Fare Game

Daniele Goffi

June 30, 2025

Abstract

How does a change in concentration in the transportation sector affect the spatial distribution and economic activity? And what distortions arise when models ignore firm conduct in this sector? The analysis is built on a static discrete choice model where consumers choose both their residence and travel destination, and consume both tradable and non-tradable goods. For each residence-destination route, consumers must purchase airline tickets from an oligopoly of carriers. The model is simulated on US data and suggests that a proportional decrease in entry costs across all active routes affects local specialization through the balance between inward and outward market access.

I am thankful to Stelios Michalopoulos and Matthew Turner for their invaluable guidance and support. I would also like to thank Oded Galor, David Weil, and Brown Growth Breakfast participants for their helpful feedback that greatly enhanced the paper. All errors are mine.

1. Introduction

Current infrastructures are often considered in the background of the economic landscape, since most of them were designed or built decades ago. Furthermore, planned improvements currently focus on areas with either underinvestment or congestion, consequences of a gap between the current economy and where initial projects thought it would be. This view might lead to believe that the expected distribution of economic activity dictates where infrastructure will go.

This has not been true historically. In fact, the mere presence of fixed costs has impeded these sectors from being perfectly competitive, and thus has allowed a small number of players to choose both where to invest and how much to charge consumers for transportation. While policy makers have not been oblivious to this situation, how the transportation sector affects economic activity is still an area of active research.

This work explores how concentration in the transportation sector can reshape regional economic production. To this end, I develop a static model where an oligopoly of transportation companies chooses available passenger seats for each route, while consumers decide where to reside and where to consume. These choices, in turn, determine the volumes and the types of production across locations.

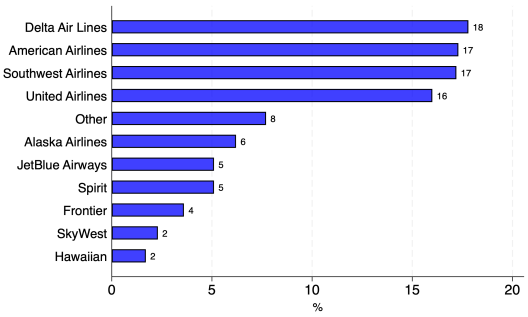
The main intuition put forward is that the degree of competition in the transportation sector changes the notion of distance between locations through transportation prices. This will affect the relative attractiveness of regions and thus differentially impact their economies. In fact, transportation companies will set route-specific capacities explicitly considering consumer preferences.

To evaluate this mechanism, I will examine the case of U.S. domestic air passenger travel. This is a suitable setting for several reasons. First, a limited number of airline companies operate several air travel routes. As shown in Figure 1A, the top four carriers collectively account for approximately 68% of the total market share. Moreover, focusing on within-US interstate flights —the setting of this study—Figure 1B makes it clear that the lion's share of routes are served by a handful of airlines, that handle about half of total passenger traffic. Together, these factors support the idea that air passenger travel has an oligopolistic market structure. Second, the attractiveness of a location is influenced by local amenities, that are not dependent on the distance between the attraction and consumers.

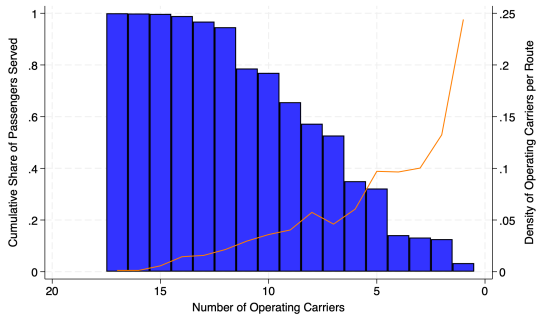
Third, sectors such as hospitality and retail, that benefit from the presence of visitors, require consumers to be physically present at the destination to make purchases. This distinction naturally paves the way to an analysis also focused on understanding how firms in tradable and non-tradable sectors will react to these transportation-driven changes in demand. Lastly, travel-adjacent sectors benefit less from technological advancements compared to other industries (Smeral 2003). Consequently, changes in visitors' demand are less likely to drive significant improvements in technology or productivity, making it appropriate to focus on prices and employment in the non-tradable sector as key outcomes.

FIGURE 1: US Domestic Airline Industry Concentration

A. Overall Market Share in 2024



B. Concentration and Passenger Volume



Notes: The data for Panel 1A comes from Bureau of Transportation Statistics (2024). Panel 1B displays both the cumulative number of passengers enplaned on routes by the number of active airlines and the distribution of routes based on the number of operating carriers. Round trips are treated as one-way directional flights to maintain directionality. The data are drawn from the DB1B survey conducted by the Department of Transportation for the year 2016.

I use the model with two respects. First, as a thought experiment, I illustrate what would be overlooked by ignoring the degree of competitiveness in the transportation sector. I do so by comparing a Cournot equilibrium on the observed set of active routes to a stylized benchmark in which fares are set equal to marginal costs (normalized to zero for simplicity in both scenarios). While not intended as a policy recommendation, this exercise highlights how different assumptions about conduct can lead to distinct spatial patterns of sectoral specialization, even with a fixed set of routes. Secondly, I simulate the effect of a 25% reduction in entry costs across all active routes. I find that the combination of changes in inward market access and outward market access correlates with specialization.

The paper is structured as follows. Section 2 presents the relevant literature. Section 3 presents the the main intuition. Section 4 discusses the model. Section 5 discusses data, model inversion, and calibration. Section 6 presents the results. Section 7 discusses next steps. Section 8 concludes.

2. Literature

This work relates to the large literature interested in the role of transportation on economic activity, that focused, among others, on the role of railroads (Fogel 1964; Donaldson and Hornbeck 2016; Donaldson 2018), highways (Baum-Snow 2007; Michaels 2008), and roads (Duranton and Turner 2012). Given the inherent difficulty in dissecting between economic expansion and re-allocation of economic activity highlighted by Redding and Turner (2015), I approach this question via a general equilibrium discrete-choice model. This allows me to distinguish between the two possibilities. More specifically, this work contributes to the understanding of the role of flights and airline infrastructure in affecting welfare and economic activity. By leveraging a discontinuity in long-haul air travel, previous studies have shown that air links positively influence business connectivity and economic growth (Campante and Yanagizawa-Drott 2018), as well as innovation (Bahar et al. 2023), confirming an earlier positive relationship found by Green (2007) between air traffic and regional growth.

Second, the focus on air passenger travel enables me to address a broader question concerning the effects of visitors' demand on local welfare. Indeed, the current literature on tourism focuses either on its effects on economic growth (Arezki, Cherif and Piotrowski 2009; Schubert, Brida and Risso 2011; Brida, Cortes-Jimenez and Pulina 2016; Faber and Gaubert 2019; Chen and Ioannides 2020; Bronzini, Ciani and Montaruli 2022) or on differential impacts within each locality (Allen et al. 2022; Almagro and Domínguez-Iino 2024). Here, I am bridging these two strands of literature by providing a parsimonious framework where transportation endogenously affects regional outcomes and consumers' choices for travel.

Third, this paper relates to the renewed interest in the role of imperfect competition in trade (Atkin and Donaldson 2015; Antràs 2024) and spatial economics (Brancaccio, Kalouptsidi and Papageorgiou 2020; Allen et al. 2020; Wong 2022). I contribute to this literature by studying whether the concentration of the airline

sector may shift the balance between tradable and non-tradable production in flight destinations.

Finally, the framework I provide will be useful to read the prevailing empirical evidence on employment effects of air traffic and airport sizes, that found no impact on manufacturing employment, a positive one mainly on the service sector (Brueckner 2003; Sheard 2014; Bilotkach 2015; Lakew and Bilotkach 2018; Sheard 2019) and a positive effect on overall employment (Blonigen and Cristea 2015; McGraw 2020). The mechanism I will consider draws inspiration from the tourism literature, particularly the potential for a Dutch disease effect, wherein a boom of visitors induces de-industrialization, a phenomenon first pointed out by Copeland (1991). In this context, Chao et al. (2006) offers a model of an open economy with both tradable and non-tradable sectors, shedding light on the trade-off between de-industrialization and improvements in terms of trade. To this literature, I contribute by explicitly nesting the consumer's residence and destination choice in a discrete choice framework based on Albert and Monras (2022), that allows me to properly take into account how the transportation sector influences both supply and demand dynamics.

3. Intuition

Consider a world whose geography consists of the segment $[-\bar{d}, \bar{d}]$. Each point $x \in [-\bar{d}, \bar{d}]$ is a different location and produces a non-tradable good NT_x. Homogeneous consumers live and work exclusively in 0, consume a tradable good T, and a non-tradable good NT_x coming from their preferred visit destination x. To reach their location of choice x, consumers need to pay transportation companies a fee that scales linearly with distance at a rate of τ, chosen by the firms. To keep the problem simple, let consumers' income be exogenously set to w_0 and the number of transportation firms on the route from 0 to x be K_x. Thus, the consumer problem is

$$\max_{x,T,NT_x} U(T, NT_x) \quad \text{such that} \quad T + p_x^{NT} NT_x = w_0 - \tau x$$

For a fixed x, solving for T and NT_x gives

$$U_T = p_x^{NT} U_{NT_x}$$

At the same time, consumer homogeneity and spatial equilibrium imply that in equilibrium consumers going to each location are equally satisfied, and thus unwilling to amend their holiday decision,

$$U(w_0 - \tau x - p_x^{NT} NT_x, NT_x) = \bar{u} \quad \forall x \tag{1}$$

Now, let transportation companies choose their number of seats for each route. Then, the problem of firm k choosing its capacity V_x^k to get to distance k can be phrased as follows

$$\max_{V_x^k} (\tau - c) x V_x^k$$

where c stands for the marginal cost of supplying transportation, the price that would prevail under perfect competition. The first-order condition of this problem reads

$$\frac{\partial \tau}{\partial V_x^k} V_x^k + (\tau - c) = 0$$

In other words, when transportation companies compare marginal revenues to marginal costs, they internalize that an additional unit of capacity supplied increases profits by the price of a ticket and at the same time decreases profits through the effect of that marginal unit on the demand for travel. Noting that in a Cournot game[1],

$$\frac{\partial \tau}{\partial V_x^k} = \frac{\partial \tau}{\partial V_x} \frac{\partial V_x}{\partial V_x^k} = \frac{\partial \tau}{\partial V_x} \cdot 1$$

and exploiting the symmetry across competitors, we can rewrite the first-order condition removing the dependence on k

$$\frac{\partial \tau}{\partial V_x} \frac{V_x}{K_x} + (\tau - c) = 0$$

Given that we expect the market price τ to be above the marginal cost of providing transportation, it must be that $\frac{\partial \tau}{\partial V_x} \leq 0$. Furthermore, It is possible to rearrange

[1]The fact that the other competitors would not react if company k were to expand its own output by one unit is a special characteristic of Cournot competition. Indeed, in the case of perfect collusion, where all the companies in the market agree on production volume, $\partial V_x / \partial V_x^k = K_x$, since whenever one company raises its capacity by one, the other companies will follow suit. A more detailed discussion on what is the conduct of other firms in other oligopolistic settings can be found in Seade (1980). Furthermore, a more thorough discussion on the use of Cournot competition in this setup is postponed to section 4.3.

terms so as to get

$$\tau = c - \frac{\partial \tau}{\partial V_x} \frac{V_x}{K_x} \tag{2}$$

that reassures us that in a perfectly competitive setup the price is equal to the marginal cost, whereas it will be higher with finite K_x. From this setup, we can proceed to the intuition. Differentiating both sides of Equation 1 by K_x and using the envelope theorem for the non-tradable good, allows us to see that the relative price of the non-traded good (in terms of the traded one) in location x is increasing in the competitiveness of the transportation sector, here proxyied by the number of companies[2].

$$\frac{\partial p_x^{NT}}{\partial K_x} = -\frac{x}{NT_x} \frac{\partial \tau}{\partial K_x} \tag{3}$$

The logic behind this result is that imperfectly competitive transportation distorts the definition of distance between an origin and a destination (Allen et al. 2020). A quick way to confirm this is by differentiating again both sides of Equation 1 by x and using the first order condition coming from the firms' problem

$$\frac{\partial p_x^{NT}}{\partial x} = -\frac{x}{NT_x} + \frac{\partial \tau}{\partial V_x} \frac{V_x}{K_x} \tag{4}$$

The negative sign of this gradient tells us that more remote locations have a lower price of non-tradable goods given the higher cost borne by the consumers visiting them. However, while the first term on the right-hand side concerns the true cost of getting to d, there is also a second term mapping directly to the competitive structure of the transportation sector. In fact, the change in the non-tradable price (compared to the tradable price) in terms of one's location accessibility will be the main object of interest in this work.

To prepare for the analysis, I will now present a more general version of this model. In particular, I will relax many simplifying assumptions currently at work. First, I will explicitly model the labor market distinguishing between tradable and non-tradable production in each location. Second, I will consider a setup

[2]This way of approaching the problem is defined as the Marshallian approach in the literature (Duranton and Puga 2015).

where each location can be both a place of residence and a destination. Indeed, one should imagine the imperfectly-competitive pressure shown above to hold with respect to all the other locations. Third, I will allow residents to consume the non-tradable good in their own location in addition to the non-tradable good in their destination. In fact, non-tradable sectors rely on local demand, that is heavily dependent on residents. Fourth, I will not set exogenously the number of airline companies, but I will allow for entry. Last, I will allow ticket prices not to be a linear function of distance. The next section will describe how each of these steps is implemented.

4. Model

To keep a tractable structure for the problem, I will follow the current literature in quantitative spatial and urban models (Allen and Arkolakis 2024; Redding 2024) and consider the world's geography to be a discrete set of locations D. I will now describe the three sides of the economy.

4.1. Producer Side

Production in each location $d \in D$ is perfectly competitive and relies solely on labor as its input. Furthermore, the production function is linear for the tradable good, whereas it exhibits decreasing marginal returns for the non-tradable good. The purpose of this distinction is to provide a stylized representation of the tradable sector as one where capital—though not explicitly modeled —ensures that labor is not a limiting factor in production. In contrast, the non-tradable sector is constrained by a fixed resource, such as land (also not explicitly modeled), that limits worker productivity. Thus, the profit maximization problem in the tradable sector T and the non-tradable sector NT can be described as follows

$$\begin{aligned} &p_d^{NT}(L_d^{NT})^{\alpha} - w_d L_d^{NT}, && \text{Non-Tradable} \\ &p_d^{T} A_d^{T} L_d^{T} - w_d L_d^{T}, && \text{Tradable} \end{aligned}$$

where the productivity of the non-tradable sector is set to 1 in every location. This allows us to interpret A_d^T as the location-specific productivity of the tradable sector relative to the non-tradable sector. The optimization problem for both sectors thus

gives us

$$p_d^T = \frac{w_d}{A_d^T}$$
$$p_d^{NT} = w_d (L_d^{NT})^{1-\alpha}$$

that allows us to relate the relative price of both goods to sectoral employment as follows

$$L_d^{NT} = \left(\frac{p_d^{NT}}{A_d^T p_d^T} \right)^{\frac{1}{1-\alpha}} \tag{5}$$

This expression shows that as the production of the non-traded good becomes more appealing, a larger share of individuals will be spurred to work in such a sector.

Finally, to encompass trade across locations, I will introduce an exogenous iceberg transportation cost for tradable goods defined as τ_{dr}, and thus imply by no-arbitrage that the price of a good shipped from d to r to be

$$p_{dr}^T = \tau_{dr} p_d^T$$

This perfectly competitive formulation of the producer side is chosen to isolate the pure costs of an imperfectly competitive airline sector, that features a much lower number of companies than the number of active inter-state motor carriers in the US[3].

4.2. Consumer Side

Let a set Ω[4] of consumers who choose their place of residence and work, r, as well as their trip destination, d. To reach their chosen destination d, consumers must incur travel costs, represented by a ticket price P_{rd}^V. Further, their income is allocated across tradable goods from all locations, non-tradable goods consumed

[3]Source: https://www.bts.gov/content/number-air-carriers-railroads-interstate-motor-carriers-marine-vessel-operators-and-pipeli-0

[4]For simplicity of notation, let this set have a measure of 1 in this section. This allows me to treat shares of consumers traveling between two locations as actual counts. This simplification is made for clarity in exposition and will be removed in subsequent sections.

at r and d, and the cost of travel from r to d. Finally, each consumer ω is subject to an array of residence-destination specific Fréchet-distributed taste shocks $\varepsilon_{rd}(\omega)$ with dispersion parameter θ. The entire problem for consumer ω can be summarized as follows

$$\max_{(r,d)\in D^2} \left[\max_{NT_r^r(\omega), NT_d^r(\omega), \{t_{d'r}(\omega)\}_{d'\in D}} T_r(\omega)^{\alpha_T} NT_{rd}^r(\omega)^{\alpha_{NT}} \right] \cdot \varepsilon_{rd}(\omega)$$

such that

$$T_r(\omega) = \left(\sum_{d'} t_{d'r}^{\frac{\sigma-1}{\sigma}}(\omega) \right)^{\frac{\sigma}{\sigma-1}}$$

$$NT_{rd}^r(\omega) = \left[A_r NT_r^r(\omega)^{\frac{\rho}{\rho-1}} + A_d NT_d^r(\omega)^{\frac{\rho}{\rho-1}} \right]^{\frac{\rho-1}{\rho}}$$

$$\sum_{d'} p_{d'r}^T t_{d'r}(\omega) + p_r^{NT} NT_r^r(\omega) + p_d^{NT} NT_d^r(\omega) = w_r - P_{rd}^V$$

where $t_{dr}(\omega)$ represents the amount of the traded good imported from d to r, $NT_d^r(\omega)$ the consumed amount of the non-traded good produced in d by a resident in r, A_d location-specific amenities, and ρ/σ the elasticity of substitution for non-traded/traded goods.

This setup, that borrows from Albert and Monras (2022), has some features worth noting. First, the homogeneity of income within a location implies that individuals effectively spend a share of their income on holiday travel[5]. This makes the framework analogous to the traditional iceberg cost formulation, where costs are proportional to the value of the good being transported. The key distinction here is that transportation prices operate purely as an income effect on consumers. The critical assumption in this setting is the uniqueness of consumers' destination[6]. Lastly, it must be stressed that it is possible for consumers not to travel by choosing a location as both their residence and destination. In this case the cost of travel will be zero.

[5] Indeed,

$$w_r - P_{rd}^V = w_r(1 - s_{rd}) \implies P_{rd}^V = w_r s_{rd}$$

This formulation will be used in practice for the analysis.

[6] To relax it, one could recast the problem as jointly selecting a residence and a "chain" of trips, following the work by Miyauchi, Nakajima and Redding (2021). While this extension would enrich the analysis, it would also raise its complexity without altering, a priori, the core insights presented in Section 3. For this reason, I will keep considering the case of a unique destination in what follows.

We will solve the consumer problem in steps. For a given (r, d) choice, consumers need to allocate their income net of travel costs across goods. This will result in

$$t^*_{d'r}(\omega) = \frac{(p^T_{d'r})^{-\sigma}}{\mathbb{P}^{1-\sigma}_{T,r}} \alpha_T \left(w_r - P^V_{rd}\right) = t^*_{d'r}$$

$$NT^{r*}_r(\omega) = \frac{(A_r)^{\rho}(p^{NT}_r)^{-\rho}}{\mathbb{P}^{1-\rho}_{NT,rd}} \alpha_{NT} \left(w_r - P^V_{rd}\right) = NT^{r*}_r$$

$$NT^{r*}_d(\omega) = \frac{(A_d)^{\rho}(p^{NT}_d)^{-\rho}}{\mathbb{P}^{1-\rho}_{NT,rd}} \alpha_{NT} \left(w_r - P^V_{rd}\right) = NT^{r*}_d$$

where $\mathbb{P}^{1-\sigma}_{T,r}$ and $\mathbb{P}^{1-\rho}_{NT,rd}$ are price indices respectively for tradable and non-tradable goods and are defined as follows

$$\mathbb{P}_{T,r} = \left[\sum_{d'} \left(p^T_{d'r}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$$

$$\mathbb{P}_{NT,rd} = \left[(A_r)^{\rho}\left(p^{NT}_r\right)^{1-\rho} + (A_d)^{\rho}\left(p^{NT}_d\right)^{1-\rho}\right]^{\frac{1}{1-\rho}}$$

The optimal quantities of each good, including tradables, depend on the chosen destination via the definition of disposable income. Substituting these demands in the original maximization problem and removing terms that do not depend directly on *rd*, one can rephrase the optimal location choice in terms of consumers' indirect utility

$$\max_{rd} \frac{w_r - P^V_{rd}}{\mathbb{P}^{\alpha_T}_{T,r}\mathbb{P}^{\alpha_{NT}}_{NT,rd}} \cdot \varepsilon_{rd}(\omega)$$

This second step gives some further insight into the classes of shocks considered in this analysis. Indeed, while their interpretation in terms of residence-destination tastes is certainly valid, any shock affecting disposable income multiplicatively will be observationally equivalent for this application.

Using properties of Fréchet shocks, the individuals that reside in r and visit d,

denoted as V_{rd}, are

$$V_{rd}^{D} = \frac{U_{rd}^{\theta}}{\sum_{rd} U_{rd}^{\theta}}, \text{ where } U_{rd} = \frac{w_r - P_{rd}^{V}}{\mathbb{P}_{T,r}^{\alpha_T} \mathbb{P}_{NT,rd}^{\alpha_{NT}}} \tag{6}$$

Intuitively, the share of consumers willing to reside in r and visiting d is increasing in the income prevailing in the origin w_r and decreasing in the cost of reaching d from r. Furthermore, it decreases in the cost of non-tradable goods in both the residence and destination and rises in the centrality of the residence, as proxyied by the price index for tradable goods.

4.3. Airline Transportation Sector

To travel from a residence to a destination, consumers must pay airline companies for transportation. Specifically, consider a set K of airlines, where each airline $k \in K$ decides for every rd route whether to enter the market by paying its fixed cost F_{rd}, and if so its plane capacity V_{rd}^{k} by solving the following maximization problem:

$$\max_{V_{rd}^{k} \; \forall rd} (P_{rd}^{V} - c_{rd}) V_{rd}^{k} - F_{rd}$$

where P_{rd}^{V} is a function of the total quantity of seats for a given route $V_{rd} = \sum_k V_{rd}^{k}$, and c_{rd} is the route-specific marginal cost of adding an additional seat to one's capacity.

This choice of market conduct builds on work from both the trade (Atkeson and Burstein 2008) and the airline transportation literature (Alves and Forte 2015), and is equivalent to a two-stage game where airlines choose their capacity before competing on prices (Kreps and Scheinkman 1983).

While this way of modeling delivers a tractable structure for the airline industry, it is crucial to stress that having companies maximize independently on each route comes with costs. First, this formalization ignores cross-route cannibalization effects. While it could be possible to incorporate them by modeling the hubbing choice of transportation providers as in Allen et al. (2020), differently from their application only some airlines use a hub-spoke system.[7] In practice, this means that I am abstracting from having in the airlines' profit function either economies

[7] Flores-Fillol (2009) helps establish conditions to allow for such equilibria, but at this stage adding this layer would undermine the tractability of this application.

of density (Brueckner and Spiller 1991, 1994; Mayer and Sinai 2003; Fageda and Flores-Fillol 2015), or cross-routes market power spillover in pricing decisions (Orzach and Dix 2021), beyond what general equilibrium will entail.

Following Section 3, one can solve this problem by backward induction. Indeed, considering an airline k out of the K_{rd} airlines that entered the market for the rd route, one can obtain the first-order condition

$$\left(P_{rd}^{V} + \frac{\partial P_{rd}^{V}}{\partial V_{rd}} \frac{V_{rd}}{K_{rd}}\right) = c_{rd}$$

Then, using the demand for travel in Equation 6 it is possible to derive the total supply of seats for a given route

$$V_{rd}^{S} = 1 - \frac{w_r - P_{rd}^{V}}{K_{rd}\theta(P_{rd}^{V} - c_{rd})} \tag{7}$$

Intuitively, the supply of seats is increasing in the profits accruing from each trip and in the number of transportation providers. Finally, imposing free-entry, we get the number of providers in a given route

$$K_{rd} = \frac{(P_{rd}^{V} - c_{rd})V_{rd}}{F_{rd}} \tag{8}$$

4.4. Equilibrium

Given the description of the previous market actors, it is possible to describe the competitive equilibrium of this economy as follows.

DEFINITION 1. *An equilibrium is a set of prices* $(\mathbf{w}, \mathbf{p^T}, \mathbf{p^{NT}}, \mathbf{P^V})$ *and allocations for consumers* $(\mathbf{t}, \mathbf{NT}, \mathbf{V^D})$*, producers* $(\mathbf{L^T}, \mathbf{L^{NT}})$ *and airlines* $(\mathbf{V^S}, \mathbf{K})$ *such that*

a. *given* $(\mathbf{w}, \mathbf{p^T}, \mathbf{p^{NT}}, \mathbf{P^V})$*,* $(\mathbf{t}, \mathbf{NT}, \mathbf{V^D})$ *solve consumer* ω*'s maximization problem* $\forall\, \omega$
b. *given* $(\mathbf{w}, \mathbf{p^T}, \mathbf{p^{NT}}, \mathbf{P^V})$*,* $(\mathbf{L^T}, \mathbf{L^{NT}})$ *solve the producer's problem in location* d $\forall\, d$
c. *given* $(\mathbf{w}, \mathbf{p^T}, \mathbf{p^{NT}}, \mathbf{P^V})$*,* $(\mathbf{V^S}, \mathbf{K})$ *solve airlines' problem*
d. *markets clear*
   - *Tourism Flows*

$$V_{rd} = V_{rd}^{S} = V_{rd}^{D} \;\forall\; rd$$

- *Labor Market*

$$V_{r\cdot} = \sum_d V_{rd} = L_r^T + L_r^{NT} \ \forall \ r$$

- *Tradable Good*

$$\sum_d Y_d^T = \sum_r T_r V_r = \sum_r \sum_d T_{rd} V_{rd}$$

- *Non-Tradable Good*

$$Y_r^{NT} = \underbrace{\sum_r NT_{rd}^r V_{rd}}_{r \text{ residents visiting } d} + \underbrace{\sum_d NT_{dr}^d V_{dr}}_{d \text{ residents visiting } r} \quad \forall \ r$$

for given location amenities $\mathbf{A}$*, relative tradable productivities* $\mathbf{A^T}$*, and transportation costs* $(\tau, \mathbf{c}, \mathbf{F})$.

Furthermore, in the current setting, the following is true

PROPOSITION 1. *There exists an equilibrium for this economy for given location amenities* $\mathbf{A}$*, relative tradable productivities* $\mathbf{A^T}$*, and transportation costs* $(\tau, \mathbf{c})$

The proof of Proposition 1 is an application of Brower's fixed point theorem and is provided in Appendix A.

5. Model Inversion

5.1. Amenities and Productivities

In this subsection I will invert the model to back out amenities and productivities. To do so, I will proceed in steps. First, I will present the data I will use. Then, I will estimate trade costs. Lastly, I will present my choice of parameters for this application.

5.1.1. Definitions and Data

In this analysis, US states will be the core units of analysis. While Brueckner, Lee and Singer (2013) and Sheard (2020) argue in favor of Metropolitan Areas and Combined/Core-Based Statistical Areas, I posit that restricting one's attention to interstate flights reduces the relevance of alternative transportation modes. This

choice may mitigate concerns about missing travelers who use other means of travel.

I will use the 2017's 5% American Community Survey (Ruggles et al. 2024) to obtain average wages for employed workers and the number of employed workers by NAICS sector. Specifically, I will aggregate 2-digit NAICS sectors into tradable and non-tradable categories following the model presented. The tradable sector will include "Manufacturing" and "Wholesale Trade", while the non-tradable sector will consist of "Construction", "Retail Trade", "Arts, Entertainment, and Recreation", "Accommodation and Food Services", and "Other Services (except Government and Government Enterprises)"[8].

The rationale for this definition of non-tradability comes from the structure of the model. Indeed, one needs to have 1) a sector that may benefit from cheaper flight connections, in this case via airline competition, 2) and whose product is non-tradable in nature.[9]. For the first point, my choice of sectors aligns with the sectors benefiting from increased air passenger travel, i.e. hospitality services and retail, as outlined by Appold (2015). Further, it is also consistent with the idea that some sectors primarily serve local markets and are thus are more spread out across space, whereas sectors whose goods are more intensely traded tend to concentrate (Porter 2003; Mian and Sufi 2014; Delgado, Porter and Stern 2016; Gervais and Jensen 2019)[10]. Lastly, my definition of non-tradability broadly aligns with that of Muñoz (2024), who examines the EU posting policy—a framework that allows firms to send employees abroad to export consumer-facing services. The main difference from my application is that in Muñoz (2024) non-tradability tends to shift toward services that primarily support the supply side of the economy.

Based on these definitions for the tradable and the non-tradable sectors, I first use the 2017's Commodity Flow Survey to construct state-level freight shipment values. Then, I aggregate County Business Pattern data to derive state-level estimates of Gross Domestic Product for the non-tradable sector.

[8]The following sectors will be excluded from this classification and from the count of employed workers in each state: "Finance, Insurance, Real Estate, Rental, and Leasing", "Professional and Business Services", "Educational Services, Health Care, and Social Assistance", "Government and Government Enterprises", and "Natural Resources and Mining, Transportation, and Utilities".

[9]The description of this second aspect is deeply indebted to the following posts By Jonathan Dingel: https://cepr.org/voxeu/blogs-and-reviews/what-economic-activities-are-tradable and https://tradediversion.net/2023/08/28/classifying-industries-as-traded-or-non-traded/

[10]However, it must be kept in mind that geographic concentration may reflect not only sectoral differences in tradability, but also variations in agglomeration forces.

Lastly, for air passenger travel, I use the quarterly ticket-level domestic DB1A/DB1B surveys from the US Department of Transportation for 2016. This data represents a 10% sample of airline tickets from reporting carriers for US domestic flights. From this data, I derive the average itinerary fares[11] and flow of passengers for each reported route. For this calculation, I treat passengers with layovers as if they were traveling nonstop and I consider round trips as unique directional flights from an origin to a destination to be consistent with the model setting. Lastly, I exclude Alaska and Hawaii from the sample due to their geographic remoteness, and Delaware and the District of Columbia because of the lack of observed flights originating from these locations in the DB1A/DB1B data.

Since the model focuses on traveling to enjoy amenities and consume non-tradable goods, one might object that a portion of US domestic travel serves business rather than leisure purposes, and that could potentially affect the interpretation of my results. While detailed statistics for US inter-state air travel are not readily available, broader estimates suggest that leisure travel dominates business travel. In particular, US Travel Association (2024) reports that in 2022, 84% of 2.25 billion trips in the US across all modes of transportation were for leisure. Furthermore, 71 % of fliers in the U.S. report traveling for personal reasons (A4A 2018). Lastly, the focus on non-tradable sector activity remains relevant even if some travel is business-related, given that such trips also generate demand for non-tradables like lodging and food services.

5.1.2. Estimation of Trade Costs

To back up trade costs, I follow the approach pioneered by Head and Ries (2001). Let X^T_{rd} be the value of tradable exports from r to d. Then, assuming symmetry in trade costs, the model presented implies

$$\left(\frac{X^T_{rd}X^T_{dr}}{X^T_{rr}X^T_{dd}}\right)^{\frac{1}{2(1-\sigma)}} = \tau_{rd}$$

Furthermore, parametrizing costs as a power function of the geodesic distance in miles between state centroids (Eckert et al. 2019), it is possible to write the

[11] I exclude itinerary fares priced at less than $20 following https://www.nber.org/research/data/department-transportation-db1adb1b.

following relationship, that involves only observable variables

$$\log\left[\left(\frac{X_{rd}^{T}X_{dr}^{T}}{X_{rr}^{T}X_{dd}^{T}}\right)^{\frac{1}{2(1-\sigma)}}\right] = \delta \log(distance_{rd})$$

Hence, I am able to recover trade cost estimates from the fitted values of its empirical analog that also controls for origin and destination fixed effects.

5.1.3. Calibration

The set of parameters I will use in my analysis is described in Table 1. First, in order to have a measure of income that matches the notion of disposable income w_r in the model, I start from the average wage per employed individual from Ruggles et al. (2024) and I net out both the tax share t and the housing expenditure share h. The former refers to US government revenues as a share of GDP in 2023 (International Monetary Fund 2025), while the latter is derived by Davis and Ortalo-Magné (2011)'s estimates based on Decennial Census of Housing (DCH) surveys. The non-tradable share α_{NT} is calculated from the Consumer Expenditure Survey as the ratio of food, entertainment, and trip expenditure to household expenditure net of rent payments. This is also consistent with the share of income net of housing, using the h defined above, calculated in the same survey. The labor share in the non-tradable sector α is close to the 0.65 chosen by Albert and Monras (2022), with the notion that their model does not feature labor as the only input.

TABLE 1: Calibration

Explanation	Parameter	Value	Source
Tax Rate	t	0.292	International Monetary Fund (2025)
Housing Share	h	0.25	Davis and Ortalo-Magné (2011)
Non-Tradable Share	α_{NT}	0.3	Consumer Expenditure Survey
Production Function Parameter	α	0.7	Albert and Monras (2022)
Non-Tradable Elasticity of Substitution	ρ	5	Gervais and Jensen (2019)
Tradable Elasticity of Substitution	σ	6	Gervais and Jensen (2019)
Consumer Preference	θ	4	Upper bound of Bryan and Morten (2019)

The elasticities of substitution for the traded and non-traded sectors are taken from Gervais and Jensen (2019), who provide disaggregated estimates for NAICS sectors in the US. In particular, σ will be obtained as the median between the elasticities for wholesale trade and manufacturing. The non-tradable elasticity of

substitution ρ will be taken as the median between the elasticities for the available non-tradable sectors, i.e. retail trade, recreation and food services , and other personal services.

The choice of the dispersion parameter θ, is inherently hard. In this model, θ governs the joint distribution of residence and visits, meaning that locations that are more attractive get both more residents and visitors. The closest parameter in the literature can be found in Bryan and Morten (2019), who consider migration decisions only and estimate a dispersion parameter of 2.7 with US data. I will conservatively set the parameter to 4.

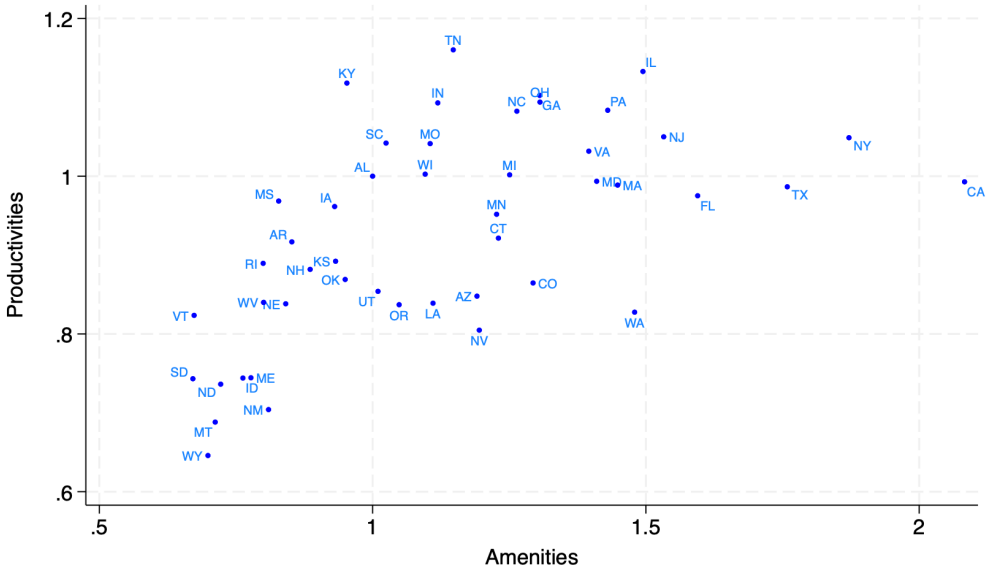
5.1.4. Results

Given the trade costs and the parameter choices discussed above, I infer productivity, and amenities, from the observed data on wages, employment shares, shipments, fare prices, and visitors. To perform this inversion, I use fixed-point iteration methods for amenities and productivities. Details are available in Appendix B.

Figure 2 plots the model-implied amenities and productivities both normalized with respect to the state of Alabama. At first glance, productivities appear reasonable, as Rust Belt states are clustered in the north/northwest quadrants of the graph. Moreover, these estimates align well with the insights of Holmes (1999) on historical industry shares. Holmes highlighted that industries with greater geographic concentration tend to rely more on specialized suppliers, that, in turn, are more likely to emerge within the same region, reinforcing agglomeration economies. This pattern helps explain the prominence of Ohio, and Indiana with their deep-rooted auto supply chains, as well as the presence of advanced manufacturing hubs in states like North Carolina, South Carolina, and Tennessee in the northern quadrants of Figure 2.

For what concerns amenities, the model assigned high amenities to the most populated states, coherently with the idea that individuals prefer to live in areas that are deemed more enjoyable.

FIGURE 2: Productivities and Amenities

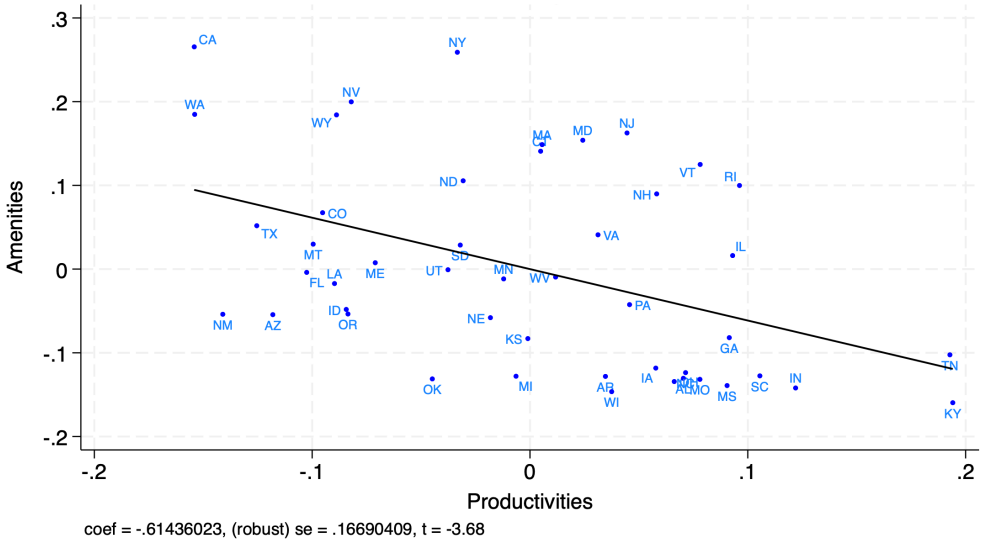


Notes: Dots represent US states in the productivity-amenity space. Since both productivities and amenities are identified up to scale, both of them are normalized with respect to the state of Alabama.

However, Figure 3 reassures us that conditional on the actual number of workers in both sectors, the obtained measure of amenities has two desirable features. Firstly, Panel 3A shows now a negative relationship between amenities and productivities, where top amenity states align reasonable well with the expected natural/cultural attractiveness for visitors of states such as California, New York, and Nevada. Furthermore, Figure 3B shows that amenities positively correlate with number of hotel employees, further validating the intuition of amenities being related to visitors and the size of the non-tradable sector.

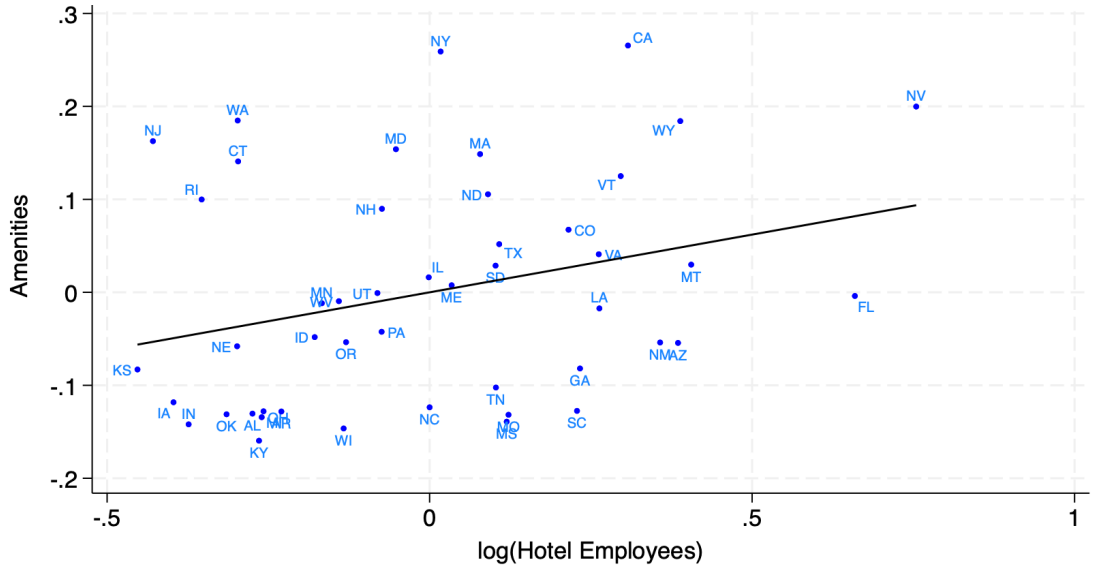
FIGURE 3: Validation of Amenities

A. Amenities and Productivities - Conditional



coef = -.61436023, (robust) se = .16690409, t = -3.68

B. Amenities and Hotel Employees - Conditional



coef = .12417226, (robust) se = .06070821, t = 2.05

Notes: Dots represent US states. Both Panels control for the logarithm of the sum workers in both the tradable and non-tradable sectors (Ruggles et al. 2024). Data on hotel employees are from Melendez et al. (2024).

5.2. Airline Cost Structure

Before moving to the model inversion for airlines' cost structure, I will rewrite their profit function as follows

$$(P^V_{rd} - c_{rd})V_{rd} - F_{rd} \implies P^V_{rd}\left(1 - \frac{c_{rd}}{P^V_{rd}}\right)V_{rd} - F_{rd} \implies P^V_{rd}(1 - \gamma_{rd})V_{rd} - F_{rd}$$

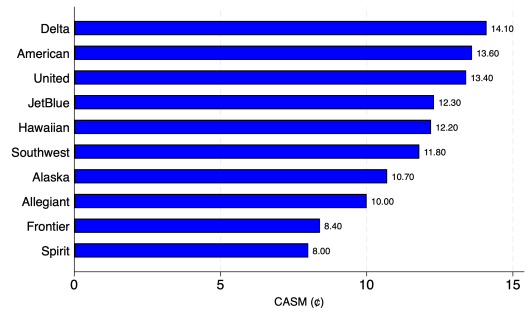
Then, I will calibrate the value of γ_{rd} as

$$\hat{\gamma}_{rd} = \frac{\$0.1145 \times \text{Distance in miles}_{rd}}{\text{Average Ticket Price}_{rd}}$$

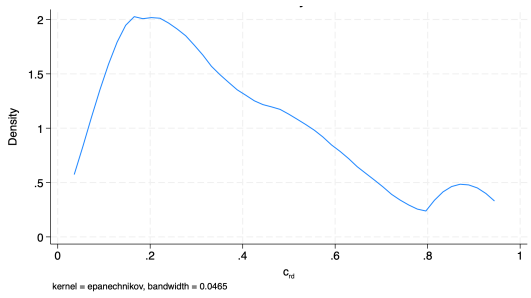
where \$0.1145 is the average of the Domestic Cost per Available Seat Mile (CASM) estimates provided by Oliver Wyman (2019) and depicted in Figure 4A. CASM consists of a standard measure of operating costs—including fuel, maintenance, labor, and airport fees—calculated per seat per mile flown. To avoid extreme values for these estimates, I winsorize $\hat{\gamma}_{rd}$ at the 5% and 95% percentile. The resulting density is shown in Figure 4B. I calibrate and hold the cost share fixed across simulations, effectively fixing the markup. This simplifies the analysis by abstracting from route inter-dependencies and strategic pricing adjustments, which are not modeled in this framework.

FIGURE 4: Operating Costs

A. Domestic CASM for Major US Carriers



B. Distribution of winsorized $\hat{\gamma}_{rd}$



Notes: The blue bars in Figure 4A represent CASM estimates from Oliver Wyman (2019) in cents. Figure 4B plots the density of the model-implied cost shares after winsorization.

Finally, fixed costs of entry are backed up from the free-entry condition

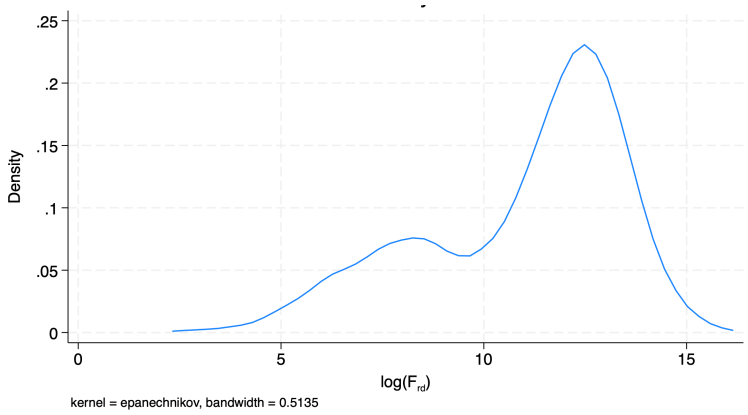
$$\hat{F}_{rd} = P^V_{rd}(1 - \hat{\gamma}_{rd})\frac{V_{rd}}{K_{rd}}$$

In what follows, I will not impute entry costs for unobserved routes and thus focus only on active ones. Thus, I can back out the fixed cost of entry for 1560 out of 2162 possible inter-state routes

Figure 5A plots the density of the implied F_{rd} in logs due to their high skewness. Table 5B shows routes at the extrema of the distribution. Routes with the highest costs involve states with high amenity values and major hubs such as California, New York, Texas, and Nevada.

FIGURE 5: Entry Costs

A. Density



B. Top and Bottom Routes

Highest	Lowest
NY - CA	UT - RI
NJ - CA	CA - ME
CA - NY	SC - NM
CA - NJ	FL - MT
NY - FL	WI - ID
CA - NV	ID - NJ
TX - CA	CT - OK

Notes: Figure 5A plots the density of the model-implied entry costs. Figure 5B lists the routes with the highest and lowest implied fixed costs of entry.

Conversely, routes with the lowest costs involve less populated states, that might reasonably map to both lower fees and the use of smaller aircrafts. This intuition matches findings by Fageda and Flores-Fillol (2012), who report that both US low-cost and network airlines prefer high-density routes, whereas regional carriers mainly serve thin routes.

6. Results

What are the costs of ignoring the competitiveness of the transportation sector? And what would happen to the distribution of economic activity if the transportation sector were to become more competitive? To shed light on these issues, I will run here two experiments, fixing in both cases the actual U.S. network for flight itineraries.

In the first experiment, I hold the number of carriers on each route at its observed level and switch firm conduct from Cournot oligopoly to the Bertrand benchmark. Since firm conduct is truthfully endogenous and based on market conditions, this exercise should not be interpreted as a counterfactual. Rather, it serves as a theoretical comparison to illustrate the possible implied distortions when firm selection across routes is not considered. To make these distortions more transparent, I eliminate entry barriers by setting $F_{rd} = 0 \ \forall \ rd$, thus allowing for free mobility in the Bertrand case.

On the other hand in my second experiment, I will follow the Cournot structure developed in Section 4 throughout the observed U.S. network, but I will allow for a 25% decrease in entry costs in all the active routes in the data. Given the existing cost structure, this will allow me to isolate how easier entry conditions for carriers will affect the equilibrium sectoral allocations.

To generalize the notion of distance presented in the simple model in Section 3, I will define two quantities: outward and inward market access, respectively Φ_r^O and Φ_r^I

$$\Phi_r^O = \left[\sum_d \left(\frac{w_r - P_{rd}^V}{\mathbb{P}_{NT,rd}^{\alpha_{NT}} \mathbb{P}_{T,r}^{\alpha_T}} \right)^\theta \right]^{\frac{1}{\theta}} \quad , \quad \Phi_d^I = \left[\sum_r \left(\frac{w_r - P_{rd}^V}{\mathbb{P}_{NT,rd}^{\alpha_{NT}} \mathbb{P}_{T,r}^{\alpha_T}} \right)^\theta \right]^{\frac{1}{\theta}}$$

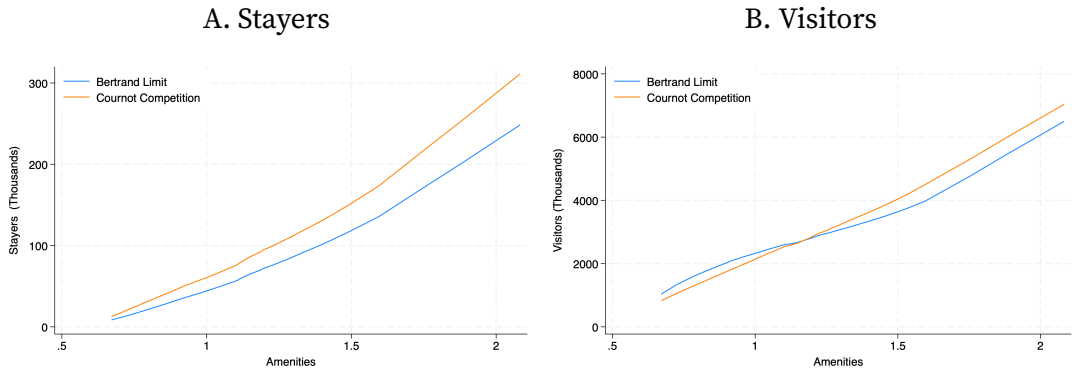
States with higher outward market access are those for whose residents it is easier to visit other regions. Conversely, states with higher inward market access are those that can be reached more easily by consumers.

6.1. Comparison across conducts

Figure 6 presents the results of the first experiment. As expected, pricing to marginal costs predicts a lower number of non-traveling individuals through-

out the range of amenity values (Panel 6A). However, the distribution of visitors changes across space. Indeed, more/fewer consumers will travel to lower/higher amenity destinations (Panel 6B). Indeed, we reasonably expect more competitors to be in routes toward high amenity destinations, leading to relatively easier accessibility towards them. This feature is preserved in the Cournot case.

FIGURE 6: Visitor Flows



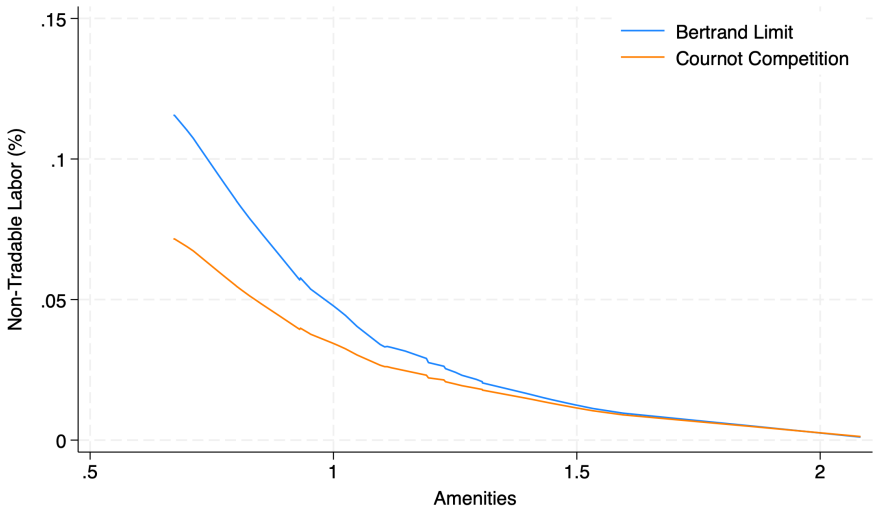
Notes: Panels 6A and 6B plot LOWESS curves of stayers and visitors against amenity values. Light blue lines show the marginal-cost pricing scenario, while orange lines show the Cournot scenario.

Figure 7A shows how the shifts in these flows translate to different local specialization patterns. Indeed, low amenity destination, which enjoy more visitors and less stayers in the Bertrand case, are also characterized by a higher observed labor share in the non-tradable sector.

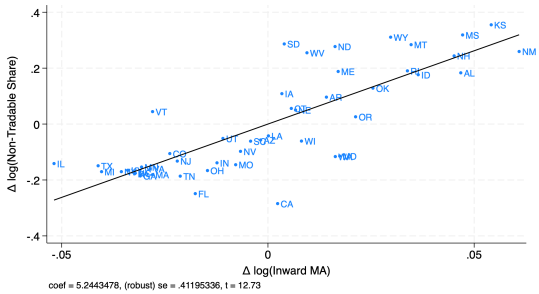
This intuition can be also expressed in terms of how differently the two conduct types distribute market access measures across space. Specifically, Panels 7B and 7C highlight that the Bertrand case allocates a larger fraction of workers to non-tradables especially where both inward and outward access expand the most. Moreover, the inward market access appears to be a much stronger predictor of this difference, indicating that differences in visitor demand, driven by the observed sorting of transportation companies in the Cournot setting, drive the wedge between these two scenarios.

FIGURE 7: Allocation of Non-Tradable Workers

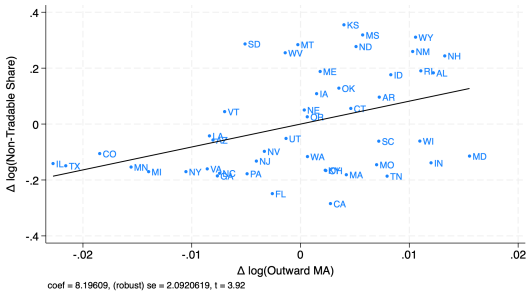
A. Amenities



B. Inward MA - Adj R^2=0.68



C. Outward MA - Adj R^2=0.18

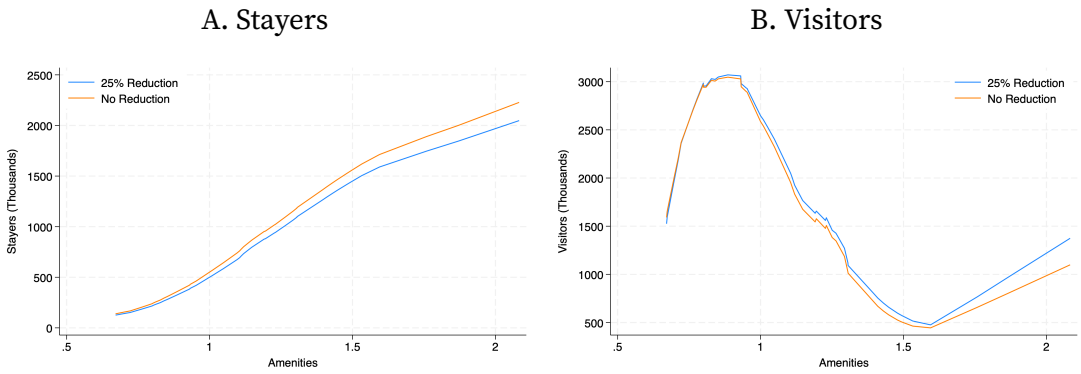


Notes: Panel 7A plots the LOWESS curve of the share of non-tradable labor against amenity. The light blue line shows the marginal-cost pricing scenario, while the orange line shows the Cournot scenario. Panels 7B and 7C display linear fits of the log difference in the non-tradable share against the log difference in market access measures between the Bertrand and Cournot settings.

6.2. Counterfactual fall in entry costs

Moving to a more policy-oriented setting, let us now suppose that entry costs are cut by 25%. In such a case, Figure 8A shows that the count of non-travelers falls more steeply as amenity rises. This occurs because in high-amenity states, lower entry costs broaden the choice set of residents, who preferred the local non-tradable goods without the cost reduction.

FIGURE 8: Visitor Flows

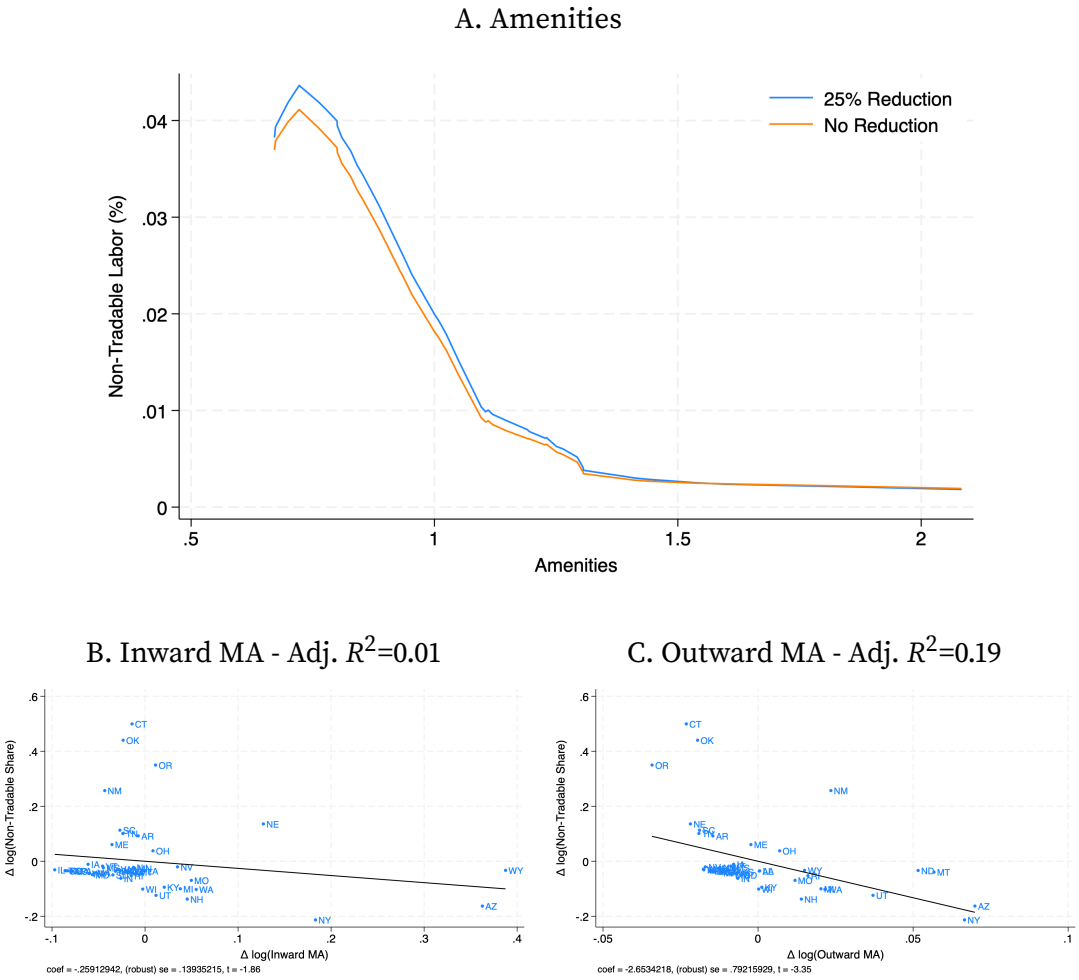


Notes: Panels 8A and 8B plot LOWESS curves of stayers and visitors against amenity. Orange lines show the baseline scenario, while light blue lines show the scenario featuring a 25% reduction in all entry costs.

Similarly, Figure 8B illustrates that visitor flows are slightly lower for low amenity states and rise at an increasing rate in the amenity level. These two facts, lead to a nuanced shift in specialization, depicted in Figure 9A. Indeed, lower amenity states show a higher share of non-tradable workers in this counterfactual scenario. Figures 9B and 9C help us reconcile this pattern by showing that low amenity states mostly enjoy a lower increase in inward market access than their high amenity counterparts. However, they also experience a lower increase (if not a decrease) in outward market access. While these two channels seem to balance out on the upper tail of the amenity distribution, the fall in outward market access seems to prevail on the lower tail, and to increase the demand for the non-tradable good.

While these results are still consistent with the price gradient interpretation of Section 3, where there was only one residence and several destinations and distance was symmetric, two caveat should be noted. Firstly, by fixing the network, and thus impeding new routes from opening, the inward market access channel is likely to be mitigated. Indeed, these results might still be in line with a narrative where the visitor demand channel occurs through the addition of new routes, rather than through the expansion of capacity on the existing ones. This could also put into perspective the size of the effect coming from outward market access. Furthermore, the inclusion of economies of density is likely to further enhance such a channel. Indeed, expanding capacity on a segment should in principle benefit all itineraries that may make use of it.

FIGURE 9: Allocation of Non-Tradable Workers



Notes: Panel 9A plots the LOWESS curve of the share of non-tradable labor against amenity values. The orange lines shows the baseline scenario, while the light blue line shows the scenario featuring a 25% reduction in all entry costs. Panels 9B and 9C display linear fits of the log difference in the non-tradable share against the log difference in market access between the counterfactual and the baseline scenario.

Nonetheless, these findings suggest that the visitor-demand-driven effect favoring non-tradables may not be strong enough to drive changes in employment shares only through changes in capacity. Specifically, if more consumers travel to high-amenity locations, residents in those areas are also more likely to travel elsewhere, mitigating the impact on local non-tradables. This finding underscores the importance of accounting for general equilibrium effects when evaluating the consequences of reduced airline concentration—similar to how such effects are

considered in infrastructure improvements. Therefore, studies such as Brueckner (2003), Sheard (2014), and Lakew and Bilotkach (2018) should be interpreted as either relying on the addition of new connections or richer mechanisms involving the structure of the airline network.

7. Next Steps

How competitiveness in transportation actively shapes the distribution of economic activity is an area of active research. The previous section highlighted the potential distortions that arise when this aspect is omitted and provided an initial glimpse at how increased competition may influence patterns of specialization. To further evaluate the role of visitor demand, a natural next step is to restrict consumer choice to destination only. This will help assess the extent to which free mobility may be acting as an attenuating force.

Then, incorporating network structure and allowing for the endogenous formation of new routes would bring the model closer to real-world airline dynamics. In the current framework, itineraries are treated as disjoint. Yet, increased capacity on one segment will likely impact several itineraries. Further, the use of a finer geographic resolution could support more targeted interventions at key hubs, rather than uniform policy changes. Following the insights of Chiovelli, Michalopoulos and Papaioannou (Forthcoming), uniform interventions across routes may incur costs that outweigh their welfare benefits. Instead, more localized policies focused on central hubs may achieve comparable welfare gains at lower cost. This approach could also be contrasted with route-level subsidies, such as those in the Essential Air Service (EAS) program, which remains an area of ongoing policy discussion (Drukker et al. 2023).

Finally, a crucial step for future work is to estimate (a subset of) the currently calibrated parameters, in order to better capture and quantify these mechanisms. One promising direction is offered by Breinlich et al. (2020), who develop a strategy to identify gravity-model parameters by leveraging information on firms' market shares as well as supply and demand elasticities.

8. Conclusion

This work explores how changes in concentration in the transportation sector affect the distribution of economic activity, and the costs of ignoring competition in this setting. I tackle this question in a static discrete choice model where an oligopoly of transportation companies choose their capacity, while consumers decide where to live, what region to visit, and how to allocate their budget across tradable goods, non-tradable goods, and travel costs.

Focusing on US inter-state flights I show that for a fixed network, a decrease in concentration in the transportation sector affects the equilibrium distribution of the non-tradable sector via the net effect of inward and outward market access. At the same time, higher-amenity regions enjoy both of an increasing the number of visitors and of a larger range of affordable destinations for their residents.

Beyond these findings, I see this work as offering some insights to a broader policy debate: regulating transportation is not only about the volume of flows, but also about their direction, and their local economic consequences.

References

A4A (2018): " U.S. air passengers' main trip purposes in 2017, by type," Statista, https://www.statista.com/statistics/539518/us-air-passengers-main-trip-purposes-by-type/. 5.1.1

Albert, C., and J. Monras (2022): "Immigration and spatial equilibrium: the role of expenditures in the country of origin," *American Economic Review*, 112(11), 3763–3802. 2, 4.2, 5.1.3, 1

Allen, T., and C. Arkolakis (2024): "Quantitative Economic Geography," *Handbook of Regional and Urban Economics*, 6. 4

Allen, T., D. Atkin, S. Cantillo, and C. Hernandez (2020): "Trucks," *Unpublished data*. 2, 3, 4.3

Allen, T., S. Fuchs, S. Ganapati, A. Graziano, R. Madera, and J. Montoriol-Garriga (2022): "Is tourism good for locals? Evidence from Barcelona," *Dartmouth College, Mimeograph*. 2

Almagro, M., and T. Domínguez-Iino (2024): "Location sorting and endogenous amenities: Evidence from amsterdam," Discussion paper, National Bureau of Economic Research. 2

Alves, V., and R. Forte (2015): "A Cournot model for analysing the effects of an open skies agreement," *Journal of Air Transport Management*, 42, 125–134. 4.3

Antràs, P. (2024): "The Uncharted Waters of International Trade," *Journal of the European Economic Association*, p. jvae060. 2

Appold, S. J. (2015): "The impact of airports on US urban employment distribution," *Environment and Planning A*, 47(2), 412–429. 5.1.1

Arezki, M. R., R. Cherif, and J. M. Piotrowski (2009): *Tourism specialization and economic development: Evidence from the UNESCO World Heritage List*. International Monetary Fund. 2

Atkeson, A., and A. Burstein (2008): "Pricing-to-market, trade costs, and international relative prices," *American Economic Review*, 98(5), 1998–2031. 4.3

Atkin, D., and D. Donaldson (2015): "Who's Getting Globalized?: The Size and Implications of Intra-national Trade Costs," Discussion Paper w21439, National Bureau of Economic Research Cambridge, MA. 2

Bahar, D., P. Choudhury, D. Y. Kim, and W. W. Koo (2023): "Innovation on wings: Nonstop flights and firm innovation in the global context," *Management Science*, 69(10), 6202–6223. 2

Baum-Snow, N. (2007): "Did highways cause suburbanization?," *The quarterly journal of economics*, 122(2), 775–805. 2

Bilotkach, V. (2015): "Are airports engines of economic development? A dynamic panel data approach," *Urban Studies*, 52(9), 1577–1593. 2

Blonigen, B. A., and A. D. Cristea (2015): "Air service and urban growth: Evidence from a quasi-natural policy experiment," *Journal of Urban Economics*, 86, 128–146. 2

Brancaccio, G., M. Kalouptsidi, and T. Papageorgiou (2020): "Geography, transportation, and endogenous trade costs," *Econometrica*, 88(2), 657–691. 2

Breinlich, H., H. Fadinger, V. Nocke, and N. Schutz (2020): "Gravity with granularity," *CEPR Discussion Paper No. DP15374*. 7

Brida, J. G., I. Cortes-Jimenez, and M. Pulina (2016): "Has the tourism-led growth hypothesis been validated? A literature review," *Current Issues in Tourism*, 19(5), 394–430. 2

Bronzini, R., E. Ciani, and F. Montaruli (2022): "Tourism and local growth in Italy," *Regional Studies*, 56(1), 140–154. 2

Brueckner, J. K. (2003): "Airline traffic and urban economic development," *Urban Studies*, 40(8), 1455–1469. 2, 6.2

Brueckner, J. K., D. Lee, and E. S. Singer (2013): "Airline competition and domestic US airfares: A comprehensive reappraisal," *Economics of Transportation*, 2(1), 1–17. 5.1.1

Brueckner, J. K., and P. T. Spiller (1991): "Competition and mergers in airline networks,"

International Journal of Industrial Organization, 9(3), 323–342. 4.3

——— (1994): "Economies of traffic density in the deregulated airline industry," *The Journal of Law and Economics*, 37(2), 379–415. 4.3

Bryan, G., and M. Morten (2019): "The aggregate productivity effects of internal migration: Evidence from Indonesia," *Journal of Political Economy*, 127(5), 2229–2268. 1, 5.1.3

Bureau of Transportation Statistics (2024): "Domestic market share of leading U.S. airlines from March 2023 to February 2024 [Graph]," Retrieved March 11, 2025. 1

Campante, F., and D. Yanagizawa-Drott (2018): "Long-range growth: economic development in the global network of air links," *The Quarterly Journal of Economics*, 133(3), 1395–1458. 2

Chao, C.-C., B. R. Hazari, J.-P. Laffargue, P. M. Sgro, and E. S. Yu (2006): "Tourism, Dutch disease and welfare in an open dynamic economy," *The Japanese Economic Review*, 57, 501–515. 2

Chen, Y., and Y. M. Ioannides (2020): "International tourism and short-run growth," Discussion paper, working paper, Tufts University. 2

Chiovelli, G., S. Michalopoulos, and E. Papaioannou (Forthcoming): "Landmines and Spatial Development," *Econometrica*, Conditionally accepted. 7

Copeland, B. R. (1991): "Tourism, welfare and de-industrialization in a small open economy," *Economica*, pp. 515–529. 2

Davis, M. A., and F. Ortalo-Magné (2011): "Household expenditures, wages, rents," *Review of Economic Dynamics*, 14(2), 248–261. 5.1.3, 1

Delgado, M., M. E. Porter, and S. Stern (2016): "Defining clusters of related industries," *Journal of Economic Geography*, 16(1), 1–38. 5.1.1

Donaldson, D. (2018): "Railroads of the Raj: Estimating the impact of transportation infrastructure," *American Economic Review*, 108(4-5), 899–934. 2

Donaldson, D., and R. Hornbeck (2016): "Railroads and American economic growth: A "market access" approach," *The Quarterly Journal of Economics*, 131(2), 799–858. 2

Drukker, A., et al. (2023): "How Essential Is Essential Air Service? The Value of Airport Access for Remote Communities," *National Institute for Transportation and Communities (NITC)*. 7

Duranton, G., and D. Puga (2015): "Urban land use," in *Handbook of regional and urban economics*, vol. 5, pp. 467–560. Elsevier. 2

Duranton, G., and M. A. Turner (2012): "Urban growth and transportation," *Review of Economic Studies*, 79(4), 1407–1440. 2

Eckert, F., et al. (2019): "Growing apart: Tradable services and the fragmentation of the us economy," *mimeograph, Yale University*. 5.1.2

Faber, B., and C. Gaubert (2019): "Tourism and economic development: Evidence from Mexico's coastline," *American Economic Review*, 109(6), 2245–2293. 2

Fageda, X., and R. Flores-Fillol (2012): "Air services on thin routes: Regional versus low-cost airlines," *Regional Science and Urban Economics*, 42(4), 702–714. 5.2

——— (2015): "A note on optimal airline networks under airport congestion," *Economics Letters*, 128, 90–94. 4.3

Flores-Fillol, R. (2009): "Airline competition and network structure," *Transportation Research Part B: Methodological*, 43(10), 966–983. 7

Fogel, R. (1964): "American Economic Growth," *and*, 45, 44. 2

Gervais, A., and J. B. Jensen (2019): "The tradability of services: Geographic concentration and trade costs," *Journal of International Economics*, 118(C), 331–350, Publisher: Elsevier. 5.1.1, 1, 5.1.3

Green, R. K. (2007): "Airports and economic development," *Real estate economics*, 35(1), 91–112. 2

Head, K., and J. Ries (2001): "Increasing returns versus national product differentiation as an explanation for the pattern of US–Canada trade," *American Economic Review*, 91(4), 858–876. 5.1.2

Holmes, T. J. (1999): "Localization of industry and vertical disintegration," *Review of Economics and Statistics*, 81(2), 314–325. 5.1.4

International Monetary Fund (2025): "Public Finances in Modern History Database," . 5.1.3, 1

Kreps, D. M., and J. A. Scheinkman (1983): "Quantity precommitment and Bertrand competition yield Cournot outcomes," *The Bell Journal of Economics*, pp. 326–337. 4.3

Lakew, P. A., and V. Bilotkach (2018): "Airport delays and metropolitan employment," *Journal of Regional Science*, 58(2), 424–450. 2, 6.2

Mayer, C., and T. Sinai (2003): "Network effects, congestion externalities, and air traffic delays: Or why not all delays are evil," *American Economic Review*, 93(4), 1194–1215. 4.3

McGraw, M. J. (2020): "The role of airports in city employment growth, 1950–2010," *Journal of Urban Economics*, 116, 103240. 2

Melendez, R., J. Finlay, P. Clarke, G. Noppert, L. Gypin, and E. Dyke (2024): "National Neighborhood Data Archive (NaNDA): Arts, Entertainment, and Leisure Establishments by Census Tract and ZCTA, United States, 1990–2021," Distributed by ICPSR. 3

Mian, A., and A. Sufi (2014): "What explains the 2007–2009 drop in employment?," *Econometrica*, 82(6), 2197–2223. 5.1.1

Michaels, G. (2008): "The effect of trade on the demand for skill: Evidence from the interstate highway system," *The Review of Economics and Statistics*, 90(4), 683–701. 2

Miyauchi, Y., K. Nakajima, and S. J. Redding (2021): "The economics of spatial mobility: Theory and evidence using smartphone data," Discussion paper, National Bureau of Economic Research. 6

Muñoz, M. (2024): "Trading Nontradables: The Implications of Europe's Job-Posting Policy*," *The Quarterly Journal of Economics*, 139(1), 235–304. 5.1.1

Oliver Wyman (2019): "U.S. airlines' domestic cost per available seat mile in Q3 2018 (in U.S. dollar cents) [Graph]," Retrieved March 11, 2025. 5.2, 4

Orzach, R., and R. Dix (2021): "Market Power Spillovers Across Airline Routes," *Available at SSRN 3915484*. 4.3

Porter, M. (2003): "The Economic Performance of Regions," *Regional Studies*, 37(6-7), 549–578, Publisher: RSA Website _eprint: https://doi.org/10.1080/0034340032000108688. 5.1.1

Redding, S. J. (2024): "Quantitative urban economics," *National Bureau of Economic Research*. 4

Redding, S. J., and M. A. Turner (2015): "Transportation costs and the spatial organization of economic activity," *Handbook of regional and urban economics*, 5, 1339–1398. 2

Ruggles, S., S. Flood, M. Sobek, D. Backman, A. Chen, G. Cooper, S. Richards, R. Rodgers, and M. Schouweiler (2024): *IPUMS USA: Version 15.0 [dataset]*. Minneapolis, MN. https://doi.org/10.18128/D010.V15.0. 5.1.1, 5.1.3, 3

Schubert, S. F., J. G. Brida, and W. A. Risso (2011): "The impacts of international tourism demand on economic growth of small economies dependent on tourism," *Tourism Management*, 32(2), 377–385. 2

Seade, J. (1980): "On the effects of entry," *Econometrica: Journal of the Econometric Society*, pp. 479–489. 1

Sheard, N. (2014): "Airports and urban sectoral employment," *Journal of Urban Economics*, 80, 133–152. 2, 6.2

——— (2019): "Airport size and urban growth," *Economica*, 86(342), 300–335. 2

——— (2020): "The geography of US airport markets," *Unpublished manuscript*. 5.1.1

Smeral, E. (2003): "A structural view of tourism growth," *Tourism economics*, 9(1), 77–93. 1

US Travel Association (2024): "Number of domestic business and leisure trips in the United States from 2019 to 2022, with a forecast to 2027 (in billions) [Graph]," Statista, Retrieved March 18, 2025, from https://www.statista.com/statistics/207103/forecasted-number-of-domestic-trips-in-the-us/. 5.1.1

Wong, W. F. (2022): "The round trip effect: Endogenous transport costs and international trade," *American Economic Journal: Applied Economics*, 14(4), 127–166. 2

Appendix A. Proof of Existence

The equilibrium equations can be rewritten as follows

$$
\begin{aligned}
L_r &= \sum_d V_{rd} \\
L_r^{NT} &= \frac{\alpha_{NT}}{w_r} \sum_d \frac{A_r^{\rho} (P_r^{NT})^{-\rho}}{\mathbb{P}_{dr}^{1-\rho}} \left(w_d - P_{dr}^V\right) V_{dr} \\
w_r &= \frac{\alpha_T}{L_r^T} \sum_d \frac{(P_r^T \tau_{rd})^{-\sigma}}{\mathbb{P}_r^{1-\sigma}} \left(w_d - P_{dr}^V\right) V_{dr} \\
P_r^{NT} &= w_r (L_r^{NT})^{1-\alpha} \\
P_r^T &= \frac{w_r}{A_r^T} \\
V_{rd} &= \left(\frac{w_r - P_{rd}^V}{\mathbb{P}_r^{\alpha_T} \mathbb{P}_{rd}^{\alpha_{NT}}} \right)^{\theta} \left[\sum_{r'd'} \left(\frac{w_{r'} - P_{r'd'}^V}{\mathbb{P}_{r'}^{\alpha_T} \mathbb{P}_{r'd'}^{\alpha_{NT}}} \right)^{\theta} \right]^{-1} \\
K_{rd} &= \frac{(P_{rd}^V - c) V_{rd}}{F} \quad r \neq d \\
P_{rd}^V &= \frac{1}{1 + K_{rd}\theta(1 - V_{rd})} w_r + \frac{K_{rd}\theta(1 - V_{rd})}{1 + K_{rd}\theta(1 - V_{rd})} c \quad r \neq d
\end{aligned}
$$

Then, one can define an operator $F : \mathbb{R}_+^{4D+D^2} \times \Theta \to \mathbb{R}_+^{4D+D^2}$

$$
\mathbf{z} = \mathbf{F}(\mathbf{z}) \,, \quad \mathbf{z} = (\mathbf{L}, \mathbf{L^{NT}}, \mathbf{w}, \mathbf{P^{NT}}, \mathbf{P^T}, \mathbf{V}, \mathbf{K}, \mathbf{P^V})
$$

where Θ is the space of parameters $(\sigma, \rho, \theta, \alpha, \alpha_T, \alpha_{NT})$ and exogenous variables $(A_r^T, A_r, \tau_{rd}, c, F_{rd})$, that are all assumed to be positive and different than zero. $\mathbf{F}(\cdot)$ is a self-map, mapping a convex and compact set to itself. Moreover, the operator $\mathbf{F}$ is continuous, since $\mathbf{F_i}$ is a continuous function $\forall i$. Then, by Brower's theorem, there exists a fixed point $\mathbf{z}^*$, implying that an equilibrium exists.

Appendix B. Model Inversion

B.1. Simulation Analysis

B.1.1. Tradable Sector Productivities

Starting from

$$\sum_d X_{dr}^T = \alpha_T \frac{\sum_d \left(\tau_{dr} \frac{w_d}{A_d^T}\right)^{1-\sigma} \left(w_r - P_{rd}^V\right) V_{rd}}{\sum_{d'} \left(\tau_{d'r} \frac{w_{d'}}{A_{d'}^T}\right)^{1-\sigma}}$$

let us define

$$b_r = \sum_d X_{dr}^T$$
$$T_{dr} = (\tau_{dr} w_d)^{1-\sigma}$$
$$z_d = \left(\frac{1}{A_d^T}\right)^{1-\sigma}$$

to rewrite the previous equation as

$$b_r = \alpha_T \frac{\sum_d T_{dr} \left(w_r - P_{rd}^V\right) V_{rd} z_d}{\sum_{d'} T_{d'r} z_d'}$$

that allows us to get

$$z_r = \frac{\sum_{d' \neq r} z_{d'} T_{d'r} \left[\alpha_T (w_r - P_{rd'}^V) V_{rd'} - b_r\right]}{b_r - \alpha_T w_r V_{rr}}$$

This implies that we can set up the following linear system

$$\mathbf{z} = M\mathbf{z}\,, \quad M_{rd} = \begin{cases} 0 & r = d \\ \frac{T_{dr}\left[\alpha_T (w_r - P_{rd}^V) V_{rd} - b_r\right]}{b_r - \alpha_T w_r V_{rr}} & r \neq d \end{cases}$$

from that we can retrieve productivities by

$$A_r^T = z_r^{\frac{1}{\sigma-1}}$$

Given the linearity of the system, this implies that there exists a unique set of productivities that can be retrieved from the data. However, since levels are not identified, we normalize productivities by dividing them by the Alabama's one.

B.1.2. Amenities

Starting from

$$\sum_d X_{rd}^{NT} = \alpha_{NT} \sum_d \frac{A_d^\rho (w_d (L_d^{NT})^\alpha)^{1-\rho} (w_r - P_{rd}^V)}{\left[(A_r)^\rho (w_r (L_r^{NT})^\alpha)^{1-\rho} + (A_d)^\rho (w_d (L_d^{NT})^\alpha)^{1-\rho} \right]}$$

Let us define

$$\begin{aligned} b_r &= \sum_d X_{rd}^{NT} \\ Z_{rd} &= \left(w_r - P_{rd}^V \right) V_{rd} \\ \lambda_d &= A_d^\rho \left[w_d (L_d^{NT})^\alpha \right]^{1-\rho} \end{aligned}$$

and rewrite

$$b_r = \alpha_{NT} \sum_d \frac{\lambda_d}{\lambda_r + \lambda_d} Z_{rd}$$

Then,

$$\lambda_r = \frac{\alpha_{NT}}{b_r} \sum_d \frac{\lambda_r \lambda_d}{\lambda_r + \lambda_d} Z_{rd}$$

This is a fixed point problem that can be efficiently solved with the Anderson acceleration method. From the obtained solution, it is possible to back up amenities as

$$A_r = \frac{\lambda_r^{\frac{1}{\rho}}}{\left[w_d (L_d^{NT})^\alpha \right]^{\frac{1-\rho}{\rho}}}$$

Finally, since levels are not identified, we normalize amenities by dividing them by the Alabama's one.