally to traffic. Therefore, the rewards to capturing a larger market are lower for airports than for software applications and platform developers. Even in those cases, the platforms that attempted to grow large quickly often failed (Evans, 2003). The rewards to the bold approach may be modest and the costs high. Even in software development, the broad vision is often developed post hoc. Actual development is often in incremental steps of capabilities.

Fifth, not only do platforms compete with each other, different actors compete to be the platform. Airlines, travel agencies, and resorts, such as RyanAir, Neckarmann, and the several resort-owned airlines attest, have each attempted to become platforms for two-sided market strategies. In general, they offer air transportation on a narrow margin in order to increase their revenues on high-margin operations. Airports, airlines, regional governments, or other actors may be the optimal platforms for two-sided market pricing strategies. The applicability of such strategies is limited by the ability to capture the value created by the infrastructure and by the broader market maturity factors which cause all businesses to shift between cross-subsidized activities and individual profit centers.

Finally, the last two case studies suggest the limitations on two-sided market strategies for regional development. Despite the strengths of pricing policy, personal computers became popular products only once applications were developed which filled consumer needs. Similarly, singles bars did not become popular until a threshold level of unattached adults emerged. Pricing policy played a critical, but contributory, role in the emergence of both types of platforms. Stronger effects cannot be expected at airports.

The theory of two-sided markets offers considerable promise for informing airport region development strategy. Such lessons will be central in an era in which surplus military airfields continue to be offered for development in the U.S. and Europe and in which many new commercial airports are planned in Asia and Africa. To the extent the two-sided strategy holds, non-aeronautical revenue sources are more than a traveler service strategy or portfolio revenue diversification strategy. As part of an overall multi-product pricing strategy, non-aeronautical revenue becomes an essential part of the investor value proposition and a method to maximize airport and regional financial returns. Future work will further specify the theoretical parameters of airport pricing policy and will require improved airport financial and performance data to estimate those parameters. More broadly, as airports continue to remain central in the development policies of established, growing, and declining regions alike, improved understanding is needed of the impact of airport-linked strategies on economic growth.

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