

An Empirical Analysis of Airport Capacity Expansion

Paper 128

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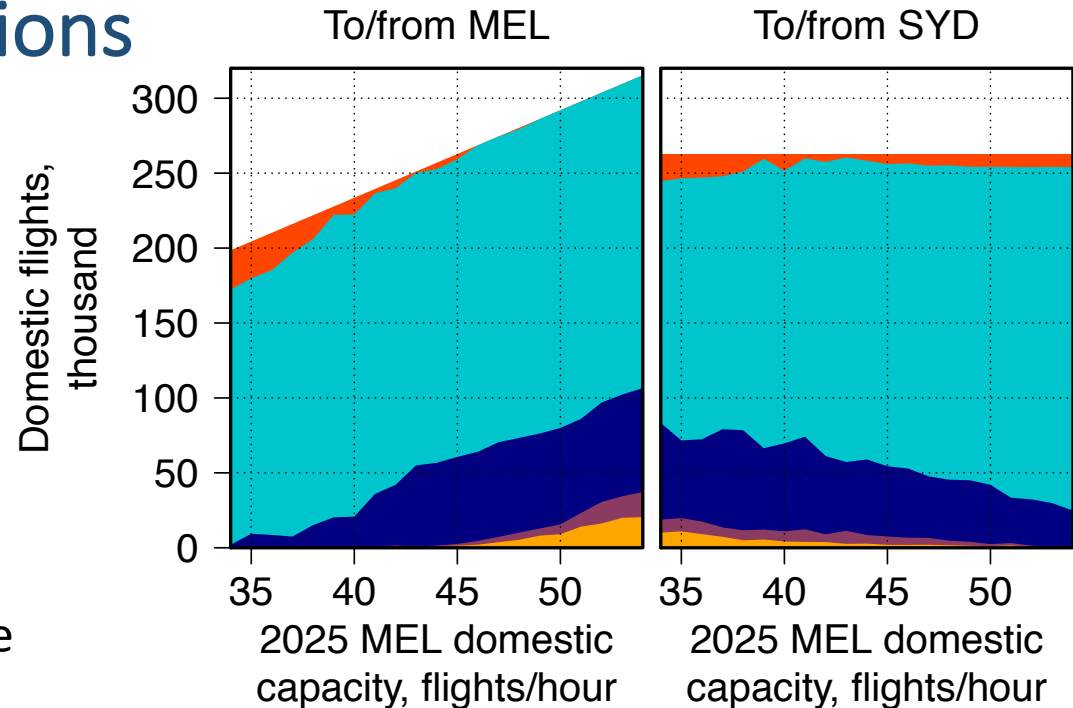
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Background

- Currently around \$600 billion in airport construction/expansion programmes worldwide (CIC, 2016)
- Demand projections suggest further expansions will be needed (Airbus, 2018; Boeing, 2018)
- Many expansion projects are highly controversial
 - Global CO₂ and local noise and air quality impacts need to be balanced against economic and connectivity benefits
 - Impact assessments are vital in evaluating these effects
- However:
 - Relatively few studies looking at what actually happened when airports were expanded
 - *Ex ante* impact assessments of large projects are **frequently** inaccurate (Flyvbjerg, 2009)
 - Projections of how airports/airlines will behave after expansion are often under 'ideal' conditions

Theoretical expectations

- When constraints are lifted, broadly expect:
 - More frequency competition, smaller aircraft
 - Reduction in fares
 - Possible return of routes that were abandoned due to capacity constraints



- At UCL: ACCLAIM project looking at how the global aviation system responds to capacity expansion
 - Includes response at other airports, via fleet redeployment, etc. (e.g. Doyme et al. 2018)
 - To do this we need to be sure assumptions for the expanded airport are correct

[Data: Dray et al., 2019;
High-growth scenario shown]

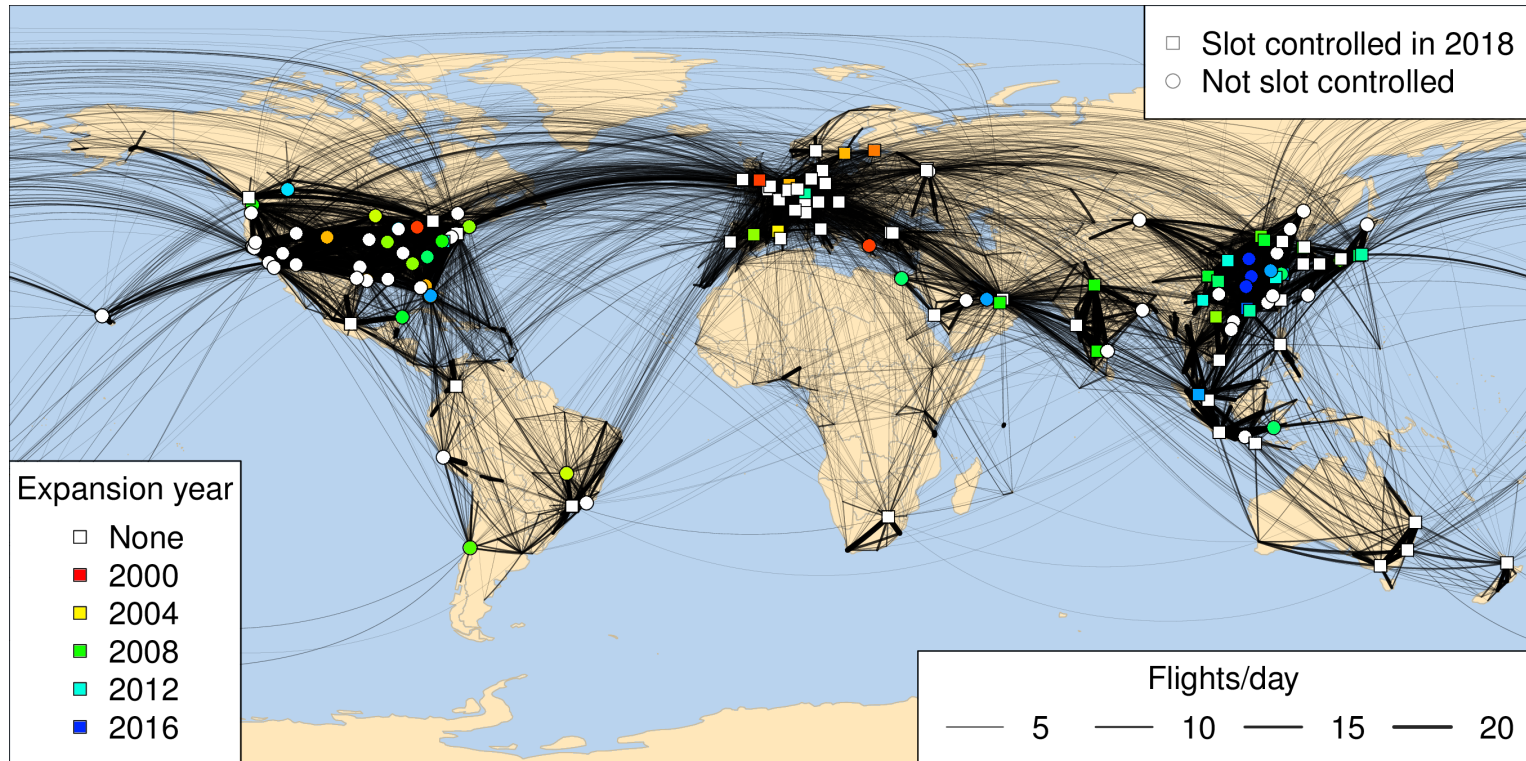
Some complicating factors

- Expansion may change **other airport characteristics**
 - Funding expansion often requires increased landing charges
 - A longer runway may allow larger aircraft to use the airport
- There may be additional **constraints**:
 - Expansion conditional on noise/emissions/regional connectivity
 - Regulations on who can add flights and to where
 - Movement totals may be constrained (with intention e.g. to reduce delay)
 - Terminal and/or airspace capacity may need subsequent upgrades
- Other factors may change over the (10+ years) **construction timescale**
 - E.g. recession, airline bankruptcy, changes in fuel price, ...
 - Long-term system-wide trends in aircraft size/business models/etc.
- Response to congestion easing depends on how airport handles congestion

Ways airports can deal with congestion

- Allow unrestricted movements and let increasing delay at peak times act as a limit on demand
- Charge higher landing fees at peak times (congestion pricing)
 - This is unpopular with airlines and not much used
- Restrict the number of movements per hour to a value that can (usually) be operated at 'acceptable' delay (slot control)
 - In this case, slots are a valuable resource to airlines
 - IATA 'use it or lose it' – airlines forfeit a slot they use less than 80% of the time
 - **50% of non-allocated slots (new/forfeited) must be offered first to new entrants (new carrier and/or new route)**
 - Some airports allow slot trading
 - E.g., reportedly £15 million for a morning slot pair at LHR (Haylen & Butcher 2017)

The data

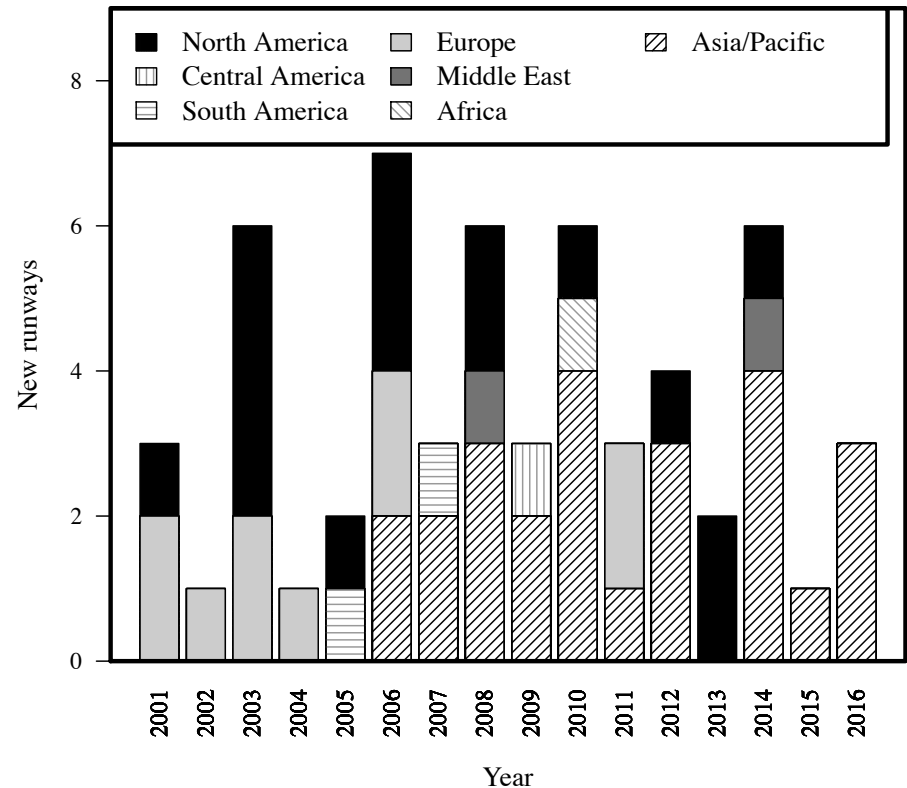


[Data: Sabre, 2017, using slot control = IATA Level 3]

- Of the top 150 airports by scheduled flights in 2015 (Sabre, 2016)
 - 55 either added runways or were replaced by a higher-capacity airport between 2000 and 2016
 - Many smaller-scale expansions (e.g. rapid exit taxiways, CDM, runway lengthening)

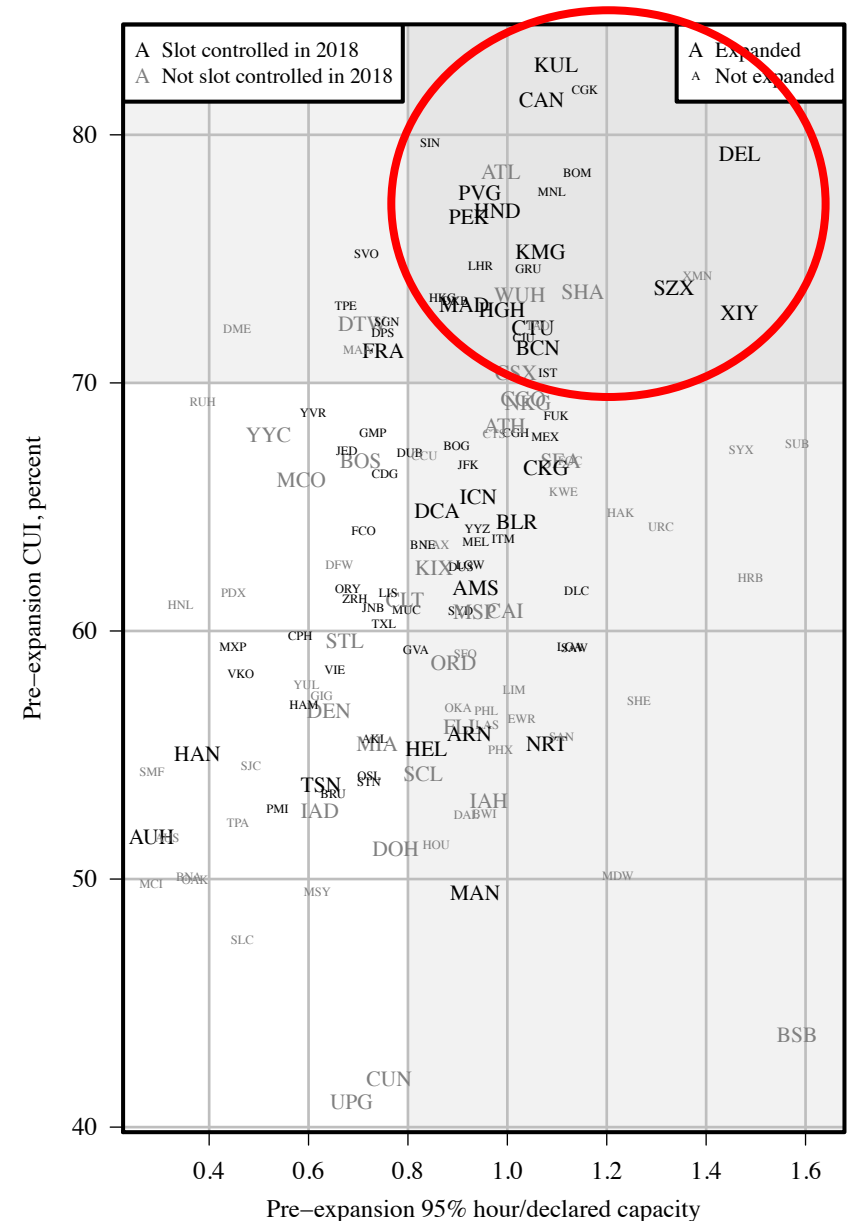
The data

- Initially European and North American airports dominate
- Significant increase in Asian airport expansions post-2005
- For each airport:
 - Schedule, fare and passenger data from Sabre (2017) and BTS (2018)
 - Delay data from BTS (2018), Flightstats (2017), FAA (2018)
 - Expansion and capacity information from literature and media reports (e.g. FAA, 2014; Odoni & Morrisset, 2010; Zhang et al., 2018)



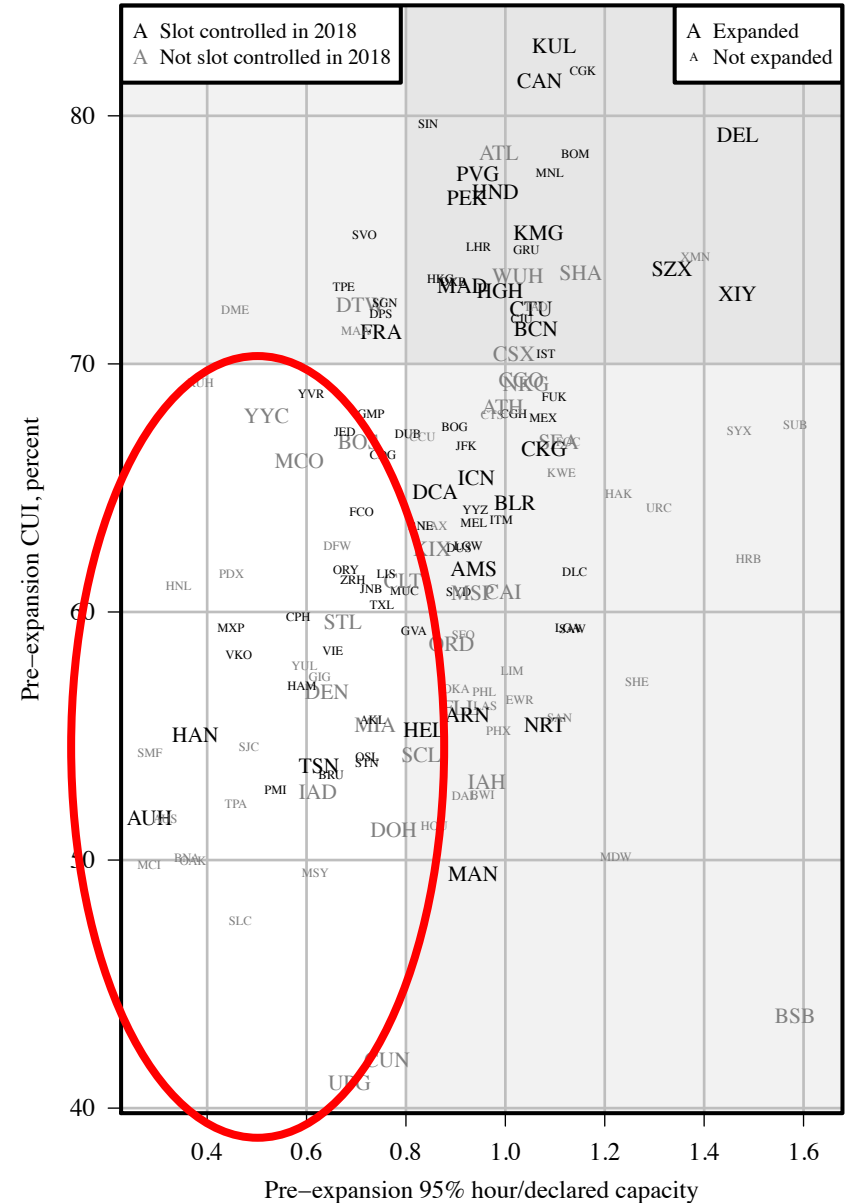
Measuring capacity constraints

- These airports are **highly** constrained
 - Peak hour close to capacity and flat schedules
 - 32 airports:
 - 17 were expanded or replaced 2000-2016
 - 2 with runways under construction
 - 6 being replaced or supplemented by new airports
 - 3 have expansion plans moving through approval process



Measuring capacity constraints

- These airports are **relatively unconstrained**
 - However, 14 of them still expanded between 2000-2016
 - Reflects various factors:
 - FAA guidance to consider expansion when an airport reaches 60-75% of capacity (GAO, 2003)
 - Ambitions for future growth
 - Expansion for operational improvements rather than growth

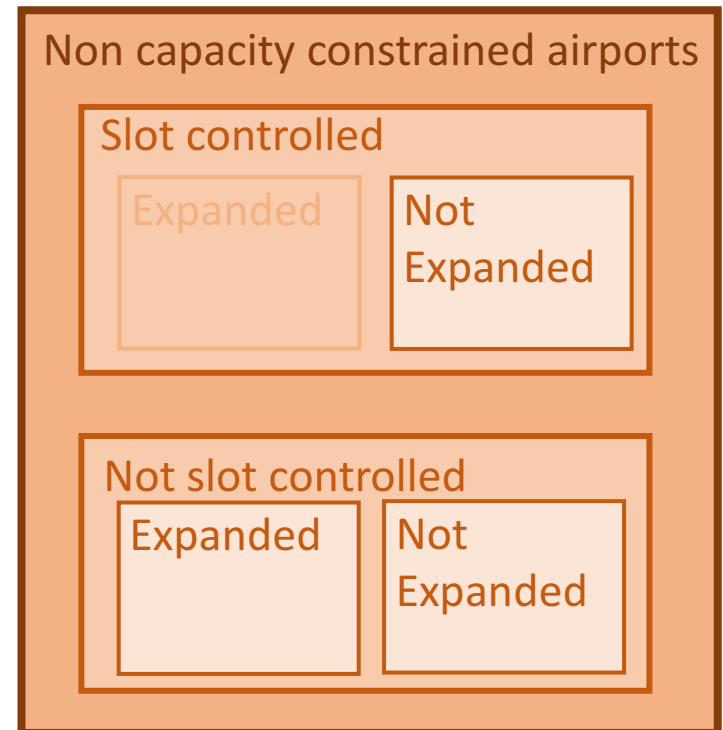
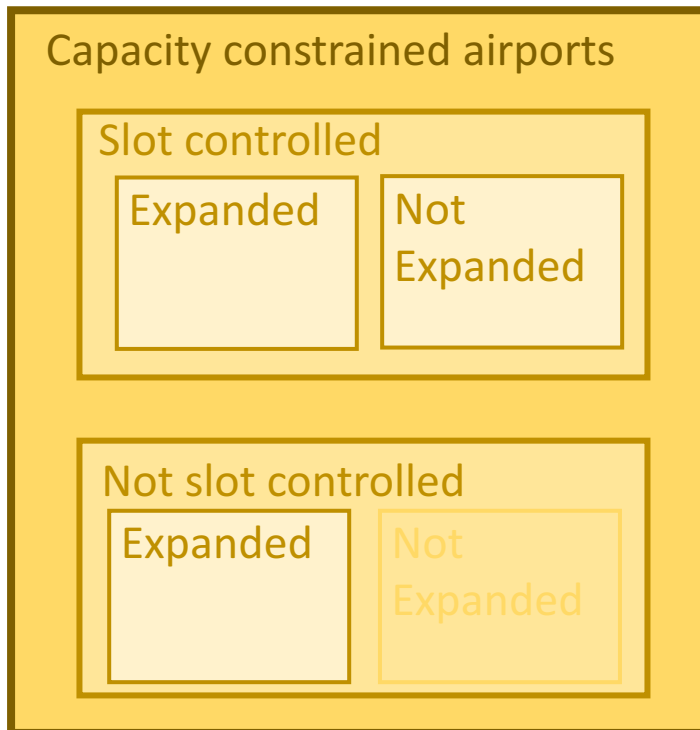


Capacity constraints by 2016

- Of the 55 airports expanded between 2000 and 2016:
 - 15 have year-2016 peaks under 90% of **pre-expansion** capacity
 - 10 under 80%
 - 19 have year-2016 peaks over 90% of **post-expansion** capacity
 - 15 over 95%
 - i.e., **over half** of the expanded airports either aren't using any of the extra capacity yet, or are still capacity constrained
- Many airports are also significantly affected by external events over this time period:
 - Recessions and airline bankruptcies (e.g. IAD, SEA, MEL, SYD)
 - In the case of AKL, construction was halted due to reduced demand
 - Regulator decisions about which flights airports can host (e.g. NRT, HND)
 - Opening of high-speed rail lines (BCN, MAD, Chinese airports)

Aggregate outcomes

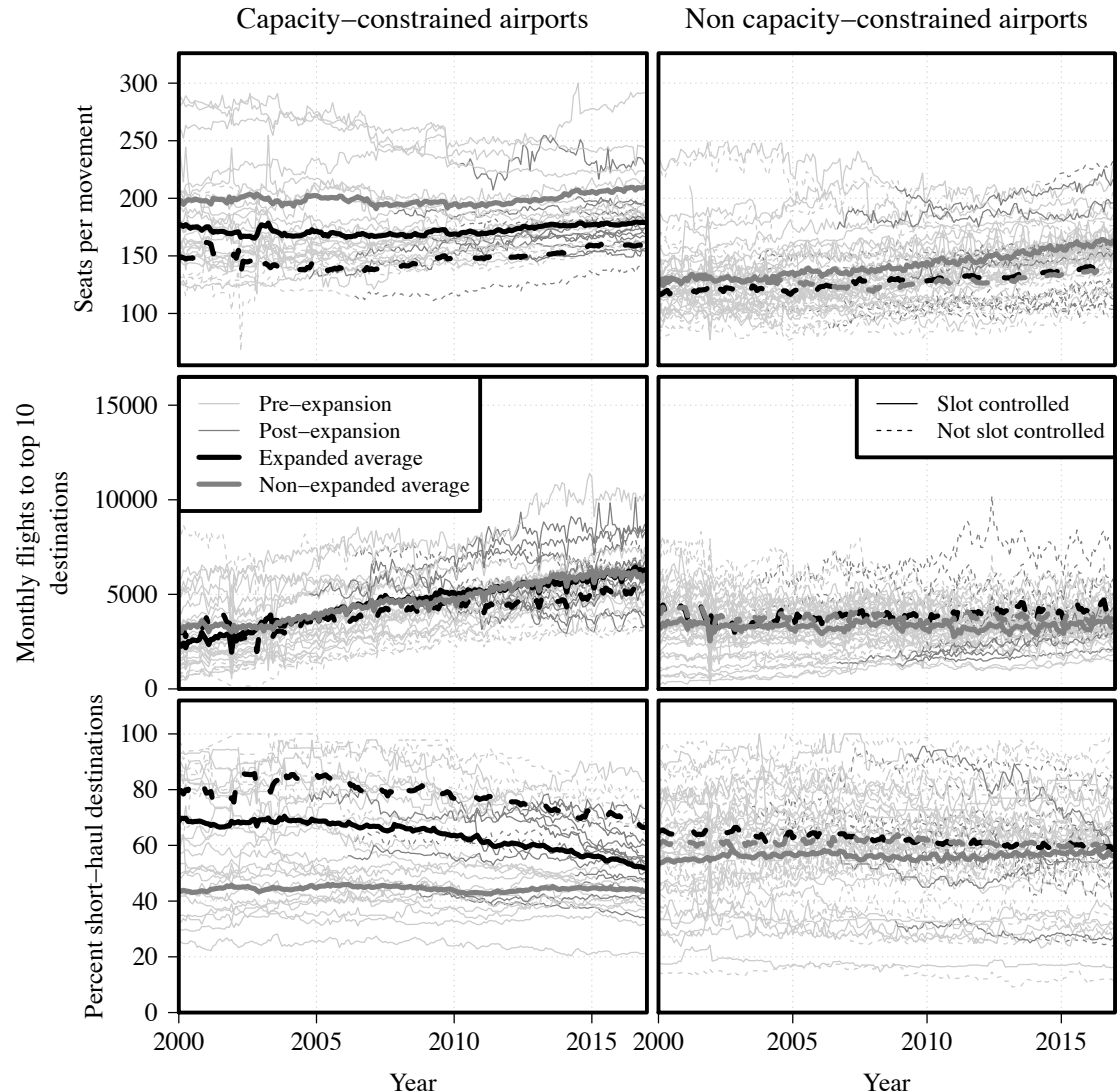
- Compare average metrics for:



- Note there are some differences in the groups
 - e.g. more non slot controlled, expanded airports in the US
 - Demand growth rates are not necessarily the same

Aggregate outcomes

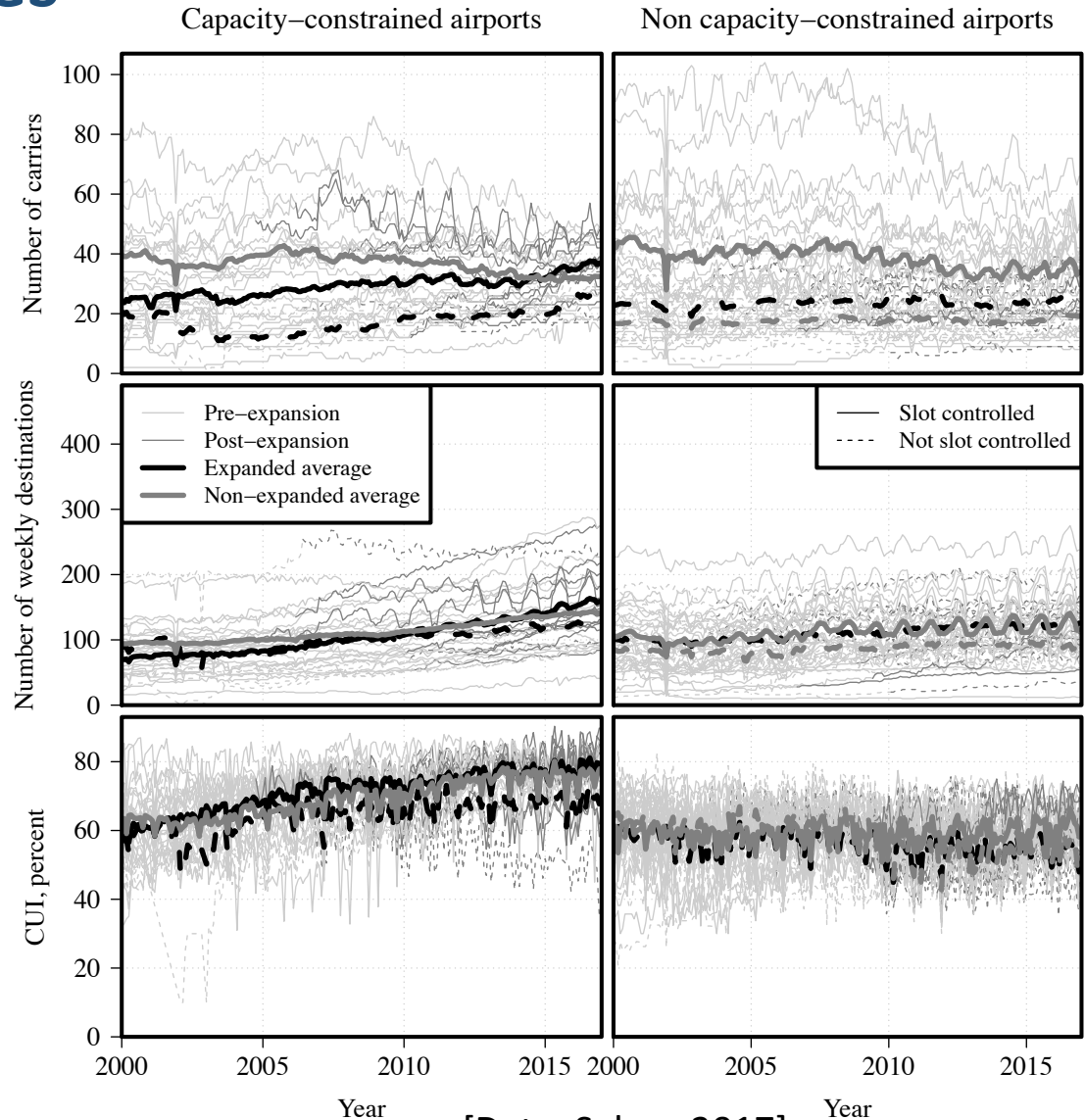
- **Aircraft size** behaves similarly between expanded and non-expanded groups
 - Average is higher at constrained airports
 - Does not come down on expansion
- **Frequency to top destinations** increases across all constrained airports
 - Expanded and non-expanded groups behave similarly
- **% short-haul destinations** decreases on expansion
 - Constrained airports only



[Data: Sabre, 2017]

Aggregate outcomes

- **Number of carriers** increases on expansion
 - Average is highest at constrained, slot-controlled airports (50% growth 2000-2016)
 - Constrained, slot-controlled airports that were **not** expanded saw 20% drop
- **Number of destinations** increases across all constrained groups
 - More seasonality at non-constrained airports
- **CUI** does not decrease on expansion (on average)
 - Affects slot-controlled airports
 - Suggests schedules are not returning to peaked structure



[Data: Sabre, 2017]

Aggregate outcomes – fare and delay

- Less data available for fare and delay
 - Typically there is a short-term decrease in delay on expansion (as in e.g. Hansen et al. 2008)
 - Longer-term impacts are less clear
 - For those (US) airports with 2000-2016 data, little difference in average delay between expanded and non-expanded groups
 - Comparing congested, slot-controlled airports that were/were not expanded:
 - In 2010, average fare was 50% lower at the expanded group
 - By 2015, average fare was 23% lower at the expanded group
 - Might be fare changes on expansion from landing charge changes
 - But also might be impact of oil price changes/hedging on flights of different lengths

Conclusions

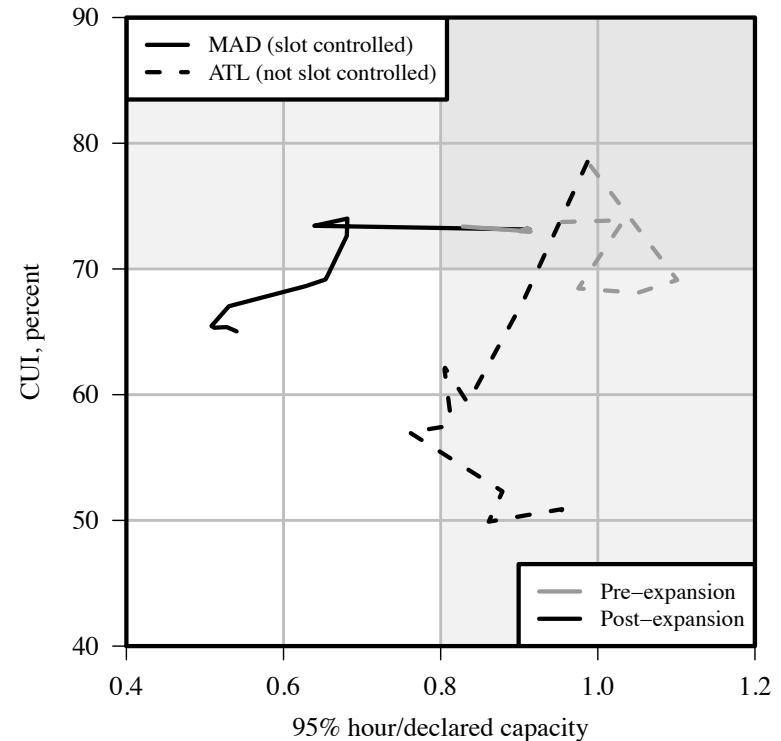
- Outcomes of airport capacity expansions vary widely
 - There were 55 major airport expansions in the top 150 airports between 2000 and 2016
 - By 2016, **over half** of these airports were operating below pre-expansion capacity or close to post-expansion capacity
 - These potential outcomes are usually not examined in impact assessments
- Expanded airports tend to add (longer-haul) routes and carriers rather than adding frequency on existing routes
 - Slot control regulations have a strong impact where present
 - Inertia on existing routes may be due to difficulty in changing schedules
 - Expected theoretical impacts (decreasing aircraft size, re-opening of domestic routes, etc.) are generally small compared to system-wide trends and airport-specific factors
 - This needs to be considered when modelling outcomes

For more information on
ACCLAIM and aviation
modelling at UCL:
www.atslab.org

Extra slides

Schedule behaviour on expansion

- Divergence between slot-controlled and non slot-controlled airports
 - Likely reflects difficulty in moving slots
 - For many flights, changing time requires both an arrival and a departure slot
 - This means the schedule of an expanded airport remains different from one which was never capacity-constrained
- Slot control regulations are also likely part of the reason that expanded airports tend to add destinations and carriers rather than frequency



[Data: Sabre, 2017]