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Airport Diseconomies of Scale

PwC Malaysia and PwC Vietnam

Aviation Competency Group

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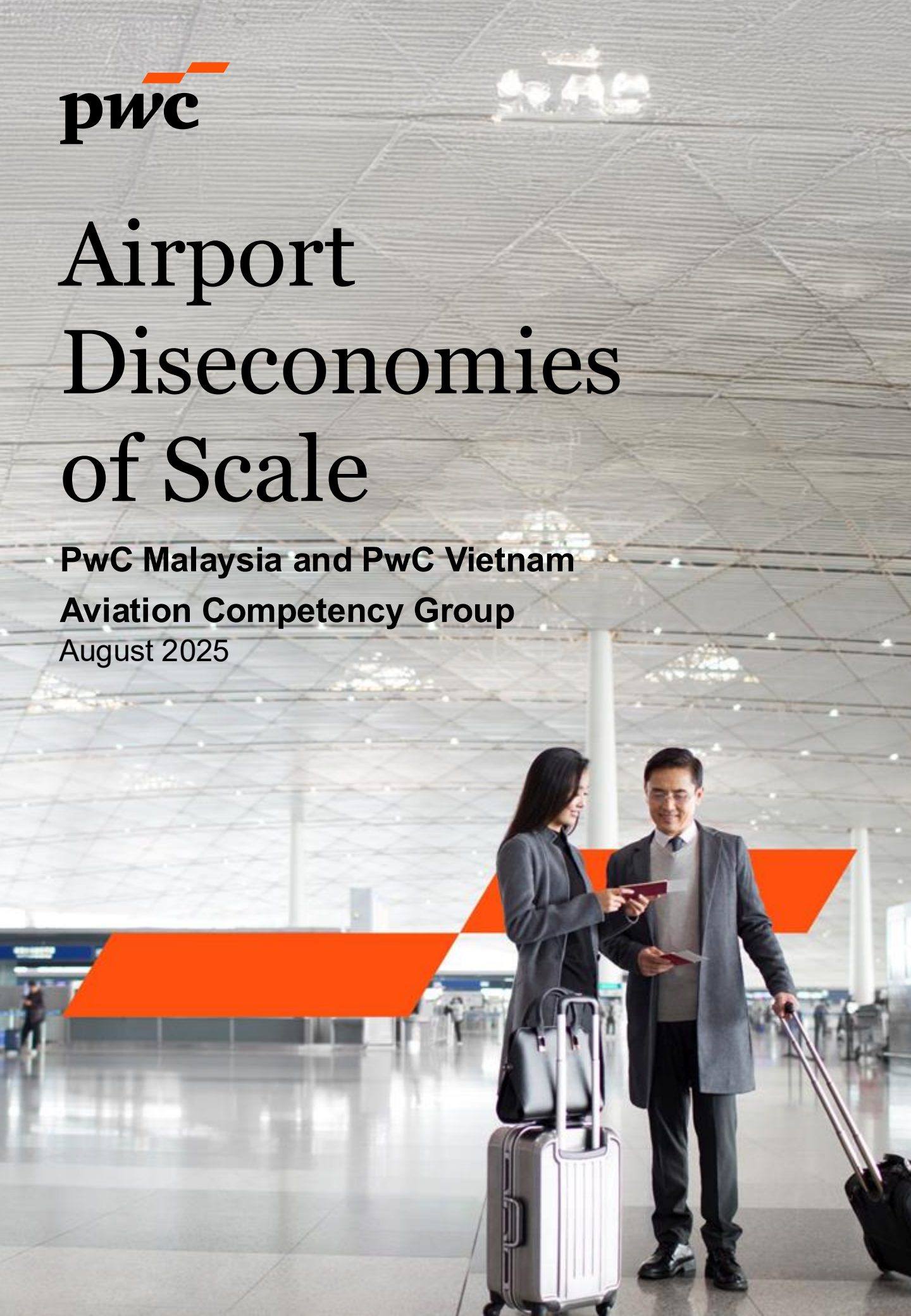


Introduction

Airport diseconomies of scale

The scale of an airport can significantly influence its efficiency, cost structure, and overall profitability.

While existing research on airport economies of scale largely focuses on smaller facilities, there is limited analysis on whether these benefits persist—or begin to reverse—at higher traffic volumes. Yet observations suggest that very large airports, particularly those exceeding 40 million WLU (Work Load Unit—either 1 passenger or 100kg of air cargo, either departing from or arriving at the airport) annually, often incur disproportionately high costs.

Development of mega hubs around the world

In recent years, global aviation has witnessed significant growth, resulting in many large airports. In 2001, only 8 airports worldwide handled more than 40 million passengers per annum (mppa); by 2019, that number had risen to 56, with numerous plans underway to develop mega-airports designed for over 100 million WLU annually. However, it remains unclear whether such large-scale infrastructure delivers the expected efficiencies—or whether the additional complexities risk triggering cost escalations instead.

Hence, new analysis on airport diseconomies of scale is needed, particularly in the context of new airport infrastructure development and post-COVID recovery of the aviation sector.

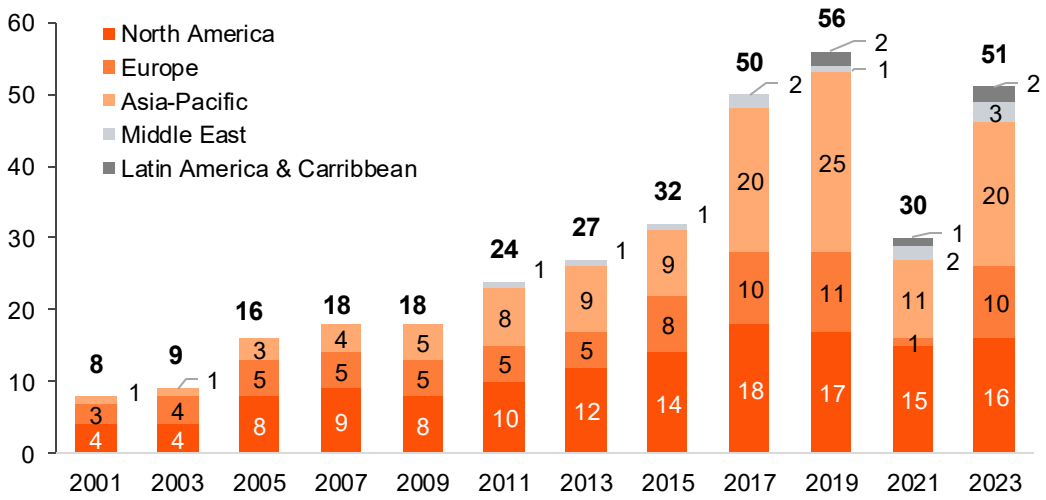
Overview of airport scale development over the past 20 years

The number of airports with traffic beyond 40 mppa has risen rapidly between 2001 and 2023

The busiest airports become busier, with Asia-Pacific emerging as the region with largest number of large airports

During the last two decades, the number of large airports (>40 million passengers per annum, mppa) has increased rapidly. The Asia-Pacific region, especially China, contributed the largest percentage of this growth.

Number of large airports > 40 mppa by region, 2001-2023



↑24 more airports

in Asia-Pacific airports with traffic >40 mppa (from 1 in 2001 to 25 in 2019)*

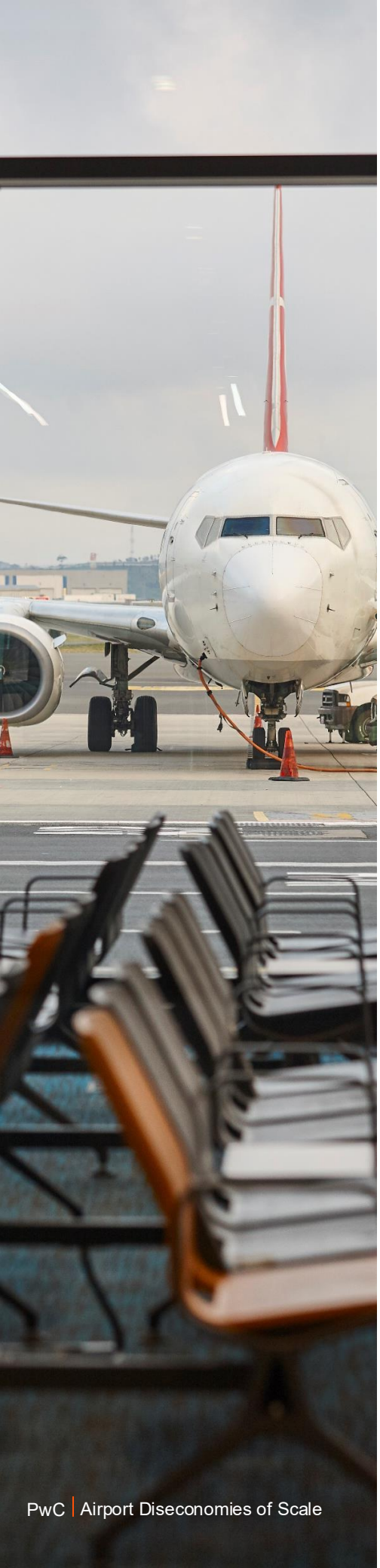
↑43.5%

Traffic contribution of APAC airports with >40 mppa to global airports with >40 mppa in 2019*

Source: ACI World Airport Traffic Report 2023, PwC Analysis
*To avoid the COVID-19 pandemic's effect, 2019 traffic was selected for comparison.

Airports across Asia-Pacific are undergoing significant expansions, with many targeting capacities of 100 million passengers per annum or more to meet rising demand and establish themselves as global hubs.

Major ongoing expansions include **Bangkok Suvarnabhumi airport** (150 mppa by 2033) and **Beijing Daxing airport** (100 mppa by 2040). New mega airports like **New Manila** and **Long Thanh** are each designed to eventually handle 100 mppa. Similarly, **Kuala Lumpur International Airport** has long-term plans for up to 140 mppa, while **Hong Kong International Airport aims** to serve 120 mppa in around 10 years through its Three Runway system.



Rationale for the development of large airports

The development of large airports can be justified for various reasons:

- Urbanisation & population growth
- Prestige & geopolitical influence
- Socioeconomic benefits
- Commercial incentives
- Location & lack of alternatives
- Connectivity

However, it is important to ask:

What are the potential challenges that come with having a large-scale airport?

Smaller and mid-sized airports may achieve greater connectivity gains relative to their size, avoiding the diseconomies of scale and network saturation

In terms of connectivity

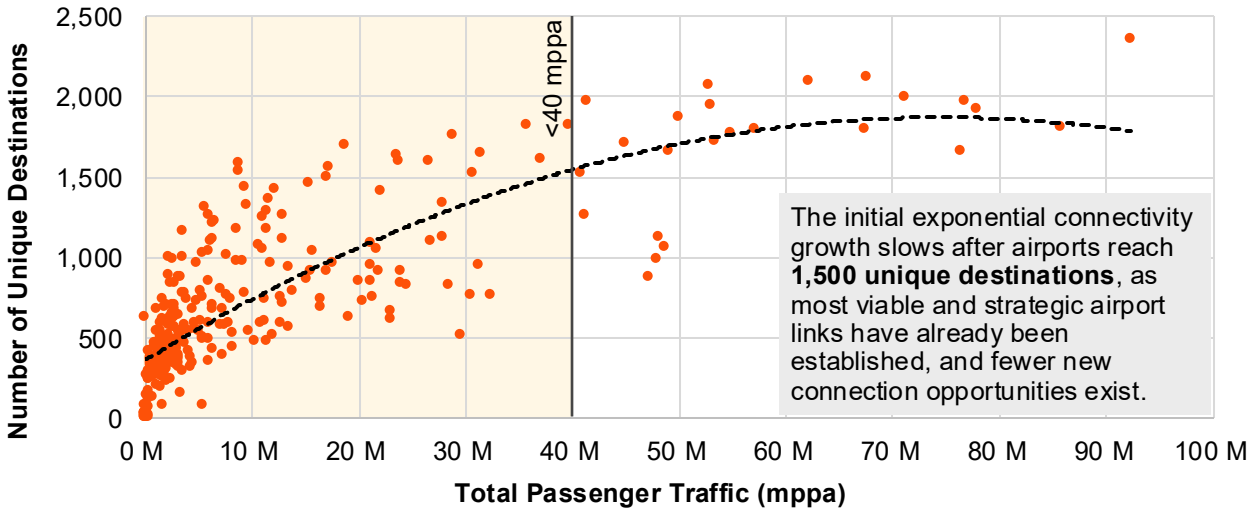
Airports with higher passenger traffic generally serve more unique destinations, but this connectivity growth slows significantly beyond 40 mppa. At this point, each additional million passengers yields only up to 30 new destinations via both direct and indirect (up to 2 stops) connections, compared to up to 60 for smaller airports. This decline occurs because there are fewer viable new connection opportunities with significant global airports.

Beyond 40 mppa, airports also face rising capital and operational costs for expansions and maintenance, yet connectivity levels grow at a much slower rate. This reflects diseconomies of scale, where the benefits of increased size are outweighed by the costs of enhancing connectivity.

A key factor contributing to this is the operational constraints faced by large hubs, such as slot shortages and congestion. As airports approach their capacity limits, scheduling flights to new destinations becomes challenging without significant infrastructure upgrades or highly efficient operational systems, which are costly and complex to implement.

Meanwhile, mid-sized hubs (typically includes airports which handle between 5 to 25 mppa) and smaller regional airports (typically those handling fewer than 1 mppa) are experiencing growing market potential, driven by population growth in secondary cities and increased services by low-cost carriers (LCCs). These carriers often establish operations at less congested airports, enabling them to offer new destinations more efficiently than large hubs.

Number of O&D destinations served via direct and indirect connections (up to 2 stops) vs. passenger traffic (Sample of 300 airports in Asia Pacific and Middle East)



As airports exceed 40 mppa, the addition of new destinations slows considerably, indicating diminishing returns caused by fewer viable connection opportunities and operational constraints.

Note: The graph above covers data of selected 300 airports in Asia Pacific and Middle East, representing ~93% total traffic in both regions, based on traffic data for the full year of 2024. Each datapoint represents an airport, with number of unique destinations serving as a measure of connectivity relative to passenger traffic.
Source: Cirium, PwC Analysis

Airports with 25-50 million WLU benefit from optimal cost efficiency through effective cost spreading and lean operations

In terms of cost

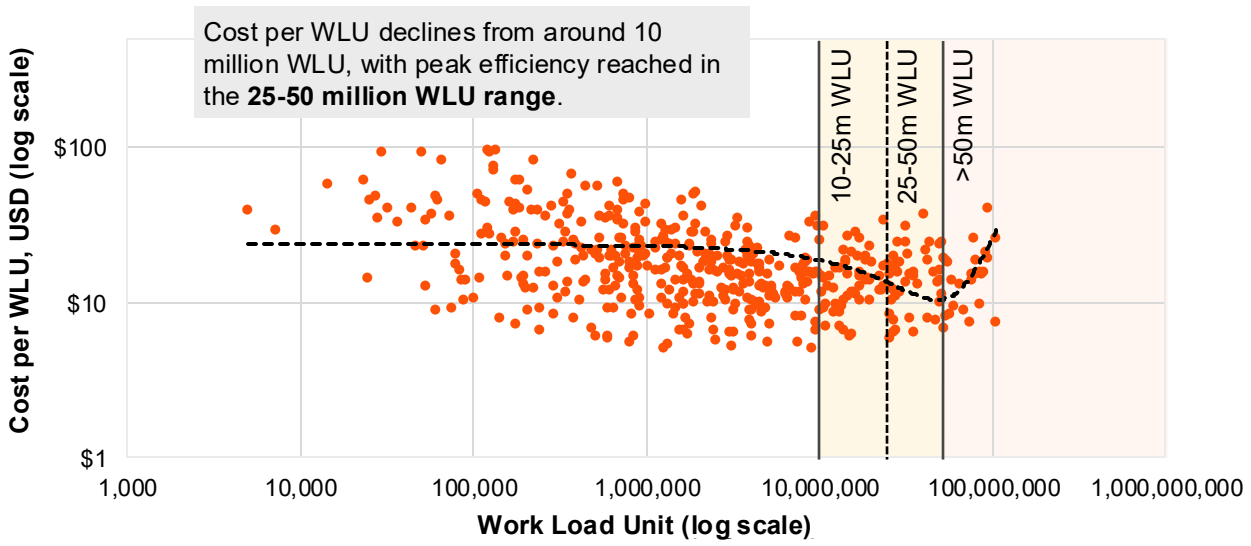
Airports with 25-50 million workload units (WLU) achieve the lowest cost per WLU by efficiently spreading fixed costs across a large number of passengers. Many airports in this category adopt LCC or hybrid models, which streamline processes like check-in and turnarounds, often in less congested areas with lower land costs.

Cost per WLU tends to rise beyond 50 million WLU due to operational challenges such as congestion, longer aircraft taxi times, and increased maintenance expenses. Large airports in metropolitan areas, often full-service hubs, also face land scarcity, requiring expensive expansions, and may deal with complex management structures that add to overhead costs. While these hubs prioritise extensive connectivity, this comes at a higher cost compared to low-cost-focused airports which emphasise point-to-point travel.

Additionally, **airports with significant non-aeronautical activities - such as retail, real estate, and hospitality - may incur higher operating costs for a similar level of WLU**, particularly where commercial development is actively pursued. This is often shaped by ownership models: privatised or corporatised airports tend to diversify revenue streams more aggressively, while publicly operated airports may remain focused on core aeronautical functions.

If external costs, such as passenger travel time, aircraft fuel from extended taxiing, and environmental impacts like noise and emissions, were factored in, costs are likely to rise further for airports above 50 million WLU. Geographic constraints, like limited land availability, and stricter regulations in some regions would also elevate costs, reinforcing their position on the upward slope of the cost curve.

Cost per WLU by airport size in USD, log-log scale (2023)



The cost trend complements the earlier finding that connectivity gains begin to plateau beyond the 40 mppa mark. Airports in the 25-50 million WLU range strike a balance between cost efficiency and continued connectivity growth – suggesting that diseconomies of scale, in terms of both rising costs and diminishing network returns, tend to emerge only at large hubs.

Note: Each point in the scatter plot above represents an airport, covering data of 477 airports worldwide with costs per WLU within the range of USD5 to USD100, based on financial year 2023. Unit costs represents an airport's total operating expenses and capital costs reported in USD.

Source: Airport Economic Performance Surveys, PwC Analysis

Mid-sized airports demonstrated better resilience and adaptability during the post-pandemic recovery

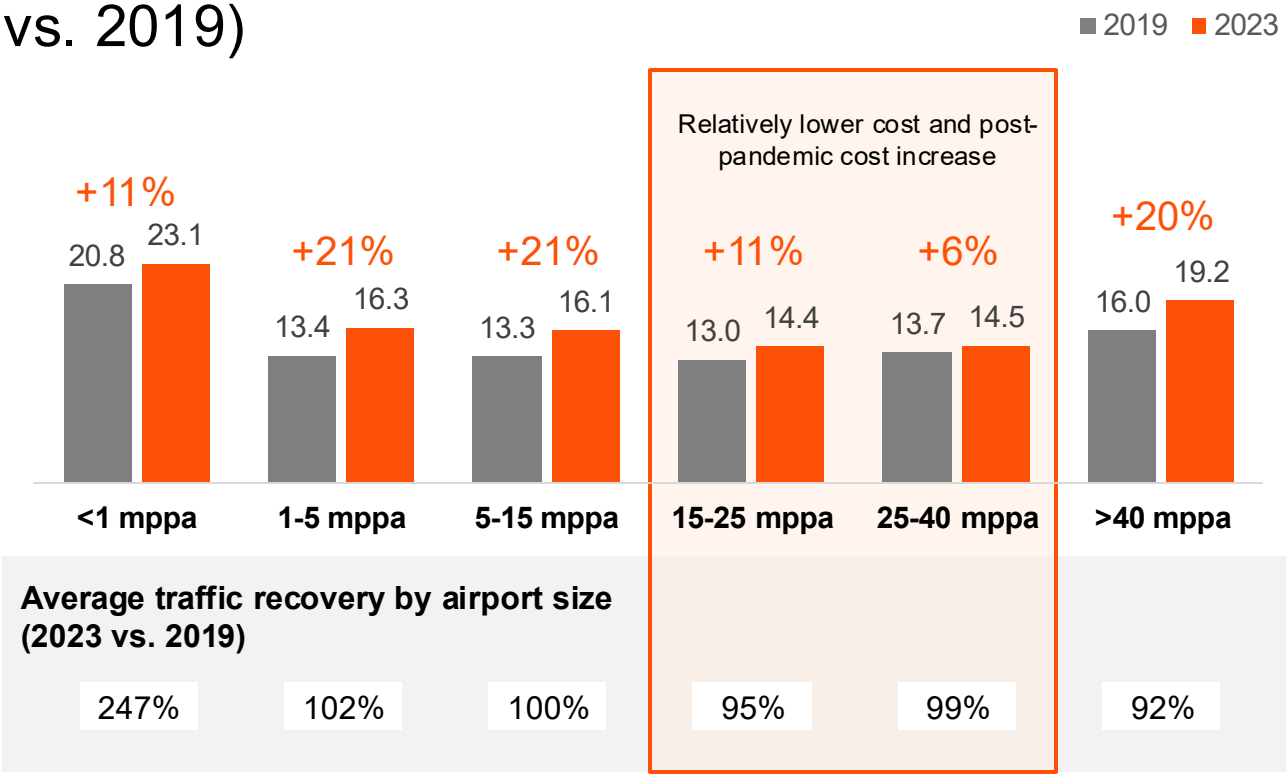
In terms of crisis resilience

Analyses of airport operating costs before and after the pandemic reveals mid-sized airports were uniquely positioned to adapt quickly, minimise disruptions, and maintain a positive passenger experience under challenging conditions.

While larger airports have historically benefited from economies of scale, the pandemic disrupted these dynamics and exposed structural inefficiencies at the upper end of the scale spectrum.

Mid-sized airports, specifically those between 15 and 40 mppa, emerged as the most resilient segment during the post-pandemic recovery. Their operational agility and balanced scale enabled a more effective response to fluctuating passenger demand and evolving health protocols. Their size also allowed for more efficient resource use and closer coordination with regional stakeholders, supporting tailored recovery strategies and a quicker return to stability.

Cost per passenger by airport size (in USD, 2023 vs. 2019)



Average traffic recovery by airport size (2023 vs. 2019)

<1 mppa	1-5 mppa	5-15 mppa	15-25 mppa	25-40 mppa	>40 mppa
247%	102%	100%	95%	99%	92%

Source: ACI Airport Economics Reports, Cirium, PwC Analysis.

Note: Airport size categories are based on 2019 passenger traffic. Average traffic recovery represents annual origin & destination (O&D) traffic data covering 3,999 airports globally in 2023 and 2019.

Pre-COVID

The lowest cost per passenger occurred in the **15–25 mppa** range (USD 13.0), with large airports already showing higher costs (USD 16.0).

Post-COVID Recovery

Airports handling less than 15 mppa saw the **fastest traffic recovery**, with traffic exceeding pre-COVID levels – including a remarkable

247% recovery in the <1 mppa category, driven by a **quicker rebound in domestic and short-haul travel demand**.

Larger mid-sized airports (15–40 mppa) **achieved near-full recovery** (95 to 99%) while **keeping cost increases moderate** (+6 to +11%), highlighting their operational resilience.

Large airports (>40mppa) were the **slowest to recover** (92%) and saw relatively **higher cost increase per passenger** (+20%), reflecting the challenges of scale, fixed overheads, and reliance on long-haul traffic.

Airports below 40 mppa excel in profitability by balancing scale and agility, avoiding the inefficiencies seen at larger airports

In terms of profitability

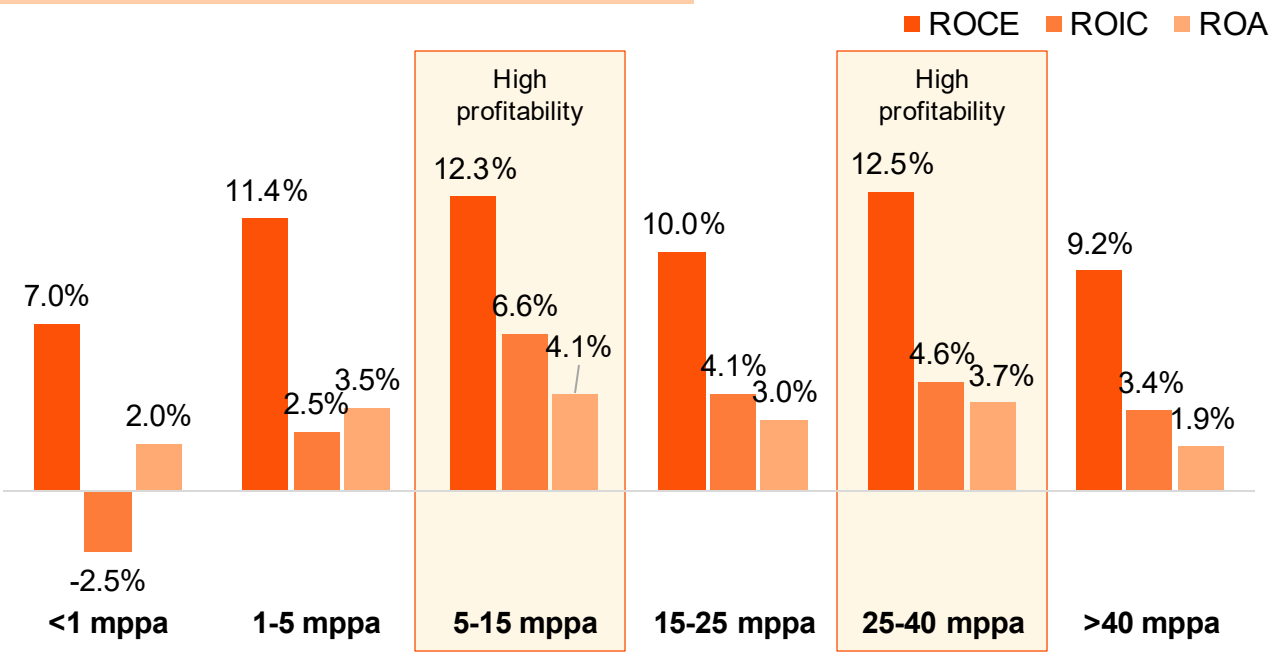
Airports in the 5–15 mppa and 25–40 mppa ranges outperformed others across all three profitability indicators—ROCE, ROIC, and ROA—suggesting a sweet spot where scale supports both efficiency and financial return. This success is partly attributed to their capacity to recover a significant volume of flights after a crisis.

Profitability data reinforces the earlier findings around cost efficiency and traffic recovery: bigger isn't always better. The largest airports faced a sharp drop in profitability post-pandemic, probably due to high fixed costs, delayed recovery in long-haul demand, and operational inflexibility.

Conversely, mid-sized airports (particularly 5–15 mppa and 25–40 mppa) appear to have been in a sweet spot, where scale drives strong capital returns without tipping into complexity and rigidity. Their ability to recover traffic, maintain cost discipline, and generate returns on both capital and assets positions them as the most financially resilient segment in the post-COVID landscape.

As the industry looks to the future, these findings underscore the importance of right-sizing infrastructure, ensuring not just growth potential, but long-term financial viability—especially under stress conditions.

ROCE, ROIC, and ROA by airport size (2023)



Source: ACI Airport Economics Report 2025, PwC Analysis

Note: ROCE: Return on capital employed; ROIC: Return on invested capital excluding non-operating income; ROA: Return on assets

Size categories based on 2019 passenger traffic; The ACI Airport Economics Report 2025 data is based on an annual survey that generated responses from 1,062 airports for the 2023 financial year.

Assessing diseconomies of scale of airports: Relevant stakeholders

Airlines

- With the advent of new aircraft generations that are smaller and have extended flight ranges, mid-sized airports are now capable of handling long-haul flights and are also well-suited to meet the growing demand for regional jets.
- Mid-sized airports generally have shorter taxi times, less congestion, and more efficient gate use, translating to reduced operating costs and better on-time performance.

New aircraft are smaller and fly further

B787 – 8 Dreamliner
60m x 57m x 17m

7,355 nmi

B747 – 100
59.60m x 70.60m x 19.30m

5,300 nmi

Passengers

- Mid-sized airports provide a more pleasant, efficient journey due to their simpler layouts and shorter walking distances between key areas such as check-in counters and gates, which can improve the overall passenger experience.
- In comparison, large airports have more delays, long walking distances, increased land travel distances, and lower passenger satisfaction.

Airports sized 15-25 mppa
Optimal terminal utilisation (e.g. Jeju International Airport)

Airports sized >60 mppa
Inconvenience in movement if airports have many terminals (e.g. London Heathrow Airport) or large-sized terminals (e.g. Suvarnabhumi Airport)

Governments

- The infrastructure required for large airports involves substantial capital investment, which can place significant strain on state budgets, either directly, or via absorbing PPP capacity in the country.
- Upgrading and expanding facilities at large airports, such as runways and air navigation systems, also demands considerable financial resources.

Three large airport projects in Southeast Asia were listed under top 10 most expensive airports globally in 2021: **U-Tapao, Long Thanh,** and **Bulacan International Airports**.

Due to high capital expenditure costs and budget constraints, governments need to seek private sector capital.

Assessing diseconomies of scale of airports: Relevant stakeholders (cont.)

Environment

- While most environmental discourse focuses on flight-related (Scope 3) emissions, the direct (Scope 1) and energy-related indirect (Scope 2) emissions of airports themselves also represent a measurable carbon footprint.
- Mid-sized airports are best positioned to achieve balance between size, infrastructure complexity, and operational demand that avoids the high fixed energy use of small airports and the more complex, energy-intensive systems of large airports.

Scope 1 & 2 Emissions* (2023)

London Heathrow Airport (79.2 mppa)
405.5 tCO_2 per million passengers

London Gatwick Airport (40.9 mppa)
225.0 tCO_2 per million passengers

London City Airport (3.4 mppa)
178.5 tCO_2 per million passengers

*Market-based emissions.

Investors

- Mid-sized airports often outperform larger hubs on financial metrics like ROA, ROCE, and ROIC, as they tend to be more agile and require less costly upgrades than mega hubs.
- Investors prefer mid-market infrastructure like mid-sized airports due to more predictable cash flows and manageable risk. These airports are less exposed to demand shocks and congestion risks compared to mega hubs.

Research indicate that medium-sized airports exhibit superior financial performance, particularly in terms of liquidity and profitability. Conversely, large airport companies were found to be the most indebted.

Conclusion

We recommend that policy makers, planners, and airport developers expand their focus beyond merely addressing capacity to meet demand. Instead, they should evaluate options for **delivering a cost-effective travel experience for passengers**. These options should consider factors such as surface travel distances to the airport, the time spent navigating the airport from curbside to aircraft, and the operational efficiencies that airlines achieve with shorter taxi distances from runway to gate. Additionally, the availability of slots that align with passenger and airline schedules should be taken into account.

Undertaking the development of mega-hub airports is not a guaranteed success. Such projects entail significant challenges related to connectivity, operational efficiency, and the complexity of overall management. Ensuring optimal performance and satisfaction for all stakeholders presents considerable difficulties in the context of large-scale airport operations.

Secondary or mid-sized airports with terminal capacities of 15-40 mppa can provide more sustainable air connectivity growth compared to mega hubs. There are many growth opportunities at secondary or mid-sized airports, with more efficient management of return and expense, and better implication for various relevant stakeholders.

Considerations for policy makers and airport developers

Regular evaluations and studies

Identifying inefficiencies and developing targeted solutions to reduce the impact of airport size on profitability and efficiency.

Environment

Promoting environmentally sustainable practices.

Congestion and delay issues

Building smaller airports in multiple locations, investing in technology and automation to resolve diseconomies of scale issues.

Alliance and partnerships

- Forming partnerships with neighbouring airports
- Developing policies to encourage airlines to use regional airports
- Working with hub airlines to optimise their operations and costs at the airport

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