Causality in the Air Transportation and Regional Growth Relation

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30*th* March 2016

Growth and Aviation: reality spot

Why aviation is important for growth?

Aviation is essential for people and freight mobility

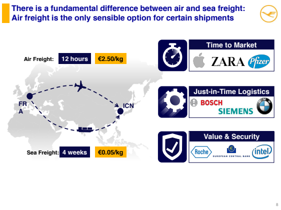

Figure 1: Modal comparison

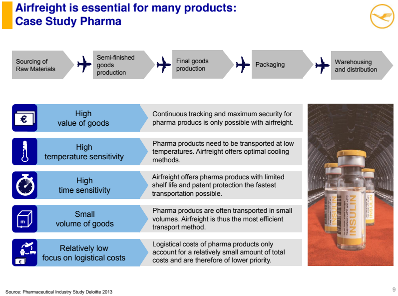

Figure 2: An example of aviation advantages

Growth and aviation: theory

- Aviation is a key factor in the growth process of regional and national economies.
- Four main economic impacts (Percoco 2010, Button & Yuan 2013)
  1. direct/primary (income generated by fixed investments)
  2. indirect/secondary (income generated by chain of suppliers)
  3. induced/tertiary (income generated by spending of employees generated by direct & indirect)
  4. catalytic/perpetuity (driver of productivity growth & attractor of new firms)
- Different relationships between:
  - national economies (aviation system)
  - major cities (inverse relationship?)
  - regional economies (inverse relationship?)
  - peripheral and remote regions

Methodological issues

- Anecdotal evidence suggests that air transport improves business operations (rapid access to input supplies, interaction by enabling face-to-face meetings, and provides critical input for "on-time" industries, Baker et al. 2015)
- BUT is aviation a determinant of growth or is growth a determinant of aviation?
- More developed cities/regions lead to higher aviation activities?
- Bi-directional causal relationship (i.e., jointly determined)?
- Need to explore the causal link between aviation and growth
- Two approaches ...
  1. Granger causality test (Button & Yuan 2013, Mukkala & Tervo 2013, Baker et al. 2015)
  2. 2-stage least square/instrumental variables regression (Brueckner 2003, Green 2007, Percoco 2010)
- ... and "new" stuff.

Methodological issues

First approach: Granger test

Typical Granger causality test (Mukkala & Tervo)

$$y_{it} = \sum_{k=1}^{p} \gamma^k y_{it-k} + \sum_{k=1}^{p} \beta_i^k x_{it-k} + \epsilon_{it}$$

- ϵ_{it} = error term of a panel model (with $\epsilon_{it} = \alpha_i + \vartheta_{it}$, α_i = fixed effects), p = number of lags, γ^k = autoregressive coefficients, β_i^k = regression coefficient slopes (x includes aviation), y includes growth, t = period, i = (country, region, city?)
- Equation above implies testing for linear restrictions on coefficients:
  1. if $\beta_i^k = 0, \forall i \forall k \Rightarrow$ no casual relation between growth (G) and aviation (A) $\forall i$;
  2. if $\beta_i^k = \beta^k \forall i \Rightarrow$ casual relation between G & A $\forall i$;
  3. if $\beta_i^k = 0$ for some i's (chosen with some criteria) (the other coefficients are unconstrained) then no casual relation between G & A for this group of i's.
- Mukkala & Tervo take 2 lags and differences in logarithms for all variables (growth rates)
- Run above equation in both directions (A $\Rightarrow$ G; G $\Rightarrow$ A)

Methodological issues

Second approach: IVs

An example of 2SLS/IV approach (Percoco 2010)

$$G_{it} = f(A_{it}, \boldsymbol{X}_{it}) + \epsilon_{it} \tag{1}$$

- $\boldsymbol{X}_{it}$ = set of controls, A_{it} is function of some variables

$$A_{it} = \sum_{k=1}^{K} \beta_k \boldsymbol{Z}_{k,it} + \upsilon_{it} \tag{2}$$

- Z_{it} = variables related with A but not with G
- E.g.: Age, education, tourism, centrality (distance between local and national centroids), hub
- First regress Eq. (2) and get predicted $\hat{A}_{it}$, then regress Eq. (1) using $\hat{A}_{it}$.

Empirical evidence on Aviation & Growth

Convergence that A $\Rightarrow$ G

- Button et al. (1999) higher high-tech employment if airport located in US metropolitan areas
- Brathen & Halpern (2012) relevance of aviation in Northern Europe remote regions
- Mukkala & Tervo (2013) show Granger causality between A and G for 86 European regions, stronger for peripheral areas
- Brueckner (2003) finds +10% in PAX leads to +1% in service employment
- Percoco (2010) shows +10% in PAX leads to +0.45% in employment in the province with airport and +0.2% in neighbouring provinces (spatial effects)
- Bilotkach (2015) shows that +10% in flights $\Longrightarrow$ +0.1% in wages

We have a paper on Africa

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Connecting African urban areas: airline networks and intra-Sub-Saharan trade

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- Positive impact of aviation on trade in African developing countries
- +1% in available seats $\Rightarrow$ +0.22% in trade flows
- +1% in number of airlines $\Rightarrow$ +0.78% in trade flows

Some comments

- Assessing the **causality** is essential
- For robustness adopt **both methods** (if good IVs available, see later)
- Separate **core** from **remote** regions
- Consider more **detailed variables** for different types of economic activities (e.g., industry *vs* services, high-tech *vs* low-tech, etc.)
- Include the idea of **sustainable growth** (add local pollution and climate change)
- Clean the impact of aviation from that of **other transport modes**
- Investigate the relation between **trade** and aviation (growth may suffer for omitted variables)
- Split trade into **good & services** and **tourism**
- Investigate different **characteristics of aviation activities** (e.g., airlines, alliances, airports hubs *vs* non-hubs, different size airport categories)

Comments

- Possible IVs:
  1. lagged variables for passengers or freights
  2. lagged variables for flights
  3. lagged variables for number of available routes
  4. lagged relative importance of each airport in the national system
  5. passengers with LCCs
  6. airport non-aviation revenues
  7. airport delays/congestion
  8. local population
  9. average passengers in airport of same size
- Recent alternative: Blonigen & Cristea (JUE, 2015) have adopted an approach based on time series variation.
- They study a quasi-natural experiment that exploit the **shift in aviation** due to US 1978 Deregulation Act.
- Intuition: deviations in passenger changes over time are unrelated to urban/regional/national growth changes)
- Econometric model: difference-in-difference (DID)