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All Clear for Takeoff: Evidence from Airports on the Effects of Infrastructure Privatization
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ABSTRACT

Infrastructure assets have undergone substantial privatization in recent decades. How do different types of owners target and manage these assets? And does the contract form—control rights (concession) vs. outright ownership (sale)—matter? We explore these questions in the context of global airports, which like other infrastructure assets have been privatized by private firms and private equity (PE) funds. Our central finding is that PE acquisitions bring marked improvements in airport performance along a rich array of dimensions such as passengers per flight, total passengers, number of routes, number of airlines, cancellations, and awards. Net income increases after PE acquisitions, which does not reflect lower costs or layoffs. In contrast, in the few cases where non-PE acquisitions bring some improvement, it appears to reflect targeting rather than operational changes. Overall, we find little evidence that privatization alone increases airport performance; instead, infrastructure funds improve performance both in privatization and subsequent acquisitions from non-PE private firms. These effects are largest when there is a competing airport nearby. Finally, we show that outright ownership rather than control rights alone is associated with the most improvement after privatization.

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1 Introduction

Trade and transportation infrastructure has undergone massive privatization worldwide over the past 50 years. Assets such as seaports, airports, roads, bridges, railroads, water systems, and internet cables have transitioned from government ownership and operation to the private sector, via either long-term concession leases or outright ownership transfers. Over time, private equity (PE) investors—-usually through dedicated infrastructure funds—-have come to play an important role in this process. The privatization of traditionally publicly-owned infrastructure raises questions about what types of goods private markets can efficiently provide, a topic that economists have long debated, perhaps most famously in the context of lighthouses.[1] Studying infrastructure privatization in the modern era sheds light on the economics of these types of goods, the public policy questions around who should own these assets, and the role of PE in the economy.

We focus on airports, examining how changes in ownership relate to changes in service quality and financial performance. Airports are crucial strategic and economic assets, serving as gateways for people and goods from around the globe to enter a city and its country. Airports and infrastructure more broadly have distinctive features relative to other assets: They are large, long-term, provide an essential service, and face little competition and high barriers to entry. Unlike other types of infrastructure, however, airport revenue can be volatile and linked to the business cycle, as it depends on passenger and freight transport.

In this paper, we document airport privatization patterns over nearly four decades. We examine the consequences of ownership type as well as variation across regulatory regimes. Airports provide a useful setting for an international analysis because they share a common business model: Sell to passengers in terminals and charge airlines for using the terminals and gates. Around the world, airports adhere to common standards that enable aggregate performance analysis. We consider three ownership types that have dominated the industry over the past fifty years: Public, non-PE private, and PE. Under public ownership, the government owns and manages the airport. When the airport privatizes, a firm acquires the right to operate, invest in, and earn residual cash flows from the airport in either a sale or a concession. Following industry standards, we define a sale as either an outright sale or a long-term (>30 years) lease, while concessions are shorter-term leases. We segment the private firms into those owned by infrastructure funds (PE) and those that are not (non-PE private).

Relative to other work on infrastructure or privatization, one contribution of this paper is to consider

[1] See Mill and Robson (1965), Pigou (1938), Samuelson (1964), and Coase (1974).

PE separately. PE represents a different economic model from independent private ownership, including higher-powered incentives to maximize profits and shorter time frames for creating value. Infrastructure funds have been growing rapidly and are now a major asset class within private capital markets. Between 2015 and 2019, these funds invested $388 billion and have more than $300 billion of capital raised and ready to invest ("dry powder") as of 2022, up from $69 billion in 2011.[2] The real effects of PE have been studied in other sectors such as retail and manufacturing, but there is little evidence on whether PE creates value in infrastructure, which is characterized by longer holding periods and intensive government monitoring. With long term, stable cash flows, privatized infrastructure has proven an attractive class to institutional investors. However, Andonov et al. (2021) document that in practice infrastructure funds have failed to outperform the market on average, and value creation has been driven by short-term capital gains from quick exits, not long-term holdings. This contrasts with evidence of strong returns in PE overall (Harris et al., 2014). It is an open question whether infrastructure funds have similar real effects as PE in other sectors.

We combine a wide array of sources to paint a reasonably holistic picture of airport ownership and operations. We begin with an expansive dataset of 2,444 unique airports in 217 countries. In the most comprehensive, hand-collected privatization data effort to date (to our knowledge), we document that 437 have been privatized. Of these, 102 have at least once been owned by an infrastructure fund. As government plays a crucial role in determining airport outcomes, even after privatization, we collect information on airport price regulation as well as local government quality and business climate.

In our main analysis, we use airport-year panel data, with information on traffic and passengers at airports with more than 10,000 passengers and 100 flights a year. We first examine determinants of private ownership. Notably, PE but not non-PE buyers avoid airports with cost-based price regulation, where prices must reflect costs and thus profits are limited. Infrastructure funds also target airports with higher trade volumes. Motivated by Lerner and Schoar (2005), who show how cross-country governance affects PE investment approaches, we consider local governance indices. Infrastructure funds target airports in countries with better judicial effectiveness, and more financial freedom. A takeaway from this exercise is that these two types of private ownership have different predictors, suggesting a more systematic approach on the part of the infrastructure funds.

We next explore whether the ownership type is associated with operational changes. Our empirical

[2]See https://www.ey.com/en_us/private-equity/how-pe-infrastructure-funds-are-getting-new-options, https://www.ft.com/content/b00cb6b4-a015-493f-8cf6-ddc89e93ff34, and the Pitchbook 2021 Q1 Real Assets Report (does not include Oil & Gas).

model, following the approach commonly used in the literature, is a differences-in-differences design. As we are interested in both how airport performance changes post-privatization, and also whether PE ownership has distinct effects from non-PE private ownership, we employ a single specification that makes use of the four types of ownership changes we observe in the data. The first two are the privatization events, where the airport transitions from government to either private non-PE or PE ownership. The second two are post-privatization transactions where an airport transitions from non-PE private to PE or vice-versa.

Clearly, airports are not randomly targeted for ownership changes. PE and non-PE private firms acquire airports where they believe they will earn the highest returns. Our case for causal effects is based on dynamic, fully saturated differences-in-differences event studies which assess whether airports were already on track to the outcomes we observe. To the degree the event studies suggest no pre-trends, we argue that our results have a causal interpretation within the treated population. That is, they would not necessarily generalize to any random airport by itself. Across broad swathes of the world, airports have in practice transitioned to private and PE ownership, making the treated population economically relevant.

The results, estimated during our sample period of 1996 to 2019, paint a consistent picture in which infrastructure funds improve airport performance. First, we consider traffic. Passengers per flight is a key efficiency metric, enabling the airport to serve more customers with the same runway and gate infrastructure. Under PE ownership, both in privatization events and in subsequent acquisitions from non-PE private firms, the number of passengers per flight increases, for example by 20% in privatization events. In contrast, non-PE privatization has no effect. This appears to reflect encouraging airlines to bring larger planes, as the share of jets increases at the expense of regional and small aircraft. Overall passenger traffic increases under both ownership types, but by more than four times as much–84%–under PE ownership. The number of flights exhibit a similar pattern.

Airports are the sole gatekeepers to a key downstream sector: commercial airlines and the routes they offer. Although we find average increases in the number of airlines and routes for both non-PE and PE ownership, the event studies have strong pretrends for non-PE, suggesting that targeting rather than operational changes explains the average effects. For PE, the increase in airlines reflect more low-cost carriers. Greater competition among airlines may lead to better service and lower prices. Both in privatization and post-privatization transactions, PE also increases the number of routes by much more than non-PE. This is is driven by international routes, which increase by 46% after PE privatization. This benefits passenger welfare and the local economy, as access to more routes creates new economic

opportunities (Bernstein et al., 2016).

We find dramatic declines in the flight cancellation rate under PE ownership, again both in privatization and subsequent transactions. This presumably reflects improved operations. The event studies indicate that under PE ownership, there is a decline in the share of departures that leave on time in the deal year, but by the second year after the deal there is a large increase in the on-time departure rate relative to before the deal. However, the average effects suggest declines in the on-time departure rate for both PE and non-PE. This might reflect airport congestion, driven by the higher volume documented above, or more delayed incoming flights. The airport can improve the former, but the latter is out of the airport's control.

There are a number of aspects of the passenger's experience in an airport that cannot be directly observed, such as the quality of the stores, waiting areas, and overall cleanliness. To evaluate the impact of privatizations on these factors, we employ ACI Word's annual ASQ awards, which recognize airport excellence in customer experience, based on surveys of passengers. We find that post-privatization transitions to PE ownership increase the chances of winning an award.

We consider two financial dimensions: prices and airport financials. First, consistent with the airline industry's dim view of privatization (see Section 2.1), fees charged to airlines increase after privatization by non-PE firms and in non-PE to PE transactions. Relatedly, there is a strong relationship between PE acquisitions from non-PE private firms and the removal of price regulation, which could reflect PE owners lobbying for deregulation. In a rare look at the income statements of private, PE-owned firms, we see that net operating income increases by 108% after PE privatization. This appears to reflect higher revenues rather than significant cost-cutting, as we see increases in operating expenditure and no change in employees per passenger. We observe revenue increases, driven by both aeronautical (i.e., charged to airlines) and non-aeronautical (i.e., terminal retail) sources. After transitions from PE to non-PE private ownership, we see significant declines in net income and revenue, as well as in operating expenditure.

An important but understudied question in corporate finance is the extent to which ownership leads to more efficient investments than control rights alone (Hart, 1995b). Airport privatization presents an interesting setting for distinguishing between the roles of ownership and control by comparing concessions (which confer control) with sales (which confer ownership). We find that across the main outcome variables, sales lead to larger efficiency improvements than concessions, especially when they the new owner is a PE fund. This suggests that ownership rights may lead to better aligned incentives, at least in our context.

Finally, we examine the role of the competitive landscape, which is especially relevant given antitrust

authorities' increased scrutiny of PE. Our estimates indicate that improvements are much larger in the presence of a competing airport, consistent with competition playing a beneficial role in the airport industry for inducing the most productive outcomes under private ownership. However, this relationship is magnified for PE relative to non-PE private ownership. PE ownership may be more responsive to competitive incentives than other types of ownership because it entails higher quality managers and higher-powered incentives to maximize profits.

In general, event studies indicate no pre-trends for our key results before PE acquisitions, consistent with PE owners introducing operational changes. In contrast, there are strong pre-trends for outcomes where we do see average improvements after non-PE private acquisitions, suggesting that these improvements reflect targeting. In other words, non-PE private firms tend to purchase airports already on track to better performance. We perform a number of robustness tests. For example, we use three methods to address potential bias from multiple treatment periods (i.e., staggered roll-out), even though the vast majority of observations in our sample are never-treated: the Callaway and Sant'Anna (2021) estimator, a stacked regression (Cengiz et al., 2019; Baker et al., 2022) and a matching estimator (Huntington-Klein, 2021). Our key findings showing productivity gains following PE buyouts are robust to all of these approaches.

Overall, we find strong evidence that infrastructure funds improve efficiency of the airports they acquire. Of course, this conclusion comes with some caveats. Airports are (as we document) not randomly targeted for privatization and PE acquisition, so despite our tests and the absence of pre-trends, it is possible that the airport would have experienced the changes we observe in the absence of the ownership change. Furthermore, we do not observe all dimensions of airport operation. Each data source does not cover all airports, and some samples have relatively small numbers of PE-owned airports, though the main results are robust to the overlapping samples. Nonetheless, we believe our sample and outcome variables represent by far the most complete picture of ownership and operations for a class of infrastructure to date. These data allow us to document for the first time how privatization and PE ownership affect the operational and financial performance of infrastructure. Future research is needed and we hope that our data will be useful in those efforts.

One takeaway from our analysis is that privatization consistently improves productivity only with PE involvement. This likely reflects a combination of new strategies, including more equity-based compensation for management and investment in better passenger services and technology alongside

well-targeted cost-cutting. One reason a hard-nosed airport owner may benefit the airport is the nature of airport customers. Airports negotiate access, prices, and capital expenditure with airlines, which are well-informed and well-resourced corporate stakeholders. Conversely, the customer population is more vulnerable and faces information asymmetry in settings where PE has been found to have detrimental effects, such as for-profit colleges and nursing homes (Eaton et al. (2020), Gupta et al. (2021)). For airports bargaining with airlines, power varies depending on airline market share, ability to add new carriers, and whether the airline can hold up the airport by using common new resources but refusing to pay higher fees. Airports also often face competition from nearby airports or high-speed rail, limiting their monopoly power, and their relatively wealthy, sophisticated passengers are likely to purchase less in terminals or go elsewhere if quality is poor. Finally, airports face intensive local and central government scrutiny, creating an ever-present threat of regulation. For these reasons, airports may be a setting in which PE's capacity to finance and orchestrate complex operational improvements benefits at least one key non-investor stakeholder: passengers. Airlines may suffer from higher fees, but seem likely to benefit from higher passenger volume. Importantly, the absence of strong effects for non-PE firms may not generalize to other privatization settings, as it may be that the private firms—which were often founded to operate a newly privatized airport—are not especially productive.

This paper sits at the juncture of three literatures: the political economy of privatization, infrastructure economics, and the real effects of PE. Our results offer contributions to all three. First, while the privatization literature has typically found large positive effects on firm performance of privatization (e.g. Dinc and Gupta (2011)), we find weak effects in the context of airports for non-PE private firms.[3] One possibility, in addition to less-productive private firms mentioned above, is that the essential and highly salient nature of airports may lead to decent performance under government ownership compared to other infrastructure assets. Existing work on airport privatization has used small samples or case studies, with more descriptive methods, and finds mixed effects of privatization on efficiency.[4] There is also work on congestion in airports (Brueckner (2002), Mayer and Sinai (2003)).

Second, we contribute to the literature on who should own and invest in infrastructure. This literature

[3]Dinc and Gupta (2011) study drivers of firm privatization in India. While their study is mostly focused on targeting, they also find evidence of efficiency improvements after privatization. Other work on privatization includes La Porta and Lopez-de Silanes (1999), Megginson et al. (2004), Biais and Perotti (2002), and Dastidar et al. (2008).

[4]In a sample of about 100 mostly North American airports, Oum et al. (2008) find evidence that privatization increases efficiency. Van Dender (2007) studies determinants of airport revenues in the U.S. Other work includes Oum et al. (2006), Assaf and Gillen (2012), Adler and Liebert (2014), Gutiérrez and Lozano (2016), Olariaga and Moreno (2019), Aguirre et al. (2019).

has focused primarily on the role of government, asking how political agendas affect investment, and how that investment affects macroeconomic growth (Gramlich (1994), Milesi-Ferretti et al. (2002), Esfahani and Ramırez (2003), Cadot et al. (2006)). For example, Donaldson (2018) shows the large impact of India's colonial rail network. Motivated by these findings and the fact that air travel represents the modern equivalent of the rail, boat, and road systems studied in previous works, we take a different approach, focusing on the nature of ownership. Our results shed light on control rights versus ownership rights and highlight that especially in regulated contexts, high-powered incentives matter for performance.

Finally, we contribute to work on the real effects of PE.[5] Studies have found positive effects on firm performance and productivity in sectors with relatively little government interference, transparent product quality, and high levels of competition, such as grocery stores, fast food restaurants, and manufacturing (Davis et al. (2014), Fracassi et al. (2020), Bernstein and Sheen (2016)). In contrast, in sectors with opaque product quality, intensive subsidy, and which traditionally rely on implicit contracts with consumers and the government, there is evidence of negative effects (Eaton et al. (2020), Gupta et al. (2021), Phalippou (2020), Liu (2021), Ewens et al. (2022)).[6] We offer a setting that helps to reconcile some of these findings. We find largely positive effects of PE ownership in a sector with intensive government regulation and little competition. However, airport quality is salient to the local population and airports' national strategic importance and safety concerns yield motivated and politically empowered regulators, with other sophisticated stakeholders—such as airlines—also monitoring. Thus it appears that PE can work well in a highly regulated setting when incentives are well-aligned.

2 Institutional Context

In this section, we describe the history of airport ownership, privatization, and regulation, introducing the key concepts peculiar to the strategic infrastructure assets that we will analyze later in the paper. We first briefly discuss the history of privatization, then explain why infrastructure funds represent an economically interesting and important class of ownership that is distinct from other private ownership.

[5] A strand of the PE literature studies returns to investors, including Franzoni et al. (2011), Sensoy et al. (2014), Cavagnaro et al. (2019), Harris et al. (2014), Robinson and Sensoy (2016), Andonov et al. (2021), and Gupta and Van Nieuwerburgh (2021). Other work considers how PE structures transactions to create value (Ivashina and Kovner (2011)).

[6] Other work on the real effects of PE includes Boucly et al. (2011), Olsson and Tåg (2017), Bellon (2020), Cohn et al. (2021), Fang et al. (2021), Gao et al. (2021), Gornall et al. (2021), and Liu (2021). See Jenkinson et al. (2021) and Gompers and Kaplan (2022) for surveys.

2.1 Privatization Background

Airports have historically been government-owned and operated, reflecting their role as vital strategic assets for national economic growth, prestige, and security, with further implications for the local environment and economy. Regardless of ownership, these features lead airports to be closely monitored and regulated. Although today most airports remain owned by national or regional public sector agencies, there has been a wave of privatization over the past fifty years, along with the privatization of many other types of infrastructure, such as seaports, railroads, and utilities. This wave was inaugurated in 1987 when the UK floated the British Airports Authority (BAA)—which consisted of Heathrow and six other airports—on the London Stock Exchange. The rationales for this move and subsequent early privatizations were reducing public sector inefficiencies and improving service quality (Graham (2020)). In the BAA privatization, parliament explained that:

> "The Government is committed to converting as many as possible of Britain's airports into private sector companies as part of its policy of reducing the role of the State... It will also encourage more innovative management, and lead to efficiency gains and greater responsiveness to customers."[7]

After the 2008 financial crisis, the rationale for privatization shifted towards emphasizing financial gains for the public sector (i.e., reducing public debt) and accessing private capital for needed new investment (Van Nieuwerburgh et al. (2015), Cruz and Sarmento (2017)). Overall, airports have transitioned from being considered public utilities to being considered as firms delivering services to airlines and retail stores (Gillen (2011)).

Alongside these ideological trends, privatization manifested in three main ways. In the early phase, IPOs were a common means, as in the case of BAA or Malaysia in 1999.[8] In the late 1990s, governments began to rely on two other forms: concessions and sales. In a concession, also called a public-private partnership (PPP), governments grant rights to operate an airport and control the airport's activities to a private sector company for a specific period. During this concession period, the concessionaire operates the existing facility and undertakes necessary capital investment to expand the airport while paying series of concession fees to government, which can be fixed or variable (e.g., as a percentage of revenue). At the end

[7] Secretary of State for Transport (1985), Airports Policy, Cmnd 9542, London: HMSO

[8] Other examples are Vienna (1992), Copenhagen (1994), Auckland (1998), Zurich (2000), Fraport (2001), Thailand (2004), Paris (2005), and Navegacion Aerea (AENA) in Spain (2015).

of the contract period, the airport typically reverts to the government. The government remains the airport owner and has ultimate control rights (IATA (2018)). Examples of concessions include London Luton in 1998, as well as the Delhi and Mumbai airports in India in 2006.[9] The third form, a sale, usually involves a very long lease of the whole airport (say, 100 years) to a private company. For example, in 1997 and 2002, Australia privatized the Brisbane, Melbourne, Perth, and Sydney airports this way.[10] In a sale, the private company obtains ultimate control rights over the airport. However, in both concessions or sales the private firm typically has de facto control over operations and rights to residual cash flows conditional on the local regulatory regime. Government typically closely regulates aspects of operations, sometimes limiting the prices the airport may charge (discussed further below).

Early private airport owners were entities created to run one privatized airport, which then expanded, purchasing others as they privatized in turn. One example of this is Fraport, which was initially established to operate Frankfurt Airport and now runs most airports in Greece, among other countries. These private conglomerates sometimes retain a tie to government; for example, local German governments—the State of Hesse and the city of Frankfurt—together own just over 50% of publicly-traded Fraport. In most cases, however, the private companies have minimal, if any, government ownership. Following the financial crisis, the composition of airport buyers shifted away from private operators and international infrastructure companies towards international funds sponsored by financial institutions, notably infrastructure-specific PE.[11] This new type of owner brought larger amounts of capital for improvements and, in theory, more professional operational knowledge. As an early example, in 2001, asset manager H.R.L Morrison & Co purchased Glasgow Prestwick Airport in the UK. More recently, in 2015, Corsair Capital purchased the Lynden Pindling International Airport in the Bahamas.

Beyond the three broad categories of public, non-PE private, and PE ownership, there are many other ways in which airports have private sector involvement, for example, by engaging private firms to develop or run specific terminals. For the purposes of our study, since we do not observe terminal-level performance, we are interested in overall airport ownership. This is also the most interesting unit of observation from the perspective of control rights and residual claim to profits.

Privatization has not always been well-received by the airline industry, which complains of higher

[9] Further examples of concessions, which sometimes involve new terminal construction contracts, include Lima (2000), Ankara (2003), Montego Bay (2003), Brasilia/Sao Paulo (2012), Zagreb (2012), ANA in Portugal (2013), and Kansai (2015)

[10] Other examples are Dusseldorf (1998), South Africa (1998), Turin (2000), Rome (2000), Milan (2011), and Toulouse (2015), among many others, including regional airports in the UK.

[11] See Condie (2015), Graham (2020).

charges without commensurate service improvements. During our sample period, the airline trade association, IATA, reports that about 11% of total airline revenue is paid to airports.[12] IATA also pointed out in 2017 that average airport per-passenger charges in Europe increased from 16 to 33 Euros between 2006 and 2016. They noted that "The share of fully privately owned airports in Europe increased from 9% to 16% between 2010 and 2016...While publicly owned airports may be considered as benign monopolists, often pursuing economic and social goals in support of their local region, this is not the case with privately-owned airports which are driven by investor returns" (IATA 2017).[13] Airline welfare is beyond the scope of this paper, but it is worth highlighting their opposition to privatization.

The U.S. has not historically privatized its airports because of strong federal government incentives to remain publicly owned and operated, which do not exist in most other countries. First, public sector airports in the U.S. can raise tax-exempt revenue bonds, while investors in bonds issued by private companies must pay tax on the interest they earn. Second, airports can receive large federal Airport Improvement Program grants if they commit to not making a profit from airport operations.[14] Over the past 10 years, the federal government has offered a limited number of exceptions to the normal grant restriction, but the only successful instance of privatization has been the airport in San Juan, Puerto Rico. In other cases, such as that in Westchester County Airport and Chicago Midway, local opposition to expansion or to privatization on principle has derailed the efforts.[15]

A new model in the U.S., pioneered by the New York City airports, employs PPPs for the financing, development, and operation of new airport terminals. PE has played an active role, with for example Carlyle leading a $9.5 billion development at JFK.[16] Unfortunately, operations and financials are not typically available at the terminal level, and these terminal-specific deals are also too recent for evaluation. For this reason, we do not evaluate these deals and instead treat the few airports in this category as government-owned and operated.[17] That said, it appears likely that PE's footprint in the U.S. airport sector will expand. For example, in 2017 Carlyle's then-president Glenn Youngkin said: "There's an

[12] International Air Transport Association-IATA. (2007). IATA economics briefing 6: Economic regulation. Geneva: IATA.

[13] https://www.iata.org/en/iata-repository/publications/economic-reports/airport-competition-myth-or-reality/

[14] https://reason.org/wp-content/uploads/annual-privatization-report-2021-aviation.pdf

[15] For example, see https://www.theexaminernews.com/opposition-to-privatization-strong-at-airport-hearing-in-armonk/a

[16] https://centreforaviation.com/analysis/reports/jfks-new-terminal-one-accentuates-the-appeal-of-the-airport-p3-590729

[17] Another reason why U.S. airports are more challenging to study is that airlines sign complex, bespoke contracts in which the airlines often manage and finance airport assets (such as terminals), and these contracts determine the payments they make (Van Dender (2007)).

extraordinary amount of investment needed in airports... That's probably going to be the top prospect for investing in infrastructure over the near term."[18]

2.2 Private Equity

This paper studies the evolution of airport ownership across three major categories: government, non-PE private, and PE. PE represents a fundamentally different model for creating value. PE funds are financial intermediaries, with capital raised from limited partners such as pension funds and endowments, who are not involved in day-to-day investment and operational decisions. The general partners (GPs), who own the PE firm and manage its funds, are responsible for the lifecycle of a deal: choosing the company to acquire, negotiating the transaction, adjusting operations at the target firm, and finally harvesting value, usually via a liquidation event in which they sell the portfolio company. The traditional transaction in PE is the leveraged buyout (LBO), where the target firm is acquired with funds comprised mostly of debt—which is placed on the target firm's balance sheet—and a small portion of equity from the limited partners.[19]

PE is associated with particularly high-powered incentives to maximize profits in part because the GPs who manage PE funds are compensated through a call option-like share of the profits (Kaplan and Stromberg (2009)). Specifically, their compensation stems primarily from the right to 20% of profits from increasing portfolio company value between the time of the buyout and an exit, when the company is sold to another firm or taken public. The funds that purchase airports in our data are mainly closed-end, with roughly 10-year time frames for liquidating assets and delivering returns to investors. Therefore, the PE managers are considering avenues for exit at the time of purchase, since they must accomplish the sale within, typically, 3-8 years. In contrast, private firms purchasing airports often have very long-term time frames for generating returns on the basis of sustainable cash flows. GPs also can receive transaction and monitoring fees, which are not tied to performance. However, deals are typically not successful if the business continues as-is, motivating aggressive and short-term value-creation strategies. In contrast, a traditional business owner running the firm as a long-term going concern with less leverage may prefer lower but more stable profits.

There is evidence that PE buyouts increase productivity, operational efficiency, and generate high returns. Kaplan and Stromberg (2009) argue that PE owners increase firm value through three channels, which

[18] https://www.infrastructureinvestor.com/carlyle-lead-12bn-modernisation-new-yorks-jfk/

[19] Kaplan and Stromberg (2009), Jenkinson et al. (2021) and Gompers and Kaplan (2022) provide detailed discussions of the PE business model and review the academic evidence on their effects. In the interest of brevity, we limit our discussion. See also Kaplan (1989), Kaplan and Schoar (2005), Gadiesh and MacArthur (2008), Guo et al. (2011), Acharya et al. (2013), Harris et al. (2014), Robinson and Sensoy (2016), Korteweg and Sorensen (2017).

they call financial, governance, and operations engineering. The first channel includes alleviating credit constraints, which may enable more investment (Boucly et al. (2011)) and exploiting the favorable tax treatment of debt (Chambers et al. (2021)). Governance engineering includes changes to the compensation, benefits, and composition of the management team at the target firm to align their incentives with those of the PE owners: for example, instituting equity-based compensation (Gompers et al. (2016)). Bloom et al. (2015) show that PE-owned firms are better managed than similar firms that are not PE-owned. In operations engineering, GPs apply their business expertise to add value to their investments. For example, they might invest in new technology, expand to new markets, and cut costs.

One motivation for our study is that infrastructure funds have distinctive characteristics that may lead to different real effects, relative to the rest of the PE market whose real effects have been studied previously. Infrastructure funds tend to be large, with more than 70% of capital raised since 2012 going to funds that raise at least $1 billion. The average infrastructure fund in recent years is $2.7 billion, while the average fund size in all other classes is $700 million. Infrastructure funds purport to offer the high returns of PE but with more stable cash flows, less business cycle correlation, and lower volatility. Preqin reports that institutional investors allocate assets to infrastructure overwhelmingly because they believe it offers diversification benefits, with low correlation with other asset classes.[20] Andonov et al. (2021) document that limited partners investing in infrastructure funds do so because they believe the funds will have these benefits. However, using cash flow data, they find that in contrast to the common narrative, infrastructure funds deliver below-market returns and have similar volatility and business cycle exposure as other PE vehicles. They believe that one reason is a focus on quick exits and the standard closed-ended structure with periods of 10-12 years in which to invest, create value, and liquidate assets. It remains to be seen whether this misalignment in time frames leads to negative real effects.

Infrastructure funds merit study in part because their footprint as an asset class has grown dramatically in recent decades; in 2000, they invested just $2.2 billion, while in 2018, they invested $119 billion.[21] It seems likely that investment will increase in the medium term given the more than $300 billion in dry powder.[22] This massive growth reflects both large increases in private capital supply from pension funds, insurance companies, sovereign wealth funds, and other institutional investors, but it also reflects

[20] https://www.preqin.com/academy/lesson-4-asset-class-101s/infrastructure

[21] Investment declined to $39 billion in 2021, which may reflect the pandemic. Based on data from Pitchbook. We use this for data beyond airports as we do not have access to Preqin outside of airport deals.

[22] https://www.ft.com/content/b00cb6b4-a015-493f-8cf6-ddc89e93ff34

governments increasingly seeking out private capital to make needed infrastructure investment under constrained public resources. Infrastructure funds appear to place a premium on GP experience and competence in the sector. Specialty knowledge about regulatory and operational issues is especially crucial, not least because winning a project typically requires much more than simply the highest bid, including a long negotiation process with the local government and a strategic plan for the airport.[23] Because of their importance and visibility, changes to airport ownership are typically politically sensitive, are closely monitored by the local government and generally are objects of close media scrutiny. This requires special expertise, including the ability to partner with government over the long term, on the part of the PE managers.

2.3 Airport Revenue

One distinctive feature of infrastructure as an asset class is that governments often regulate how the private owner or operator of an infrastructure asset may earn revenue, sometimes with the justification that the asset represents a natural monopoly. Therefore, the price regulation regime and its capacity for change are crucial inputs to profitability. From the government's perspective, there is a need to design schemes that will (a) induce effort on the part of the private firm; (b) keep prices within politically acceptable limits; and (c) ensure the private firm does not risk being held up. Regulators and politicians often face pressure from local users for "fair" prices. The constituent base may prove more impactful than the interests of a few, often non-local, investors. However, holding up investors may make it more difficult to attract new infrastructure capital. Van Nieuwerburgh et al. (2015) suggests that investors price regulatory risk into their required rate of return, which has led some jurisdictions, especially middle-income countries, to build a reputation for contract reliability. Low-income areas may be less politically stable, while high-income countries may have less urgent need for the external investment. Both situations could lead consumer demands to win the day. Acharya et al. (2020) formally model these hold-up problems in the infrastructure investment setting.

Airport revenue and pricing follows from the two basic functions of an airport: To enable the airplane to safely take off and land, and to move the passenger through the terminal. There are two primary sources of revenue. The first and larger source is aeronautical revenue, which comes from airlines. This includes per-passenger charges as well as per-landing and per-takeoff runway charges. The per-passenger charges represent fees for using the terminal building, while the runway charges represent fees for the airplane to

[23] CohnReznick. "Infrastructure Investment Report." 2021.

use the runways and gates. Passenger- and aircraft-related charges reflect features such as the size of the craft and the timing (weekday vs. weekend, morning vs. evening) of departure and arrival. Passenger charges and runway charges represent 41% and 21% of aeronautical revenues, respectively.[24] Parking charges are the third largest source of fees (12%), and the rest varies by airports, including noise and environmental charges and government fees.

Second, non-aeronautical (commercial) revenue comes from retail leases as well as ancillary passenger services such as parking garages and transportation (taxis, buses). Airports earn rents from retail space in the terminals for stores such as duty-free shops and restaurants. These leasing contracts are generally structured as minimum fixed rents plus additional profits from sales above specific thresholds. Retail leases represent 28% of non-aeronautical revenue and car parking and property (e.g., rental cars) revenue are secondary sources (20% and 18%, respectively). Non-aeronautical revenues were on average 38.8% of the total revenues in 2013.

An obvious way to improve revenue is to capitalize on passenger growth. An increase in the number of flights and passengers directly leads to improvement in per-passenger revenues, boosting retail income growth at the same time. The ACI Airport Economics Survey (2014) highlights the importance of economies of scale in profitability by documenting the positive relationship between net profit margin and airport size. While airports with less than one million passengers have average profit margins of 11.9%, airports with more than 15 million passengers earn 19-20% of net profit margins.

When it comes to reducing cost and expenses to improve profits, it is worth noting that airports are subject to high fixed costs, and the world's major airports are run at almost full capacity (Gelhausen et al. (2013), Dray (2020)). Large-scale expansion such as adding runways or terminals is often risky because it requires lumpy and irreversible capital investment with much uncertainty about future demand growth. New additions also typically must clear high local land use, noise, and environmental hurdles. Thus, for boosting economic profits, it is typically most desirable to increase operating efficiency by accommodating more passengers per flight and handling a higher volume of aircraft movement per runway.[25] Although it is not always possible to increase the number of international passengers, these are often the most profitable, especially in developing countries. Airport owners can achieve higher volume without adding space in various ways, including by investing in technology, management, and better use of existing space.

[24] According to the ACI Airport Economics Survey (2014) of 653 international airports.

[25] Based on the authors' conversations with industry executives, including from RDC Aviation.

What determines the prices that airports charge to airlines (aeronautical revenue) and to the concessions in the terminals (non-aeronautical revenue)? At privatized airports, airport revenues are sometimes regulated, with price regulation applying either to both aeronautical and non-aeronautical charges ("single-till") or to only aeronautical charges ("dual-till"). Regulation takes the form of either rate of return limits or price caps. Although it is thought that there is not a major difference in practice between these forms, price cap regulation may encourage cost reductions, potentially at the expense of service quality (Starkie (2004), Gillen and Niemeier (2008)). Finally, some governments—notably in Australia—use an explicit threat of regulation to mitigate monopoly pricing at wholly unregulated airports (Forsyth (2008)).

Airport and airline market power both play a role in price setting. Airports on islands, without nearby competing airports, without strong regional transport alternatives (e.g., high-speed rail), that are more congested, and those with more international traffic tend to have more market power (Basso (2008), Bel and Fageda (2010)). One reason that airports can be profitable is that airlines are believed to have low demand elasticity (Bel and Fageda (2010)). However, airlines also have negotiating power, which increases with their share of airport traffic (Borenstein and Rose (2014)).

3 Data Sources and Summary Statistics

This section describes the data sources and samples used in analysis.

3.1 Ownership Type and Deals Data

We begin by constructing a list of airports around the globe with more than 10,000 passengers as of 2016.[26] This initial sample includes 2,444 international or regional airports located in 217 countries. We hand-collect the historical ownership structure of these airports. We consider three ownership types, which capture the key markers along the continuum from wholly public to high-powered private incentives:

1. Public: Government owns and manages the airport;
2. Non-PE Private: A private firm owns the majority of the airport and its management rights; and
3. PE: A private equity fund owns the majority of the airport and its management rights.[27]

The ownership breakdowns are depicted in Figure 1. While other types of investors, including sovereign

[26] This list is from: https://ourairports.com/data/.

[27] We identify a deal as PE when the PE firm leads the transaction and has the single largest stake among the acquiring syndicate. In practice, the PE stake varies from 10% to 100%. Table 1 contains statistics on the stakes purchased by the PE firm.

wealth funds, insurance companies, and pension funds have direct stakes in airports, these tend to be smaller minority stakes and passive. We do not consider them since we are interested in airport operations.

To identify historical ownership changes, we combine various data sources including Preqin, privatization case reports by ICAO, annual privatization reports by the Reason Foundation, airport annual reports from airport websites, and online news reports of airport transactions. Preqin provides transaction-level data on infrastructure deals that covers asset investors, funds, assets, and deal dates. Of the 2,444 airports, 437 have been privatized during our sample period. Of these, 102 have been at least once owned by an infrastructure fund. About 43% of these 437 airports are concessions. Table 1 describes the ownership changes by parties and transaction type. In our analysis, we exploit the fact that we observe privatization to non-PE and to PE, as well as sales from non-PE private to PE. If an airport is government-owned (i.e., public) at the time of our data collection, we assume it has always been so since governments rarely buy back privatized airports.[28]

Table 1 characterizes the ownership transitions in our sample of airports. We split the transition deals into concessions in Panel A and sales in Panel B. Out of 2,444 airports, 437 (18%) were privatized. Most of these deals (401) were of government-owned airports that were privatized by a non-PE group. There are 36 PE privatizations of government-owned airports and 82 cases of a PE fund acquiring an airport that was previously privatized.[29] The privatizations occurred at an increasing rate over our sample period, with 15 before 1990, 97 in the 1990s, 160 in the 2000s, and 148 in the 2010s. Figure 1 shows how privatization has proceeded in terms of the number of airports (Panels A and B), the share of global passengers (Panel C) and the share of global flights (Panel D). We see an increase in the role of private and specifically PE-owned airports, even though the U.S.—with the second-largest number of airports (after China)—has no privatized airports. For example, Panel C shows that the share of total passenger volume at PE-owned airports increased from about 1% in the late 1990s to 11-12% in the 2010s.

Privatizations have taken place across the globe, though they are concentrated in certain regions. Figure 2 and Appendix A.1 present statistics on the number of privatizations in each decade for each country. Airport privatizations are particularly common in Latin America, with 42 in Mexico, 29 in Argentina and 19 in Brazil. In general, these events are correlated with broader privatization initiatives and adoption of more

[28]We were only able to observe 4 cases that went back to government-owned from private out of 436 privatized airports in our sample.

[29]Many of the airports (186) were privatized through concessions, in which the firm received the right to operate the airport's facilities but do not own it. These acquisitions are mostly by non-PE.

liberal, market-based economic policies.

Appendix Table A.2 lists the top PE acquirers (by number of airports acquired) as well as characteristics of funds and deals. In our data, infrastructure funds acquiring airports tend to be closed-ended (85% are closed-ended and the remainder are open-ended). However, the mean holding period in our data is 8.3 years with a median of 7, conditional on exit. However, only 27% of deals have exited by year 10. This pattern suggests much longer holding periods than the traditional standard in LBOs. This may reflect the longer investment lead times of airport infrastructure improvements, as well as the different types of risk, notably macroeconomic demand changes. PE may also be more adept at implementing new aviation and consumer retail technology. The top non-PE private firms are described in Appendix Table A.3.

3.2 Regulation and Governance Data

We obtain histories of airport price regulatory regimes from David Gillen at University of British Columbia. The data cover 79 major airports from 1990 to 2018 in Asia, Europe, and Oceania. Twenty-four of these airports were at one time owned by PE owned and 30 by non-PE private firms.

We also employ national governance indices from the Heritage Foundation. These data cover 186 countries from 1995 to 2019 and include 12 quantitative and qualitative factors of national governance measures, grouped into the following categories: rule of law (property rights, government integrity, judicial effectiveness), government size (government spending, tax burden, and fiscal health), regulatory efficiency (business freedom, labor freedom, and monetary freedom), and open markets (trade freedom, investment freedom, and financial freedom). Each of the 12 measures is graded on a scale of 0 to 100. Details on the definition of each variable are in Appendix B.

3.3 Airport Performance Data

Traffic Passenger and flight traffic data come from the International Civil Aviation Organization (ICAO). As these data begin only after 2014 for some airports, we supplement them with data from Official Aviation Guide of the Airways (OAG). We consider airports with more than 10,000 passengers and 100 flights a year to focus commercial airports, excluding airports that are exclusively for general aviation or military activities. These filters give us an airport-year level sample from 1996 to 2019 consisting of 2,353 airports, including 395 that have been privatized by non-PE private firms, and 92 that have been PE-owned.

Fees We obtain information on annual airport fees levied on airlines from RDC aviation, an analytics company. The fees that airports charge to airlines are on a per-aircraft-event basis (i.e. takeoff and landing) and are related to services provided to passengers and airlines, such as passenger service fees, runway fees, plane parking fees, infrastructure fees, aircraft security fees, and noise fees. By far the largest are passenger and runway fees. One of the advantages of the charge data from RDC is that the charges are quantity-free. In other words, the RDC database provides information on the calculated fees that airports charge to airlines at the aircraft level for various categories of aircraft types, departing and landing time and seasons. However, realized revenue for the airport depends on the passenger traffic and the volume of aircraft traffic, which would be sensitive to the economic cycles.

The fees in the data are based on three different aircraft types based on their route and size: small domestic jet, short-haul international mid-sized jet, and long-haul international jumbo jet. We consider two standard aircraft types for analysis: DH4 (small domestic jet) and 77W (long international jumbo jet). DH4 can carry up to 78 passengers per flight, and 77W can carry up to 348 passengers. Per passenger charges are calculated assuming that aircraft is 80% full. Charges with fixed aircraft type and the number of passengers make it convenient to examine the change in the fixed price charged to airlines after privatization. The data set includes each fee type by aircraft type. Applying the same filters as above, we are left with an airport year level sample from 2010 to 2020 consisting of 1,508 airports, including 79 airports acquired by PE, and 336 airports acquired by non-PE private companies.

Financials We obtain information on airport financials from the Air Transport Research Society (ATRS) at Embry-Riddle Aeronautical University. These data span 2001 to 2017. The database includes financials of 225 airports worldwide, which are focused on large international airports in the US, Europe, and Asia. The data mainly cover financial variables including total operational revenue, total operational expenditure, net operational income, total aeronautical revenue, total non-aeronautical revenue, and number of employees.

Punctuality We obtain information on airport on-time performance from the monthly reports of airport punctuality produced by the Official Aviation Guide of the Airways (OAG). The report provides punctuality performance of 1,689 airports worldwide from 2016 to 2020, including 97 airports that were acquired by PE, and 404 airports that were acquired by non-PE private companies.

Airlines and Routes We obtain information on route information and the number of passengers and flight frequencies of each route, and the operating airlines produced by the Official Aviation Guide of the Airways (OAG). The data include airport-year-airline-route level traffic information. We drop airports with less than 10,000 passengers and 100 flights a year.

Awards We obtain information on airport awards from Airports Council International (ACI). ACI gives awards every year the airports with the best service quality through the ASQ Awards program, a airport passenger satisfaction program with airports in 95 countries. The awards data span 2006 to 2021. According to their website: "ACI World's annual ASQ Awards recognize airport excellence in customer experience worldwide based on data from ASQ's renowned Departures and Arrivals Surveys."[30]

Accidents and Fatalities We obtain information on number of accidents and fatalities by scraping the Flight Safety Foundation's Aviation Safety Network (ASN).[31] The variables are the number of accidents and fatalities for flights that took off from the airport. These data span 1996 to 2019.

Table 2 presents summary statistics describing the data introduced above, separately for government, non-PE private and PE ownership. PE-owned airports tend to be in richer countries than publicly-owned airports, while non-PE owned airports tend to be in poorer countries; the average GDP per capita for PE-owned airports is around $34,020, $25,480 for publicly-owned airports, and $17,260 for Non-PE owned airports. The PE-owned airports also have better scores on measures of governance. In particular, PE deals tend to be in countries with less corruption and better government effectiveness. At the airport level, there are also systematic differences. On average, PE-owned airports are larger, have a higher fraction of international flights, and charge higher fees.

3.4 Targeting Analysis

To more rigorously analyze these differences, we explore which airport characteristics predict PE- and non-PE deals, relative to government ownership. Specifically, we use a sample of airport-year observations that omits all years after privatization. The results are reported in Table 3. The first two columns focus on economic factors. They suggest that both PE and non-PE target airports with more international

[30] See: https://aci.aero/programs-and-services/asq/asq-awards-and-recognition/
[31] https://aviation-safety.net/database/

passengers, and PE funds target countries with more trade. The third and fourth columns examine price regulation. PE appears to avoid cost-based regulation, which is natural since this would place restrictions on profits. Governance variables are in columns 5-6. PE targets airports in countries with more judicial effectiveness, financial and investment freedom, and less government spending. In unreported analysis, we do not find that other observed variables significantly predict acquisitions, nor do they substantially affect the relationships described here. Overall, these results suggest that private firms in general target airports with more profitable passenger characteristics, while PE appears to discriminate when it comes to local governance and regulation.

4 The Effect of Privatizations on Airports' Performance

The canonical question in the PE literature, dating to Kaplan (1989), concerns the extent to which acquisitions by PE funds lead to real changes in the firms they acquire. Do PE funds merely acquire firms at good prices, add leverage to increase expected returns and then realize the returns on their investments, or do their returns come at least in part from real improvements in the firms they acquire? This issue is particularly important in the case of sales of government assets such as airports, since there is concern about corruption leading to sales at prices below their value and rent extraction (Hoffman, 2011).

The ideal experiment would randomize privatization events across airports and ownership type. Unfortunately, in practice this is impossible and indeed the targeting analysis revealed that there are in fact systematic predictors of privatization that likely relate to the airports' capacity for delivering value in the future. From a policy perspective, the desirability of airport privatizations clearly depends on the extent to which the transactions that do occur lead to real improvements in the airports' operations. This is the question we seek to shed light on in our analysis.

4.1 Empirical Specification

Our interest in this paper is asking how airport performance changes post-privatization, and also whether PE ownership has distinct effects from non-PE private ownership. We accomplish both of these goals in a single specification that makes use of the four types of ownership changes we observe in the data. The first two are the privatization events, where the airport transitions from government to either private non-PE or PE ownership. The second two are secondary transactions where an airport transitions from non-PE private

to PE or vice-versa. To capture these four transitions, we employ the following differences-in-differences estimating equation.

$$Y_{i,t} = \beta_1 \mathbb{1}(\text{Privatization by PE})_{\text{i,t}} + \beta_2 \mathbb{1}(\text{Privatization by Non-PE})_{\text{i,t}} + \beta_3 \mathbb{1}(\text{Post-Priv Non-PE to PE})_{\text{i,t}} + \beta_4 \mathbb{1}(\text{Post-Priv PE to Non-PE})_{\text{i,t}} + X'_{i,t}\,\gamma + \delta_i + \theta_t + \varepsilon_{i,t} \tag{1}$$

The independent variables of interest are relative to government ownership as the base group. $\mathbb{1}(\text{Privatization by PE})_{\text{i,t}}$ is one after an airport transitions from government to PE ownership and zero otherwise. Similarly, $\mathbb{1}(\text{Privatization by Non-PE})_{\text{i,t}}$ is one after an airport transitions from government to Non-PE private ownership. $\mathbb{1}(\text{Post-Priv Non-PE to PE})_{\text{i,t}}$ is one after an airport that is already privatized by a non-PE firm transitions to PE ownership. $\mathbb{1}(\text{Post-Priv PE to Non-PE})_{\text{i,t}}$ is the reverse. We report two p-values on F-tests for equality of coefficients. The first compares the two privatization coefficients and the second compares the post-privatization coefficients. As Table 1 shows, 401 privatizations are to non-PE while 36 are to PE, and 71 post-privatization transactions non-PE to PE while just 18 are PE to non-PE. This highlights how global airports have shifted over time from government to private and then to a higher share of infrastructure fund ownership. One downside is that we should expect that estimated effects of privatization to PE as well as transitions from PE to non-PE ownership will be noisier, since they are identified off of fewer observations.

To control for macroeconomic growth, airport size, and country governance indices related to the demand for air transportation, we include in the vector $X_{i,t}$ log GDP per capita, log trade volume, log total number of passengers, share of international passengers, government size, open markets, judicial effectiveness, and government integrity. These may evolve differently at control vs. treated airports. All models also include airport and year fixed effects. The results are also robust to using deal fixed effects. Standard errors are clustered by airport.

Following the recent literature on resolving bias in two-way fixed effects models with multiple treatment periods, we test whether the main results spuriously reflect the staggered nature of the transactions. Since airports are acquired at different dates, and thus the control group depends on the year and may include not-yet-treated airports, treatment effect heterogeneity and dynamic treatment effects could lead to bias. The first test is the Callaway and Sant'Anna (2021) estimator, which estimates treatment effects specific to each group-time and then averages them together. This estimator permits only one treatment variable, and we

have four. Therefore, for this test we consider only an indicator for PE ownership, since our central results where we find evidence for causality concern PE. The second approach is stacked regression, which (Baker et al., 2022) explain resolves the concern by creating event-specific datasets and stacking them together. The estimator then includes dataset-specific unit- and time-fixed effects, enabling entirely “clean" controls. This approach has also been used in Gormley and Matsa (2011) and Cengiz et al. (2019), among others. One benefit is that we can replicate our main model and include all four treatment variables. The third approach is a matching estimator, where we address the concern by using only never-privatized airports as the controls (Huntington-Klein, 2021).

We also estimate fully saturated dynamic differences-in-differences models that allow us to take an event study approach to the data. Here, we focus on the two private ownership types, PE and non-PE, and look for the average effects of each separately, as it is infeasible to estimate all or even two effects by year in the same equation. The event studies are important for making a causal statements: they will reveal whether, conditional on our controls, airports that are acquired by either PE or non-PE firms were on track to experience the effects that we see post-acquisition. We use Equation (2) below for PE.

$$Y_{i,t} = \sum_{s \neq 0} \beta_s \text{PE Deal Year}_{\text{i,s}} + X'_{i,t}\,\gamma + \delta_i + \theta_t + \varepsilon_{i,t} \tag{2}$$

We employ the same specification for non-PE private acquisitions. Variables are as defined for Equation (1), and standard errors are again clustered by airport.

4.2 The Volume of Passengers and Traffic

The number of passengers per flight coming into and out of the airport is an important metric of performance because it means more efficiency on the tarmac and more people in the terminals to shop at concessions, conditional on tarmac capacity. Note that it can increase either because of larger planes (i.e., with more passenger capacity), or because of fewer empty seats on a plane. By adjusting fees and agreements with airlines, airports can induce them to fly more saturated routes with larger planes, which increases both aeronautical and non-aeronautical revenue to the airport, since aeronautical revenue is in part on a per-passenger basis.

Figure 3 contains dynamic differences-in-differences estimates, illustrating the change in the number of passengers per flight for PE-acquired airports around the time of the acquisition. Each coefficient estimates

an effect relative to control airports in the same year, which helps to control for factors affecting the overall economy and the airport industry. The plots indicate that following the acquisition (year 0) there is an increase in passengers per flight for both domestic and international flights. Importantly, the figure contains no evidence of pre-trends before the acquisition. While we cannot firmly identify causality, the lack of pre-trends and discontinuous change after the acquisition suggests that in the absence of the acquisition, these targeted airports would not have experienced an increase. We observe no similar pattern in an event study of non-PE acquired airports, which we present in Appendix Figure A.1.

The average differences-in-differences estimates from Equation (1) are reported in Table 4. After PE privatization, airports increase passengers per flight by about 18 relative to government ownership, which is 20% of the mean of 90 passengers (column 1, top row). This is driven by increases in primarily domestic flights (columns 2-3). In contrast, there is no overall effect for non-PE privatization (column 1, row 2), though there is a small positive effect in domestic flights (column 3, row 2). In secondary transactions, there is a robust increase in passengers per flight for non-PE to PE deals, driven by both international and domestic traffic (columns 1-3, row 3). The effect of transitions from PE to non-PE ownership is positive but insignificant (column 1, bottom row). To assess whether these effects on passengers per flight reflect larger or fuller aircraft, we examine aircraft composition. We find that the share of jets increases after PE acquisitions while the share regional and small aircraft declines (columns 4-5, rows 1 and 3). The aircraft composition does not change after Non-PE privatization, but there is an increase in the share of jets in Non-PE to PE deals (columns 4-5, rows 2 and 4). The results are consistent with PE increasing passengers per flight at least in part by inducing airlines to bring larger planes to the airport.

Another way that privatization can increase the airports' value is by increasing the total number of passengers and the number of flights. The event studies in Figure 3 again show no pre-trends, while after PE acquisition the number of passengers and number of flights increase discontinuously. This is driven by both domestic and international passengers (Panels C-D). Appendix Figure A.1 shows little change after non-PE private acquisition. The average estimates, reported in Table 4, show that following PE acquisitions the total number of passengers increases by 84% in the initial privatization and 17% in purchasing an already-privatized airport from a non-PE firm (column 4, note that since the outcome is logged we exponentiate for interpretation). Non-PE privatization also leads to more passengers, but the lack of an event study result means we should interpret this with caution. Both types of private ownership increase the number of flights (columns 7-9), with the largest effect for PE privatization (column 7, first row).

Last, we consider freight traffic in Appendix Table A.4. We see evidence of improved efficiency under PE ownership measured as freight per flight in columns 1-3. Both for privatization and subsequent transactions, there is evidence that PE ownership has statistically significantly larger effects. For levels, measured as log tons of freight, we also see much higher increases for PE ownership, though this is in some cases driven by a negative effect for non-PE private ownership. Overall, these results on volume and traffic indicate better performance under PE ownership, with non-PE private ownership being no better than government ownership.

4.3 Downstream Performance: Routes and Airlines

An airport's value to the economy depends not only on the total number of passengers, but also on the choices of routes and competition among airlines, with more routes and airlines being better for passengers, both because they have more options and likely lower prices. Indeed, the number of locations to which one can fly on a nonstop flight can materially affect the desirability of a city as a place to live, tour, or to locate a business. For example, when JP Morgan's infrastructure fund acquired the airport in Cairns, Australia (near the Great Barrier Reef), the first thing they did was to add nonstop flights to major Asian cities, which increased the number of tourists visiting the Great Barrier Reef.[32]

The event studies in Figure 4 show significant and immediate increases in the number of routes after PE acquisitions. As in the Cairns example, the increase is primarily in international routes (Panel A), which are typically more profitable. This is driven by both international routes in privatization and post-privatization acquisitions by PE firms, shown columns 1-3 of Table 5. Column 2 shows that after privatization by PE, the number of international routes increases by 46% (note that routes are logged so we exponentiate). Figure A.2 for non-PE private acquisitions shows strong pre-trends, indicating that non-PE private firms seem to select airports already on track to adding more routes, and suggesting that any positive coefficients should not be interpreted as causal effects.

In addition to routes, when more airlines serve an airport, passengers will likely benefit from more options for subsequent connections and lower prices resulting from increased competition. We evaluate whether privatization leads to entry of new airlines in Figure 4 Panel C, where there is a striking increase in the year of the deal, suggesting an immediate focus by the new owners on more carriers, especially by the low cost carriers. As mentioned in Section 2.3, the airport will have more bargaining power with its primary

[32] Source: Private conversations with deal participants.

customers—airlines—when there are many airlines at the airport jostling for access rights. Therefore, adding airlines is an obvious means to increase prices and profits. However, we do not see measurable changes to airline HHI, which is very noisy (Panel D). When it comes to non-PE private firms, Figure A.2 indicates strong pre-trends, pointing again to a different economic model from PE and an absence of causal effects. The average estimates, in Table 5 columns 4-5, paint a less clear picture for PE. PE increases the number of low cost carriers when they privatize. For all three outcomes we observe large estimates for non-PE privatization, but these come with a caveat due to the lack of event study evidence.

Putting the event studies and the table together, we conclude that there is a robust and likely causal relationship between PE acquisitions and the number of both routes and airlines, but that the rest of the results should be interpreted with caution. More airlines at PE-owned airports likely increase consumer welfare through both improved choices of routes and lower prices.

4.4 Punctuality, Safety, and Awards

We are also interested in the quality of an airport from passengers' perspectives. While product quality is typically difficult to measure, we have several useful metrics in the airport setting. First, flight cancellations are perhaps the largest nuisance to passengers and also disrupt airport operations as they tend to create unexpected congestion. The event studies, in Figure 5, indicate a clear decline in cancellations after PE ownership (Panel A). For non-PE private acquisitions, the cancellation rate decreases as well, though there again appears to be a pre-trend (Figure A.3). The average estimated effects from the multivariate model presented in Table 6 show a striking decline in the percent of flights canceled after PE acquisitions from non-PE private firms of 0.98%, which is about 50% of the mean rate of 2% (column 1). This decrease in cancellation rates is consistent with PE improving runway and gate management operations in a way that materially benefits passengers, who face fewer canceled flights.

We next examine the fraction of flights that depart on time. There is a decline in the share of departures that leave on-time in year 0, the year in which the deal occurs, but that reverses so that by year 2, the fraction of on-time departures higher than it was before the deal (see Figure 5, Panel B). Column 2 of Table 6 shows that the on-time departure rate decreases after acquisitions by both PE and non-PE. On average, a 1% increase in the number of flights leads to a 2.7% decrease in on-time departures. This decline could reflect the high correlation of flight delays with airport congestion and delayed incoming flights. The airport can improve the former, but the latter is out of its control. Therefore, higher traffic volume, routes, and

airlines could explain the decrease in on-time departure rates.

There is much more to a passenger's experience at an airport than the actual flights, including security wait times, cleanliness of the restrooms and quality of the stores and lounges. All of these vary in quality across airports and can materially affect passengers' welfare. We assess these dimensions using the ACI ASQ awards data. These prizes are offered to airports whose passengers report the most positive and smooth experiences in surveys. Column 3 of Table 6 indicates that privatization increases the likelihood that an airport wins an award. The most robust effect, however, is for transitions from non-PE private to PE ownership, in which the chance of an award increases by six percentage points, which is three times the mean. The event study in Figure 5 Panel C indicates that there is a distinct jump on the chances of winning the award after PE acquisitions.

Finally, in columns 4 and 5, we consider the possibility that airport privatization affects safety. These equations predict the number of accidents and fatalities per 1,000 flights. The coefficients on the privatization variables are small and not statistically different from zero, suggesting that privatization does not have a material impact on the safety of flying. We would expect these numbers to increase given higher volume of passengers and flights, so we can interpret this as a positive result.

4.5 Fees Charged to Airlines and Regulation

During our sample period, fees that airports charge to airlines account for about 75% of airport revenue. The two main charges are runway fees, which are paid for each takeoff and landing, and passenger fees, which are paid for processing passengers and security services. Figure 6 presents the PE event studies for the fees broken down by domestic and international flights. Fees increase immediately and persistently following the acquisition. The event studies for non-PE private in Figure A.4 suggest that fees at these airports start systematically higher than at control (public) airports, as indicated by the lower value for the omitted coefficient at year -1, and increase only slightly after the acquisition.

In Table 7, we estimate the average effects. The results indicate that, consistent with the airline industry's complaints (see Section 2.1), total fees increase substantially following privatization by non-PE deals (columns 1-6, row 2) but slightly decrease following privatization by PE.[33] In secondary transactions, the picture changes; there are fee increases when PE acquires airports from non-PE private owners, while

[33]The estimate is the combination of the runway fee and the passenger fee. Although the runway fee increases after PE privatization, the passenger fee decreases, which is the dominant of the two, so overall, the total fee decreases.

there are some decreases and some increases when PE sells to non-PE (columns 1-6, rows 3-4). In sum, both PE and non-PE ownership are associated with higher fees relative to government ownership. However, despite the higher fees, traffic increases (Table 4). Presumably, other improvements after privatization outweigh the higher fees to attract new traffic.

When airports are privatized, the government must decide whether to regulate airport prices, since airports have some degree of market power. As with other infrastructure and utility assets, regulation can take two principal forms: revenue caps and cost-based. As explained in Section 2.3, both limit the private owner's ability to increase profits and would be anathema to PE, where maximizing cash flows and firm value in the near-term is a key objective. Consistent with this idea, the estimates we present in Table 3 document that PE investors are more likely to target airports without pre-existing cost-based price regulation. Column 7 of Table 7 presents estimates of equations in which the dependent variable is an indicator for no price regulation.[34] After PE acquisitions, there is a higher chance of deregulation, with the relationship after transitions from non-PE private being almost 200% of the mean. This deregulation may help produce the incentives for the performance improvements that we see in the previous tables. There may be many drivers for pattern, but one possibility is that PE owners lobby for deregulation.

Consider the example of three Australian airports that were privatized in 1996-7, two with majority PE ownership. Each had revenue caps for five years subsequently, which were removed in 2002 in part at the request of investor groups. As Gillen (2011) explains, the airport owners and government settled on a strategy of price monitoring, which occurs to some degree at all privatized airports without price regulation, creating an explicit threat of regulation. This essentially amounts to a trigger or "grim" strategy, in which seemingly excessive profits would lead to long-term regulation. Amid a 2018 reconsideration of airport regulation, investor owners of Australian airports submitted a brief arguing explicitly against regulation, noting that the "light-handed regulatory regime encourages commercial outcomes, incentivises innovation and allows investors to earn appropriate risk-adjusted returns. . . [A]irport owners take the threat of regulation seriously."[35] While clearly this example does not necessarily apply elsewhere, it shows that investor lobbying can yield regulatory changes.

[34] Since regulatory regimes change only rarely and these changes are undoubtedly related to the causes of the privatization, we do not attempt a causal analysis here. Also, there are insufficient cases (only one) of PE to non-PE transitions in the dataset with regulation information so we exclude this transition from the model.

[35] Australian Airports Investor Group Submission to the "Productivity Commission Review of the Economic Regulation of Airports," September 2018. Available here: https://www.pc.gov.au/__data/assets/pdf_file/0011/231122/sub020-airports.pdf

4.6 Financial Outcomes and Employment

The results on fees and traffic point to higher revenues after PE acquisitions, relative to airports that remain government owned. We next evaluate the impact of privatization on the financial performance of the subset of airports for which we have income statements. Increasing cash flows is a key strategy in PE, but it is rare to observe income statements for privately owned firms, so studies of PE's operational impacts have typically been unable to show how cash flows change after buyouts and, in particular, whether revenue increases, costs decline, or both. Instead, the literature has focused on other observable outcomes. This paper contributes to the literature on PE by directly studying key elements of the income statement. We are able to do so because some countries require airports to publicly release this information. However, since only a subset of airports have financial data available, the sample size is limited and thus the results should be interpreted with some caution.

The event studies in Figure 7 show that net operating income and total operating revenue increase at the time of the acquisition, an effect that persists for at least four years (Panels A and B). This appears to reflect increases in both aeronautical (fees to airlines) and non-aeronautical (retail and parking) revenue (Panels C and D). We do not see any apparent effect on operating expenditures in Panel E. Finally, we consider the number of airport employees relative to the number of passengers and see some evidence in a decline in years zero to three.

The average effects, presented in Table 8, are consistent with Figure 7. Net income increases dramatically privatization by PE; the coefficient implies a 107.5% increase (column 1, row 1). This appears to primarily come in part from an increase in operating revenue (column 2), with non-aeronautical revenue increasing by somewhat more than aeronautical revenue (columns 3-4, row 1). The higher net income does not reflect lower operating costs, because in fact we see an increase in operating costs and no effect on employees per 1,000 passengers (column 5-6, row 1). After non-PE privatization, there is a smaller increase in net income, but no increase in revenue (Table 8 columns 1-2, row 2). Instead, columns 5-6 show a decline in expenditure and in employees per 1,000 passengers. After transitions from non-PE to PE, we do not see any measurable effects. However, in transitions from PE to non-PE we see large declines in net income and revenue, as well as expenditure (bottom row).

Together with our previous results, this analysis suggests that in the context of airports, PE does not create value primarily by cost-cutting, but rather by increasing growth and efficiency. Perhaps surprisingly,

non-PE privatization is associated with lower expenditure as the primary means to higher income. Of course, as emphasized above, airports and infrastructure generally have many unique characteristics and so the effects of PE here likely do not necessarily generalize to other sectors.

4.7 Ownership vs. Control

An important distinction in our data is between sales and concessions; in the former, the acquirer has an incentive to operate airports with a longer-term view. Following industry norms, we identify sales as cases when the acquirer obtains outright ownership or a concession lasting more than 30 years. Long-term concessions are grouped together with outright sales because they create similar incentive structures. A longer lease period may incentivize the concessionaire to undertake capital investment and improve operating performance. The incentives bestowed by ownership (or ownership-like long-term contracts) cannot be fully contracted, as established by the Grossman/Hart/Moore literature and summarized in Hart (1995b). In contrast to a non-owning operator, an owner will have both the ability and the incentives to make investments that were not contracted on initially but could be valuable. The prediction for our sample of privatized airports is that if ownership leads to more value-creating investments than control without ownership, then sales should experience larger improvements than concessions.

We evaluate this hypothesis in Table 9, which employs a new set of four independent variables representing the transaction type: sales to PE, concessions to PE, sales to non-PE private, and concessions to non-PE private. The eight outcome variables represent the key performance measures from the previous analyses. Across the board, sales to PE are associated with the largest and most robust improvements (first row). In most cases, the coefficient on sale to PE is significantly larger than the coefficient on concession to PE, as shown at the bottom of the table. For non-PE private transactions, most outcomes also exhibit a larger effect for sales, but the magnitude of the difference is smaller and usually insignificant.

We assess the robustness of this finding and examine whether it comes from the extensive or intensive margin in Appendix Tables A.5 and A.6. Table A.5 uses continuous ownership and control stakes, and continues to find that higher ownership stake is associated with the most positive results. Table A.6 uses dummies for majority ownership and control stake. These results suggest that majority control is not as important as the result being a sale vs. a concession. Overall, this analysis supports the idea that an ownership change to a PE fund improves value more than concessions or sales to a non-PE group.

4.8 Competition

The presence of a competing airport may encourage performance improvements in the interest of gaining market share. This relates to the increased scrutiny that PE is receiving from antitrust authorities, who are concerned that PE may take more advantage of market power.[36] PE ownership may be more responsive to competitive incentives than other types of ownership because it entails higher quality managers and higher-powered incentives to maximize profits.

We evaluate this in Table 10 by dividing PE and non-PE ownership according to whether or not there is a competing airport nearby, which we define as within 200 km.[37] This again gives us four independent variables. Across all the main outcome variables, we see that improvements are notably and usually statistically significantly larger in the presence of a competing airport for both PE and non-PE private ownership. For example, under PE ownership with competition, the number of flights and routes increase by 49% and 42%, respectively, while the number of airlines increases by 50% relative to the mean, compared to small and insignificant effects of PE ownership without competition (columns 3-5, first two rows). Of course, this does not mean that competition causes the different operational changes since the competing airport was typically in place before the acquisition and thus is intertwined with targeting. However, these results are consistent with competition playing a beneficial role in the airport industry for inducing the most productive outcomes under private ownership.

4.9 Robustness

We test the robustness of our results using several alternative estimation approaches and modeling specifications. First, as explained in Section 4.1, we conduce three tests to address possible bias from a staggered differences-in-differences model. In all cases, we employ for parsimony 10 key outcome variables that contain the key findings in the above analysis. Our first approach retains the main empirical model of Equation 1, but employs stacked datasets for each event (i.e. treatment year). Following (Baker et al., 2022), we include fixed effects for each dataset-by-airport and dataset-by-time group. The results are reported in Appendix Table A.7. The results are all robust to this approach, generally with more statistical significance.

[36] For example, see here: https://www.jdsupra.com/legalnews/private-equity-subject-to-increased-4754204/.

[37] Overall, 37% of total airports have a competing airport nearby. Among PE owned and non-PE privately owned airports, 53% and 48% of them, respectively, have a competing airport nearby.

The second approach is the Callaway and Sant'Anna (2021) estimator, which has the downside of permitting only one treatment variable. Therefore, the results cannot be compared exactly to our main tables. We focus on an effect of PE acquisition on average, since this is where our average effects and dynamic models suggest there is a meaningful causal effect. The results are reported in Appendix Table A.8. We see significant effects on the key productivity outcomes, such as passengers per flight (column 1) and number of routes (column 4). There is no significant effect on fees, consistent with the mixed results in the main tables. Possibly due to the much smaller sample and stringent fixed effects design of the estimator, we see no effect on income or expenditure in this model (columns 9-10).

The third strategy is a matching estimator. We match each privatized airport one-to-one with never-privatized, government-owned and operated non-target airports using Coarsened Exact Matching (Iacus et al. (2012)). To identify control airports, we employ observations two years before the privatization event. Each targeted airport is matched to government owned and operated control airport on region, the log GDP per capita, share of international passengers, government size, open markets, year, and log trade volume two years before the target date.[38] In the estimation, we include match cohort-year fixed effects to compare target and non-target airports within the matched group. These fixed effects ensure we compare airports with similar characteristics, since for example the airports targeted by PE have different characteristics from the airports targeted by non-PE private companies. The matched dataset includes 684 airports. Of these, PE acquires 90 and non-PE private acquires 324.

In Appendix Table A.9, we present estimates using the matched sample. The results are similar to the main findings. One downside of matching is that it eliminates many airports from the sample, which makes it more different to run heterogeneity tests. Our main analysis therefore uses the whole data with controls. Also, while matching improves homogeneity of the sample, we should keep in mind that privatized airports are may be chosen precisely because their performance is likely to improve relative to other airports; for example, they could be in a growing section of the country or have been selected by a prominent airline as a "hub". We keep this possibility in mind when interpreting our results.

Together, the consistent results from all three of these diverse methods offer comforting support for the basic findings. In unreported tests we find similar results using our main models with alternative controls,

[38]The matched control airports need to be in the same country and have a similar passenger type, which is why we include the proportion of international passengers. The number of passengers is the best proxy for size. We follow standard practice and do not match on outcome variables, and for this reason do not match on regulatory structure because we find evidence it appears to change after PE buyouts. However, we find similar results when we do match on regulatory regime. We also find similar results when we match on alternative governance variables.

deal fixed effects, and alternative clustering of standard errors.

5 Conclusion

Whether infrastructure should be privately owned—and if so, by whom—is an important policy question facing governments around the world. In practice, conventionally government-owned infrastructure assets have increasingly been privatized. One driver of this trend is the growing amount of capital allocated to PE infrastructure funds. Understanding what these funds do, whether they create or destroy value, and whether public infrastructure should be privatized at all, are important research questions. To begin to address these issues, we examine airports, which are an important class of infrastructure asset that have undergone significant privatization in recent decades. As of 2020, 437 airports have been privatized, which is 18% of all airports worldwide. Of these privatizations, 102 were at least once owned by PE firms. Because of their visibility, their increasing rate of privatization, and the availability of data on their operations, airports provide an ideal place to study privatization of public assets.

Our results suggest that privatizations, especially by PE funds, do well both for their investors and for the general public. They increase the fees they charge airlines but despite these higher fees, also increase the number of passengers flying through them. They appear to accomplish this by providing better service, offering passengers nonstop flights to more places, lower cancellation rates, and better amenities inside the airports. Our results suggest that PE ownership increases productivity more than non-PE private without significantly different effects on prices (fees), suggesting overall benefits relative to non-PE ownership.

Privatization of infrastructure and the role of PE in such privatization is clearly an important topic of research. This paper provides evidence suggesting that PE plays a beneficial role in the privatization of airports. However, there is much more to be learned. For example, do other types of infrastructure achieve similar improvements to airports when they are privatized? From an investor's perspective, how do the financial improvements observed in our sample of airports translate to risk-adjusted returns? These and other related questions remain important topics for future research.

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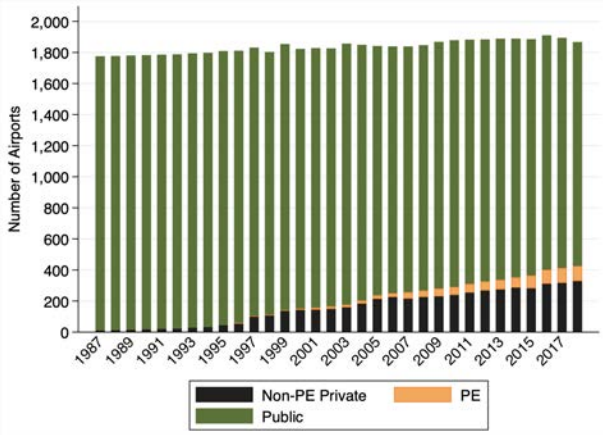
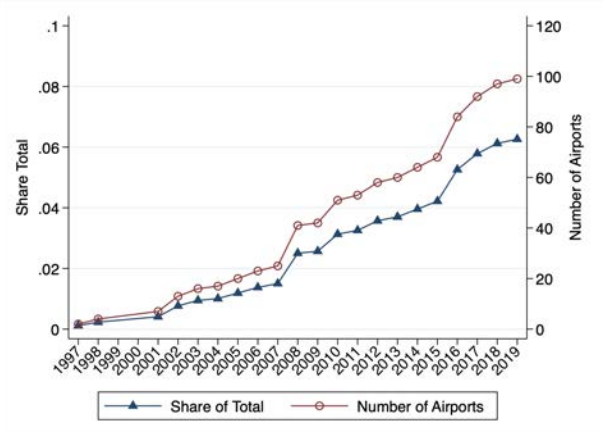
Figure 1: Airport Privatization over Time

Panel A shows the share of all airports and the number of airports owned by PE firms over time in our sample of airports. Panel B shows ownership dynamics of airports. Panel C shows the share of total number of passengers in PE or NonPE private airports. Pancel D shows the share of total number of flights in PE or NonPE private airports. We drop airports that were newly built during 2006-2019.

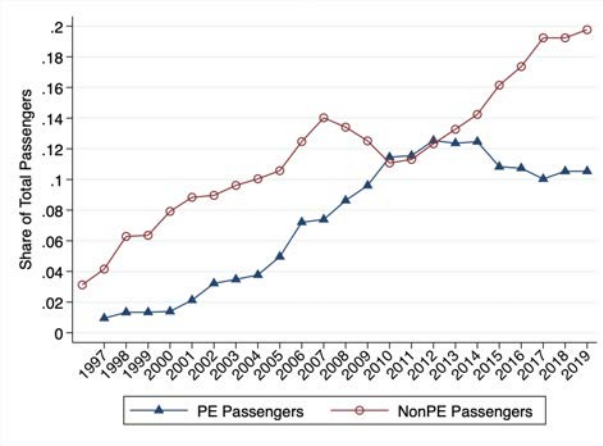
(A) Airport Ownership (1987–2019)



(B) PE Ownership of Airports (1997–2019)



(C) PE and non-PE Private Passenger Shares (1997–2019)



(D) PE and non-PE Private Flight Shares (1997–2019)

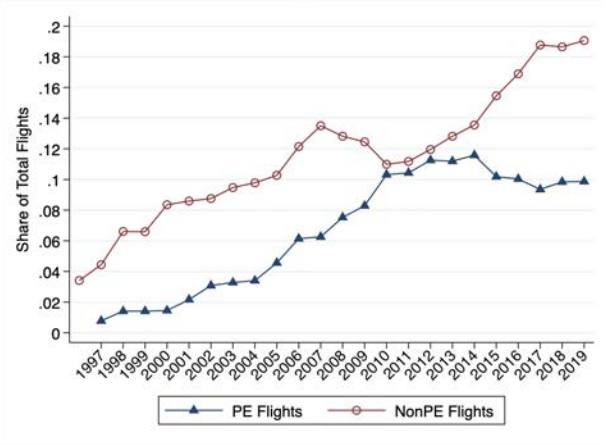
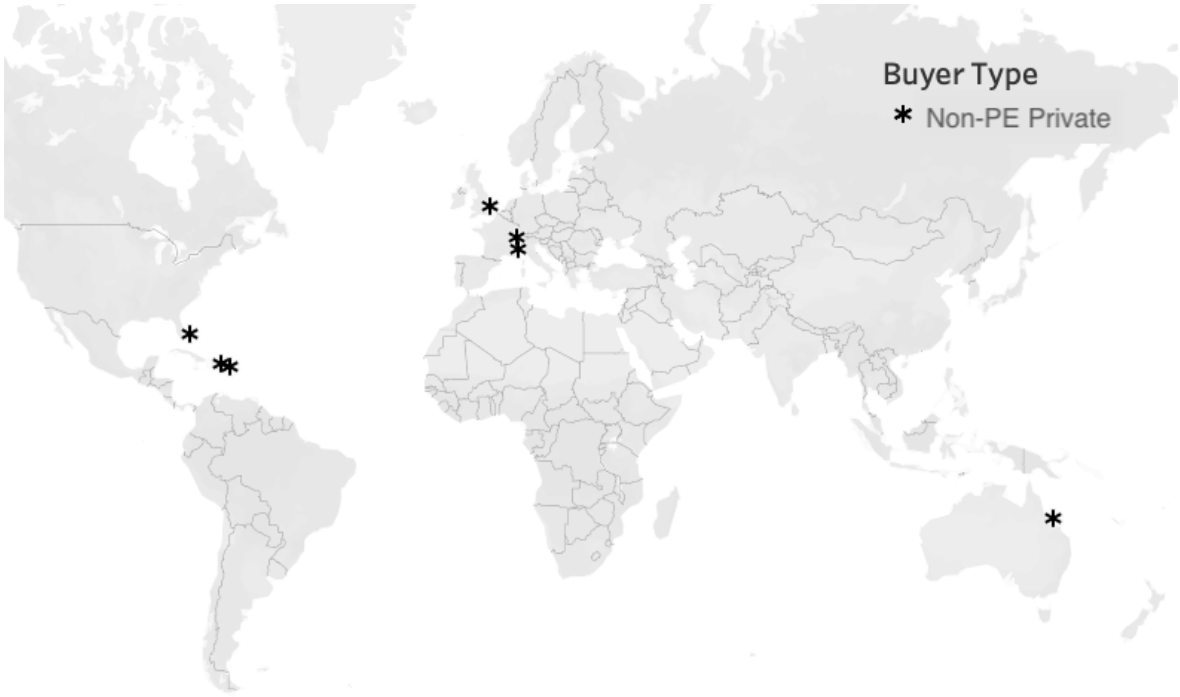


Figure 2: Airports That Experienced Privatization

This figure shows countries that experienced airport privatization by their types.

(A) Countries with Privatized Airports (As of 1984)



(B) Countries with Privatized Airports (As of 2019)

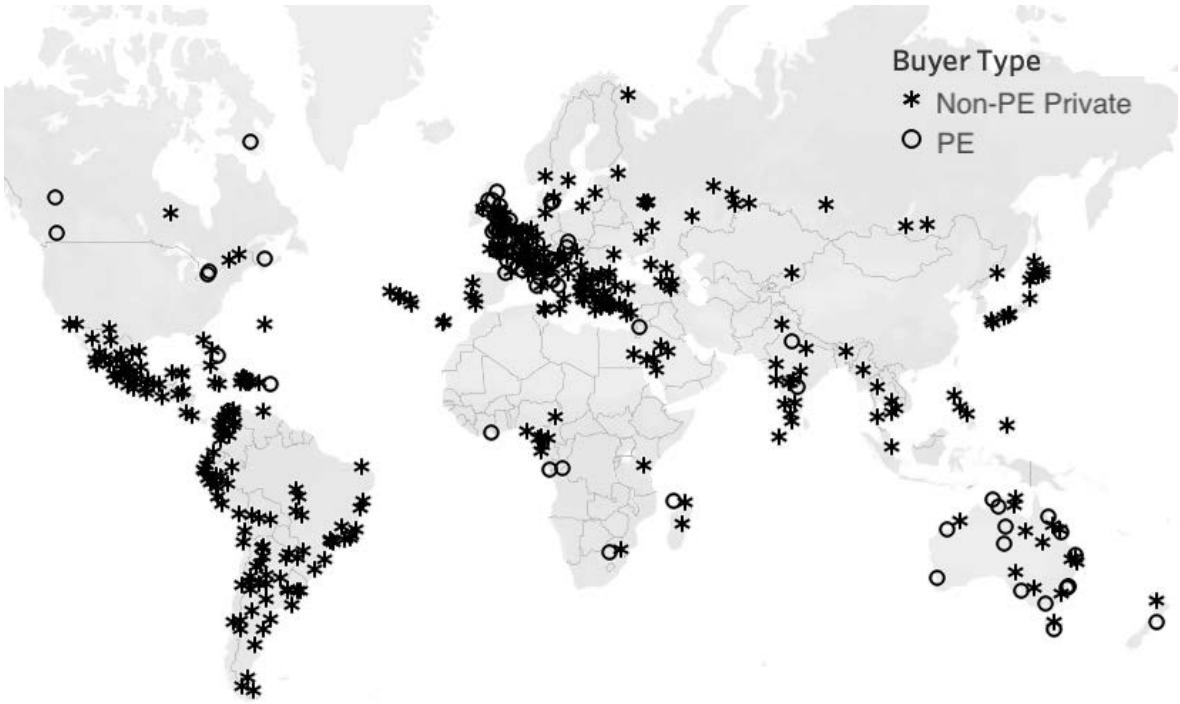
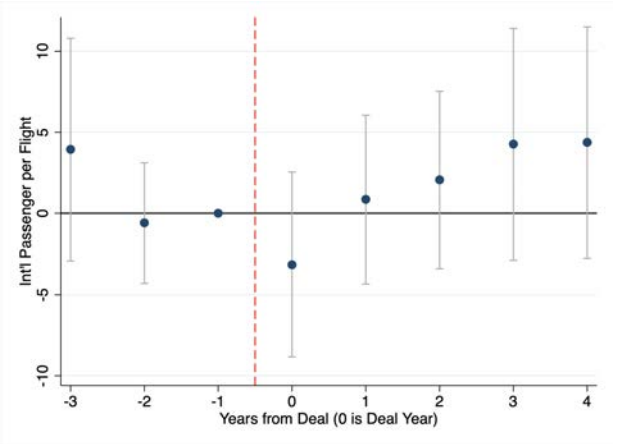


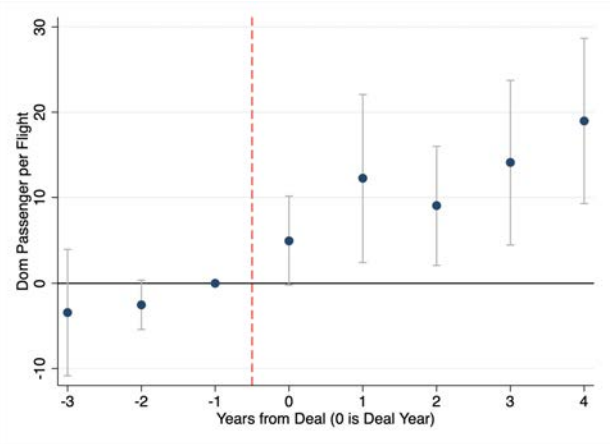
Figure 3: Event Studies – Privatization Effect on Airport Volume of Passengers and Traffic by PE

This figure shows dynamic differences-in-differences event studies of transitions to PE ownership.

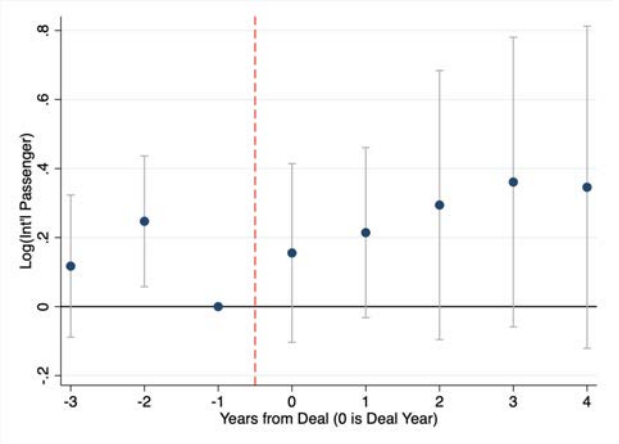
(A) Int'l per Flight Passenger Traffic



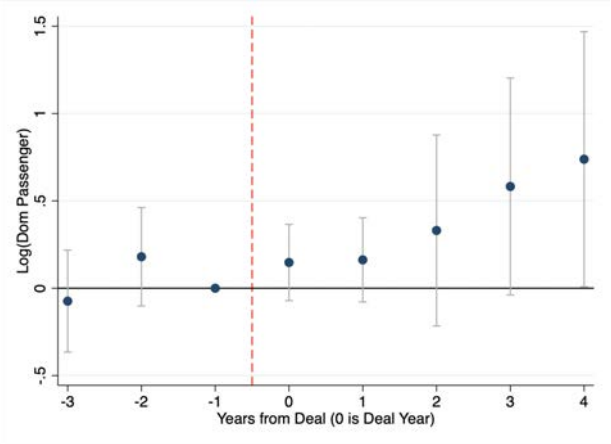
(B) Dom per Flight Passenger Traffic



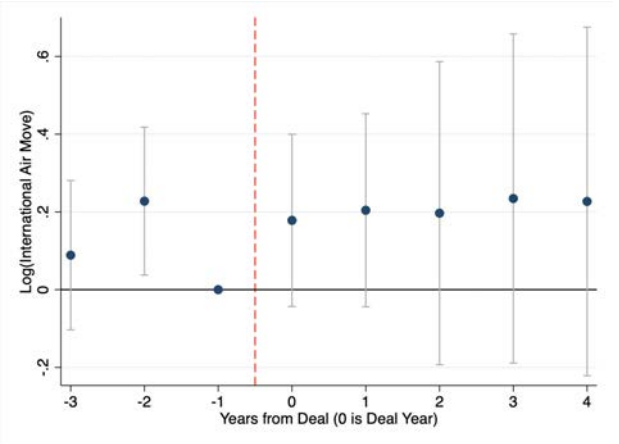
(C) Log(Number of Int'l Passengers)



(D) Log(Number of Dom Passengers)



(E) Log(Number of Int'l Flights)



(F) Log(Number of Dom Flights)

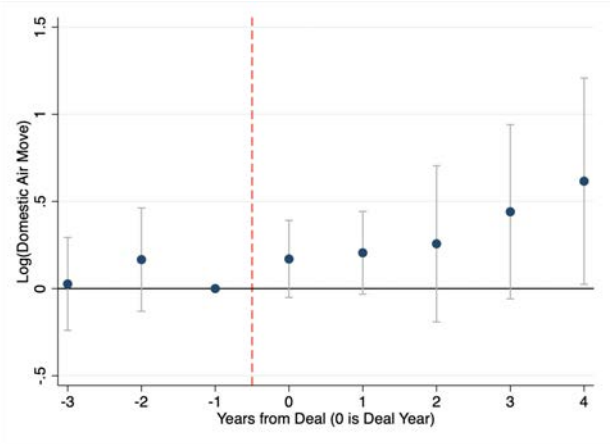
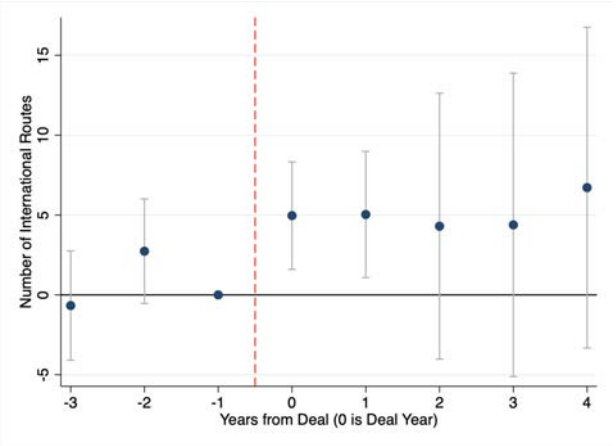


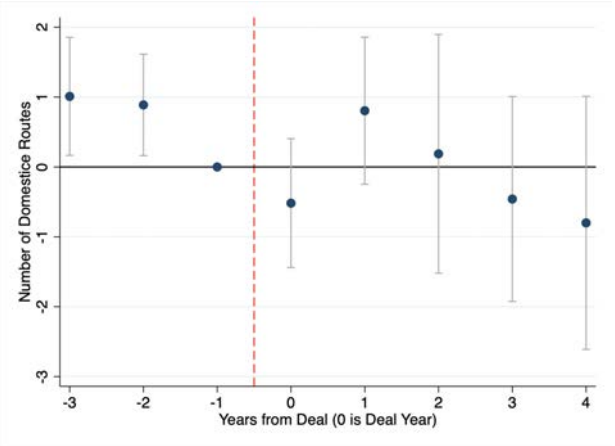
Figure 4: Event Studies – Effect of PE Ownership on Downstream Performance: Routes

This figure shows dynamic differences-in-differences event studies of transitions to PE ownership.

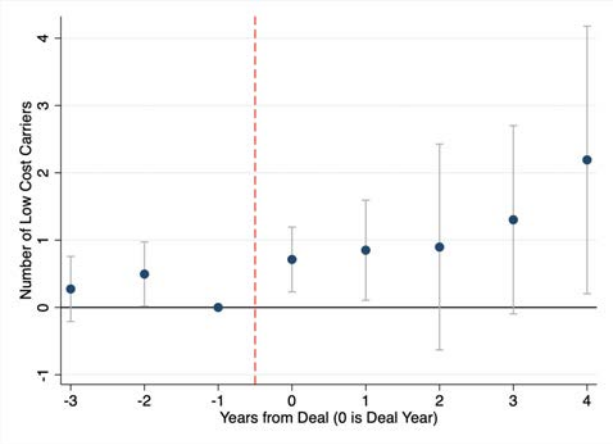
(A) Number of International Routes



(B) Number of Domestic Routes



(C) Number of Low Cost Carriers



(D) Airline HHI

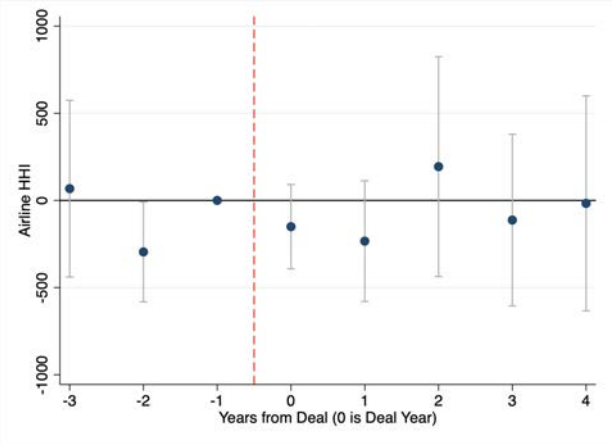
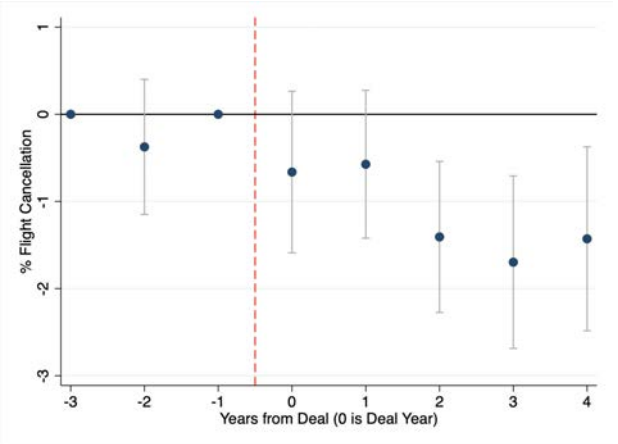


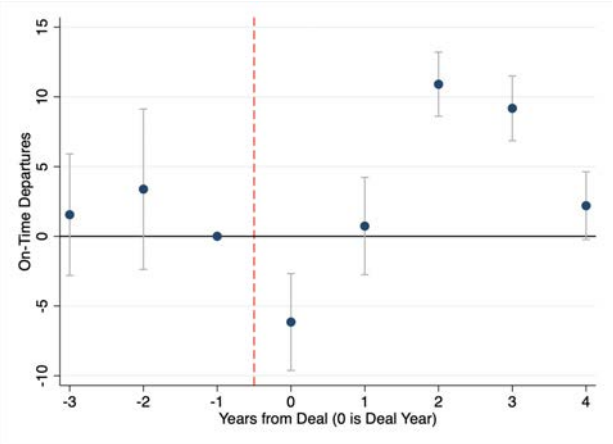
Figure 5: Event Studies – Effect of PE Ownership on Punctuality, Safety, and Awards

This figure shows dynamic differences-in-differences event studies of transitions to PE ownership.

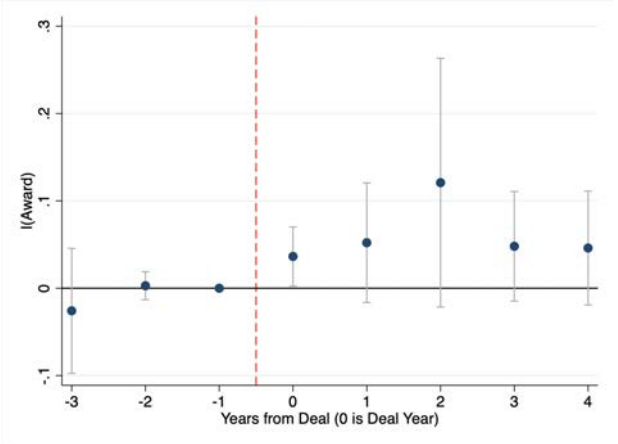
(A) Flight Cancellation Rate



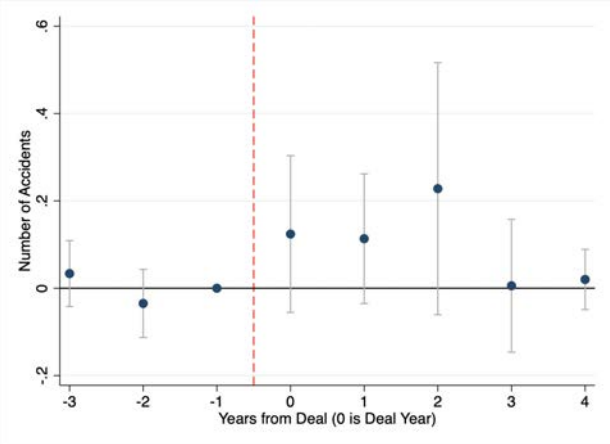
(B) On-Time Departure Rate



(C) Any Award



(D) Number of Accidents



(E) Number of Fatalities

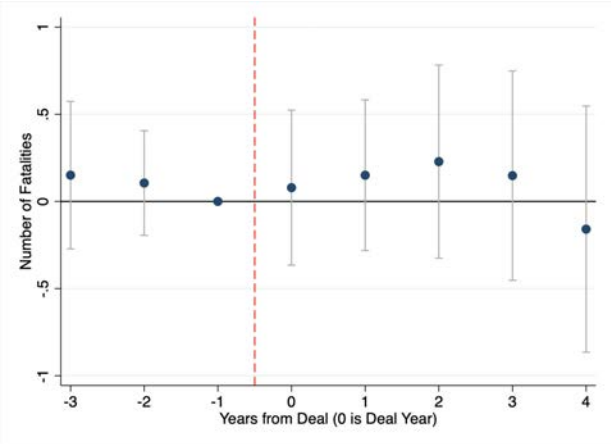
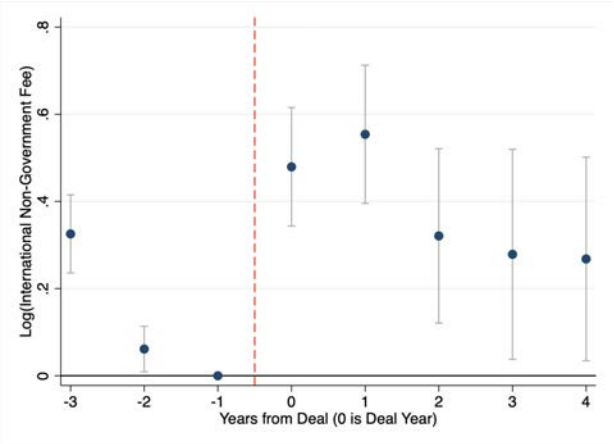


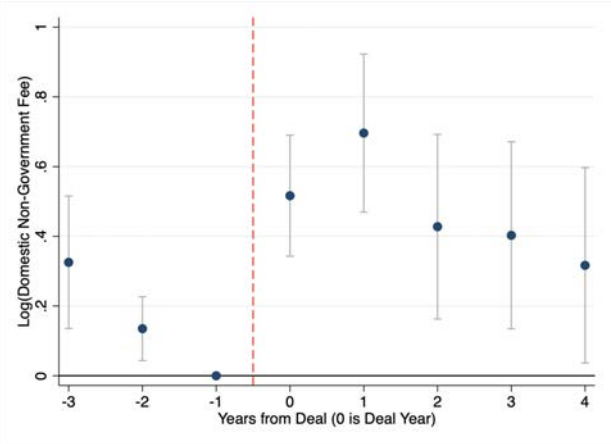
Figure 6: Event Studies – Effect of PE Ownership on Fees Charged to Airlines

This figure shows dynamic differences-in-differences event studies of transitions to PE ownership.

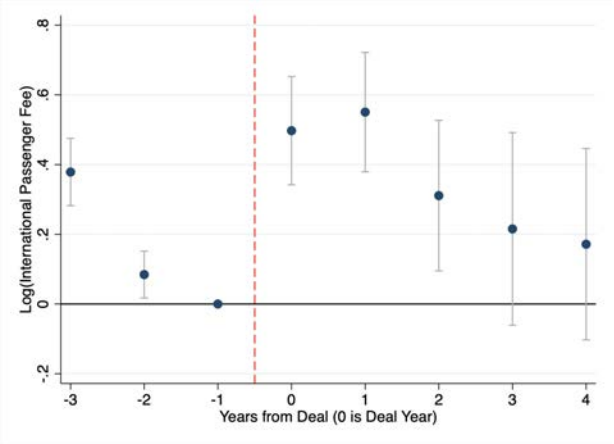
(A) Log(Int'l Fee)



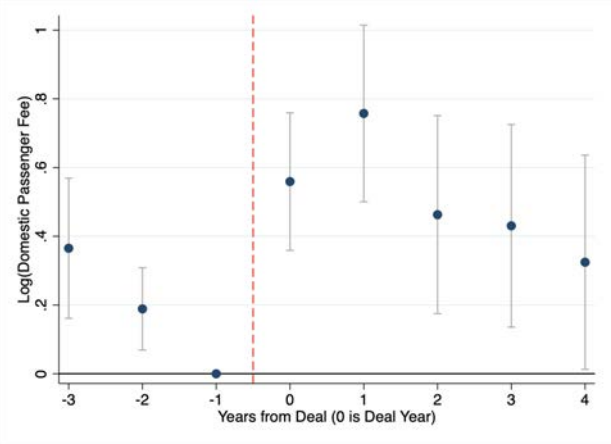
(B) Log(Dom Fee)



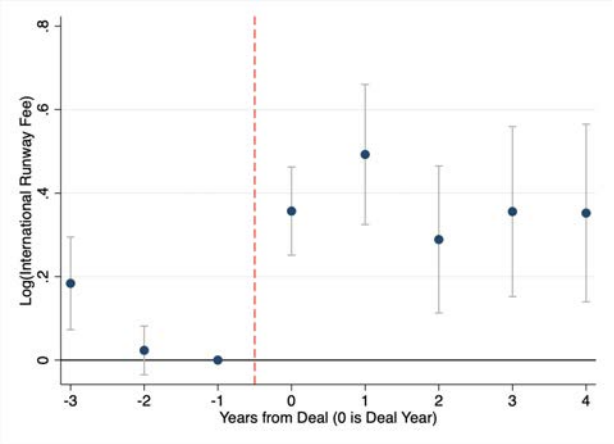
(C) Log(Int'l Passenger Fee)



(D) Log(Dom Passenger Fee)



(E) Log(Int'l Runway Fee)



(F) Log(Dom Runway Fee)

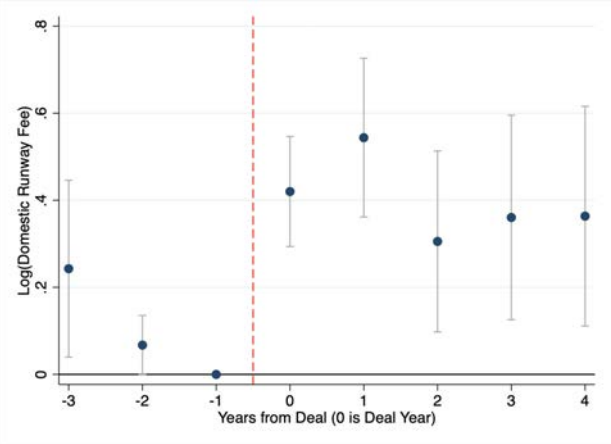
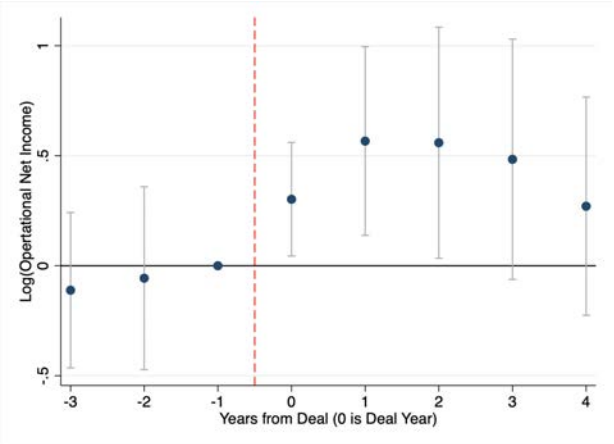


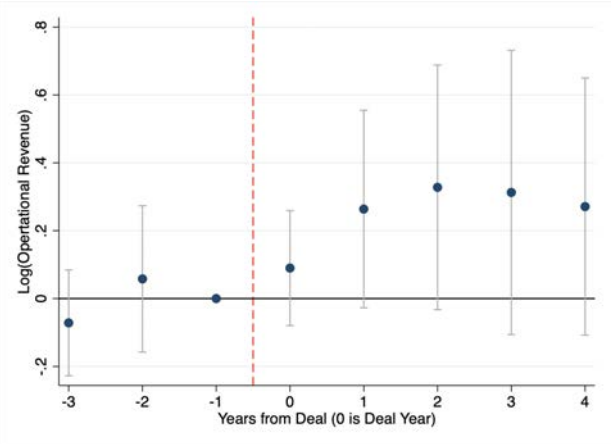
Figure 7: Event Studies – Effect of PE Ownership on Airport Financials

This figure shows dynamic differences-in-differences event studies of transitions to PE ownership.

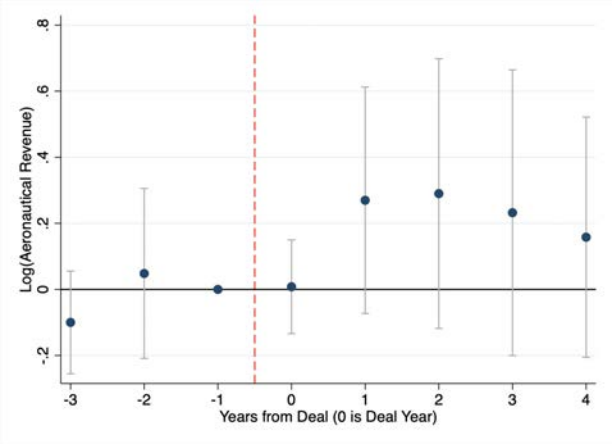
(A) Log(Net Operating Income)



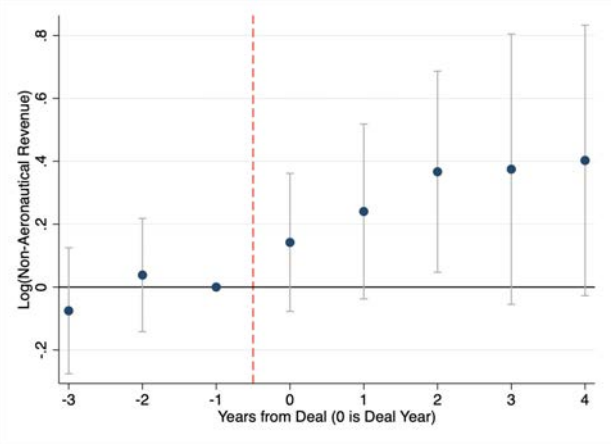
(B) Log(Total Operating Revenue)



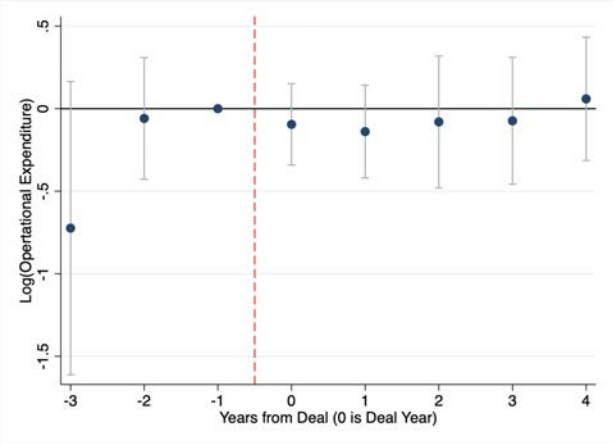
(C) Log(Total Aeronautical Revenue)



(D) Log(Total Non Aeronautical Revenue)



(E) Log(Total Operating Expenditure)



(F) Number of Employees per 1000 Passengers

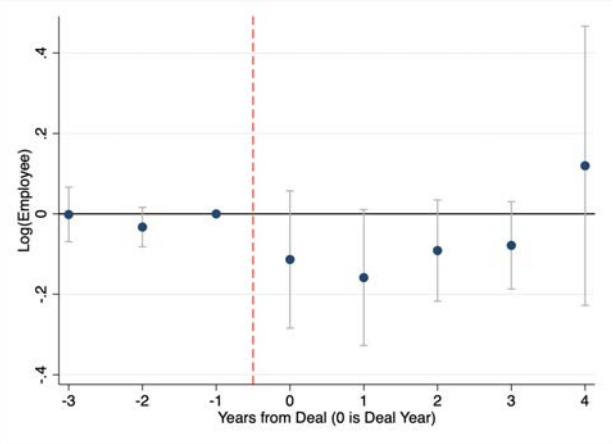


Table 1: Ownership and Control Statistics about Airport Acquisitions

This table shows the distribution of the number of transactions by privatization form and the summary statistics on the ownership and control stakes of the privatization type. Panel A shows the number of transactions and the summary statistics on control stake and concession years of the concession deals by privatization form. Panel B shows the number of transactions and the summary statistics on ownership stake and concession years of sales by privatization form. We consider a very long-term lease (concession deals that are awarded to private parties to operate for more than 30 years) as a sale.

Panel A: Concessions

	Number of Transactions	Percent Control Stake					Duration (Years)	
	N	Mean	Median	SD	Min	Max	Mean	Median
Privatization								
Total	186	94.2	100	15.37	34	100	23.04	25
Govt to non-PE Private	178	96.8	100	11.52	34	100	23.1	25
Govt to PE	8	55.73	45.26	14.05	45	80	21	15
Post-Privatization								
Total	50	88.28	100	24.5	14	100	16.66	15
Non-PE Private to PE	36	85.21	100	25.72	14	100	17.13	17
PE to non-PE Private	11	99.24	100	1.24	97.26	100	12.75	15
PE to PE	3	65.36	63	15.31	49	80	20.82	23

Panel B: Sales

	Number of Transactions			Percent Ownership Stake					Duration if Lease(Years)	
	Total	Outright Sales	Long-Term Leases	Mean	Median	SD	Min	Max	Mean	Median
Privatization										
Total	251	129	122	86.37	100	18.98	30	100	51.1	50
Govt to non-PE Private	223	110	113	88.64	100	17.43	30	100	50.82	50
Govt to PE	28	19	9	71.88	66	22.09	36	100	55.11	45
Post-Privatization										
Total	50	43	7	70.67	66	25.93	10	100	59.14	46
Non-PE Private to PE	35	28	7	72.06	68	25.92	10	100	59.14	46
PE to non-PE Private	7	7	0	67.85	51	32.04	28	100	NA	NA
PE to PE	8	8	0	69.2	66	22.47	45	100	NA	NA

Table 2: Summary Statistics

This table reports the summary statistics for the main variables used in our study at the airport-year level. We gather variables from multiple data sources. Country-level economic characteristics are from World Bank, country-level governance characteristics are from the Heritage Foundation, airport-level traffic is from The Official Aviation Guide (OAG), airport-level project stage is from Preqin, airport-level regulation is provided by David Gillen from University of British Columbia, airport-level price charged on airlines is from an aviation data vendor called, RDC, airport-level financials is from Embry-Riddle University, and airport-on-time performance is from OAG. There are four data types we use in the analyses. Traffic data covers years 1996 to 2019, Charge data covers years 2010 to 2020, Financials data covers 2001 to 2017, and On-time-Performance data covers from 2016-2020.

	Gov't				Non-PE Private				PE			
	N	Mean	Median	SD	N	Mean	Median	SD	N	Mean	Median	SD
Economic Characteristics (Country-Level)												
GDP per Capita (Th)	36,190	$ 25.48	$ 24.17	$ 21.74	3,272	$ 17.26	$ 10.20	$ 16.25	524	$ 34.02	$ 40.36	$ 17.43
Trade Volume (B)	36,190	$ 1,038.85	$ 427.83	$ 1,295.34	3,272	$ 426.67	$ 208.27	$ 495.42	524	$ 613.90	$ 619.23	$ 439.52
Governance Characteristics (Country-Level)												
Gov't Integrity	36,190	57.36	61.00	24.33	3,272	47.23	37.00	22.14	524	67.41	78.00	21.67
Judicial Effectiveness	36,190	62.90	65.40	19.03	3,272	53.00	46.53	20.17	524	71.61	85.90	21.52
Gov't Spending	36,190	60.20	60.03	20.85	3,272	62.39	67.50	23.08	524	50.85	49.60	22.67
Investment Freedom	36,190	58.72	70.00	19.66	3,272	61.65	70.00	17.68	524	75.82	80.00	13.92
Financial Freedom	36,190	59.09	60.00	20.72	3,272	59.48	60.00	17.00	524	74.09	80.00	16.25
Open Markets	36,190	64.16	66.00	15.92	3,272	65.54	67.47	12.94	524	77.51	81.03	10.70
Traffic (Airport-Level)												
Share Passengers Int'l	36,190	0.19	0.01	0.30	3,272	0.38	0.29	0.35	524	0.43	0.38	0.35
Total Passengers per Flight	36,190	85.71	76.91	53.81	3,272	117.54	120.09	41.44	524	126.92	133.22	35.77
Int'l Passengers per Flight	36,190	68.47	26.12	78.56	3,272	119.18	132.13	66.45	524	130.96	147.32	68.64
Dom Passengers per Flight	36,190	77.97	67.34	51.80	3,272	106.56	107.53	50.13	524	115.95	116.99	47.88
Total Passengers (M)	36,190	1.71	0.15	5.21	3,272	2.67	0.73	5.09	524	3.46	1.72	4.85
Int'l Passengers (M)	36,190	0.58	0.00	2.59	3,272	1.48	0.20	3.68	524	2.16	0.56	4.12
Dom Passengers (M)	36,190	1.14	0.10	3.81	3,272	1.20	0.38	2.29	524	1.30	0.62	1.89
Total Flights (Th)	36,190	13.57	2.56	37.19	3,272	19.28	7.02	32.00	524	25.65	14.75	32.31
Total Freight Tons per Flight	36,190	2.44	0.79	4.14	3,272	3.98	2.72	4.56	524	5.87	3.22	8.06
Int'l Freight Tons per Flight	36,190	2.36	0.00	5.16	3,272	4.59	2.83	5.60	524	6.43	3.88	8.24
Dom Freight Tons per Flight	36,190	2.00	0.50	3.57	3,272	3.10	1.45	4.31	524	5.19	2.21	8.94
Total Freight Tons (Th)	36,190	57.28	1.82	243.07	3,272	97.11	16.51	219.46	524	185.13	29.43	441.56
Int'l Freight Tons (Th)	36,190	24.83	0.00	144.96	3,272	57.10	4.28	144.72	524	128.78	11.57	372.23
Dom Freight Tons (Th)	36,190	32.45	0.93	160.97	3,272	40.01	4.48	110.61	524	56.35	12.80	143.97
Quality Measures (Airport-Level)												
Number of Routes	36,190	18.17	6.00	32.91	3,272	35.67	17.00	47.26	524	49.71	30.00	52.74
Number of Int'l Routes	36,190	9.01	1.00	23.70	3,272	25.71	9.00	42.80	524	38.32	17.00	51.61
Number of Dom Routes	36,190	9.16	4.00	17.21	3,272	9.96	6.00	11.50	524	11.39	9.00	9.31
I(Award)	36,190	0.02	0.00	0.12	3,272	0.04	0.00	0.21	524	0.07	0.00	0.26
Number of Accidents	36,190	0.05	0.00	0.24	3,272	0.08	0.00	0.30	524	0.11	0.00	0.35
Number of Fatalities	36,190	0.44	0.00	15.55	3,272	0.49	0.00	6.45	524	0.08	0.00	0.64
Airlines (Airport-Level)												
Number of Operated Airlines	36,190	7.70	3.00	11.92	3,272	15.72	8.00	18.80	524	17.25	11.00	18.63
Number of Low Cost Carriers	36,190	0.86	0.00	2.03	3,272	2.27	1.00	3.11	524	3.17	2.00	3.47
Airline HHI	36,190	5,727.97	5,063.13	3,045.26	3,272	3,880.68	3,212.78	2,528.96	524	3,759.94	3,131.45	2,350.43
Share of Largest Airline	36,190	66.48	63.14	25.92	3,272	51.32	47.94	23.56	524	51.00	47.32	22.12
Price Regulation (Airport-Level)												
No Regulation	777	0.08	0.00	0.27	371	0.22	0.00	0.42	197	0.32	0.00	0.47
Cost Based	777	0.52	1.00	0.50	371	0.15	0.00	0.36	197	0.02	0.00	0.12
Revenue Cap	777	0.06	0.00	0.23	371	0.11	0.00	0.32	197	0.03	0.00	0.16
Hybrid	777	0.11	0.00	0.31	371	0.10	0.00	0.30	197	0.10	0.00	0.30
Fees Charged to Airlines (Airport-Level)												
Int'l Fee (Th)	7,566	$ 7.77	$ 6.46	$ 5.31	1,465	$ 11.01	$ 10.41	$ 5.37	339	$ 10.75	$ 9.54	$ 5.93
Dom Fee (Th)	7,566	$ 0.77	$ 0.51	$ 0.76	1,465	$ 0.89	$ 0.72	$ 0.78	339	$ 1.36	$ 1.18	$ 1.05
Int'l Passenger Fee (Th)	7,566	$ 5.22	$ 4.21	$ 4.68	1,465	$ 8.47	$ 8.01	$ 4.97	339	$ 7.81	$ 6.36	$ 4.86
Dom Passenger Fee (Th)	7,566	$ 0.61	$ 0.34	$ 0.69	1,465	$ 0.74	$ 0.58	$ 0.68	339	$ 1.08	$ 0.92	$ 0.91
Int'l Runway Fee (Th)	7,566	$ 2.56	$ 2.01	$ 2.02	1,465	$ 2.54	$ 2.12	$ 1.82	339	$ 2.94	$ 2.01	$ 2.77
Dom Runway Fee (Th)	7,566	$ 0.17	$ 0.12	$ 0.19	1,465	$ 0.15	$ 0.08	$ 0.19	339	$ 0.28	$ 0.18	$ 0.30
Financials (Airport-Level)												
Total Op. Rev (M)	2,005	$ 317.74	$ 171.61	$ 392.54	363	$ 382.32	$ 180.10	$ 455.40	204	$ 219.72	$ 100.95	$ 261.31
Total Op. Exp. (M)	1,982	$ 189.35	$ 101.84	$ 240.14	361	$ 227.33	$ 99.96	$ 337.22	204	$ 118.74	$ 55.25	$ 155.92
Net Op. Income (M)	1,981	$ 130.42	$ 65.71	$ 191.57	359	$ 158.95	$ 81.20	$ 166.53	204	$ 100.98	$ 53.24	$ 117.49
Total Aero Rev (M)	2,033	$ 162.99	$ 88.20	$ 197.73	364	$ 182.60	$ 90.67	$ 184.59	204	$ 107.04	$ 55.23	$ 126.79
Total Non-Aero Rev (M)	2,006	$ 155.75	$ 78.47	$ 230.02	364	$ 199.17	$ 93.87	$ 298.40	204	$ 112.26	$ 50.85	$ 138.22
Num of Employees per 1000 psg	2,015	50.72	0.06	1,791.09	369	2,346.08	0.09	20,540.33	205	1,346.17	0.05	19,273.17
On-Time Performance (Airport-Level)												
Cancellation (%)	3,011	2.16	1.44	3.92	673	1.56	1.01	2.27	142	1.26	0.93	1.14
Departure (%)	3,011	77.89	80.00	9.73	673	77.21	78.80	8.40	142	72.80	73.51	10.25

Table 3: Economic and Governance Predictors of Privatization

This table shows predictors of acquisition by either a PE infrastructure fund ("PE") or a non-PE private firm ("Non-PE Priv"). The unit of observation is the airport-year, with years post-acquisition dropped. The model is OLS regression. The dependent variables are indicators multiplied by 100 for readability of the coefficients. Regulation is only observed for major airports in Asia, Europe, and Oceana. Regulation variables are indicator variables. No regulation is 1 if there are no price regulation in an airport at that year, Cost Based is 1 if The governance measures are from The Heritage Foundation, which also provides indices for "tax burden", "monetary freedom", "labor freedom," and "business freedom," but we find no significant effects of these and do not include them. All models include year and region fixed effects. Regions are Africa, Asia, Europe, North America, Oceana, and South America. Standard errors are clustered by airport. Significance: *p<.1 **p<.05 ***p<.01

	Economic		Regulation		Governance		Combined	
	PE	Non-PE Priv	PE	Non-PE Priv	PE	Non-PE Priv	PE	Non-PE Priv
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Total Passengers	0.039	-0.126*					0.036	-0.112
	(0.024)	(0.071)					(0.025)	(0.070)
Share Passengers Intl	0.461***	1.269***					0.401***	1.310***
	(0.128)	(0.457)					(0.128)	(0.481)
Log GDP Per Capita	0.004	-0.181**					-0.022	0.251**
	(0.016)	(0.076)					(0.030)	(0.104)
Log Trade Volume	0.052***	-0.063*					0.033**	-0.009
	(0.016)	(0.035)					(0.015)	(0.045)
𝟙(Competing Airports)	0.057	0.379**					0.039	0.292
	(0.056)	(0.186)					(0.056)	(0.185)
Share of Largest Airline	-0.001	-0.020					-0.001	-0.021*
	(0.006)	(0.012)					(0.006)	(0.012)
Airline HHI	0.000	0.000**					0.000	0.000**
	(0.000)	(0.000)					(0.000)	(0.000)
Log(Number of Airline)	-0.045	0.994***					-0.036	0.844***
	(0.102)	(0.244)					(0.102)	(0.238)
Log(Number of Routes)	0.032	-0.196					0.042	-0.122
	(0.053)	(0.139)					(0.053)	(0.143)
I(Award)	0.308	-0.466					0.310	-0.472
	(0.329)	(0.475)					(0.328)	(0.483)
No Regulation			-0.165	1.447				
			(2.420)	(1.720)				
Cost Based			-1.962***	-0.460				
			(0.653)	(0.820)				
Revenue Cap			-0.833	1.238				
			(1.059)	(2.065)				
Hybrid			0.865	0.256				
			(1.457)	(1.357)				
Judicial Effectiveness					0.002	-0.018**	0.002	-0.012
					(0.002)	(0.009)	(0.002)	(0.011)
Financial Freedom					0.010***	0.027***	0.009***	0.027***
					(0.003)	(0.009)	(0.003)	(0.010)
Investment Freedom					0.007**	0.017**	0.007**	0.019**
					(0.003)	(0.009)	(0.003)	(0.009)
Government Integrity					-0.004**	-0.015**	-0.002	-0.021***
					(0.002)	(0.006)	(0.002)	(0.007)
Gov't Spending					-0.003*	0.018**	-0.003	0.021***
					(0.002)	(0.007)	(0.002)	(0.008)
Open Markets					-0.010	-0.034**	-0.012	-0.045**
					(0.007)	(0.016)	(0.007)	(0.020)
Constant	-1.090***	3.171***	2.283***	1.559**	0.125	1.233**	-0.567	-0.786
	(0.343)	(0.898)	(0.828)	(0.640)	(0.194)	(0.479)	(0.378)	(0.973)
Observations	41008	37974	1474	1240	42379	39334	41008	37974
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Outcome Mean	0.172	0.763	0.172	0.763	0.172	0.763	0.172	0.763

Table 4: Effect of Ownership Type on Airport Volume of Passengers and Traffic

This table reports estimates of how four ownership transitions affect passengers and traffic. The sample is an airport-year level panel from 1996 to 2019. Columns 1, 2, and 3 report changes in per flight passengers, per flight international passengers, and per flight domestic passengers. Columns 4 and 5 report changes in the share of aircraft types. Jets are aircrafts that can take more than 150 passengers on board. Regional includes smaller aircraft with capacity less than 100 passengers. Columns 7, 8, and 9 report changes in total number of passengers, number of international passengers, number of domestic passengers. Column 10, 11, and 12 report changes in total, international, and domestic number of air movements. The independent variables capture four ownership type changes, with government ownership as the base group. Privatization by PE is one after an airport transitions from government to PE ownership and zero otherwise. Similarly, Privatization by Non-PE is one after an airport transitions from government to Non-PE private ownership. Post-Priv Non-PE to PE is one after an airport that is already privatized by a non-PE firm transitions to PE ownership. Post-Priv PE to Non-PE is the reverse. We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport, and year fixed effects. We report two p-values on F-tests for equality of coefficients. The first compares the two privatization coefficients and the second compares the post-privatization coefficients. Standard errors are clustered at an airport level. Significance: *p<.1 **p<.05 ***p<.01

Dependent Variable:	Passengers per Flight			Share Aircraft Type		Log(Number of Passengers)			Log(Number of Flights)		
	Total	In'l	Domestic	Jets	Regional	Total	In'l	Domestic	Total	In'l	Domestic
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
𝟙(Privatization by PE)	17.87***	11.01	20.17*	0.14**	-0.14**	0.61***	0.32	0.71***	0.48***	0.26	0.49***
	(5.56)	(7.46)	(10.60)	(0.06)	(0.06)	(0.18)	(0.25)	(0.26)	(0.17)	(0.25)	(0.15)
𝟙(Privatization by Non-PE)	1.60	0.98	3.68**	0.00	-0.00	0.17***	0.13***	0.12**	0.18***	0.12**	0.11**
	(1.45)	(2.24)	(1.77)	(0.02)	(0.02)	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)
𝟙(Post-Priv Non-PE to PE)	8.72***	7.55*	19.67***	0.09***	-0.09***	0.16**	0.18**	0.23**	0.12*	0.12	0.08
	(2.94)	(4.19)	(6.58)	(0.02)	(0.02)	(0.07)	(0.09)	(0.10)	(0.07)	(0.08)	(0.12)
𝟙(Post-Priv PE to Non-PE)	2.69	7.64	-9.84	0.06*	-0.06*	0.02	-0.17	-0.14	-0.01	-0.25	-0.02
	(7.40)	(10.05)	(6.20)	(0.03)	(0.03)	(0.17)	(0.20)	(0.28)	(0.16)	(0.20)	(0.22)
Observations	40357	40357	40357	40357	40357	40357	40357	40357	40357	40357	40357
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.91	0.93	0.87	0.87	0.87	0.96	0.99	0.96	0.94	0.98	0.93
Y-Mean	90.00	76.07	81.42	0.41	0.59	12.46	6.70	11.82	8.21	3.99	7.72
Pr > F Priv Non-PE=Priv PE	0	.2	.12	.04	.04	.02	.45	.03	.08	.57	.02
Pr > F Non-PE to PE=PE to Non-PE	.45	.99	0	.53	.53	.42	.11	.21	.46	.08	.69

Table 5: Effect of Ownership Type on Downstream Performance: Routes and Airlines

This table reports estimates of how four ownership transitions affect airports' route systems and airlines. The sample is an airport-year level panel from 1996 to 2019. Columns 1 to 3 report results on the effect of ownership changes on log number of routes that are being served in the airport. Column 4 and 5 report results on the effect of ownership changes on the number of airlines being served in the airport. Column 6 and 7 report results on the effect of the airline HHI measure and the share of the largest airline in the airport. The independent variables capture four ownership type changes, with government ownership as the base group. Privatization by PE is one after an airport transitions from government to PE ownership and zero otherwise. Similarly, Privatization by Non-PE is one after an airport transitions from government to Non-PE private ownership. Post-Priv Non-PE to PE is one after an airport that is already privatized by a non-PE firm transitions to PE ownership. Post-Priv PE to Non-PE is the reverse. We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport, and year fixed effects. We report two p-values on F-tests for equality of coefficients. The first compares the two privatization coefficients and the second compares the post-privatization coefficients. Standard errors are clustered at an airport level. Significance: *p<.1 **p<.05 ***p<.01

Dependent Variable:	Log(Number of Routes)			Number of Airlines			
	Total	International	Domestic	Total	Low Cost Carriers	Airline HHI	Share of Largest Airline
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
𝟙(Privatization by PE)	0.36**	0.38**	0.08	1.24	2.13**	291	2.73
	(0.16)	(0.17)	(0.11)	(1.13)	(1.04)	(353.22)	(3.87)
𝟙(Privatization by Non-PE)	0.14***	0.17***	0.03	3.05***	1.18***	-245**	-2.50**
	(0.03)	(0.03)	(0.03)	(0.47)	(0.18)	(101.14)	(1.02)
𝟙(Post-Priv Non-PE to PE)	0.17***	0.27***	0.01	-0.32	0.20	154	0.78
	(0.07)	(0.08)	(0.04)	(0.78)	(0.33)	(225.09)	(2.44)
𝟙(Post-Priv PE to Non-PE)	0.23**	0.05	0.17	1.07	-0.35	-464	-3.89
	(0.09)	(0.14)	(0.11)	(1.59)	(1.02)	(393.33)	(6.33)
Observations	40343	40357	40357	40357	40357	40357	40357
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.94	0.96	0.91	0.93	0.68	0.79	0.76
Y-Mean	2.30	1.26	1.78	8.70	1.01	5,474	64.44
Pr > F Priv Non-PE=Priv PE	.17	.21	.67	.14	.37	.14	.19
Pr > F Non-PE to PE=PE to Non-PE	.62	.17	.17	.43	.61	.17	.49

Table 6: Effect of Ownership Type on Punctuality, Safety, and Awards

This table reports estimates of how four ownership transitions affect other measures of airport performance, relative to government-owned airports. The dependent variables of the first two columns are related to airport's on-time performance and use a sample from 2016 to 2019. The Flight cancellation rate=Number of flights cancelled/Total number of flights * 100. Similarly the On time departure rate=Number of flights that are on-time/Total number of flights * 100. For the rest of the columns the sample is from 1996 to 2019. The dependent variable in column 3 is an indicator for winning an award. The last two columns report changes in the number of accidents and fatalities per 1000 flights that took off from the airport. The independent variables capture four ownership type changes, with government ownership as the base group. Privatization by PE is one after an airport transitions from government to PE ownership and zero otherwise. Similarly, Privatization by Non-PE is one after an airport transitions from government to Non-PE private ownership. Post-Priv Non-PE to PE is one after an airport that is already privatized by a non-PE firm transitions to PE ownership. Post-Priv PE to Non-PE is the reverse. We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport, and year fixed effects. We report two p-values on F-tests for equality of coefficients. The first compares the two privatization coefficients and the second compares the post-privatization coefficients. Standard errors are clustered at an airport level. Significance: *p<.1 **p<.05 ***p<.01

Dependent Variable:	Flight Cancellation Rate	On-Time Departure Rate	𝟙(Award)	Number per 1000 Flights	
				Accidents	Fatalities
	(1)	(2)	(3)	(4)	(5)
𝟙(Privatization by PE)	-1.44***	-8.62***	0.12	-0.01	-0.22
	(0.12)	(0.32)	(0.08)	(0.01)	(0.24)
𝟙(Privatization by Non-PE)	-0.77**	-2.33**	0.03**	0.00	-0.12
	(0.37)	(1.04)	(0.01)	(0.00)	(0.09)
𝟙(Post-Priv Non-PE to PE)	-0.98***	-1.68	0.06**	-0.00	-0.16
	(0.25)	(1.94)	(0.02)	(0.00)	(0.17)
𝟙(Post-Priv PE to Non-PE)	0.92	-7.49***	-0.02	0.00	0.13
	(0.57)	(1.78)	(0.06)	(0.01)	(0.12)
Observations	3621	3621	40357	40357	40357
Airport FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
R^2	0.66	0.82	0.31	0.08	0.06
Y-Mean	2.03	77.53	0.02	0.01	0.08
Pr > F Priv Non-PE=Priv PE	.09	0	.26	.48	.71
Pr > F Non-PE to PE=PE to Non-PE	0	.03	.21	.43	.15

Table 7: Effect of Ownership Type on Fees Charged to Airlines

This table reports estimates of how four ownership transitions affect fees charged to airlines, relative to government-owned airports. The sample is an airport-year level panel from 2010 to 2020. Columns 1 and 2 report changes in total international and total domestic charges. Columns 3 and 4 report changes in international passenger charges and domestic passenger charges. Passenger charges are fees that are levied on airlines for airports' services to passengers. Columns 5 and 6 report changes in international runway charges and domestic runway charges where runway charges are defined as fees that are levied on airlines for using the airport's runway when flights land and take off. All charges are calculated per individual flight. Column 7 considers the government regulatory regime. The sample is an airport-year level panel from 1990 to 2018. $\mathbb{1}$(No Regulation) is a dependent variable which indicates whether an airport has no price regulations at that year. The independent variables capture four ownership type changes, with government ownership as the base group. Privatization by PE is one after an airport transitions from government to PE ownership and zero otherwise. Similarly, Privatization by Non-PE is one after an airport transitions from government to Non-PE private ownership. Post-Priv Non-PE to PE is one after an airport that is already privatized by a non-PE firm transitions to PE ownership. Post-Priv PE to Non-PE is the reverse. We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport, and year fixed effects. We report two p-values on F-tests for equality of coefficients. The first compares the two privatization coefficients and the second compares the post-privatization coefficients. Standard errors are clustered at an airport level. Statistical significance is indicated by: *p<.1 **p<.05 ***p<.01

Dependent Variable:	Log(Total Fee)		Log(Passenger Fee)		Log(Runway Fee)		
	International	Domestic	International	Domestic	International	Domestic	No Regulation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\mathbb{1}$(Privatization by PE)	-0.02**	-0.05***	-0.06***	-0.06***	0.13***	0.18***	0.14*
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.07)
$\mathbb{1}$(Privatization by Non-PE)	0.28***	0.31***	0.55***	0.49***	0.05	0.11***	-0.05
	(0.08)	(0.08)	(0.15)	(0.11)	(0.03)	(0.04)	(0.06)
$\mathbb{1}$(Post-Priv Non-PE to PE)	0.17**	0.18**	0.54**	0.43*	0.04	0.06	0.28**
	(0.07)	(0.08)	(0.27)	(0.22)	(0.05)	(0.05)	(0.11)
$\mathbb{1}$(Post-Priv PE to Non-PE)	0.03	0.05	-0.03	0.04	0.07**	0.09*	
	(0.07)	(0.05)	(0.09)	(0.06)	(0.03)	(0.05)	
Observations	9125	9123	9125	9125	9125	9115	1514
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.95	0.96	0.97	0.97	0.98	0.98	0.72
Y-Mean	8.82	6.23	8.01	5.64	7.54	4.55	0.16
Pr > F Priv Non-PE=Priv PE	0	0	0	0	.03	.05	.04
Pr > F Non-PE to PE=PE to Non-PE	.19	.18	.05	.1	.59	.69	

Table 8: Effect of Ownership Type on Financial Outcomes

This table reports estimates of how four ownership transitions affect financial outcomes, relative to government-owned airports. The sample is an airport-year level panel from 2001 to 2017. The dependent variables are financial measures taken from airport income statements. They are the logs of total net operational income, total operational revenue, total operational expenditure per 1000 passengers, aeronautical revenue, non-aeronautical revenue, and number of employees per 1000 passengers. The independent variables capture four ownership type changes, with government ownership as the base group. Privatization by PE is one after an airport transitions from government to PE ownership and zero otherwise. Similarly, Privatization by Non-PE is one after an airport transitions from government to Non-PE private ownership. Post-Priv Non-PE to PE is one after an airport that is already privatized by a non-PE firm transitions to PE ownership. Post-Priv PE to Non-PE is the reverse. There are no airports with data for PE to non-PE transitions for the dependent variables in columns 3, 4, and 6, so these coefficients are empty. We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport, and year fixed effects. We report two p-values on F-tests for equality of coefficients. The first compares the two privatization coefficients and the second compares the post-privatization coefficients. Standard errors are clustered at an airport level. Statistical significance is indicated by: *p<.1 **p<.05 ***p<.01. Significance: *p<.1 **p<.05 ***p<.01

Dependent Variable:	Log(Op. Net Income)	Log(Op. Revenue)	Log(Aero Revenue)	Log(Non-Aero Revenue)	Log(Op. Expenditure)	Log(Employees per 1000 psg)
	(1)	(2)	(3)	(4)	(5)	(6)
𝟙(Privatization by PE)	0.73**	0.71**	0.71**	0.84**	0.35**	-0.00
	(0.35)	(0.33)	(0.35)	(0.34)	(0.15)	(0.07)
𝟙(Privatization by Non-PE)	0.30***	0.08	0.20**	-0.03	-0.23**	-0.08**
	(0.10)	(0.07)	(0.09)	(0.08)	(0.11)	(0.03)
𝟙(Post-Priv Non-PE to PE)	0.03	0.03	0.06	0.06	-0.01	-0.02
	(0.08)	(0.07)	(0.10)	(0.07)	(0.04)	(0.02)
𝟙(Post-Priv PE to Non-PE)	-0.54***	-0.49***	-0.61***	-0.35*	-0.41*	-0.07*
	(0.15)	(0.08)	(0.07)	(0.21)	(0.23)	(0.04)
Observations	2613	2715	2744	2717	2686	2749
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.91	0.94	0.91	0.93	0.92	0.88
Y-Mean	17.98	18.94	18.24	18.17	9.54	0.13
Pr > F Priv Non-PE=Priv PE	.23	.07	.16	.01	0	.36
Pr > F Non-PE to PE=PE to Non-PE	0	0	0	.06	.08	.11

Table 9: Role of the Privatization Form for Main Outcomes

This table reports estimates of how four ownership transitions affect eight primary performance outcomes, relative to government-owned airports. The sample is an airport-year level panel from 1996 to 2019. Column 1 reports change in total passengers per flight. Column 2 reports change in number of passengers. Column 3 reports change in number of flights. Column 4 reports change in number of direct routes. Column 5 reports change in number of airlines operated in the airport. Columns 6 and 7 report changes in international charges and domestic charges where charges are defined as fees that are levied on airlines for using the airport's passenger service and runway. All charges are calculated per individual flight. Column 8 reports changes in net operating income. All variables except for passengers per flight and number of airlines are log transformed values. The independent variables capture two ownership type changes with the variation in ownership and control stake intensity and government ownership as the base group. $\mathbb{1}$(PE-Sale) is an indicator variable of airport sale by PE. $\mathbb{1}$(PE-Concession) is an indicator variable of airport concession deal by PE. $\mathbb{1}$(NonPE-Sale) is an indicator variable of airport sale by NonPE-private. $\mathbb{1}$(NonPE-Concession) is an indicator variable of airport concession deal by NonPE-private. We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport, and year fixed effects. We report two p-values on F-tests for equality of coefficients. The first compares PE-Sale to PE-Concession and the second compares NonPE-Sale to NonPE-Concession. Standard errors are clustered at an airport level. Statistical significance is indicated by: *p<.1 **p<.05 ***p<.01

Dependent Variable:	Passengers per Flight	Log(Number of Passengers)	Log(Number of Flights)	Log(Number of Routes)	Number of Airlines	Log(Int'l Fee)	Log(Domestic Fee)	Log(Op. Net Income)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}$(PE-Sale)	12.37***	0.46***	0.39***	0.37***	4.35***	0.67***	0.61***	0.83**
	(2.46)	(0.06)	(0.06)	(0.06)	(0.98)	(0.17)	(0.15)	(0.32)
$\mathbb{1}$(PE-Concession)	4.65	0.23**	0.21**	-0.04	0.70	0.22***	0.28**	0.00
	(4.53)	(0.10)	(0.08)	(0.09)	(0.94)	(0.08)	(0.11)	(.)
$\mathbb{1}$(NonPE-Sale)	4.77***	0.21***	0.18***	0.16***	2.96***	0.25***	0.27***	0.58**
	(1.73)	(0.04)	(0.04)	(0.04)	(0.50)	(0.09)	(0.10)	(0.26)
$\mathbb{1}$(NonPE-Concession)	-2.17	0.14***	0.17***	0.13***	2.43***	0.09**	0.12**	-0.38***
	(1.85)	(0.05)	(0.05)	(0.04)	(0.72)	(0.04)	(0.05)	(0.09)
Observations	40320	40320	40320	40306	40320	9105	9103	2613
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.91	0.96	0.94	0.94	0.93	0.95	0.96	0.87
Y-Mean	89.99	12.46	8.21	2.30	8.71	8.81	6.23	17.82
Pr > F PE Sale = PE Concession	.12	.04	.08	0	0	.02	.07	.01
Pr > F Non-PE Sale = Non-PE Concession	0	.27	.93	.54	.53	.11	.17	0

Table 10: Role of the Competitive Landscape for Main Outcomes

This table estimates how the effects of PE and non-PE private ownership are mediated by having competing airports nearby, for the main outcome variables. 𝟙(PE with Airports Nearby) is 1 when PE has airports with a comparable size within 200 km. 𝟙(PE without Airports Nearby) is 1 when NonPE-Private does not have airports with a comparable size within 200 km. 𝟙(NonPE-Private with Airports Nearby) is 1 when NonPE-Private has airports with a comparable size within 200 km. 𝟙(NonPE-Private without Airports Nearby) is 1 when NonPE-Private does not have airports with a comparable size within 200 km.We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport and year fixed effects. We report two p-values on F-tests for equality of coefficients. The first compares the two coefficients for PE: having competing airports nearby ("w Comp") or not ("wo Comp"). The second compares whether NonPE-Private has airports nearby. Standard errors are clustered at an airport level. Statistical significance is indicated by: *p.1 **p.05 ***p.01.

Dependent Variable:	Passengers per Flight	Log(Number of Passengers)	Log(Number of Flights)	Log(Number of Routes)	Number of Airlines	Airline HHI	Log(Int'l Fee)	Log(Domestic Fee)	Log(Op. Net Income)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
𝟙(PE with Airports Nearby)	9.17***	0.45***	0.41***	0.35***	4.24***	-285.98*	0.60***	0.46***	1.00**
	(2.75)	(0.06)	(0.06)	(0.06)	(0.95)	(168.95)	(0.14)	(0.12)	(0.45)
𝟙(PE without Airports Nearby)	8.47*	0.16*	0.13	-0.06	0.29	283.31	0.54***	0.95***	-2.31
	(4.39)	(0.09)	(0.10)	(0.09)	(1.17)	(404.84)	(0.14)	(0.31)	(1.67)
𝟙(NonPE-Private with Airports Nearby)	1.84	0.20***	0.21***	0.19***	3.36***	-281.92**	0.29***	0.20***	0.73*
	(1.71)	(0.04)	(0.04)	(0.04)	(0.58)	(117.59)	(0.09)	(0.07)	(0.38)
𝟙(NonPE-Private without Airports Nearby)	1.69	0.13**	0.12**	0.06	1.53**	68.55	0.03	0.27**	0.14
	(2.12)	(0.06)	(0.05)	(0.04)	(0.63)	(154.25)	(0.04)	(0.11)	(0.27)
Observations	40320	40320	40320	40306	40320	40320	9105	9103	2613
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.91	0.96	0.94	0.94	0.93	0.79	0.95	0.96	0.87
Y-Mean	89.99	12.46	8.21	2.30	8.71	5,474.43	8.81	6.23	17.82
Pr > F PE w Comp=PE wo Comp	.89	.01	.02	0	.01	.19	.74	.15	.1
Pr > F NonPE Priv w Comp=NonPE Priv wo Comp	.95	.33	.16	.03	.03	.07	.01	.55	.27

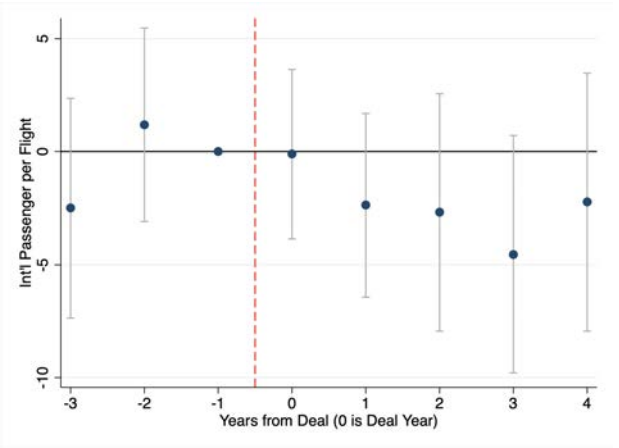
Appendix

(For Online Publication)

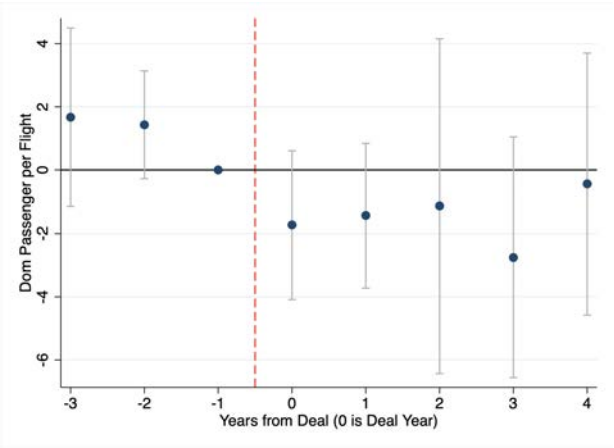
Figure A.1: Event Studies – Privatization Effect on Airport Efficiency by Non-PE

This figure shows event studies of privatization effect on Airport Efficiency by Non-PE Private

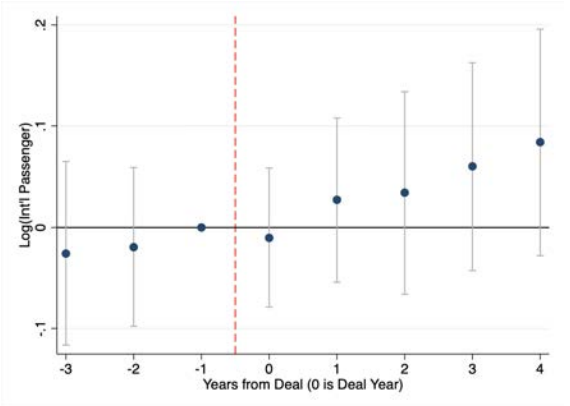
(A) Int'l per Flight Passenger Traffic



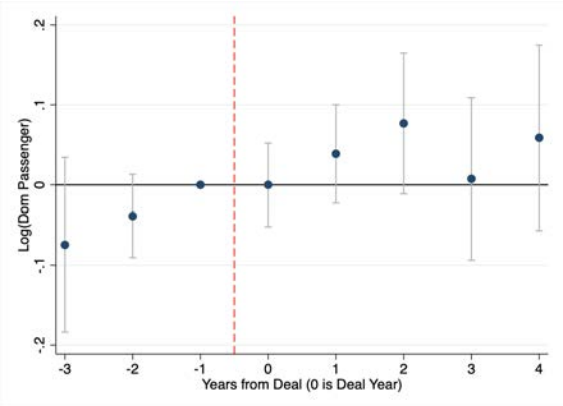
(B) Dom per Flight Passenger Traffic



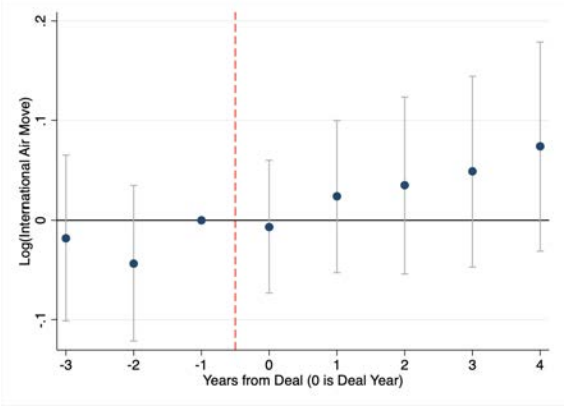
(C) Log(Number of Int'l Passengers)



(D) Log(Number of Dom Passengers)



(E) Log(Number of Int'l Flights)



(F) Log(Number of Dom Passengers)

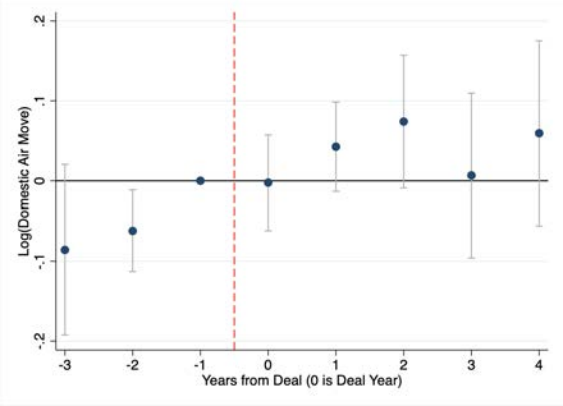
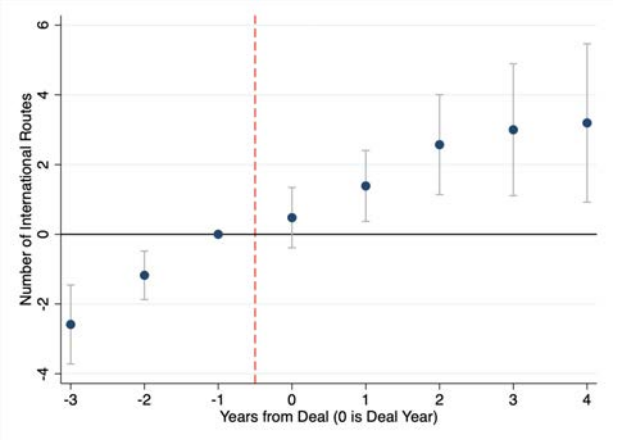


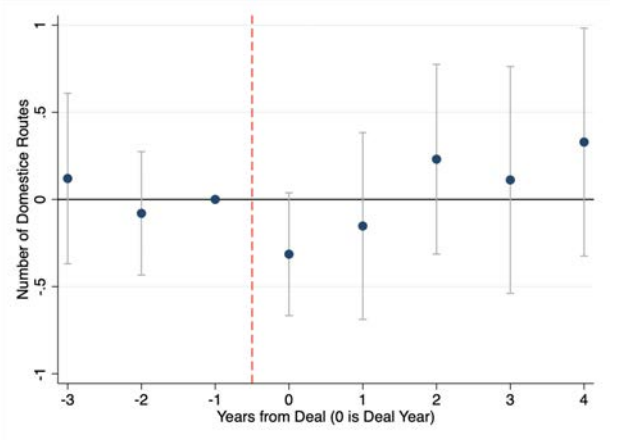
Figure A.2: Event Studies – Privatization Effect on Number of Routes by Non-PE Private

This figure shows event studies of privatization effect on Number of Routes by Non-PE Private

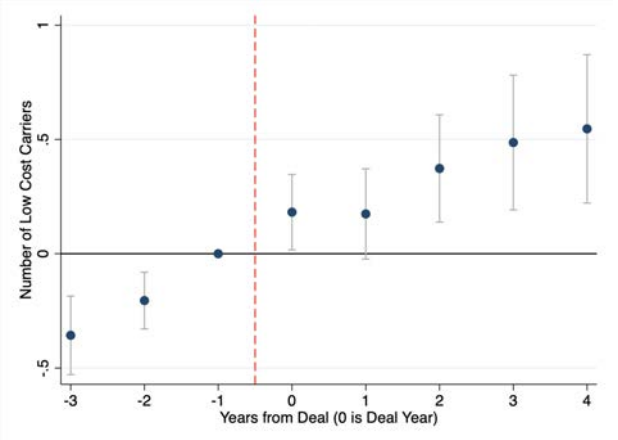
(A) Number of International Routes



(B) Number of Domestic Routes



(C) Number of Low Cost Carriers



(D) Airline HHI

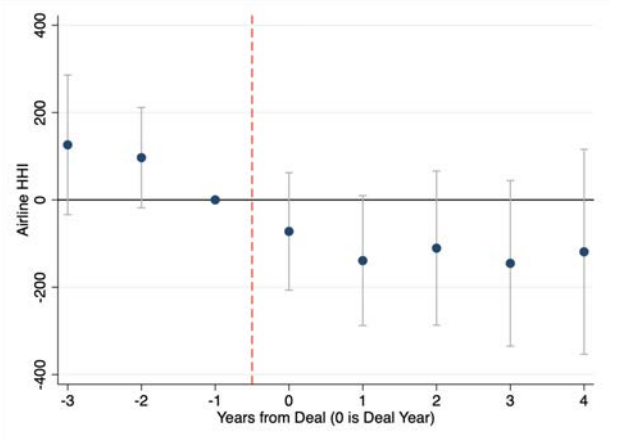
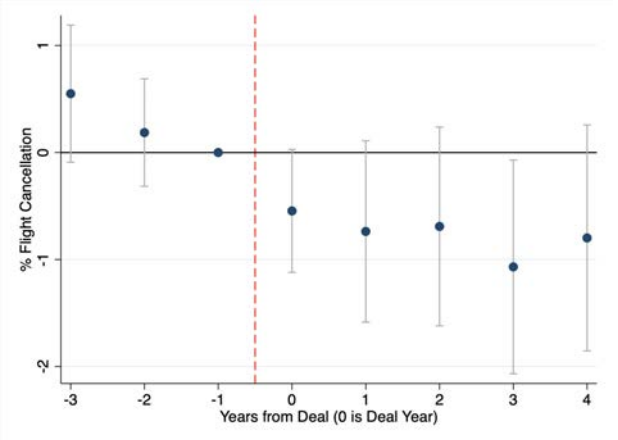


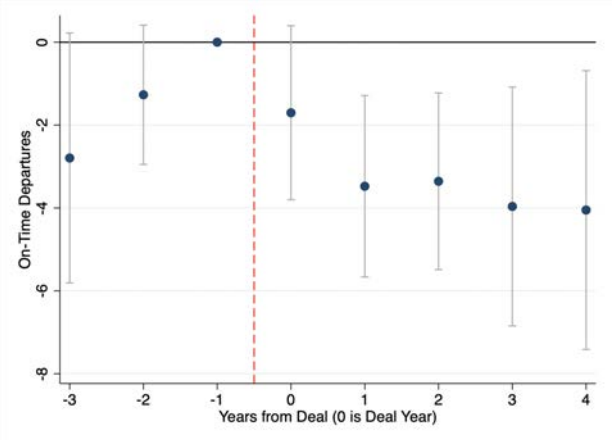
Figure A.3: Event Studies – Effect of Non-PE Private Ownership on Punctuality, Safety, and Awards

This figure shows dynamic differences-in-differences event studies of transitions to PE ownership.

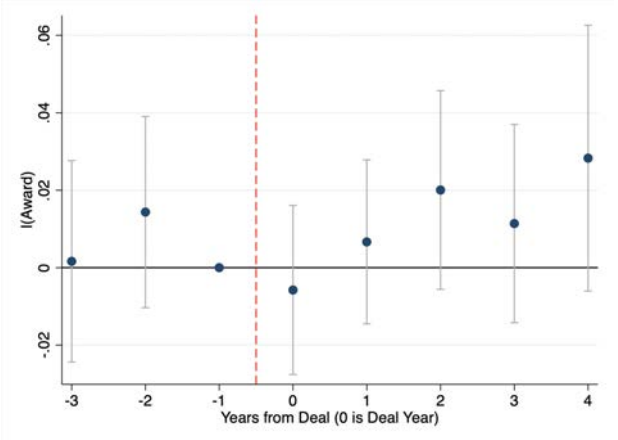
(A) Flight Cancellation Rate



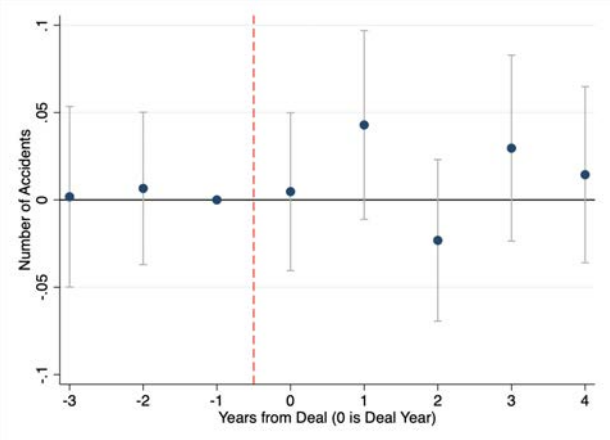
(B) On-Time Departure Rate



(C) Any Award



(D) Number of Accidents



(E) Number of Fatalities

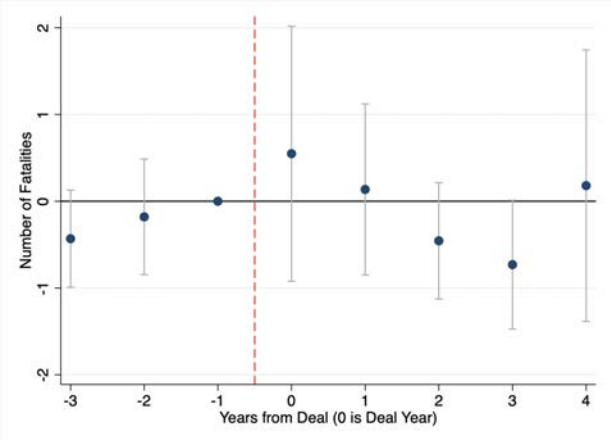
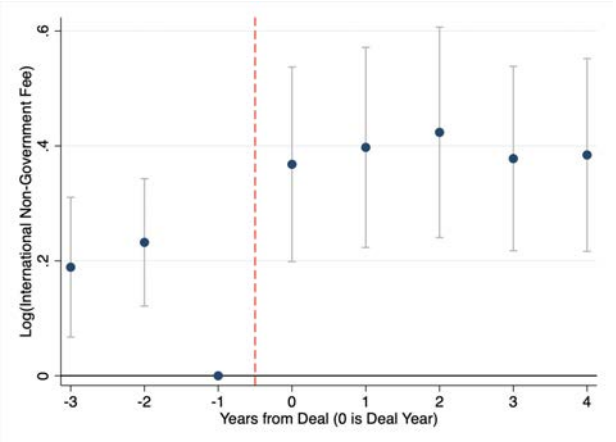


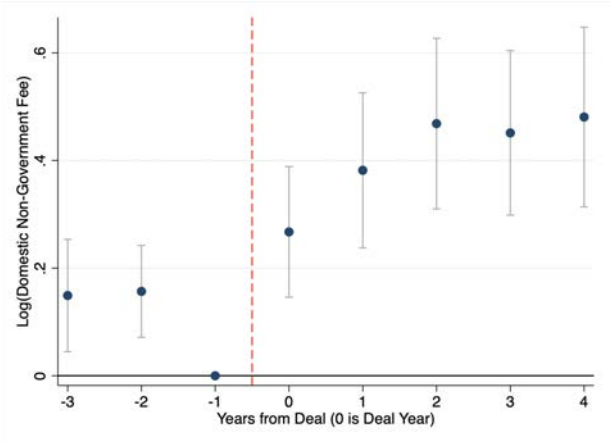
Figure A.4: Event Studies – Privatization Effect on Airport Charges on Airlines by Non-PE

This figure shows event studies of privatization effect on Airport Charges on Airlines by Non-PE Private

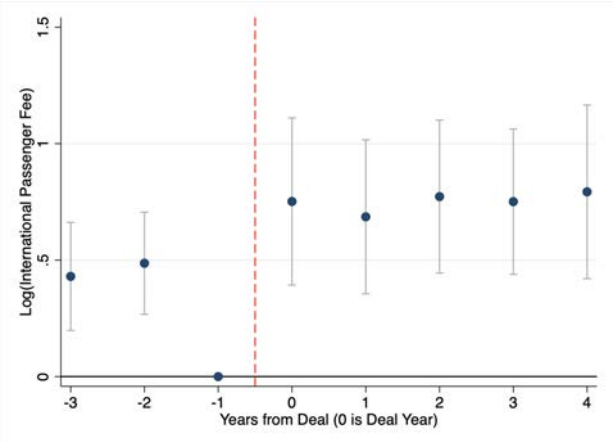
(A) Int'l Fee



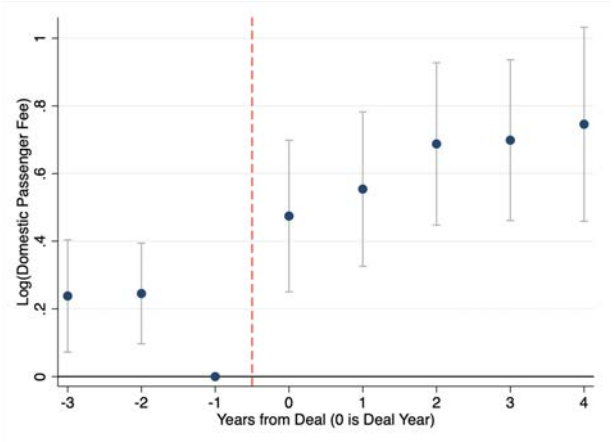
(B) Dom Fee



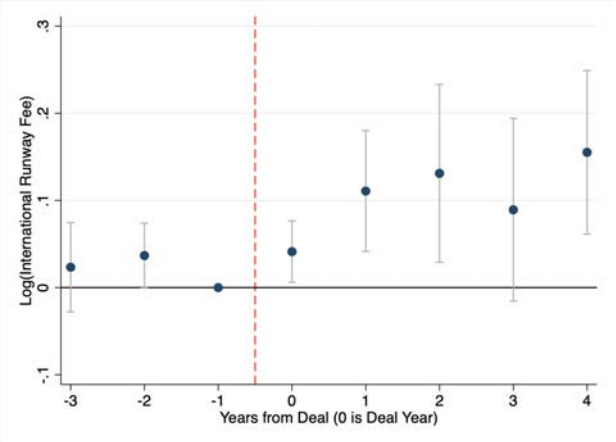
(C) Int'l Passenger Fee



(D) Dom Passenger Fee



(E) Int'l Runway Fee



(F) Dom Runway Fee

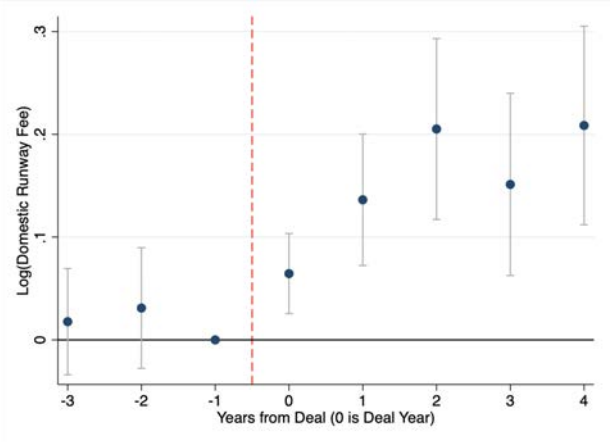
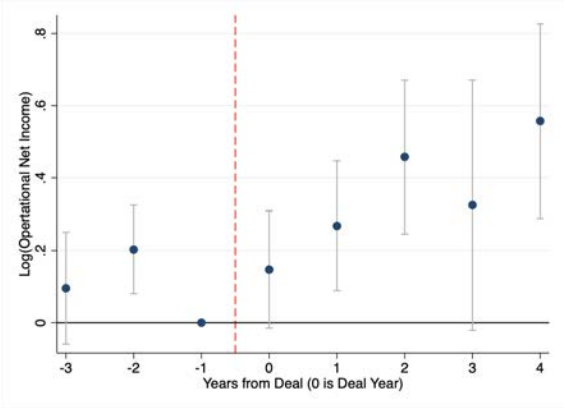


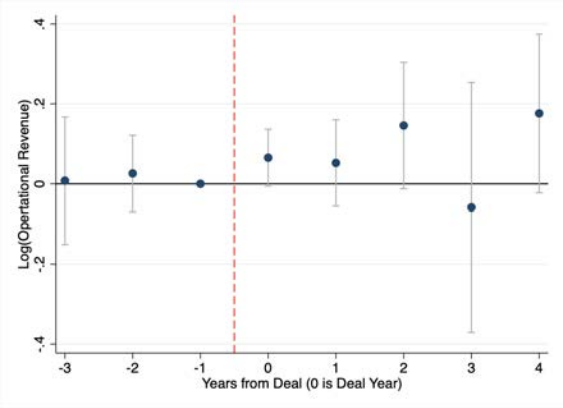
Figure A.5: Event Studies – Privatization Effect on Airport Financials by Non-PE

This figure shows event studies of privatization effect on airport financials by Non-PE Private

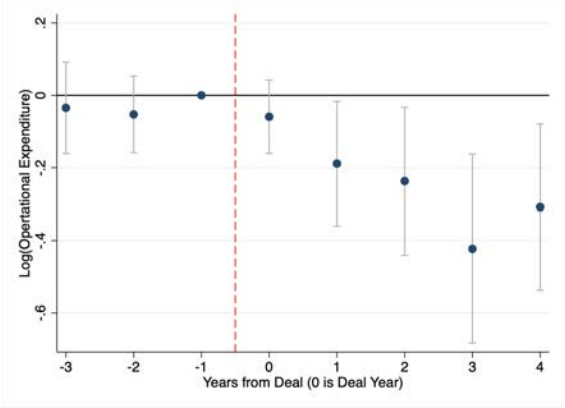
(A) Log(Total Net Operating Income)



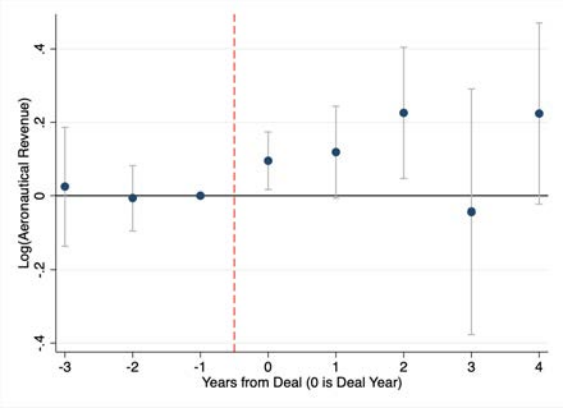
(B) Log(Total Operating Revenue)



(C) Log(Total Operating Expenditure)



(D) Log(Total Aeronautical Revenue)



(E) Log(Total Non-Aeronautical Revenue)

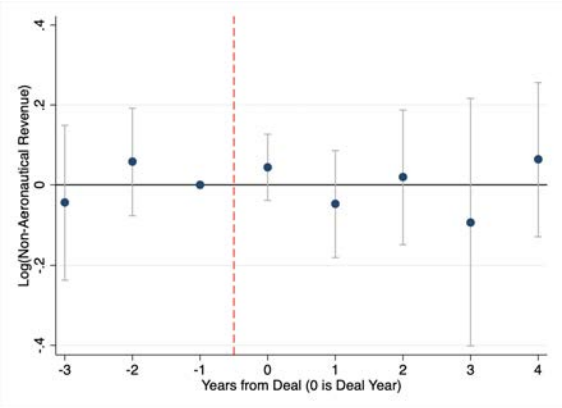


Table A.1: The Distribution of Privatized Airports and PE Investor Fund Statistics By Country and Time

This table shows the distribution of privatized airports by country and time. We start with identifying privatization events for 2,444 airports with more than 10,000 passengers in 2016 in 75 countries for the period 1929-2020. The sample includes 436 airports that were privatized during the period 1929-2020

Country	Before 1990s	1990s	2000s	2010s	2020s	Total
Albania	0	0	1	0	0	1
Argentina	0	28	1	0	0	29
Armenia	0	0	2	0	0	2
Australia	1	14	11	3	0	29
Austria	0	0	1	1	0	2
Bahamas	1	0	1	0	0	2
Belgium	0	0	1	2	0	3
Bermuda	0	0	0	1	0	1
Bolivia	0	3	0	0	0	3
Brazil	0	0	0	18	1	19
Bulgaria	0	0	2	2	1	5
Cambodia	0	3	0	0	0	3
Cameroon	0	3	0	0	0	3
Canada	0	6	1	1	0	8
Chile	0	3	2	0	0	5
Colombia	0	0	3	7	0	10
Congo	0	0	0	3	0	3
Costa Rica	0	0	1	1	0	2
Cote D'Ivoire	0	1	0	0	0	1
Croatia	0	1	0	1	0	2
Cyprus	0	0	2	0	0	2
Czech Republic	0	0	0	1	0	1
Denmark	0	0	4	0	0	4
Dominican Republic	2	1	6	0	0	9
Ecuador	0	0	2	0	0	2
Egypt	0	1	0	0	0	1
Equatorial Guinea	0	0	2	0	0	2
France	0	1	9	23	0	33
Gabon	1	0	0	0	0	1
Georgia	0	0	2	0	0	2
Germany	0	2	3	2	0	7
Greece	0	1	0	14	0	15
Honduras	0	0	3	0	0	3
Hungary	0	0	1	0	0	1
India	0	1	9	1	5	16
Indonesia	0	0	0	1	0	1
Italy	1	4	6	7	0	18
Jamaica	0	0	1	1	0	2
Japan	0	0	0	6	8	14
Jordan	0	0	1	0	0	1
Kazakhstan	0	0	0	0	1	1
Kosovo	0	0	0	1	0	1
Latvia	0	0	0	1	0	1
Macedonia	0	0	2	0	0	2
Madagascar	0	0	0	2	0	2

Country	Before 1990s	1990s	2000s	2010s	2020s	Total
Malaysia	0	0	1	0	0	1
Maldives	0	0	0	1	0	1
Malta	0	0	1	0	0	1
Mexico	0	0	41	1	0	42
Moldova	0	0	0	1	0	1
Myanmar	0	0	0	1	0	1
Netherlands	0	0	1	0	0	1
New Zealand	0	2	0	0	0	2
Nigeria	0	1	0	0	0	1
Norway	0	1	0	0	0	1
Pakistan	0	0	1	0	0	1
Peru	0	0	13	1	0	14
Philippines	0	0	0	3	0	3
Portugal	0	0	2	10	0	12
Puerto Rico	0	0	0	1	0	1
Russia	0	3	0	15	0	18
Saudi Arabia	0	0	0	5	0	5
Serbia	0	0	0	1	0	1
Slovenia	0	0	1	1	0	2
South Africa	0	0	1	1	0	2
Sweden	0	1	0	1	0	2
Switzerland	1	0	1	0	0	2
Tanzania	0	1	0	0	0	1
Thailand	1	1	0	0	0	2
Tunisia	0	0	2	0	0	2
Turkey	0	2	6	0	0	8
UK	7	10	10	2	0	29
US	0	1	0	1	0	2
Ukraine	0	0	1	0	0	1
Uruguay	0	1	1	0	0	2
Total	15	97	163	146	16	437

Table A.2: PE Investor Fund Statistics

Panel A: Top 5 Firms by Number of Airports

	Number of Airports
Ciclad	16
Macquarie	11
Advent International	7
IFM Investors	6
F2i	5

Panel B: Fund and Deal Statistics

	Mean	Median	N
Fund Size	2.71b	1.17b	43
Closed-Ended	85%		20
Deals Exited	37.78%		90
Deals Exited by Year 10	26.67%		90
Years to Exit	8.32	7	34
Fund Region			
EU	41.3%		46
NA	23.91%		46
OC	17.39%		46
AS	6.52%		46
SA	6.52%		46
AF	4.35%		46
Same Region as Airport	76.74%		43

Table A.3: Government Ownership of Top 10 Non-PE Firms

This table shows the list of top 10 non-PE private firms in terms of the number of airport deals and government ownership of each firm as of 2022.

Non-PE Private Firms	Country	# of Deals	Gov't (%)	Major owners
Aeropuertos Argentina 2000	Argentina	33	15	Corporacion America S.A. 75.65% Government 15.00% Cedicor 9.35%
Vinci Airports	France	29	0	Subsidiary of VINCI SA. VINCI SA Ownership: Vinci Sa 13.94% Qatar Holding Llc 3.74% Partners Group (UK) Ltd. 0.02%
Fraport	Germany	20	52.02	State of Hesse 31.31% City of Frankfurt 20.71% Deutsche Lufthansa AG 8.44%
Grupo Aeroportuario del Sureste	Mexico	18	0	Fernando Gerardo Chico Pardo 21.0% Grupo ADO 13.3%
TAV Airports Holding	Turkey	17	0	Aeroports de Paris SA 46.1% Tepe Insaat Sanayi AS 5.06%
SNC-Lavalin	France	15	0	The Caisse de depot et placement du Quebec 19.9% Jarislowsky, Fraser Ltd. 10.7% RBC Global Asset Management, Inc. 10.1%
Grupo Aeroportuario del Pacifico	Mexico	13	0	Weston Hill Equity Holdings LP 5.62% Controladora Mexicana de Aeropuertos SA 4.39% Grupo Mexico, S.A.B. de C.V. 3.58%
Grupo Aeroportuario Centro Norte	Mexico	12	0	Fintech Holdings, Inc. 19.9% Norges Bank Investment Management 4.11% Fidelity Management & Research Co. LLC 4.11%
Egis	France	8	0	The Vanguard Group, Inc. 2.91% Norges Bank Investment Management 1.72% Dimensional Fund Advisors LP 1.34%

Table A.4: Effect on Freight

Dependent Variable:	Freight per Flight			Log(Freight Tons)		
	Total	In'l	Domestic	Total	In'l	Domestic
	(1)	(2)	(3)	(4)	(5)	(6)
𝟙(Privatization by PE)	2.94**	1.03	2.50*	0.77	0.46	0.40
	(1.25)	(0.74)	(1.32)	(0.54)	(0.56)	(0.47)
𝟙(Privatization by Non-PE)	0.06	0.25	-0.10	-0.62***	0.40***	-0.78***
	(0.19)	(0.27)	(0.19)	(0.16)	(0.14)	(0.19)
𝟙(Post-Priv Non-PE to PE)	1.31	2.38**	2.05**	-0.12	0.98***	0.21
	(0.99)	(1.07)	(0.91)	(0.32)	(0.37)	(0.37)
𝟙(Post-Priv PE to Non-PE)	-0.75	2.93	-3.98*	-1.20**	0.80	-0.33
	(4.05)	(3.45)	(2.04)	(0.49)	(0.76)	(0.89)
Observations	40357	40357	40357	40357	40357	40357
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.54	0.57	0.47	0.76	0.89	0.72
Y-Mean	2.62	2.65	2.12	12.46	3.88	5.84
Pr > F Priv Non-PE=Priv PE	.02	.33	.05	.01	.92	.02
Pr > F Non-PE to PE=PE to Non-PE	.62	.88	.01	.06	.82	.57

Table A.5: Continuous Ownership and Control Stake

Dependent Variable:	Passengers per Flight	Log(Number of Passengers)	Log(Number of Flights)	Log(Number of Routes)	Number of Airlines	Airline HHI	Log(Int'l Fee)	Log(Domestic Fee)	Log(Op. Net Income)	Log(Op. Expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
PE*Ownership Stake	7.74	0.27*	0.23**	0.50***	2.30	-211.87	0.00	0.01	2.45**	1.23
	(6.36)	(0.14)	(0.11)	(0.12)	(1.51)	(441.12)	(0.10)	(0.13)	(1.21)	(0.87)
PE*Control Stake	6.28	0.23*	0.20**	-0.07	0.50	47.65	0.11*	0.17**	-1.72*	-0.95
	(5.65)	(0.13)	(0.10)	(0.10)	(1.00)	(350.76)	(0.06)	(0.07)	(1.02)	(0.73)
NonPE*Ownership Stake	4.40**	0.21***	0.19***	0.15***	2.84***	-350.01**	-0.00	0.09	0.38*	-0.14
	(1.96)	(0.04)	(0.04)	(0.04)	(0.57)	(141.89)	(0.05)	(0.10)	(0.21)	(0.18)
NonPE*Control Stake	-2.70	0.12**	0.16***	0.10**	2.63***	54.95	0.05	0.08	-0.38***	-0.22**
	(2.06)	(0.06)	(0.06)	(0.04)	(0.79)	(149.94)	(0.05)	(0.06)	(0.09)	(0.11)
Observations	40320	40320	40320	40306	40320	40320	9105	9103	2613	2686
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.91	0.96	0.94	0.94	0.93	0.79	0.94	0.96	0.87	0.84
Y-Mean	89.99	12.46	8.21	2.30	8.71	5,474.43	8.81	6.23	17.82	9.45
Pr > F PE Ownership=PE Control	.9	.87	.87	.01	.42	.73	.48	.38	.06	.17
Pr > F NonPE Private Ownership=NonPE Private Control	.01	.16	.68	.37	.83	.04	.44	.94	0	.70

Table A.6: Majority vs. Minority Stake

Dependent Variable:	Passengers per Flight	Log(Number of Passengers)	Log(Number of Flights)	Log(Number of Routes)	Number of Airlines	Airline HHI	Log(Int'l Fee)	Log(Domestic Fee)	Log(Op. Net Income)	Log(Op. Expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
𝟙(PE-Sale-Majority)	15.83***	0.47***	0.36***	0.42***	2.91***	-135.45	0.27**	0.30***	0.78**	0.25
	(2.78)	(0.08)	(0.08)	(0.07)	(1.11)	(272.72)	(0.11)	(0.11)	(0.37)	(0.25)
𝟙(PE-Sale-Minority)	9.25**	0.58***	0.55***	0.39***	7.89***	-585.91***	1.13***	0.97***	2.77**	1.95*
	(4.06)	(0.10)	(0.09)	(0.08)	(1.59)	(147.24)	(0.24)	(0.21)	(1.37)	(1.16)
𝟙(PE-Concession-Majority)	4.23	0.21**	0.19**	-0.07	0.66	88.13	0.13**	0.18***	-0.28*	-0.15
	(4.85)	(0.10)	(0.09)	(0.09)	(0.97)	(298.35)	(0.06)	(0.07)	(0.16)	(0.12)
𝟙(PE-Concession-Minority)	6.21	0.24	0.27	0.11	1.47	164.45	0.38***	0.47**	0.00	0.00
	(5.77)	(0.23)	(0.23)	(0.17)	(1.91)	(406.11)	(0.11)	(0.21)	(.)	(.)
𝟙(NonPE-Sale-Majority)	4.38**	0.19***	0.16***	0.14***	2.81***	-351.57***	0.17**	0.21**	0.30*	-0.17
	(1.76)	(0.04)	(0.04)	(0.04)	(0.50)	(123.00)	(0.08)	(0.10)	(0.17)	(0.14)
𝟙(NonPE-Sale-Minority)	14.08**	0.52***	0.42***	0.40***	3.93	-107.06	0.60**	0.53**	2.37**	1.58*
	(5.72)	(0.17)	(0.16)	(0.13)	(2.46)	(395.97)	(0.27)	(0.23)	(1.13)	(0.88)
𝟙(NonPE-Concession-Majority)	-16.49***	-0.40**	-0.26	-0.29**	-1.20	161.22	-0.51*	-0.40*	-2.75**	-1.80**
	(6.02)	(0.18)	(0.16)	(0.13)	(2.57)	(418.02)	(0.27)	(0.23)	(1.15)	(0.91)
𝟙(NonPE-Concession-Minority)	-13.20*	-0.15	-0.12	0.03	-5.55*	589.17	0.00	0.00	0.00	0.00
	(6.90)	(0.33)	(0.34)	(0.24)	(2.96)	(847.10)	(.)	(.)	(.)	(.)
Observations	40320	40320	40320	40306	40320	40320	9105	9103	2613	2686
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.91	0.96	0.94	0.94	0.93	0.79	0.95	0.96	0.87	0.84
Y-Mean	89.99	12.46	8.21	2.30	8.71	5,474.43	8.81	6.23	17.82	9.45

Table A.7: Stacked Regression

This table estimates the main effects in a stacked regression estimator. We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport, match cohort-year and year fixed effects. Prob > F is the F-test probability that tests the likelihood of Non-PE Private and PE coefficients being different from each other. Standard errors are clustered at an airport level. Statistical significance is indicated by: *p.1 **p.05 ***p.01.

Dependent Variable:	Passengers per Flight	Log(Number of Passengers)	Log(Number of Flights)	Log(Number of Routes)	Number of Airlines	Airline HHI	Log(Int'l Fee)	Log(Domestic Fee)	Log(Op. Net Income)	Log(Op. Expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
𝟙(Privatization by PE)	17.99***	0.61***	0.49***	0.37**	1.28	288.66	-0.02**	-0.05***	2.38**	1.66**
	(5.55)	(0.18)	(0.17)	(0.16)	(1.13)	(353.12)	(0.01)	(0.01)	(1.02)	(0.71)
𝟙(Privatization by Non-PE)	1.37***	0.17***	0.18***	0.13***	3.11***	-248.87***	0.29***	0.31***	0.23***	-0.28***
	(0.32)	(0.01)	(0.01)	(0.01)	(0.11)	(22.94)	(0.02)	(0.02)	(0.03)	(0.03)
𝟙(Post-Priv Non-PE to PE)	8.87***	0.17**	0.13*	0.19***	-0.32	156.69	0.17**	0.19**	0.09	0.04
	(2.94)	(0.07)	(0.07)	(0.07)	(0.78)	(223.41)	(0.07)	(0.08)	(0.13)	(0.10)
𝟙(Post-Priv PE to Non-PE)	2.73	0.02	-0.00	0.23**	1.07	-465.53	0.04	0.06	-1.71***	-1.35*
	(7.45)	(0.17)	(0.16)	(0.09)	(1.59)	(392.71)	(0.06)	(0.05)	(0.54)	(0.72)
Observations	827727	827727	827727	827727	827727	827727	184378	184336	47731	49024
Airport-Group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.91	0.96	0.94	0.94	0.93	0.79	0.95	0.96	0.89	0.92
Y-Mean	89.37	12.42	8.18	2.27	8.42	5,514.71	8.80	6.20	17.98	9.51
Pr > F Priv Non-PE=Priv PE	0	.01	.06	.15	.11	.13	0	0	.04	.01
Pr > F Non-PE to PE=PE to Non-PE	.44	.4	.47	.68	.43	.17	.18	.18	0	.06

Table A.8: Callaway Sant'Anna Estimator

This table estimates the main effects using the Callaway Sant'Anna estimator. We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport, match cohort-year and year fixed effects. Prob > F is the F-test probability that tests the likelihood of Non-PE Private and PE coefficients being different from each other. Standard errors are clustered at an airport level. Statistical significance is indicated by: *p.1 **p.05 ***p.01.

Dependent Variable:	Passengers per Flight	Log(Number of Passengers)	Log(Number of Flights)	Log(Number of Routes)	Number of Airlines	Airline HHI	Log(Int'l Fee)	Log(Domestic Fee)	Log(Op. Net Income)	Log(Op. Expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
𝟙(PE)	7.71*	0.23***	0.18**	0.16**	-0.09	315.17*	0.11	0.11	-0.12	-0.22
	(4.41)	(0.09)	(0.08)	(0.07)	(0.61)	(177.38)	(0.08)	(0.08)	(0.19)	(0.27)
Observations	40622	40622	40622	40622	40622	40622	9239	9237	2641	2714
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.9: Main Outcomes Using Matched Sample

This table estimates the main effects in a matched sample. We match each privatized airport with never-privatized, government-owned non-target airports 2 yrs before privatization using CEM, on passengers per flight, total number of passengers, total number of routes, GDP per Capita, Trade Volume, the share of international passengers, judicial eectiveness, and financial freedom. The ratio of treated vs. control is 1:1. Privatization by PE is one after an airport transitions from government to PE ownership and zero otherwise. Similarly, Privatization by Non-PE is one after an airport transitions from government to Non-PE private ownership. Post-Priv Non-PE to PE is one after an airport that is already privatized by a non-PE firm transitions to PE ownership. Post-Priv PE to Non-PE is the reverse. We include the log GDP per capita, share of international passengers, government size, open markets, and log trade volume as control variables, and include airport and year fixed effects. We report two p-values on F-tests for equality of coefficients. The first compares the two privatization coefficients and the second compares the post-privatization coefficients. Standard errors are clustered at an airport level. Statistical significance is indicated by: *p.1 **p.05 ***p.01.

Dependent Variable:	Passengers per Flight	Log(Number of Passengers)	Log(Number of Flights)	Log(Number of Routes)	Number of Airlines	Airline HHI	Log(Int'l Fee)	Log(Domestic Fee)	Log(Op. Net Income)	Log(Op. Expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
𝟙(Privatization by PE)	16.45**	0.62***	0.54**	0.45***	0.97	300.57	-0.01	-0.10***	2.39*	1.73**
	(7.22)	(0.24)	(0.22)	(0.17)	(1.24)	(455.34)	(0.02)	(0.03)	(1.28)	(0.85)
𝟙(Privatization by Non-PE)	-0.86	0.14***	0.18***	0.14***	2.40***	-206.24*	0.20***	0.26***	0.13	-0.24
	(1.60)	(0.04)	(0.04)	(0.03)	(0.50)	(112.63)	(0.06)	(0.08)	(0.21)	(0.19)
𝟙(Post-Priv Non-PE to PE)	5.19*	0.06	0.05	0.10*	-0.73	202.14	0.18**	0.17**	0.36	0.26
	(2.88)	(0.06)	(0.07)	(0.05)	(0.79)	(242.53)	(0.08)	(0.08)	(0.22)	(0.17)
𝟙(Post-Priv PE to Non-PE)	4.16	-0.75	-0.76	-0.13***	-2.59	-1,027.44	-0.08***	-0.16***	0.00	0.00
	(13.43)	(1.07)	(0.95)	(0.05)	(1.82)	(1,872.89)	(0.03)	(0.05)	(.)	(.)
Observations	12520	12520	12520	12518	12520	12520	3429	3429	1094	1127
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.90	0.96	0.94	0.93	0.94	0.80	0.90	0.95	0.90	0.87
Y-Mean	101.80	12.99	8.54	2.61	11.62	4,761.46	8.98	6.32	17.41	9.64
Pr > F Priv Non-PE=Priv PE	.02	.05	.1	.07	.28	.28	0	0	.09	.03
Pr > F Non-PE to PE=PE to Non-PE	.94	.45	.4	0	.35	.51	0	0	.11	.12

Panel C: Fees Charged to Airlines								
Dependent Variable:	Log(Int'l Fee)				Log(Domestic Fee)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
𝟙(Privatization by PE)	0.23***				0.23***			
	(0.05)				(0.04)			
𝟙(Privatization by Non-PE)		0.08**				0.06*		
		(0.04)				(0.04)		
𝟙(Post-Priv Non-PE to PE)			0.16**				0.27**	
			(0.08)				(0.12)	
𝟙(Post-Priv PE to Non-PE)				-0.02*				-0.03
				(0.01)				(0.02)
Observations	7121	7259	7162	7111	7119	7257	7160	7109
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.96	0.96	0.96	0.96	0.97	0.97	0.97	0.97
Y-Mean	8.82	8.82	8.82	8.82	6.24	6.24	6.24	6.24

Panel D: Financials								
Dependent Variable:	Log(Op. Net Income)				Log(Op. Expenditure)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
𝟙(Privatization by PE)	0.32				-0.07			
	(0.27)				(0.07)			
𝟙(Privatization by Non-PE)		-0.07				0.09***		
		(0.06)				(0.03)		
𝟙(Post-Priv Non-PE to PE)			0.84				0.41	
			(0.58)				(0.69)	
𝟙(Post-Priv PE to Non-PE)				0.00				0.00
				(.)				(.)
Observations	1938	1997	1970	1922	1980	2039	2012	1964
Airport FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.94	0.94	0.94	0.93	0.89	0.91	0.83	0.87
Y-Mean	17.80	17.80	17.80	17.80	9.43	9.43	9.43	9.43

B. Variable Definitions

Governance Variables

All governance variables are from the Heritage Foundation. For details please see: https://www.heritage.org/index/pdf/2022/book/02_2022_IndexOfEconomicFreedom_METHODOLOGY.pdf.

- Gov't Integrity: The score for this component is derived by averaging scores for the following three sub-factors, all of which are weighted equally: Perceptions of corruption, Risk of bribery, and Control of corruption including "capture" of the state by elites and private interests. Each sub-factor is converted to a scale of 0 to 100 using the following equation:
$Sub-Factor_i = 100 \times (Sub-Factor_{Max} - Sub-Factor_i)/(Sub-Factor_{Max} - Sub-Factor_{Min})$

- Judicial Effectiveness: The score for the judicial effectiveness component is derived by averaging scores for the following three sub-factors, all of which are weighted equally: Judicial independence, Quality of the judicial process, and Perceptions of the quality of public services and the independence of the civil service. Each sub-factor is converted to a scale of 0 to 100 using the following equation:
$Sub-Factor_i = 100 \times (Sub-Factor_{Max} - Sub-Factor_i)/(Sub-Factor_{Max} - Sub-Factor_{Min})$

- Gov't Spending: The scale for scoring government spending is nonlinear, which means that government spending that is close to zero is lightly penalized while government spending that exceeds 30 percent of GDP leads to much worse scores in a quadratic fashion. The equation used to compute a country's government spending score is: $GE_i = 100\breve{}\alpha(Expenditures_i)^2$ where GE_i represents the government expenditure score in country i; $Expenditures_i$ represents the average total government spending at all levels as a percentage of GDP for the most recent three years; and is a coefficient to control for variation among scores (set at 0.03). The minimum component score is zero.

- Investment Freedom: The Index evaluates a variety of regulatory restrictions that typically are imposed on investment. Points, as indicated in (https://www.heritage.org/index/pdf/2022/book/02_2022_IndexOfEconomicFreedom_METHODOLOGY.pdf), are deducted from the ideal score of 100 for each of the restrictions found in a country's investment regime. It is not necessary for a government to impose all of the listed restrictions at the maximum level to eliminate investment freedom. The few governments that impose so many restrictions that they total more than 100 points in deductions have had their scores set at zero.

- Financial Freedom: The Index scores an economy's financial freedom by looking at five broad areas: The extent of government regulation of financial services, The degree of state intervention in banks and other financial firms through direct and indirect ownership, Government influence on the allocation of credit, The extent of financial and capital market development, and Openness to foreign competition. These five areas are considered so that the overall level of financial freedom that ensures easy and effective access to financing opportunities for people and businesses in the economy may be assessed. An overall score on a scale of 0 to 100 is given to an economy's financial freedom.

- Open markets: The index scores free market economy and is derived by equal-weighting indices like trade freedom, financial freedom, and investment freedom. The trade freedom score is based on two inputs: The trade-weighted average tariff rate and A qualitative evaluation of nontariff barriers (NTBs).

Downstream Performance Measures

- Airlines: Number of Airlines that are operated in the airport.
- Low Cost Carriers: Number of low cost carriers that are operated in the airport.
- Airline HHI: Herfindahl-Hirschman Index created using the share of Airlines.
- Share of Largest Airline: The share of the airline with the largest share.
- Competing Airports: An indicator variable that is 1 if an airport has airports nearby with comparable sizes within 200 km.

Price Regulation Variables

All regulation variables are provided by David Gillen at University of British Columbia and are only observed for major airports in Asia, Europe, and Oceania. For details please see: Gillen, D., Niemeier, H. M. (2008). The European Union: evolution of privatization, regulation, and slot reform.

- No Regulation: Indicator variable of 1 if there is no regulation in that airport-year and 0 if there is a regulation.
- Cost Based: Cost based regulation charges the same price that would ideally prevail in a perfectly competitive market, equal to the efficient costs of production, plus a market-determined rate of return on capital. It is an indicator variable of 1 if there is a cost based regulation and 0 if not.
- Revenue Cap: Revenue Cap regulation sets an overall limit in the allowed average price increase. This differs from cost based regulation which seeks to regulate individual prices. Revenue Cap can be regarded as a form of incentive regulation, though the strength of the incentives varies. The Revenue Cap can be under a single or dual till regime; under a single till all revenues are considered when setting the Revenue Cap while in a dual till only revenues derivative from aviation operations (landing, passenger and parking charges) are considered.
- Hybrid: Some revenue capped airports are subject to regular cost based resets, and this form of regulation can be seen as a combination of cost based and incentive regulation (or hybrid regulation).

Safety Measures

- Accidents: The number of accidents is from over 23,000 airliner (aircraft originally certified to carry 12 or more passengers), military transport category aircraft, and corporate jet aircraft accidents dating back to 1919. The information is primarily derived from official governmental agencies, such as air accident investigation boards and civil aviation authorities.
- Fatalities: The number of fatalities within an accident. It is a per flight measure aggregated at an airport-year level.
- Award: An indicator variable that is 1 if an airport received an award for its service that year.

Airport Charge Variables

- Int'l Fee: International Fee is the sum of International passenger and runway charges. They are charged per aircraft movement.
- Dom Fee: Domestic Fee is the sum of domestic passenger and runway charges. They are charged per aircraft movement.
- Int'l Passenger Fee: International Passenger Fee is levied for processing passengers and includes security costs. They are charged per aircraft movement.
- Int'l Runway Fee: International Runway Fee is levied for using the runway infrastructure of the airport. They are charged per aircraft movement.
- Dom Runway Fee: Domestic Runway Fee is levied levied for using the runway infrastructure of the airport. They are charged per aircraft movement.

Airport Financial Variables

- Total Operating Revenue: Total operating revenue is the total amount of money coming into airport from both aeronautical and non-aeronautical activities.
- Total Operating Expenditure: Total operating expense is total expense an airport incurs through its normal operations.
- Net Operating Income: Total operating revenue minus total operating expenditure.
- Total Aeronautical Revenue: Total aeronautical revenue is the total amount of money coming into airport from aeronautical activities.
- Total Non-Aeronautical Revenue: Total Non- aeronautical revenue is the total amount of money coming into airport from non-aeronautical activities such as typically includes retail food and beverages, shopping, car parking, and property and real estate.
- Number of Employees per 1000 passengers: Derived by Number of Employees/Number of Passengers $\times$ 1000

Airport On Time Performance Variables

- Cancellation: Percentage of flights that is cancelled.
- Departure: Percentage of flights that is on-time.