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Globally Consistent Creditor Protection, Reallocation, and Productivity

Bo Bian

Center for Advanced Studies on the Foundations of Law and Finance | House of Finance | Goethe University
Theodor-W.-Adorno-Platz 3 | 60629 Frankfurt am Main | Germany www.lawfin.uni-frankfurt.de

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Bo Bian†

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Abstract

This paper documents that resource reallocation across firms is an important mechanism through which creditor rights affect real outcomes. I exploit the staggered adoption of an international convention that provides globally consistent strong creditor protection for aircraft finance. After this reform, country-level productivity in the aviation sector increases by 12%, driven mostly by across-firm reallocation. Productive airlines borrow more, expand, and adopt new technology at the expense of unproductive ones. Such reallocation is facilitated by (i) easier and quicker asset redeployment; and (ii) the influx of foreign financiers offering innovative financial products to improve credit allocative efficiency. I further document an increase in competition and an improvement in the breadth and the quality of products available to consumers.

JEL Classification: D22, D24, G32, G33, K12, K33, L11

Keywords: Creditor Rights, Allocative Efficiency, Reallocation, Productivity and Growth, Law and Finance

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†University of British Columbia, Sauder School of Business, 2053 Main Mall, Vancouver, BC V6T 1Z2, Canada, bo.bian@sauder.ubc.ca.

1 Introduction

Since the pioneering work by La Porta, Lopez-De-Silanes, Shleifer, and Vishny (1997, 1998), Levine (1998, 1999) and Levine, Loayza, and Beck (2000), numerous studies have documented the positive effects of creditor protection on credit market development and economic growth. The underlying theoretical argument is that strengthening creditor protection relaxes financial constraints, which allows greater investment in technology and higher firm-level efficiency (Midrigan and Xu (2014) and Cole, Greenwood, and Sanchez (2016)).[1] A burgeoning literature provides firm-level micro evidence supporting the above argument.[2]

This representative firm's view, however, ignores heterogeneity across firms and the potential distributive effect due to changes in legal institutions (Lilienfeld-Toal, Mookherjee, and Visaria (2012)). Economic reforms often create winners and losers, generating growth through the downsizing of inefficient producers and the disproportionate growth of efficient producers.[3] It is natural to expect that creditor rights reforms also induce such across-firm resource reallocation. Theoretically, strengthening creditor protection allows quick repossession of assets upon default and facilitates asset redeployment to more productive asset users (Harris and Raviv (1990), Jensen (1993) and Hart and Moore (1995)).[4] Moreover, the formal legal protection of creditors' rights encourages the entry of new and efficient lenders, leading to better credit allocation (Sengupta (2007)). Do stronger creditor rights yield productivity improvements by reshuffling resources across firms? Do industry dynamics, such as exit, contribute to this process? What is the relative importance of this across-firm reallocation channel in explaining the aggregate productivity growth? This paper attempts to empirically investigate these questions.

Tracing the micro channels underlying economic growth is policy-relevant because the welfare costs of economic reforms depend largely on the specific channel that generates aggregate growth. If

[1] For the disciplining role of debt finance, see Gale and Hellwig (1985), Bolton and Scharfstein (1990, 1996), Aghion and Bolton (1992), and Dewatripont and Tirole (1994), among others.

[2] See Haselmann, Pistor, and Vig (2010), Benmelech and Bergman (2011), Campello and Larrain (2016), Ponticelli and Alencar (2016) and Calomiris, Larrain, Liberti, and Sturgess (2017) among others. There are also a few exceptions that discuss the potential adverse consequences of strong creditor rights, see Acharya, Amihud, and Litov (2011), Vig (2013), and Adler, Capkun, and Weiss (2013).

[3] See deregulation in Olley and Pakes (1996) and trade liberalization in Pavcnik (2002).

[4] These theory papers discuss the benefits of efficient bankruptcy by triggering a change in control of the firm and the exit from unprofitable projects. Empirically, Bernstein, Colonnelli, and Iverson (2019) compares the consequences of liquidation and reorganization on asset allocation and utilization in bankruptcy.

growth is exclusively achieved by individual firm-level investment and expansion, then strengthening creditor protection is likely to be welfare-enhancing. Alternatively, if aggregate gains come from the reallocation of resources, which involves the scaling down or exit of inefficient firms, then a reform can be controversial due to displacements of capital and labor.[5] So far, scant attention has been paid to understanding and quantifying the different micro mechanisms underlying the argument that law promotes growth.

Researchers face several empirical challenges in identifying the micro mechanisms, especially the across-firm reallocation mechanism. In an ideal setting, to detect reallocation, we first need high-quality micro data to track asset users over time. Standard corporate data sources do not usually contain information at such a granular level. Second, we need to measure the economic performance of assets consistently across firms. This allows us to determine firms' efficiency levels and gauge whether the reallocation produces aggregate efficiency gains. The key is to have assets of similar quality as input, which produce homogeneous output. This ensures that the economic activity generated by the assets is comparable and can be consistently measured, even if assets are redeployed to different users. Most assets, however, differ in their quality and usage to a certain degree. Third, because reallocation happens across firms, measuring it requires a census style dataset that captures most of the activities within the economy or sectors where reallocation occurs. Lastly, beyond the severe data limitations, shocks to creditor protection are required to constitute a reasonable identification strategy.

The airline industry provides a rare laboratory to address the above challenges. First, aircraft are easily identifiable and traceable, which ensures granular and high-quality *aircraft-level* data on asset user history and aircraft utilization. In particular, being movable and redeployable within the aviation sector, aircraft generate output that is relatively homogeneous and can be proxied by flying hours. These features allow consistent and accurate measurement of redeployment and economic performance of assets. Furthermore, the stringent registration requirement facilitates tracking of economic activities, such as expansion or contraction of the fleet, for every single airline. Lastly, over the past fifteen years, this industry has undergone a significant reform regarding creditor protection. The mobility of aircraft calls for an internationally consistent contracting framework

[5] Local governments are usually concerned about the initial cost of labor displacement and firm bankruptcies, which can deter the implementation of pro-market policies.

for aircraft finance. In this context, *the Cape Town Convention on International Interests in Mobile Equipment* [the "Convention"] and *the Protocol to the Convention on International Interests in Mobile Equipment on Matters Specific to Aircraft Equipment* [the "Protocol"] were introduced in the early 2000s. The Convention provides a unified scheme of strong creditor protection by enabling international registration of creditor rights and rapid repossession within 60 days upon default.

Countries adopted the Convention at different times. As of late 2018, there are 77 Contracting States, including most of the large economies (Figure 1). The Convention applies whenever the debtor belongs to a Contracting State. The *staggered* nature of the reform and the richness of the aviation data allow me to investigate how stronger creditor protection affects aggregate productivity in the aviation sector through across-firm reallocation of assets and credit.[6] Using the differences-in-differences methodology, I compare changes in the *aggregate productivity* and the *responsiveness of resource allocation to firms' efficiency levels* across treated and untreated countries.

Using the average aircraft utilization rate in a country as a measure of aggregate productivity, I first find that stronger creditor protection leads to a remarkable increase in aggregate productivity. Following the adoption of the Convention, the average monthly flying hours per aircraft in a ratifying country increase by 11.7%. The significance and magnitude of this result is robust to controlling for a wide range of industry regulatory, macroeconomic, institutional, and political factors.

Second, I unbundle the gain in aggregate productivity. Aggregate productivity can be higher either because firms individually become more productive or because the allocation of resources across firms becomes more efficient. The analysis suggests that across-firm changes dominate in my setting. I find that after the reform, more efficient asset users, i.e., airlines with higher aircraft utilization rates, expand and adopt new technology at the expense of less efficient asset users. The reallocation effect is significant and economically large: a one standard deviation increase in pre-reform productivity translates into a 13% increase in fleet size, and a reduction in average fleet age of close to one year. Post-reform, more than a quarter of firms are subject to contraction. Among them, the least productive ones are likely to downsize substantially and exit the market.

[6] Economic growth can be achieved through factor accumulation or higher productivity. I focus on productivity, since reallocation affects total output via its impact on aggregate productivity rather than factor accumulation, when firms differ in their efficiency levels. I also study outcome variables such as capital stock, investment, vintage of capital, and total output. I find large and positive effects on these variables. See Table D1.

According to point estimates, shifts in relative firm size among surviving firms and inefficient firms' exits indeed explain most of the growth in aggregate productivity.

A key assumption of the paper is that we can infer productivity from capacity utilization of aircraft. I provide an extensive discussion and empirical evidence in Section 4.2 and Appendix B to support this assumption. Moreover, to reduce concerns that capacity utilization captures variations in other firm characteristics rather than their productivity, I show that the results are robust to using an alternative productivity measure that incorporates differences in the quality and vintage of capital used in production. Restricting the sample to airlines with similar business profiles or product offerings does not change the findings, either.

Why does the reform lead to across-firm reallocation? I find evidence supporting two explanations, which relate to easier *physical asset reallocation* and more efficient *credit allocation* that underpins the redeployment and allocation of physical capital. With swift repossession, capital that was stuck with distressed or bankrupted airlines can now be quickly redeployed to healthier and more efficient airlines. Consistent with this, asset redeployment increases by 15% to 20% after the reform. The time it takes to redeploy aircraft from failing airlines to new users also shortens from ten months before the reform to four months after the reform.

Also central in the reallocation process is the active engagement of foreign financiers. Following the reform, I find that the share of deals financed by foreign lenders increases by 10%. These expanding foreign financiers also introduce innovative financing instruments, such as the Enhanced Equipment Trust Certificate (EETC), to the treated markets.[7] As a result, I further find that credit allocation in treated countries becomes more responsive to firm-level productivity. This higher credit allocative efficiency allows productive airlines to borrow more to potentially acquire both used and new aircraft. The more prominent role of foreign financiers and the associated positive outcomes suggest that domestic lenders, which are predominately government-owned banks, might be the source of inefficiency before the reform. Consistent with this, I find that the gain in productivity and the across-firm reallocation are mostly observed in

[7]EETCs became available to non-US airlines only when the Convention took effect. Air Canada issued its first EETC in April 2013, while Canada ratified by the end of 2012. The other examples include Latam, Turkish Airlines, Emirates, and Norwegian. In all these cases, EETC first appeared after the reform. Moody's has documented the adoption of the Convention as the critical trigger for the successful issuance of an EETC.

countries with significant government intervention in the banking sector. Such evidence supports the political view of government ownership of banks (La Porta, Lopez-De-Silanes, and Shleifer (2002), Sapienza (2004), Khwaja and Mian (2005) and Haselmann, Schoenherr, and Vig (2018)).

Lastly, I also study the reform's impact on market structure and consumers. I find that the Convention triggers consolidation among the traditional full service carriers and encourages the creation of new, differentiated products offered by specialized carriers, such as low cost and leisure airlines. Competition intensifies, especially in countries that had a highly concentrated airline industry. These changes also bring benefits to consumers. Following the reform, consumer choice broadens and the average quality of products, measured by air travel safety and consumer satisfaction ratings, also improves. These results suggest that stronger creditor rights can benefit consumers through diverse and better product offerings in a more competitive environment.

The identification strategy treats the timing of the Convention's ratification in a given country as exogenous. One reassuring fact is that, on average, the cumulative market-adjusted returns earned by listed airlines over the three-day period surrounding the ratification dates of respective countries reach 2%. Such stock price reactions suggest that the Convention is unlikely to be anticipated by the market. However, one may still worry that a country's choice to ratify could be correlated with other omitted variables, such as investment opportunities in the aviation industry. While I cannot completely rule out alternative explanations, I take several steps to alleviate such concerns.

First, I use a hazard model with a wide range of explanatory variables to study the entry decision.[8] I find that most factors, including macroeconomic variables, legal origins and political systems do not matter significantly. More importantly, a spurious positive correlation between the entry and demand or investment opportunities does not seem to be borne out by the data. On the one hand, I find that the pre-convention size and growth of the aviation industry do not affect the entry decision. On the other hand, I show that countries characterized by higher concentration and more severe distortion tend to benefit more from the Convention, while in the hazard model these two features impede the entry. This implies a negative correlation between entry into the Convention and investment opportunities, which makes finding any effects more difficult.

[8] In light of the recently raised caution against identification strategy based on legislation, regulations, or court decisions, such analysis is helpful in addressing identification concerns (see Karpoff and Wittry (2018)).

Second, I analyze the dynamic effects of the Convention and detect no obvious pretrends (Figures 2 and 3). Third, I exploit the cross-country variation in treatment intensity and find that the effects are concentrated in countries with *weak* ex-ante creditor protection. Fourth, I include region $\times$ year fixed effects to absorb any region-specific trends, such as the integration of the European Aviation market and the Middle Eastern airlines. The estimates are also stable after controlling for a series of group-specific time varying trends. I further ensure robustness against a wide range of control variables, including macroeconomic, legal, institutional and political factors, and in particular, contemporaneous changes in pro-market aviation policies. Another piece of evidence is that the reallocation results survive the inclusion of country $\times$ year fixed effects, which absorb country-specific macroeconomic shocks or trends. In the end, as a falsification test, the effect on other transportation industries, such as the rail industry, is not significantly different from zero.

Related Literature. This paper contributes to several strands of the literature. It first adds to the large and still growing literature that examines how different aspects of creditor protection affect lending and real economic outcomes.[9] A closely related paper is Benmelech and Bergman (2011), which considers the impact of stronger creditor rights on the vintage of capital in the airline industry across countries. Similarly, Ersahin (2020) studies the effect of stronger creditor rights on firm-level technology adoption and productivity using U.S. Census microdata. Haselmann, Pistor, and Vig (2010) differentiate between collateral and bankruptcy law in shaping banks' lending behavior in transition economies. Campello and Larrain (2016) study how the enlargement of collateral menus affects total factor productivity, labor, and profitability. By exploiting the congestion of civil courts, Ponticelli and Alencar (2016) examine the effect of bankruptcy enforcement on firms' access to finance and investment. This paper deviates from the existing literature in two ways. First, I examine changes in *aggregate* productivity in the aviation sector, while the above papers primarily study *firm-level* responses. Affected by both within-firm and across-firm dynamics, aggregate productivity allows me to better evaluate the *overall* impact of stronger creditor protection. Second, combining aggregate and micro-level evidence allows me to draw conclusions on the mechanisms underlying the effect of creditor rights on real economic outcomes. In contrast to prior studies, which focus on the role of within-firm investment and technology adoption of an average firm, I

[9] See two recent papers: Campello and Larrain (2016), Calomiris, Larrain, Liberti, and Sturgess (2017), and the reference therein.

emphasize the role of across-firm reallocation. In a related paper, Lilienfeld-Toal, Mookherjee, and Visaria (2012) study the distributive impact of legal changes in creditor rights. While they compare small versus big borrowers, I study the redistribution from unproductive to productive asset users and highlight the role of new financiers' entry.

This paper is related to the microeconomics literature on productivity. An influential paper by Hsieh and Klenow (2009) argues that resource misallocation significantly lowers aggregate total factor productivity and may account for a large portion of the cross-country difference in average productivity.[10] This literature, however, has not pinned down the exact source of misallocation. This paper joins the recent empirical work that studies the role of mitigating financial frictions in improving allocation. Wurgler (2000) and Fisman and Love (2004) arrive at the broad conclusion that a more developed financial market is associated with a better allocation of capital. Two closely related papers are Larrain and Stumpner (2017) and Bai, Carvalho, and Phillips (2018). The former connects capital account liberalization to aggregate total factor productivity through higher allocative efficiency while the latter studies how bank deregulation leads to labor and capital reallocation to young and productive firms. This paper similarly emphasizes the central role of reallocation, but focuses on a different source of financial friction—weak creditor protection. Another deviation is the setting, which allows me to compute a quantity-based measure to assess firms' efficiency levels instead of relying on revenue-based measures that tend to mix true efficiency levels with mark-ups (Foster, Haltiwanger, and Syverson (2008)). Related to this, Haltiwanger, Kulick, and Syverson (2018) argue that most measures of misallocation are sensitive to assumptions on both the demand and supply sides, and therefore these measures may reflect model misspecifications rather than distortions. Focusing on one specific industry with microdata and leveraging a quantity-based measure lessen this concern.

In the end, this paper attempts to connect financial contracting to the product market and the consumers (Varela (2018)). By analyzing the effect of creditor protection on competition, product variety and quality, I am able to discuss the potential gains of this reform from the consumers' perspective.[11] Such analysis is rare due to data limitations.

[10]See also Banerjee and Duflo (2005) and Restuccia and Rogerson (2008), among others.

[11]See Matsa (2011) and Olivares and Cachon (2009) for studies on market concentration or product quality.

The remainder of this paper is organized as follows: Section 2 describes the institutional details. Section 3 explains the construction of the dataset and provides descriptive statistics, and Section 4 introduces the empirical strategy. In Section 5 and Section 6, I present the main results on productivity and reallocation. Section 7 explores why such a reform induces reallocation, while Section 8 discusses implications for consumers and Section 9 concludes. More details on the data and additional results are presented in the Appendix.

2 The Airline Industry and the Cape Town Convention

The aviation industry is one of the world's most economically significant industries. Commercial aviation related business currently provides 8.4% of jobs and contributes to over 5% of GDP in the US.[12] Across the world, the industry has been growing rapidly over the past twenty years and is expected to continue doing so in the next few decades. According to the International Air Transport Association (IATA), the trade association of the world's airlines, the annual number of air passengers will double to seven billion by 2034. In the past three years, the commercial aircraft manufacturers delivered around $130 billion worth of new aircraft every year. The financing needs of such a fast growing industry are enormous.

Despite the industry's attractive prospects, financing an aircraft is challenging. A typical Boeing or Airbus jet costs $70 million to $400 million, with a median value of $200 million. The high cost of aircraft suggests the need for external financing. At the same time, airlines are susceptible to distress and bankruptcy, which means financing is very risky for lenders.[13] As aircraft are also highly tractable and redeployable, asset based financing is a solution to financing challenges.

However, the mobility of aircraft poses a problem: it impedes efficient repossession upon default. Aircraft can easily move across jurisdictions, making it difficult to clearly define the rights of creditors and debtors. To make things worse, unlike most tangible assets, the value of an aircraft can depreciate rapidly if it is left unused or not properly maintained while waiting for recovery.[14] These factors call for a globally integrated framework of strong creditor protection, in order to

[12] See estimates from FAA (`https://www.faa.gov/air_traffic/by_the_numbers/`).

[13] Air Berlin, Monarch Airlines and Flybe are recent examples of airline collapse. Over the past four decades, there are more than 100 bankruptcies alone in the US airline industry, see `http://airlines.org/dataset/u-s-bankruptcies-and-services-cessations`.

[14] According to Gray, MacIntyre, and Wool (2015), the inspection tasks required to return an aircraft to service can cost more than $2 million if the aircraft is left unused for one month.

allow easier external financing for aircraft. The Cape Town Convention and the Aircraft Protocol were designed to address these needs. The Convention was initially inspired by Section 1110 of the US Bankruptcy Code. This section contains a brief introduction of Section 1110 and then discusses the main features of the Convention.

2.1 US Section 1110 and Aircraft Finance in the US

US Section 1110 (11 U.S.C. §1110) was developed based on protections available to financiers in the nineteenth-century rail industry (Ripple (2002)). Section 1110 enables a secured party with an interest in an aircraft to take possession of the equipment within 60 days after a bankruptcy filing, unless all defaults are cured by the airline. More specifically, it provides relief from the automatic stay following termination of the waiting period. Therefore, the lender's right to take possession of the collateral is not hindered by the automatic stay provisions of the US Bankruptcy Code. Section 1110 is the major difference between airline reorganizations and other Chapter 11 reorganizations. Since its introduction, US Section 1110 has greatly reshaped the US aircraft finance market. Asset-backed securities, such as ETCs and EETCs, are widely used by US carriers to obtain financing from capital markets at favorable prices.

2.2 The Cape Town Convention

The Cape Town Convention on International Interests in Mobile Equipment was inspired by US Section 1110 and its pivotal role in the expansion of financing resources for US carriers. It is designed to provide an internationally consistent contracting framework for the financing of high value movable assets. Three protocols to the Convention are applicable to three types of movable equipment: Aircraft Equipment (aircraft and aircraft engines), Railway Rolling Stock and Space Assets. As of now, only the Aircraft Equipment Protocol has taken effect. The Convention was signed in 2001 as a result of a diplomatic conference held in Cape Town, South Africa. The drafting agency is the International Institute for the Unification of Private Law (UNIDROIT). Countries began to ratify the Convention in 2003. Currently there are 77 Contracting States, with most of the large economies ratifying over the past decade.[15] Figure 1a shows the status map of the Convention by the end of 2015. Among the large economies, the US ratified in 2004, India and the

[15] http://www.unidroit.org/status-2001capetown provides information on the current status.

United Arab Emirates in 2008, China in 2009, Brazil in 2012, and Australia and the UK in 2015. From Figure 1b, it can be seen that around 70% of the global aviation market is exposed to the Convention by 2015.

2.2.1 Key Components

The mobility of an aircraft across jurisdictions creates discretion of the insolvency administrator in the case of an airline default, insolvency or reorganization. Consequently, it generates uncertainty in the probability, timing and procedure of aircraft repossession, which is considered a major friction in aircraft finance. The Convention was drafted with the objective of creating an enhanced and harmonized contracting environment. The two building blocks of the Convention are international registration of security interest and standard insolvency remedies, which are functionally similar to US Section 1110. The details are specified below.

International Registry. First, the Convention establishes an international legal registration system of security interests on aircraft transactions. It enables a creditor to officially register its international security interest if the debtor is situated in a member state. The security interest is recognized by all the Contracting States with agreed priority position.[16] The International Registry system is fully electronic with 24/7 web access. As a result, the system greatly reduces potential conflicts over the assignment of security interest. According to Djankov, McLiesh, and Shleifer (2007), this sort of registry institution is usually associated with a more developed credit market.

Standard Insolvency Remedies. Second, and perhaps more importantly, the Convention provides consistent remedies in the event of an airline's insolvency. The Convention gives ratifying states the right to choose between three insolvency regimes: Alternative A, Alternative B and keeping their own insolvency laws. Alternative A is the so-called hard, rule-based version, which is most creditor-friendly. Effectively, it is an improvement over US Section 1110. It similarly defines a maximum 60-day waiting period, following which the creditor must be given the opportunity to take possession of the underlying aircraft object.[17] In addition to Section 1110, Alternative A clarifies a debtor's obligation to preserve the aircraft and maintain its value during the waiting

[16] The priority scheme has the following main principles: registered international interests take priority over unregistered ones, earlier registrations take priority over later ones and the parties can vary priorities by agreeing and (for increased protection) registering subordination arrangements at the International Registry.

[17] Most Contracting States choose a 60-day waiting period. There are a few exceptions that choose 30 or 40 days.

period.[18] Importantly, under this alternative, the ratifying states' courts have no powers of intervention. Alternative B is the so-called soft, discretion-based version, which is broadly similar to Alternative A, with one crucial difference in the engagement of local courts: under Alternative B, the local courts can determine whether, when, and on what terms the creditor can take possession of the underlying equipment at the expiry of the waiting period. The vast majority of countries have adopted Alternative A. Only Mexico has so far declared Alternative B, though it is currently considering switching to Alternative A. By and large, the speedy and less uncertain repossession process in ratifying states greatly improves the power of creditors.

From a practical perspective, the average worldwide enforcement delay for aircraft repossession is around 10 to 12 months without the Convention.[19] Developing countries with weak creditor rights are likely to have a longer delay of up to two years. However, even in a country like the UK where creditor protection is strong, the pre-Convention waiting period could be substantially higher than the two-month maximum delay proposed by the Convention. According to solicited opinions of a UK insolvency expert, the realistic worst case repossession delay would be 4 to 5 months for a UK airline. Moreover, before UK joined the Convention, British Airways would be required to provide a liquidity facility of 24 months for its EETC issuance. In contrast, the liquidity facility requirement for a US airline issuance is typically only 18 months. This 6-month gap, and the 60-day waiting period under Section 1110 of the US bankruptcy code, imply that the EETC market participants assume a repossession delay of up to 8 months in the UK. Therefore, the Convention is expected to speed up repossession in the event of airline insolvency and reorganization globally.

2.2.2 Applicability

The Convention is widely applicable to aircraft equipment that satisfies certain size requirements. An airframe must be type certificated to transport eight persons including crew or goods in excess of 2,750 kilograms. An engine should have 1,750 pounds of thrust or 550 rated take-off horsepower. All the aircraft types in my sample satisfy these size requirements.

Additionally, the debtor must belong to a Contracting State for the creditor to be protected by the Convention. I use an airline's country of incorporation, which also tends to be the country

[18]Under Section 1110, lenders must seek protection outside of Section 1110 in order to preserve aircraft.
[19]Based on the estimation by Aviation Working Group, see Linetsky (2009).

where the main business takes place, to determine the Convention status. Airlines mostly operate from the country of incorporation for the following reasons. The airline industry is heavily regulated with restrictions on the routes a carrier is allowed to fly. Typically, an airline is not allowed to do business between two foreign countries.[20] Apart from the restriction on routes, domestic airlines enjoy advantages when it comes to obtaining valuable slots in busy home-country airports. This gives carriers an incentive to operate most of their business in the country of registration. Another critical point is that the decision on where to locate is usually based on business profiles rather than the financing environment. Thus, it is rare for airlines to change the country of incorporation because of this Convention.

2.2.3 Enforcement

The vast majority of the Contracting States adopt Alternative A and agree to give repossession rights to the creditor without the intervention of local courts. If necessary, a local court must also issue a court order by the end of the waiting period. To a certain extent, this guarantees effective enforcement in the actual insolvency proceedings of debtors. Moreover, the ratifying state "*is bound by international law to perform its obligations under the Convention even if this conflicts with national law.*" The Convention further limits the room of misinterpretation or misapplication of the relevant rule, by providing an Official Commentary with clear guidance on how to apply the rules. Nevertheless, a Contracting State could still violate its obligations under the Convention. Could this non-compliance cause problem in reality? Wool (2014) argues that the cost associated with non-compliance is high. He documents several factors that suggest the low likelihood of non-compliance, including reputation concerns, the political cost, and the co-sponsorship of the Convention by International Civil Aviation Organization (ICAO), which has a "*long-standing compliance culture*".

2.3 Entry Decision and Political Economy of the Reform

Since the ratification of the Convention is staggered, a natural question is what drives the decision to ratify. Why are there huge variations in the timing of ratification? Are there any political economy considerations? In the following context, I use a hazard model to study these questions.

[20] There are only a few exceptions. The 5th freedom gives the right to fly between two foreign countries on a flight originating or ending in one's own country. The number of these routes is declining. The European Common Aviation Area (ECAA) promotes a more integrated within-Europe aviation market, in general allowing airlines to fly freely between two foreign European countries.

Another purpose is to gauge the severity of the concern that the entry timing of this Convention coincides with investment opportunities or positive economic climates. More specifically, I use the following Weibull hazard model to study the timing of ratification in each country:

$$Pr_{entry_{j,t}} = \phi(\boldsymbol{\alpha_k} + \boldsymbol{\pi' C_{j,t}}) \tag{1}$$

where j indexes country, t indexes time, k indexes region, and $C_{j,t}$ summarizes a wide range of country-level predictors.

I first include macroeconomic factors to study whether the level or trend of economic development has any impact on the entry decision. Legal origin is examined, since it is argued to be highly correlated with legal protection of investors (La Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998)), and may thus affect a country's attitude towards the Convention. The political system of a country may also matter, since democratic countries are more pro-competition and may welcome such a reform. To investigate whether the demand side matters, I add proxies for the level and trend of aviation market development. To explore potential interactions among neighboring countries I further include the number of neighboring countries that have adopted the Convention as a predictor. In the end, I include two variables related to the level of concentration and distortion in a country's aviation market. The argument is that large and inefficient incumbents have the incentive and also the ability to lobby against the Convention. These incumbents are likely to lose out as a result of reallocation. In light of the potential loss, they may impose pressure against the government's prospective adoption of the Convention. If this is the case, high concentration and severe distortion should predict a lower probability of entry.

Table 1 presents the results from a Weibull model. The methodology is similar to that of Kroszner and Strahan (1999), which uses the same Weibull model instead of the Cox proportional hazard model, so that the coefficients can be easily interpreted.[21] By converting the dependent variable into the log of the time to entry, the coefficients in Table 1 represent the percentage change in the time to entry into the Convention for a one-unit change in the dependent variables.

I find that most factors do not matter. As exhibited by column (2), GDP per capita, GDP growth, inflation, export to GDP ratio, import to GDP ratio, government expenditure, and domestic credit market can hardly predict the entry decision. In fact, a casual look at the current status

[21] Fitting a Cox proportional hazard model does not affect the direction or the significance of my results.

map (Figure 1) of the Convention reveals the wide divergence in the levels of economic development among all the Contracting States. In column (3), I find that population growth has a statistical significant effect and I therefore include population size and growth in all regressions. Columns (4) and (5) show that legal origins and the political system do not play a significant role in ratification decisions. According to column (6), the size and growth of a country's aviation market in the pre-entry years do not seem to matter, neither. Therefore, it is rather unlikely that favorable aviation market conditions have triggered the entry into the Convention. In column (7), the insignificant coefficient on the number of treated neighbors suggests that countries do not seem to react to the entry decision of their neighbors.

Aligned with the above conjecture, two consistent and economically meaningful predictors are the levels of concentration and distortion in a country's aviation market. In all columns of Table 1, I find a positively significant coefficient on the proxy of concentration—Herfindahl-Hirschman Index (HHI), and a negatively significant coefficient on the Olley-Pakes covariance term, which can be considered as a proxy for the level of sector-wise distortion. The magnitude is also economically large: a one standard deviation increase in HHI is linked with a 20% to 30% increase in the time until entry, or about 2 years. On the other hand, a one standard deviation decrease in the covariance between size and productivity results in an over 10% increase in the time until entry, or around 1 year. Taking these two factors together, the ratification of the Convention is less likely in countries where the airline industry is more concentrated and more distorted. These results are consistent with a view that large and inefficient incumbents have the desire and also the ability to lobby against the Convention. As shown later in Table 5, these inefficient incumbents are likely to lose out when the Convention enters into force and the across-firm reallocation takes place. In a heavily regulated industry that operates under political influences, such a scenario of established rent-earning interests affecting government decisions is not difficult to imagine.

Critically, as argued later in Table D3, it is exactly these high-concentration, high-distortion countries that can benefit the most from the Convention. Therefore, the unlikely adopters tend to be countries where the potential for improvement is greater and the investment opportunities are better. If anything, this suggests an underestimation of the Convention's impact.

A general message from the hazard model analysis is that the decision to enter the Convention seems fairly idiosyncratic, to the extent that it is not correlated with a wide range of measurable factors. Even though I shall further deal with endogeneity issues in Section **??**, the evidence from the hazard model already helps to mitigate this concern.

2.4 Stock Market Response to the Reform

Since its introduction, the Convention has received extensive coverage by the media and legal practitioners.[22] There is a consensus among market participants that the reform is one of the most successful commercial law treaties and has fundamentally changed global aircraft finance. To further confirm that this reform has a real bite, I study its impact on stock prices of listed airlines.

More specifically, I focus on cumulative abnormal returns earned by airlines over the three-day period surrounding the ratification date of the respective country. Abnormal returns are computed as cumulative residuals of the market model estimated over the 200-day period starting 205 days before the announcement of the ratification, where the relevant country's market index is used as the market proxy. I detect a 2.3% three-day abnormal return on average for listed airlines exposed to the Convention (Panel A of Table 2). The strong reactions in stock price suggest that the reform is unlikely to be fully anticipated by the market. Interestingly, a simple cross-sectional test reveals that the positive abnormal returns are enjoyed exclusively by healthier airlines (Panel B of Table 2). Airlines that go bust or are delisted within five years, on average, have a slightly negative abnormal return. Such comparison implies that efficient airlines can benefit more from the reform than inefficient ones. Given that there exist even more inefficient private airlines, the reform can be value-destroying for them. If this argument is true, the reform may have a distributive effect, allowing good firms to grow at the expense of others. In the empirical analysis below, this conjecture will be tested formally.

[22] The Cape Town Convention Journal is devoted to reviewing the law and practice related to the Cape Town Convention. Market leading media of the global aviation business, such as the Airfinance Journal, reports regularly on the Convention.

3 Data and Summary Statistics

3.1 Data Sources

I combine several datasets for the empirical analysis in this paper. Below is a brief description of the data sources. Appendix A provides the definition of variables.

UNIDROIT. UNIDROIT provides data on the status of the Convention in different countries. For each Contracting State, I collect information on the ratification and entry-into-force date.

FlightGlobal. The main data source is FlightGlobal, a leading producer of aviation market information. FlightGlobal provides an extensive database that tracks the ownership and operation history of each commercial aircraft. For each aircraft, the database also provides information on the type (e.g., Airbus 380), manufacturer, engine, purpose of operation (e.g., passenger, cargo, and so forth), delivery date, and date when the aircraft was scrapped, if applicable. FlightGlobal also reports detailed information on aircraft utilization. At the individual aircraft level, one can observe the number of hours flown each month.

Airfinance Journal. Airfinance Journal provides information on financing deals of airlines. This dataset reports the name and country of the issuer, relevant date, deal structure, assets being financed, and the financial institutions involved in the deal.[23] The Airfinance Journal covers around 8,000 deals that have taken place in more than 140 countries, beginning from 2000.

Bureau of Transportation Statistics. To study the variety of products provided to consumers, I extract information on routes, destinations and origins from *Air Carrier Statistics (Form 41 Traffic)- All Carriers*. The data are available monthly beginning in 1990.

AviationSafetyNetwork. The ASN safety database provides descriptions of airliner accidents from 1919 onwards. Information on all commercial airline accidents is first collected from ASN, and then matched to the country of the carrier.

[23] Unfortunately, the dataset does not have good coverage on detailed terms financing, such as spreads and LTV, which prevents me from studying the direct impact of the Convention on financing at the deal level. Nevertheless, I provide evidence on financing at firm level in Table D2.

Skytrax. Skytrax collects numerical customer ratings of individual flights, beginning in 2007. A customer can rate a flight experience on a scale of 1 to 5, regarding seating, cabin staff, food and beverages, in-flight entertainment, ground service and wifi.[24]

Air Services Agreements Projector and the US Open Skies Partners. The WTO's Air Services Agreements Projector (ASAP) provides information on a Signatory's network of the bilateral Air Services Agreements (ASAs). Using this, together with the US Open Skies Partners list, I calculate proxies for the openness of the air transport policy of any given country.

World Development Index. Data on individual aircraft are matched to country-level macro variables from the World Bank's World Development Indicators (WDI) database according to each aircraft's operator country. I extract macro variables on GDP, population, import-export, financial sector development, and transportation industry development.

Legal, Polity, and Others. Data on legal origins are compiled by La Porta, Lopez-de Silanes, and Shleifer (2008) and data on political systems are from Polity IV Project. The Fraser Institute provides data on the Economic Freedom Index.

3.2 Summary Statistics

Table 3 shows the basic summary statistics. In Panel A, the sample consists of all commercial aircraft operating between 1980 and 2015. The unit of observation is at aircraft-year level. There are in total over 50,000 unique aircraft in my sample and around 36,000 of them have information on utilization rate, i.e., monthly flying hours. The average aircraft in my sample is 11 years old, and it typically lasts 26 years before being scrapped. The technological age, defined as the number of years since the introduction of the underlying aircraft's type, is roughly 20 years. There are, however, some long-living types, such as the Boeing 737, which was first put into operation in 1968 and is still the most popular type today. A typical aircraft flies for around 210 hours per month, or 7 hours per day.[25] There are large variations across aircraft in terms of utilization, and the standard deviation is around 100 hours.

[24] Examples of ratings and reviews can be accessed through this link: `http://www.airlinequality.com/review-pages/latest-airline-reviews/`

[25] Around 2.7% of all observations in my sample have flying hours equal to zero. Those aircraft are typically parked and inactive. Some of them return to service after being sold to new carriers, while the rest return to air with the original operator.

In Panel B of Table 3, I collapse the data at firm level and provide basic summary statistics. The sample consists of all airlines, including those providing slightly differentiated products, such as low-cost or leisure carriers. There are around 8,200 airlines that have ever existed globally between 1980 and 2015. The average airline in my sample has around 20 aircraft in operation, with an average age around 15.5 years. The large standard deviation in both fleet size and age reflects considerable heterogeneities across firms. An airline typically operates its aircraft for 128 hours per month. Note that this value is substantially lower than the average utilization at the aircraft level, suggesting that there are a significant number of small and inefficient airlines.

Panel C of Table 3 presents country-level summary statistics. The sample includes a total of 218 countries, and 64 of them have ratified the Convention by the end of 2015. The unit of observation is at country-year level. The average country has 12 carriers and 125 aircraft in operation, with an average aircraft age of around 15 years. The average flying hours per month is around 160—higher than firm-level average, suggesting that countries with larger fleets utilize their aircraft more.

4 Empirical Specification

The main identification strategy exploits the staggered adoption of the Convention across countries. There are typically two important dates in the process of adopting the Convention: the ratification date and the entry-into-force date.[26] I use the ratification date as the time of treatment for the following reason. The Convention comes into force in the ratifying country on the first day of the month following the expiration of three months after the ratification date. Therefore, once the Convention is ratified, it is guaranteed to take effect with a fully anticipated date. To benefit from the Convention, borrowers and lenders can deliberately delay the transactions until the entry-into-force date. This can create a drop in financing in the three-month interval between ratification and entry into force. As a result, the estimated coefficient can be inflated. To mitigate the contamination from borrowers' and lenders' responses in light of an anticipated event, I instead use the ratification date as the event date in the main specification.

[26]For some countries, there is also a signature date, though this is unlikely to be the time of treatment. First, signing the Convention does not perfectly predict ratification later on. A few countries signed but never ratified the Convention. Second, many countries directly ratify without signing. Third, there can be a large gap between the signature date and ratification date. For example, this gap is eight years for Canada.

As explained in Section 2.2.2, I use an airline's country of incorporation to determine the Convention status. There are two remaining issues regarding the sample construction: pre-existing deals and leasing.

Pre-existing Deals. In theory, the Convention does not apply retrospectively. In practice, contracts are often amended, extended, supplemented or replaced so that they are protected by the Convention.[27] Since I do not have information on the exact financial contracting terms of each aircraft, I include the entire fleet in the estimation.

Leasing. For each airline, I do not differentiate between leased and owned aircraft. There are two reasons for this. During my sample period, airlines own more than half of their fleet. The rest are capital lease and operational lease. Following the GAAP, capital lease is classified as essentially equivalent to a purchase by the lessee and is capitalized on the lessee's balance sheet.[28] Such leases are often intended as security and therefore aircraft under capital lease are similarly exposed to the Convention as under secured lending. Moreover, the distinction between capital lease and operational lease is clear on paper, but can be obscure in reality, especially when it comes to airline bankruptcy. In the US, disputes often arise regarding the proper legal classification between "true" lease and "disguised" financing. Judicial reasoning in such decisions requires case-specific and fact-specific analysis. The economic substance, rather than the form, of the transaction is the key determinant. Without detailed information on financial agreements regarding each aircraft, I cannot determine precisely whether an aircraft under lease should be classified as true lease or as disguised secured financing in bankruptcy.

In many other countries, the line between true leases and financing agreements is even more blurred. Local courts sometimes believe in creating equity rights for the lessees, making the lessor's position closer to a secured creditor. These lessors are also likely to face issues with automatic stay. Considering this, all types of creditors with a security interest tend to be affected by the Convention to a certain extent. I thus simply use the entire fleet in the empirical analysis, regardless of its

[27] For example, a newly created instrument, the Aircraft Object Security Agreement (AOSA), becomes popular. This instrument creates a new international interest, which triggers the Convention and permit quick repossession.

[28] The newest IFRS 16 changes the accounting treatment of off-balance sheet operating leases. For lessees, those lease becomes an on-balance sheet liability, together with a new asset on the other side of the balance sheet.

exact financing structure. Nevertheless, I also make sure the reallocation results go through using the subsample of the owned aircraft.

4.1 Regression Equations

The first goal is to evaluate the impact of the Convention on country-level real consequences. In particular, I am interested in aggregate productivity, which is proxied by monthly flying hours averaged across a country's entire fleet. To do this, I estimate the following equation:

$$Prod_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t} \tag{2}$$

where j indexes country, t indexes time and k indexes region.[29] The dependent variable $Prod_{j,t}$ is average productivity. Country and region $\times$ year fixed effects are captured by $\boldsymbol{\gamma_j}$ and $\boldsymbol{\alpha_{k,t}}$. The dummy variable $CTC_{j,t}$ denotes the status of the Convention in the respective country-year. It equals to one if country j is a Contracting State and zero otherwise. Country level control variables are summarized by $X_{j,t}$. In the basic specification, it includes five macro variables: ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. I further add in control variables to account for time-varying industry regulatory, institutional and political factors. The coefficient of interest is β, which is identified from the cross-country, cross-time variation in the Convention status.

I then use firm-level analysis to study whether the aggregate change in productivity can be explained by average within-firm effects. The regression equation resembles Equation 2, except that the observation unit is firm-year and that firm instead of country fixed effects are used.

To pin down the reallocation channel, I add an interaction term between the Convention's status and firm-level pre-determined productivity:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \delta Prod_{i,t-1} + \varepsilon_{i,t} \tag{3}$$

where i indexes firm, j indexes country and t indexes time. Firm and country $\times$ year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{j,t}}$. The Convention status term, $CTC_{j,t}$, is absorbed by country $\times$ year fixed effects. I also report results from the specification where region $\times$ year fixed effects are included and $CTC_{j,t}$ is kept. The interaction term $CTC_{j,t} \times Prod_{i,t-1}$ includes the pre-determined firm-level

[29]There are 6 regions in the main specification: North America, Central and South America, Europe, Asia Pacific, Africa and the Middle East. The results are the same when regions defined at a more granular level are used (22 regions according to United Nations Groupings).

productivity, or average monthly flying hours. In countries that have adopted the Convention by 2015, I use the productivity in the pre-convention year. In countries that have not adopted the Convention, I use lagged productivity at $t-1$. The coefficient on the interaction term captures the differential effect of the Convention on real outcomes. The dependent variable $Y_{i,t}$ can be fleet size, technology, or financing, depending on the specification. The coefficient of interest, β, estimates the pre-post change in the responsiveness of resource allocation to productivity in countries adopting the Convention relative to the pre-post change in countries not adopting the Convention.

4.2 Measurement: Productivity Based on Flying Hours

One key assumption is that we can infer productivity from aircraft capacity utilization. Theoretically, the model in Gavazza (2011b) suggests that capital utilization move one-to-one with the firm's underlying productivity.[30] Besides its use by economists (Benmelech and Bergman (2011) and Gavazza (2011a,b)), aircraft utilization per day is also considered a key performance indicator in the airline industry.

Using capacity utilization to measure productivity abstracts away from other factors of production, such as labor and fuel costs. But empirically, data suggests that aircraft utilization, productivity, and profitability are closely related (see Appendix B for details). For instance, at the aggregate level, aircraft are parked and inactive more frequently in recessions than in booms. At the individual firm level, aircraft utilization is substantially lower before entering distress or bankruptcy. Moreover, airlines do not seem to achieve higher capacity utilization at the cost of emptier aircraft. An obvious advantage utilizing flying hours rather than other performance measures such as load factor or profitability is the wide availability and extreme accuracy of this data due to maintenance and safety considerations. The other performance measures are self-reported and mostly available only for large, public airlines. This measure also ignores the fact that airlines may fly the same hours but deliver heterogeneous products. To alleviate this concern, I restrict the sample to airlines with similar business profiles or product offerings in empirical tests.

[30] The model relies on a specific form of complementarity between productivity and capacity utilization. But even under more general forms of complementarity, the optimal capacity utilization is still an increasing function of the underlying productivity.

5 Aggregate Country Level Effect on Productivity

Numerous papers have documented the impact of creditor rights on lending. Departing from this line of research, I focus on the real consequences of the Convention, and in particular, on aggregate productivity. Panel A of Table 4 shows how the Convention affects the aggregate productivity of a country's aviation sector. By using average monthly flying hours as a measure of productivity, I find that the Convention has a strong, positive impact on aggregate country-level productivity. Following the adoption, average productivity across the entire fleet of a country increases by around 12%, as presented in column (1). This estimate is stable after including a few more macroeconomic controls variables (column (2)), such as import/export, investment intensity, and inflation.

One identification concern is that the timing of the Convention may coincide with other regulatory changes in the aviation sector. To determine the validity of this argument, I include in the regression a time-varying measure of the openness of each country's air transport policy. I first calculate the weighted Air Liberalization Index, which aggregates information on the number and terms of bilateral Air Services Agreements (ASAs) signed by each country and can be considered a proxy for the openness of a country's air transport policy.[31] The basic finding does not change after including this index, as shown in column (3). In column (4), I use a simpler measure to capture changes in the openness of air transport policy. I count the number of Air Services Agreements signed by each country. In column (5), I use a dummy variable capturing whether the country has entered an Open Skies air transport agreement with the US. Signing this agreement is considered an important move towards more pro-market policies. The results stay unchanged from column (2).

One further concern is that changes in the political or institutional environment may account for my findings. For example, a more pro-market business environment may spur investment, including investment in the airline industry. To alleviate these concerns, I include the democratic index in column (6) and proxies for credit market development, economic freedom and corruption in column (7). The results remain quantitatively similar.

[31] The website `https://www.wto.org/asap/resource/data/html/methodology_e.htm` introduces the methodology for calculating the Air Liberalization Index for a given Air Services Agreement. This country-pair specific index is then aggregated at country level, weighted by the respective traffic that each Air Services Agreement covers.

To further address the concern that demand for transportation may drive the results, I examine other transportation sectors and detect no significant changes around the Convention's implementation within the rail sector.[32] To further tighten identification, I also control for various group-specific time-varying trends, and the results stay unchanged. In column (2) of Table E1, I add in dummies for the interaction term between creditor rights index and year, to allow for different time-varying patterns in investment opportunities for countries with different levels of pre-treatment creditor protection. The interpretation of results in columns (3) to (8) is similar. The general message is that results hold if we compare countries that share similar characteristics, but differ in their reform status. The results are also robust to using entry-into-force date as the treatment date, excluding certain countries, adding more granular level region $\times$ year fixed effects, and weighting by the size of each country's aviation market (Table E2).

Next, I examine the dynamics of the relationship between stronger creditor protection and aggregate productivity. I consider a 12-year window, spanning from 5 years before the Convention's introduction to 7 years afterwards. Year minus one is the year before the entry, and I estimate the dynamic effect relative to this year. The time-series pattern in Figure 2a confirms that the impact of the Convention only materializes when the Convention takes effect. The coefficients in the years before the entry are not significantly different from zero while there is a clear positive post-trend. To account for the fact that aircraft are in different types and sizes, I further weight flying hours by each aircraft's seating capacity. Using this size-weighted productivity measure as the dependent variable, Figure 2b shows a similar dynamic effect of the Convention.

Importantly, the higher aircraft utilization is not achieved at the cost of emptier planes. To provide evidence, I examine the average load factor across the flights operated in a country.[33] I find that load factor does not seem to drop after the entry into the Convention. Coefficients across all four columns in Panel A of Table D5 are close to zero and insignificant. Furthermore, I find large increases in total actual air traffic, measured by the number of air departures and

[32]Panel B of Table D5 exhibits no significant change in the total rail route lines (column (3)) and the number of rail passengers (column (4)) after the Convention takes effect.

[33]I use the "Traffic by Flight Stage" (TFS) data set from the International Civil Aviation Organization (ICAO). This data provides annual passenger load factor (PLF) and weight load factor (WLF) statistics of individual flight stages. PLF (WLF) measures the total revenue passenger-kilometers (tonne-kilometers) as a percentage of the available passenger-kilometers (tonne-kilometers). I collapse the data to the country-year level using both equal weights and the seating capacity of each aircraft as weights (value weights).

the number of air passengers (see columns (1) to (2) in Panel B of Table D5). The magnitude is greater than the increase in the fleet size, consistent with the observed higher aircraft utilization rate. Therefore, the Convention does not seem to destroy value by encouraging over-investment that leads to overcapacity.

In addition to the gain in productivity, I document the Convention's impact on country level capital accumulation and average technology.[34] In column (1) of Table D1, I use the fleet size of each country as the dependent variable. The coefficient on the Convention status CTC is around 0.2 and significant at the 1% level, indicating that fleet size increases by roughly 20% after the implementation of the Convention. Airlines seem to acquire new aircraft and retire old ones at a higher rate, as illustrated by columns (2) to (4). They operate more new aircraft built by the manufacturers (column (2)) rather than second-hand ones from foreign airlines or dealers (column (3)). Consistent with the documented turnover, I observe a younger fleet with newer technology, similar to Benmelech and Bergman (2011). Column (5) shows that ratifying the Convention reduces the average age of aircraft by approximately 2.2 years, or 15% of the mean age of 15 years. Column (6) shows that the Convention is also associated with younger aircraft technological age.

6 Unbundling the Gain in Aggregate Productivity

In this section, I unbundle the gain in aggregate productivity to highlight the importance of across-firm reallocation, which helps to pin down the underlying mechanism through which creditor rights affect productivity. At the aggregate level, I show that stronger creditor protection leads to gains in aggregate productivity. Decomposing this productivity growth for a balanced panel typically yields the following three terms:

$$\begin{aligned} P_t - P_{t-1} &\equiv \sum_i s_{i,t}\omega_{i,t} - \sum_i s_{i,t-1}\omega_{i,t-1} \\ &= \underbrace{\sum_i s_{i,t-1}(\omega_{i,t} - \omega_{i,t-1})}_{within} + \underbrace{\sum_i (s_{i,t} - s_{i,t-1})\omega_{i,t-1} + \sum_i (s_{i,t} - s_{i,t-1})(\omega_{i,t} - \omega_{i,t-1})}_{reallocation} \end{aligned} \quad (4)$$

where P denotes aggregate productivity, s denotes market share, w denotes firm-level productivity, i indexes firm and t indexes time. The first term is the pure within-firm component

[34] Although the focus of this paper is real effects of the Convention, I also show more direct evidence on financing using a sample of listed airlines across the world. See Table D2.

and captures the contribution of within-firm productivity improvements. The second and third terms are often referred to as the reallocation effects, because they are related to changes in market share.[35] The second term captures the contribution of market share changes between firms, holding their productivity unchanged. The third term is a "cross" term and captures the covariance between changes in market share and changes in productivity. This cross term contributes positively to productivity growth if market shares and firm-level productivity move in the same direction.

From the above equation, it is clear that part of the gain in aggregate productivity can come from individual firm-level changes (a within-firm effect). At the same time, there can also exist a potentially very important channel through within-industry reallocation of key resources (a reallocation effect). In the following context, I present evidence that the reallocation effect dominates in my setting.

6.1 Within-firm Average Effect

Panel B of Table 4 replicates the regressions in Panel A using firm-level data. I further include firm fixed effects, and the coefficients thus indicate the average firm-level effect imposed by the Convention. Across different specifications, I find that the coefficients are all close to zero and insignificant. Figure 2c shows the dynamic effect of the Convention on firm-level asset utilization rate. The coefficients on all years, before or after the Convention, are not statistically different from zero.

The typical productivity decomposition implies that firm-level regression needs to be value-weighted (see the within term in Equation 4). In this way, the regression coefficient can better represent the within-firm component, which is effectively a weighted sum of the productivity changes holding firms' market share constant. I repeat the above firm-level regression, weighted by lagged firm size. The results are shown in Table E5 and the coefficients are very similar to those in Panel B of Table 4. Figure 2d confirms that the effect is close to zero either before or after the entry year.

[35] In addition, allowing for entry and exit requires two more terms that capture the contributions of entry and exit. These two terms are also related to industry dynamics and can be considered broadly as reallocation effects between surviving, entering, and exiting firms.

The evidence that the Convention has limited effect on average firm-level productivity seems convincing. If an average firm does not become more productive individually, the major contributor to aggregate productivity growth has to come from across-firm dynamics. The following section empirically identifies across-firm changes.

6.2 Across-firm Reallocation Effect

If the unified contracting framework under the Convention indeed reduces financing frictions and fixes misallocation, firms with higher productivity should be able to grow and use new technology, at the cost of their less productive competitors. I test this prediction by including in the regression an interaction term between the Convention status and the pre-determined firm-level productivity. If reallocation takes place in the hypothesized direction, the coefficient on this interaction term will be positive (negative) for specifications where fleet size (fleet age or technological age) is the dependent variable. A reduction in age corresponds to aircraft of a younger vintage while a reduction in technological age corresponds to newer technology. Consistent with this conjecture, I find strong evidence that more efficient asset users are able to expand and adopt new technology at the expense of inefficient asset users after the Convention takes effect.

In column (1), Panel A of Table 5, the dependent variable is log total number of aircraft in a firm's fleet. The coefficient on $CTC \times Productivity$ is positive, while that on the Convention status term CTC is negative. The coefficients are both highly significant at the 1% level. The reallocation effect is economically large: a one standard deviation increase in productivity translates into a 13% higher increase in fleet size. The negative coefficient on CTC indicates that for some airlines with low average productivity, their size may shrink following the Convention's implementation. According to the estimated coefficients, a quarter of firms are subject to contraction. While the total number of aircraft might be too simple a measure of fleet size, I construct alternative measures to account for the fact that aircraft have different sizes and capacities. In columns (1) to (3) of Table E6, I repeat the analysis with three additional measures of size: total number of seats, total maximum take-off weight, and total wingspan of the fleet. The results are highly similar.

In column (2), Panel A of Table 5, the dependent variable is the average age of an airline's fleet. As expected, the coefficient on $CTC \times Productivity$ is negative, suggesting that more productive airlines are able to operate aircraft with younger vintage, while less productive airlines are left with an obsolete fleet. The magnitude is such that a one standard deviation increase in productivity translates into a 0.9-year greater reduction in fleet age. The results are similar when I change the dependent variable to technological age in column (3). Therefore, airlines that better utilize their fleet can acquire newly designed aircraft with cutting-edge technology, which may further improve their productivity. Combined with the fact that these productive firms simultaneously expand their fleet, the covariance between changes in market share and changes in productivity is positive, suggesting that the "cross" term has a positive role in driving up aggregate productivity.

Columns (4) to (6) repeat the analysis in columns (1) to (3) with country × year fixed effects. This is a sharper test compared with columns (1) to (3), since country-specific macroeconomic shocks or trends can be absorbed. Note that the Convention status term CTC and macroeconomic variables, all varying at country-year level, are absorbed. The results are quantitatively similar to those in columns (1) to (3). This partially eases the concern that the implementation timing of the Convention coincides with country-level macroeconomic developments.

One potential concern is that capacity utilization reflects the quality and vintage of the capital deployed by the firm rather than its efficiency level. An airline may fly more intensively because it has a younger and more redeployable fleet.[36] At the same time, these assets have a higher debt capacity, allowing a firm to borrow and expand after the Convention takes effect. Moreover, one may also worry that firms' different business profiles drive the gap in aircraft utilization. For example, an airline that operates widebody aircraft and serves long-haul destinations often logs more flying hours per month. If so, the measure based on flying hours does not capture differences in productivity levels, and therefore any reallocation I detect does not necessarily translate into more efficient aggregate outcomes.

To address these concerns on measurement, I first partial out differences in the vintage and type of assets across firms. In particular, I use aircraft age- and type-adjusted monthly flying hours instead of raw hours as a measure of productivity in the regression. The results are robust to this adjustment: the direction and significance of the effect are not affected according to Panel B of

[36]Newer planes usually fly more intensively, since they require less maintenance and engine overhauls compared to older ones. More redeployable models can be used more intensively because of their flexibility.

Table 5. This assures that the documented reallocation effect is a result of fundamental differences in firms' efficiency levels when deploying *similar* assets.

Second, I compare firms with similar business profiles or product offerings. Column (6) of Table E6 restrict the sample to airlines operating only narrowbody planes. Furthermore, I restrict the sample to mainline businesses that offer similar full-service products in column (7) of Table E6. The results remain similar to that of column (1) in Panel A of Table 5.[37]

To ensure that the results are driven by significant players of the market rather than regional feeders or very small airlines, I limit the sample to more comparable airlines that have a sufficiently large fleet. For example, in column (5) of Table E6, I exclude airlines with fewer than ten aircraft. The results remain highly similar. Another concern is that differences in firm size rather than their efficiency levels drive the reallocation. To address this, I include in the regression $CTC \times Size$, where $Size$ is measured by pre-convention fleet size, and results in Table E8 are quantitatively similar to those in Table 5. To reduce endogeneity concerns, I add various group-specific time-varying trends in Table E3. I also use entry-into-force date as the treatment date, employ alternative samples, and add more granular level region × year fixed effects in Table E4. The results are robust to these alternative specifications.

Table 6 further shows that unproductive firms shrink by a large margin and start to exit. The estimate in columns (1) and (3) of Panel A suggests that the probability of substantial downsizing—by at least 50%—goes up significantly. The probability of exit also increases for unproductive firms after the Convention takes effect. A one standard deviation drop in productivity translates into a 1.6 percentage point higher probability of exit. The effect becomes even stronger when I use the age- and type-adjusted productivity measure in Panel B. Considering that the unconditional probability of exit in the airline industry is 6-8%, the economic magnitude is large. Around 20% of airlines active before the reform exit in the five years following the reform.

In Figure 3, I examine the dynamics of the reallocation effect. Figure 3a depicts the estimated coefficients and the 95% confidence intervals when the dependent variable is fleet size. I observe

[37]One may worry that while flying the same hours, airlines may deliver heterogeneous products. If so, a quantity-based productivity measure cannot capture the true variations in productivity. Comparing airlines with similar business profiles or product offerings help address this issue, too.

that the coefficients on the interaction terms between relative time dummies and productivity are not significantly different from zero in the years before the reform. However, the coefficients become positive and significant after the reform. The reallocation effect materializes rather quickly and flattens out five years after the Convention's introduction, suggesting a permanent drop in misallocation. Figure 3b depicts a similar trend using an alternative measure of firm size—total number of seats—as the outcome variable. Figure 3c and Figure 3d provide consistent patterns regarding fleet technology.

6.3 Cross-sectional Heterogeneity

To tighten identification, I study the heterogeneity in the Convention's influence across countries. I split the sample based on the pre-convention creditor rights in each country. Upon the Convention's adoption, countries starting with weak ex-ante creditor protection should experience a remarkable boost in creditor protection, while countries that already have strong protection should experience less of a boost. Thus, the treatment effect of the Convention should be stronger for countries with weak ex-ante creditor protection.

To test this, I use the creditor protection index proposed by La Porta, Lopez-De-Silanes, Shleifer, and Vishny (1998) and classify countries into two subgroups. Subgroup "Weak" ("Strong") includes countries whose index is below or equal to (above) 2 (the index ranges from 0 to 4). Table 7 presents the results. Indeed, I find that the increase in productivity and the reallocation effect are both concentrated in countries that have weak ex-ante credit rights. Columns (1) and (2) compare the productivity growth between these two subgroups, and the coefficient on CTC is substantially larger for the "Weak" group (column (1)) than for the "Strong" group (column (2)). Columns (3) to (6) compare the across-firm reallocation effect, and the coefficients on $CTC \times Productivity$ in columns (3) and (5) are significantly greater than those in columns (4) and (6).

It is also interesting to ask which countries are in a position to benefit more from reallocation. I split the countries into two groups with different levels of competition and distortion in the airline industry. One group includes North America and Europe, and the other group covers the rest of the world.[38] The first group has a lower HHI (0.37 vs. 0.59), suggesting less concentration,

[38]There are alternative ways to split the sample. The findings here are not sensitive to how the sample is split as long as it is divided into a more developed vs. less developed market.

and a higher covariance between size and productivity (0.41 vs. 0.10), suggesting less distortion. The differences in both metrics are highly significant. By comparing columns (1) and (2) in Table D3, I find that the increase in aggregate productivity is mainly driven by the second group (non-North America/Europe). The across-firm reallocation is also concentrated in this group which is characterized by higher concentration and more distortion. In column (4), the coefficient on $CTC \times Productivity$ is positive and highly significant, while that in column (3) is of a much smaller magnitude. Comparing columns (5) and (6) yields a similar pattern. Taken together, countries in which the airline industry is concentrated and severely distorted seem to benefit more from the Convention.

6.4 Reconciling Estimations

How can we reconcile the above reallocation results with the 11.7% gain in aggregate productivity in Table 4? In order to conduct back-of-the-envelope calculations, I categorize firm productivity into three groups and interact this categorical variable with CTC. Based on the point estimates in Table E7 and summary statistics on size and productivity of each group, I can estimate how much the documented reallocation effect among existing firms contributes to overall productivity growth (details in Appendix C). I find that shifts in relative firm size or market share can explain half of the gain in aggregate productivity, or around 6%. A small portion, 1% to 2%, can be explained by the "cross" term, or the positive covariance between changes in market share and changes in productivity. Exit of inefficient airlines can account for another 4%. The contribution of entry is negligible since newly entered airlines are small and inefficient when they start, but in a few years they converge to the average industry-level productivity as they grow. Adding up the contributions of different components therefore suggests a magnitude in line with the estimated aggregate productivity growth.

Following reallocation, I detect a higher covariance between firm size and productivity. This Olley-Pakes covariance term is argued Bartelsman, Haltiwanger, and Scarpetta (2013) to be a more robust moment than the dispersion in productivity to capture the level of distortion. Figure 4a shows how this covariance term varies with more countries ratifying the Convention. The upward trend indicates that with more Contracting States, the covariance between firm size and productivity increases, implying lower distortion in the global airline industry. Figure 4b has the share of aircraft in Contracting States on the x-axis and a similar upward trend is observed.

7 Channels: Why Does the Reform Affect Reallocation?

The tests above exhibit a strong and robust reallocation effect. However, it remains unclear why the Convention triggers reallocation. I propose two potential explanations: (i) easier asset redeployment from unproductive towards productive firms; and (ii) the influx of foreign financiers and their financial innovations. These two channels relate to both quicker physical capital reallocation ex-post and more efficient credit allocation ex-ante.

7.1 Efficient Repossession and Asset Redeployment

One direct explanation for reallocation is easier asset repossession and a less disruptive bankruptcy process enabled by the Convention. Capital that was previously stuck with distressed or bankrupted airlines can now be quickly redeployed to healthier and more efficient airlines. If this is the case, asset redeployment should become easier and faster under the Convention, especially when the previous asset owner is in distress.

To verify this prediction, I investigate the utilization rate of an aircraft around transactions. I back out transactions from annual reports on aircraft ownership and define an indicator for the years around transactions. The indicator is denoted by $Transaction$ and equals one if the aircraft is in its final year with the previous operator and in its first year with the new operator. The aircraft may also stay with a dealer or financier in between. If it stays shortly with the dealer or financier, this is not reflected in the data. If it stays long enough, for example, if the year end snapshot indicates that the aircraft is with the financier, $Transaction$ also equals one for that year as the aircraft is not in the hands of an active asset user. On average, for each transaction, $Transaction$ equals one for 2.3 years.

If indeed the Convention leads to more efficient asset redeployment, an aircraft should be parked for a shorter period before being transferred to its new user post-convention than pre-convention. As a result, the average productivity of that aircraft throughout the transaction period should be higher. In a regression framework, the coefficient on the interaction term, $CTC \times Transaction$, should be positive when the dependent variable is utilization rate for each aircraft-year.

Table 8 provides the statistical evidence. In column (1), I find that a typical aircraft around transactions flies 11% more per year after the reform. Equivalently, an aircraft is parked for roughly three months less before being utilized by a new operator.[39] Column (2) shows similar results when country by year fixed effects are included. Note that in these regressions, aircraft age by aircraft type fixed effects are included to ensure fair comparison across different aircraft.

I further find that quicker asset redeployment is almost exclusively driven by failing airlines. I categorize all transactions into two groups depending on whether the transaction involves failing airlines. I define failing airlines as those that are about to exit the market within three years.[40] In columns (3) and (4), the sample excludes sales by healthy airlines such that the regression compares the productivity discount around sales by failing airlines as opposed to regular operation periods pre-convention versus this discount post-convention. The coefficient on $CTC \times Transaction$ is larger compared with that in column (1), indicating a greater increase in average productivity for sales by failing airlines. The corresponding reduction in holding duration is estimated to be around 6 months.[41] On the contrary, for normal sales by healthy airlines, the Convention does not seem to affect the productivity discount around transactions or the holding duration, as shown in columns (5) and (6). This suggests that the faster redeployment is not due to lower transaction costs in general, but reduced frictions when dealing with failing airlines' assets.

The evidence from Table 8 supports the view that the Convention facilitates the redeployment of physical assets. In addition, I observe 15% to 20% more asset redeployment after the reform, largely driven by assets flowing from inefficient users to efficient users. As the Convention also drives out inefficient airlines, such redeployment of valuable assets is an important mechanism through which economic costs of distress and bankruptcy can be reduced. When the Convention has been in place for a longer time, bankruptcy proceedings are expected to become more predictable and

[39] Accordingly to my definition, a typical aircraft spends 2.3 years around a transaction, and an 11% higher productivity per year translates into $0.11 \times 12 = 1.32$ fewer months being parked. The overall holding duration is therefore reduced by $2.3 \times 1.32 = 3.04$ months.

[40] The results are robust to alternative definitions such as airlines exiting within five years or experiencing substantial downsizing.

[41] Based on the estimated coefficients in column (4), the holding duration is around 10 months pre-convention and 4 months post-convention.

efficient. Both debtors and creditors can potentially rely more on established procedures to address restructurings and asset redeployment.

7.2 Foreign Financiers and Financial Innovations

One key characteristic of the Convention is that it not only provides strong creditor protection, but it also provides it in an internationally consistent manner. This highly integrated contracting framework should in theory encourage the involvement of foreign financiers in aircraft finance. Based on the political view of government ownership of banks, these financiers can be more responsive to marginal productivity in the process of allocating their funds, compared with their local counterparts. Due to the high cost of aircraft, the local financiers in the airline industry tend to be large, state-owned banks that operate under political influence and allocate credit less efficiently. Moreover, the foreign financiers may introduce innovative financing instruments that were previously only available in a certain contracting environment (for example, US Section 1110), with which the financiers are familiar. In the following context, I establish the central role of foreign financiers in boosting credit allocative efficiency.

To formally test this foreign financier channel, I collect the deal arranger information and identify whether the financier involved in each deal is a domestic one or an international one. The data contain all airline financing deals from 2000, for which the debt arranger information is available. Aggregating across deals in each country-year, I carry out country-level tests using the specification in Equation 2. The results are presented in Panel A of Table 9. Column (1) examines the total number of financing deals involving foreign financiers. The coefficient on the Convention status CTC is economically large and significant. Column (2) shows the Convention's impact on the number of local deals. I find the effect to be much smaller and insignificant, compared to column (1). Column (3) confirms that following the Convention's ratification, the share of deals involving foreign financiers goes up significantly, suggesting their growing role in aircraft finance. There is also a surge in the number of active unique foreign aircraft financiers in the Contracting States, as displayed in column (4). The results indicate that globally consistent strong creditor protection indeed encourages the entrance of foreign financiers.

These expanding foreign financiers, on the one hand, capture a larger market share in aircraft finance. On the other hand, they introduce new, innovative financing instruments to the treated countries, which may further enhance their credit allocative efficiency. Column (5) of Table 9 shows that there are more diversified methods to finance aircraft equipment following the introduction of the Convention. Indeed, innovative financing instruments, such as EETCs, became available to non-US airlines only when the Convention took effect. These well-established products to finance aircraft equipment were initially developed in the US, largely owing to the implementation of US Section 1110, with which financiers, investors and rating agencies are familiar. The Convention, by providing similar prompt and predictable recourse to aircraft, has lent support to the introduction of these innovative financing instruments outside the US.

The influx of foreign financiers and the introduction of innovative financing instruments are expected to promote better credit allocation. To test this, I compare credit allocative efficiency before and after the introduction of the Convention. The regression specification primarily follows Equation 3, and the dependent variables summarize information on financing deals completed by airlines. For each firm-year, I count the number of financing deals completed and calculate the total value of these deals. Panel B of Table 9 presents evidence on higher credit allocative efficiency after the introduction of the Convention. It can be seen that more productive firms close a larger number of financing deals (column (1)), representing a significantly higher value (column (3)). The point estimate in column (3) suggests that a one standard deviation increase in productivity translates into a 21% greater increase in the loan volume. Columns (2) and (4) include country $\times$ year fixed effects to absorb any observed or unobserved country-specific changes that may affect the estimation. The results remain unchanged. The findings confirm the role of credit allocation in driving the differential effects of the Convention for productive versus unproductive firms.

Under the above political view, another prediction is that countries with high government bank ownership could benefit more from the Convention. The allocation of credit in these countries tends to be less efficient and is expected to improve more with stronger creditor protection and the resulting influx of foreign financiers. Consistent with such conjecture, I find that the gain in productivity and the across-firm reallocation are mostly observed in countries with significant government intervention in the banking sector. The evidence is presented in Table D4.

Taken together, the internationally-unified contracting framework encourages the involvement of foreign financiers to capture a higher market share in aircraft finance and introduce innovative financial instruments. Both components tend to result in better allocation of credit.

8 Industry Dynamics and the Consumers

This paper has so far discussed the impact of the Convention on the producers' side, i.e., the airlines. Equally important is to investigate its implications for consumers. This allows us to paint a more complete picture of the welfare gains. In the following context, I first examine how the documented reallocation reshapes the aviation business. Then I explore whether any of the effects pass on to consumers.

8.1 Industry Dynamics and Competition

As a result of substantial reallocation and entry and exit activities, the Convention has helped to reshape the aviation industry. I find that there are more airlines operating in the Contracting States, mainly driven by the entry of specialized airlines (e.g., low cost or leisure carriers) that provide differentiated products as compared with the traditional mainline business (e.g., legacy full service airlines). The statistical evidence is presented in Panel A of Table 10. Column (1) shows that an average Contracting State has approximately three more airlines after the Convention takes effect. Importantly, this is mostly fueled by the emergence of more specialized carriers (column (3)) while the number of mainline carriers drops (column (2)). In terms of average carrier size, I find that both mainline and specialized carriers scale up. Taken together, this suggests that the Convention triggers consolidation in the mainline business and encourages the creation of new, differentiated products provided by specialized carriers. This finding is in line with Black and Strahan (2002), Cetorelli and Strahan (2006) and Kerr and Nanda (2009), which document the role of reducing financial frictions through banking deregulation in fostering entry and creating a more contestable market.[42] Panel B of Table 10 further shows that competition intensifies following the introduction of the Convention, especially in countries that started with a highly concentrated aviation sector.

[42]In the context of creditor rights, Ersahin, Irani, and Waldock (2020) examine entrepreneurial activity following the strengthening of unsecured creditors' rights.

Both the HHI and market share of the top airline decrease in these countries. However, do such changes ultimately bring benefits to consumers?

8.2 Product Variety and Quality

Product Variety. Consumers value direct flights, I therefore first examine the number of direct routings available to each country's consumers. I count the number of unique routes between each country and the US.[43] Column (1) in Panel A of Table 11 shows that the consumers in a ratifying country are offered roughly 15% more direct routes to the US. Similarly, these consumers can fly to more destinations in the US (column (2)) from more cities in their home country (column (3)). Including the Open Skies agreement with the US in the regression does not change my findings, as shown in columns (4) to (6).

Product Quality. I also study whether the Convention has any implications for the quality of products offered to consumers. I focus on two aspects of quality: an objective dimension exploring the safety of air travel and a more subjective dimension relying on ratings from consumers. I use country-level regressions to provide evidence on the aggregate effect.

The results are presented in Panel B of Table 11. Columns (1) to (4) study the safety of air travel. In column (1), the negatively significant coefficient on the Convention status CTC suggests a reduction in the total number of aviation accidents. The number of distinct airlines involved in accidents also declines, as shown in column (2). Fewer fatalities also seem to be caused by aircraft accidents, according to columns (3) and (4).

Regarding service quality, I rely on data from Skytrax, which asks consumers to rate airlines on a scale of 1 to 5. In column (5), I find that the average customer rating increases by 0.27, or 10% of the average rating. The proportion of extremely low ratings (1 out of 5) also drops by 10 percentage points, as suggested by column (6). Most importantly, a remarkable decline in the standard deviation of the ratings is seen in column (7). The magnitude corresponds to 15% of the average dispersion. Therefore, airlines tend to provide better and more consistent service after the Convention is introduced.

[43] I study routes to the US only due to both data limitations and the importance of the US market.

9 Conclusion

By exploiting the staggered adoption of an international Convention, this paper highlights the role of resource reallocation in shaping the link between creditor rights and real economic outcomes. The Convention imposes globally consistent creditor protection in the Contracting States in two ways. It enables international registration of security interests, and importantly, it also provides rapid repossession in cases of default. Following the Convention's adoption, productive firms are able to finance, expand and adopt new technology, at the cost of unproductive firms. Such reallocation is a major contributor to aggregate productivity growth. I further provide evidence that reallocation is facilitated by (i) easier and quicker asset redeployment; and (ii) the influx of foreign financiers and their financial innovations. In addition, the reform seems to generate benefits for consumers.

The paper examines one important, but special industry. Aircraft are valuable, identifiable and redeployable. These features mean that abundant data are available on asset utilization and ownership, but at the same time suggest that the reallocation effect documented in this paper may be an upper bound. In other significant industries such as shipping, railways, trucking or satellite, assets share similar characteristics and the conclusion of this paper is likely to apply. In fact, a new protocol to the Cape Town Convention on matters specific to *agricultural*, *construction* and *mining* equipment is currently being negotiated.[44] Furthermore, intangible assets, such as patents, are also transferable. Having a globally integrated legal framework to protect creditors' interest in intangible assets may unleash the debt capacity of patents. Caution is required, however, in extending the findings to industries crowded with firm-specific or low-tractability assets. Although a formal and harmonized legal framework may still encourage the entry of new and efficient lenders, the movement of physical assets in cases of default is more difficult. A comforting fact is that with global integration and standardization, and innovations in asset tracking, such as blockchain technology, asset redeployment is expected to become easier over time.

This paper seems to agree with the existing literature on law and finance highlighting the benefits of stronger creditor protection, but it presents one important caveat. I find that aggregate productivity gains mostly stem from the reshuffling of resources and output, accompanied by the

[44] `https://www.unidroit.org/work-in-progress/mac-protocol` provides information on the recent progress of this protocol.

scaling down and exit of inefficient firms. From a policy perspective, such reallocation can generate complicated welfare implications due to displacement of labor and capital. This may help to explain why the Cape Town Convention, despite the documented economic benefits, is not adopted by all countries. In future work, one interesting direction would be to carefully study the political economy of creditor protection and understand why certain (seemingly) welfare-enhancing reforms do not always happen (Syverson (2011)).

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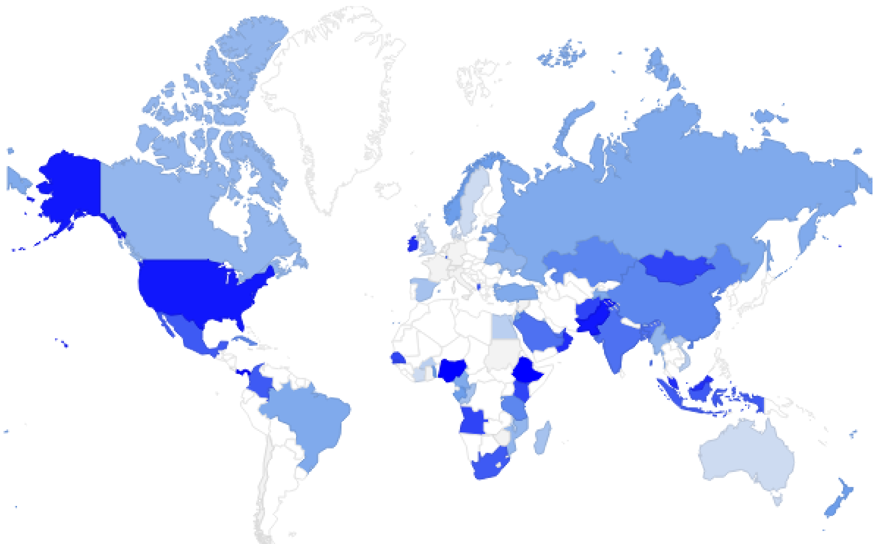
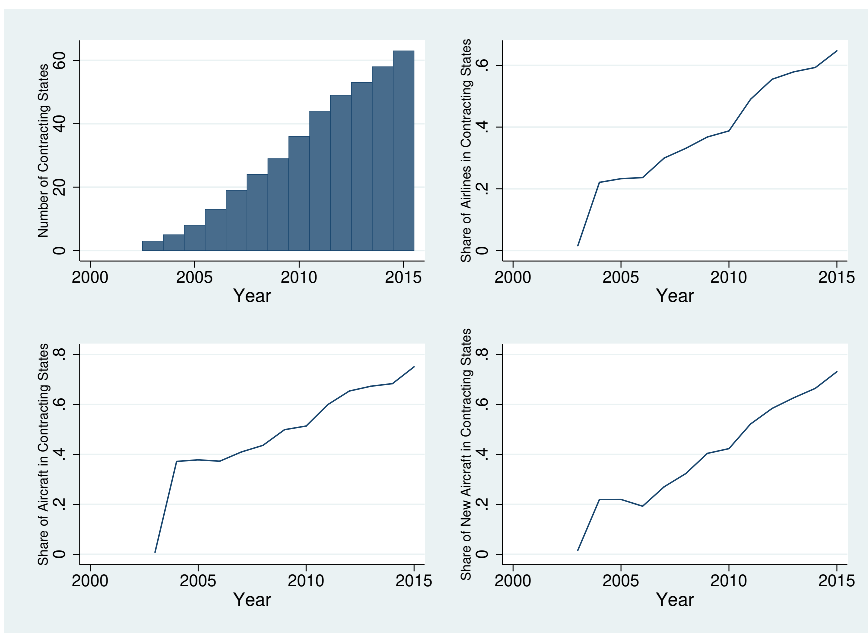


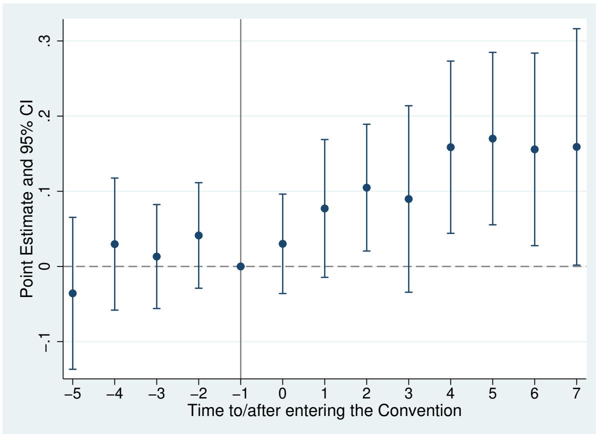
(a) Status Map of the Cape Town Convention



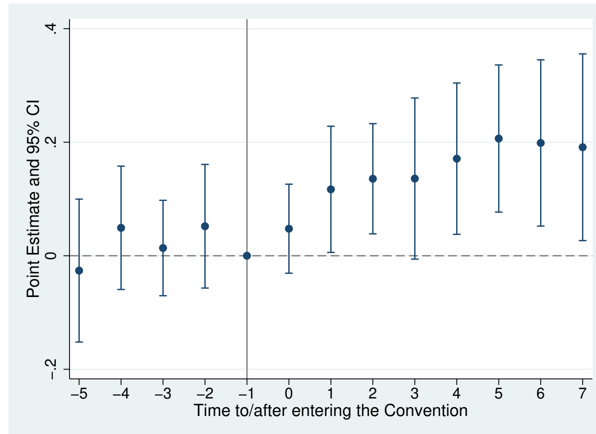
(b) Coverage of the Cape Town Convention

Figure 1: Status and Coverage of the Cape Town Convention

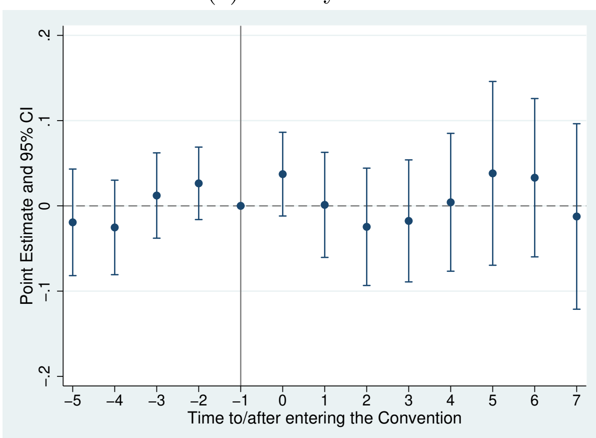
Figure 1a is the status map of the Cape Town Convention at the end of 2015. Blue shaded areas indicate the countries in which the Convention is ratified and has taken effect. The darkness of the blue areas corresponds to the number of years since ratification. The gray shaded areas indicate the countries in which the Convention is signed but not ratified. The remaining white areas indicate countries in which the Convention is neither signed nor ratified. Figure 1b shows the coverage of the Convention overtime. The four variables on the y axis are (left to right, top to bottom): number of countries that have ratified the Convention, number of airlines in countries that have ratified the Convention, number of aircraft in countries that have ratified the Convention, number of newly acquired aircraft in countries that have ratified the Convention.



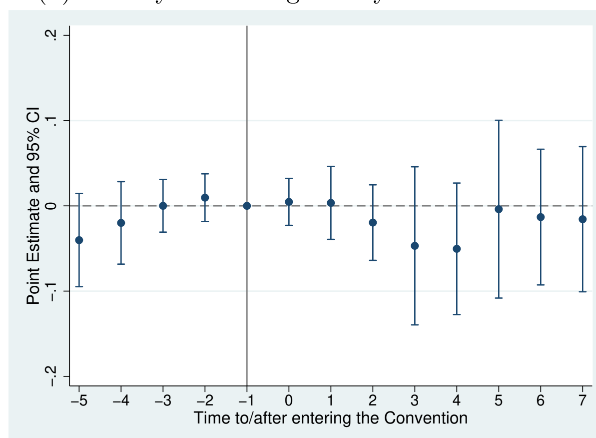
(a) country level



(b) country level: weighted by number-of-seats



(c) firm level



(d) firm level: weighted by firm size

Figure 2: Dynamic Effect of the Convention on Productivity

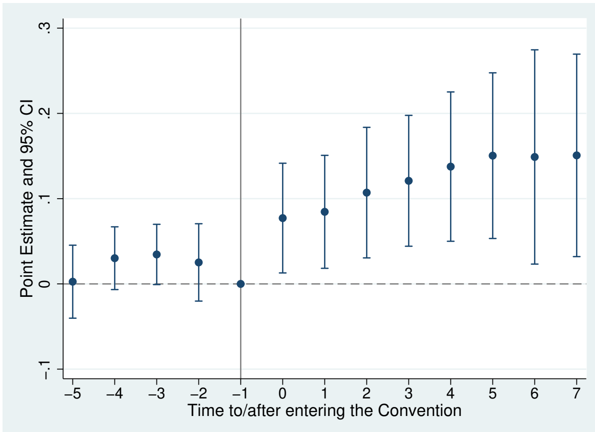
Figure 2 illustrates the dynamic effect of the Convention on average country-level and firm-level productivity in the years around the ratification of the Convention. Figure 2a and Figure 2b estimate the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \sum_{l=-7,l\neq-1}^{l=7} \beta_l CTC_{j,l} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

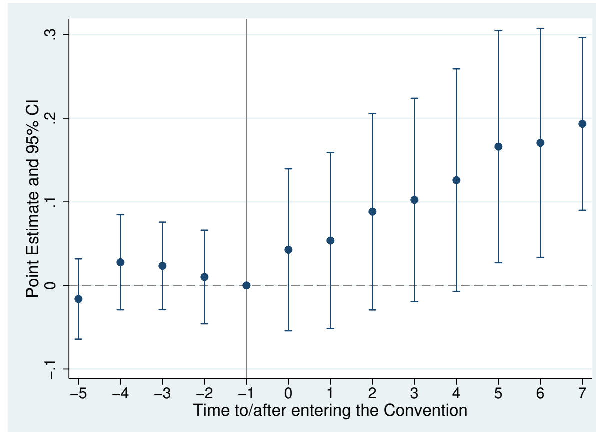
while Figure 2c and Figure 2d estimate:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{k,t}} + \sum_{l=-7,l\neq-1}^{l=7} \beta_l CTC_{j,l} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

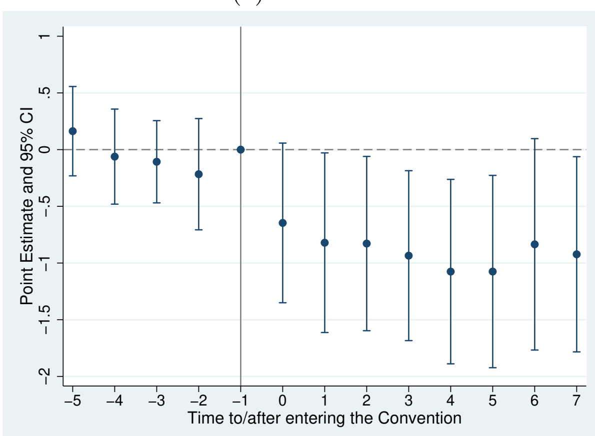
where i indexes firm, j indexes country, k indexes region, t indexes time, $X_{j,t}$ includes country-level controls and $CTC_{j,l}$ is a dummy variable indicating the relative year around the ratification of the Convention. Year minus one is the year before the ratification, and is the omitted category. In Figure 2a, the unit of observation is at the country-year level and the dependent variable is log of monthly flying hours averaged over a year across the entire fleet of each country. In Figure 2b, the unit of observation is also at country-year level and the dependent variable is log of aircraft-size-weighted (number-of-seats-weighted) flying hours. The dependent variable in Figure 2c and Figure 2d is log of firm-level flying hours. Regression in Figure 2d is further weighted by lagged firm size. Standard errors are clustered at the country-level.



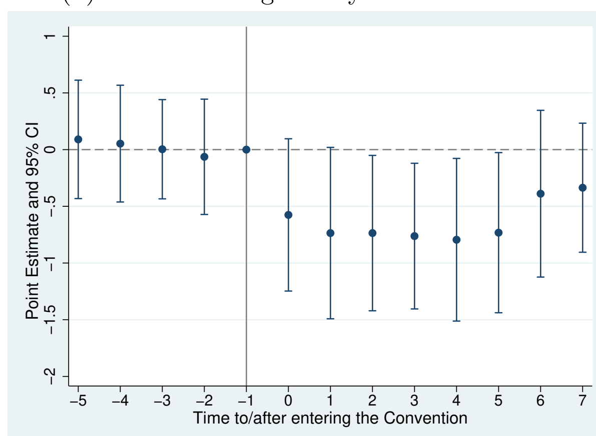
(a) fleet size



(b) fleet size: weighted by number-of-seats



(c) fleet average age



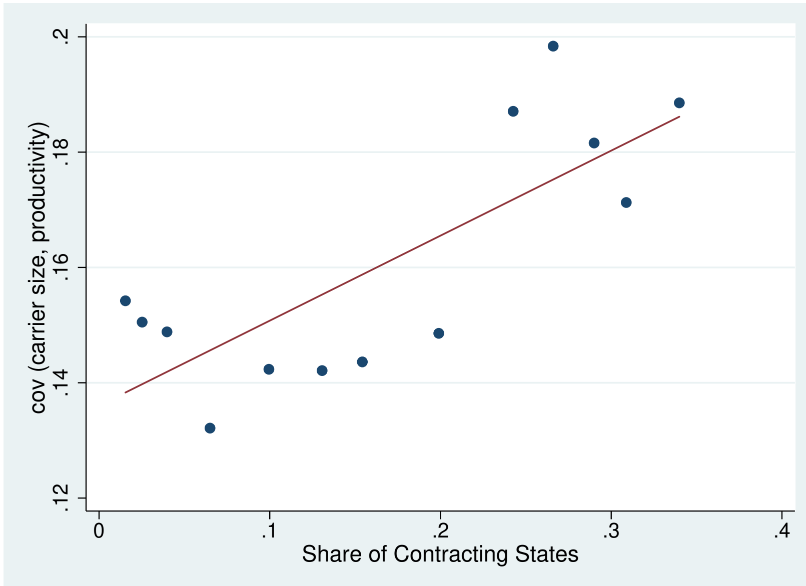
(d) fleet average technological age

Figure 3: Dynamic Effect of the Convention on Reallocation

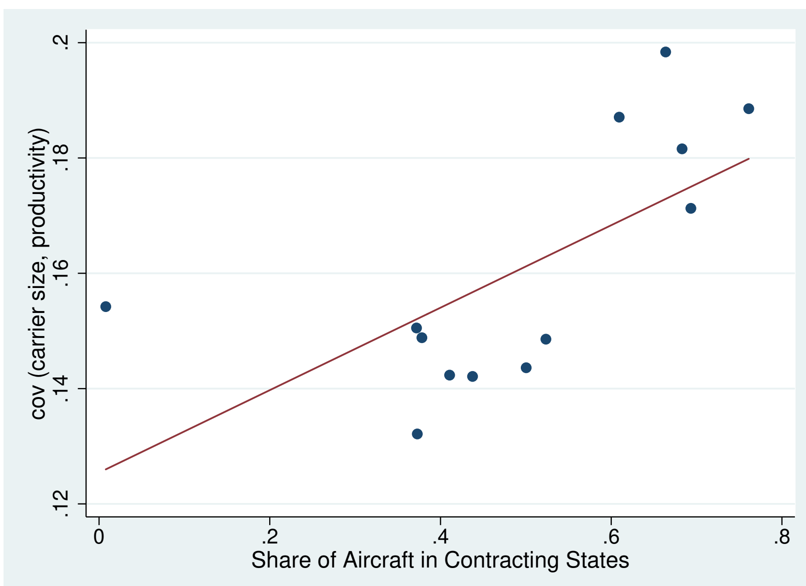
Figure 3 illustrates the dynamic effect of the Convention on the degree of reallocation in the years around the ratification of the Convention. The figures estimate the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{k,t}} + \sum_{l=-7,l\neq-1}^{l=7} \beta_l CTC_{j,l} \times Prod_{i,t-1} + \sum_{l=-7,l\neq-1}^{l=7} \mu_l CTC_{j,l} + \delta Prod_{i,t-1} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country, k indexes region, t indexes time, $X_{j,t}$ includes country-level controls and $CTC_{j,l}$ is a dummy variable indicating the relative year around the ratification of the Convention. Year minus one is the year before the ratification, and is the omitted category. Pre-convention firm-level productivity is denoted as $Prod_{i,t-1}$ and is measured by log of average monthly flying hours. The unit of observation is at firm-year level and the dependent variable is firm fleet size in Figure 3a, aircraft-size-weighted (number-of-seats-weighted) fleet size in Figure 3b, fleet average age in Figure 3c and fleet average technological age in Figure 3d. Standard errors are clustered at the country-level.



(a) OP Covariance and Share of Contracting States



(b) OP Covariance and Share of Aircraft in Contracting States

Figure 4: Olley-Pakes Covariance Term between Carrier Size and Productivity

This figure shows how the Olley-Pakes covariance term between carrier size and productivity changes with more countries entering the Convention. Carrier size is proxied by share of aircraft in the global airline industry and productivity is proxied by monthly flying hours. The covariance term is shown on the y-axis. Share of Contracting States in all states is on the x-axis in Figure 4a. Share of aircraft operated by Contracting States is on the x-axis in Figure 4b.

Table 1: Hazard Model—Determinants of Entry Decisions into the Convention

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.	Log expected time to entry						
HHI	0.309***	0.241***	0.192**	0.176*	0.167*	0.255**	0.146*
	(0.075)	(0.089)	(0.091)	(0.094)	(0.089)	(0.111)	(0.086)
$cov(size, prod)$	-0.121**	-0.092*	-0.109**	-0.106*	-0.091*	-0.113*	-0.099**
	(0.055)	(0.052)	(0.055)	(0.055)	(0.053)	(0.067)	(0.051)
ln(GDP per capita)		0.084	0.084	0.065	0.054	0.227*	0.115*
		(0.082)	(0.076)	(0.077)	(0.075)	(0.121)	(0.070)
GDP per capita growth		-0.019	-0.02	-0.021	-0.022	-0.029	-0.015
		(0.017)	(0.016)	(0.016)	(0.016)	(0.022)	(0.014)
Inflation		-0.000	-0.000	-0.000	-0.000*	-0.000	-0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Export to GDP		-0.007	-0.007	-0.007	-0.007	-0.008	-0.007
		(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)
Import to GDP		0.004	0.002	0.002	0.002	0.003	0.003
		(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)
Gov Expenditure		-0.001	-0.012	-0.009	-0.007	-0.008	-0.011
		(0.016)	(0.014)	(0.015)	(0.015)	(0.018)	(0.013)
Private Credit to GDP		-0.002	-0.002	-0.002	-0.003	-0.001	-0.002
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln(population)			-0.084	-0.100*	-0.064	0.053	-0.071
			(0.054)	(0.059)	(0.062)	(0.127)	(0.047)
Population growth			-0.188***	-0.167***	-0.158***	-0.169**	-0.165***
			(0.061)	(0.060)	(0.058)	(0.071)	(0.055)
France law				0.005			
				(0.155)			
German law				0.407			
				(0.292)			
Scandinavian law				-0.139			
				(0.258)			
Democratic Index					0.001		
					(0.023)		
ln(Air passenger)						-0.152	
						(0.125)	
Air passenger growth						0.002	
						(0.003)	
# of treated neighbors							0.056
							(0.039)
Region FE	YES	YES	YES	YES	YES	YES	YES
Log likelihood	-234.779	-208.045	-201.892	-200.079	-192.017	-172.617	-200.798
p-value of chi2 for regression	< 0.001	0.026	0.003	0.007	0.003	0.02	< 0.001
No. of Countries	197	167	167	167	151	148	167
Obs	1,979	1,591	1,589	1,589	1,406	1,343	1,589

The table shows the results from a hazard model to study the timing of entry into the Convention. The hazard model is Weibull with log expected time to ratify the Convention as the dependent variable. The hazard function is inverted and mapped into the time domain, as suggested by Kroszner and Strahan (1999). The coefficients represent the percentage change in the time to ratify for a one-unit change in the independent variables. HHI is the Hirfindahl-Hirschman index, which measures the aviation market concentration for each country. $cov(size, prod)$ measures the Olley-Pakes covariance term between carrier size and carrier productivity, as a proxy for market distortion. Both HHI and $cov(size, prod)$ are measured at the country-year level and standardized to facilitate interpretation. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 2: Returns around the Convention's Ratification

Panel A: 3-day abnormal return before and around the ratification

	[-4,-2]	[-1, 1]	Difference
Mean	0.000	0.023	0.023***
	(0.006)	(0.006)	
Obs	153	153	

Panel B: 3-day abnormal return around the ratification

	Delist/Dead, [-1, 1]	Healthy, [-1, 1]	Difference
Mean	-0.003	0.027	0.029*
	(0.015)	(0.007)	
Obs	21	132	

Abnormal returns are computed as cumulative residuals of the market model over the three-day period starting one day before the announcement of the Convention's ratification. The market model is estimated over the 200-day period starting 205 days before the announcement of the ratification, where the relevant country's market index is employed as the market proxy. All listed airlines with available information are included. Panel A compares the 3-day abnormal return before the ratification versus around the ratification. Panel B compares the 3-day return around the ratification for delisted or dead airlines (less than 5 years from delisting or death) versus relatively healthier airlines.

Table 3: Summary Statistics

Panel A: Aircraft Level

	N	Mean	P1	P50	P99	SD
Age	429,033	11.29	0.00	10.00	35.00	8.52
Tech Age	429,033	20.51	4.00	19.00	44.00	9.41
Age at Death	17,025	25.90	9.00	25.00	46.00	8.26
Average monthly flying hours	429,033	210.42	0.00	212.08	441.33	99.58
Total Number of Aircraft: 51,665						

Panel B: Airline Level

	N	Mean	P1	P50	P99	SD
Fleet Size	28,608	19.78	1.00	6.00	263.00	54.49
Age	28,608	15.53	1.00	14.50	38.00	9.01
Tech Age	28,608	24.40	6.54	24.00	46.00	9.18
Average monthly flying hours	28,608	127.87	0.00	116.50	366.00	96.49
Number of Asset Types	28,608	2.39	1.00	2.00	9.00	1.83
Total Number of Airlines: 8,175						

Panel C: Country Level

	N	Mean	P1	P50	P99	SD
Number of Airlines	5,378	11.64	1.00	4.00	151.00	35.51
Fleet Size	5,378	125.38	1.00	24.00	1347.00	573.91
Age	5,378	14.50	3.50	13.21	31.33	6.48
Tech Age	5,378	24.44	11.22	23.60	41.00	6.94
Average monthly flying hours	5,378	159.03	0.00	163.09	332.30	77.43
Total Number of Countries: 218						

The table presents the summary statistics for variables listed in the first column. Panels A, B, and C show statistics at the aircraft, carrier and country levels, respectively. The definitions of the variables are listed in Appendix A.

Table 4: Impact of the Convention on Average Productivity

Panel A: Aggregate *Country-level*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.	ln(average monthly flying hours)						
CTC	0.117**	0.132***	0.154***	0.154***	0.134***	0.138***	0.123**
	(0.049)	(0.048)	(0.052)	(0.052)	(0.049)	(0.052)	(0.053)
ln(GDP per capita)	0.268***	0.272**	0.261**	0.259**	0.271**	0.292**	0.233
	(0.074)	(0.107)	(0.114)	(0.112)	(0.107)	(0.117)	(0.173)
GDP per capita growth	-0.003*	-0.002	-0.002	-0.002	-0.002	-0.003	-0.006**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
ln(Population)	0.098	0.122	-0.068	-0.065	0.126	0.012	0.182
	(0.163)	(0.209)	(0.225)	(0.227)	(0.209)	(0.240)	(0.317)
Pop growth	-0.025**	-0.017	-0.02	-0.02	-0.017	-0.018	-0.020**
	(0.011)	(0.014)	(0.015)	(0.015)	(0.014)	(0.016)	(0.009)
Pop density	-0.000	-0.000	0.000	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Export to GDP		0.003	0.003	0.003	0.003	-0.000	0.003
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Import to GDP		0.000	0.000	0.000	0.000	0.002	0.001
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Investment to GDP		-0.002	-0.002	-0.002	-0.002	-0.002	0.003
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
Inflation		-0.001	-0.000	-0.000	-0.001*	-0.001	-0.001
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Air Liberalization Index			0.002			0.004	0.005
			(0.007)			(0.007)	(0.009)
Number of ASA countries				0.001			
				(0.002)			
Open Skies with US					-0.015		
					(0.036)		
Democratic Index						0.006	0.002
						(0.009)	(0.010)
Private Credit to GDP							-0.000
							(0.001)
Economic Freedom Index							-0.028
							(0.034)
Property Rights							0.001
							(0.002)
Corruption							0.002
							(0.004)
Country FE	YES	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES	YES
No. of Countries	177	165	160	160	163	143	126
Obs	4,216	3,847	3,338	3,338	3,777	3,041	1,666
Adj R2	0.656	0.658	0.676	0.676	0.66	0.674	0.738

The panel shows how the Convention affects average industry-wide productivity at *country* level. The unit of observation is a country-year. The coefficients are estimated from the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

where j indexes country, t indexes time and k indexes region. Country and region by year fixed effects are captured by $\boldsymbol{\gamma_j}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. The dependent variable is $ln(average\ monthly\ flying\ hours)$. The sample includes all countries with available information from 1980 to 2015 in all columns. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 4 continued...

Panel B: Individual *Firm-level*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.	ln(average monthly flying hours)						
CTC	-0.008	0.006	-0.015	-0.019	0.008	-0.017	-0.028
	(0.033)	(0.030)	(0.040)	(0.040)	(0.037)	(0.040)	(0.042)
ln(GDP per capita)	0.221***	0.164*	0.220*	0.220**	0.163*	0.215*	0.250**
	(0.081)	(0.094)	(0.112)	(0.109)	(0.095)	(0.109)	(0.124)
GDP per capita growth	0.003	0.005**	0.004*	0.004*	0.005**	0.003	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
ln(Population)	0.097	0.001	-0.047	-0.035	-0.002	-0.151	0.11
	(0.169)	(0.195)	(0.197)	(0.196)	(0.198)	(0.203)	(0.229)
Pop growth	-0.038**	-0.019	-0.018	-0.018	-0.02	-0.025	-0.015
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)
Pop density	0.001	0.001*	0.001	0.001	0.001*	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Export to GDP		0.002	0.001	0.001	0.003	-0.001	0.001
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Import to GDP		0.003	0.004	0.003	0.003	0.006**	0.002
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Investment to GDP		0.000	-0.001	-0.001	0.000	-0.001	-0.001
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Inflation		-0.000	0.000	0.000	-0.000	0.000	-0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Air Liberalization Index			0.000			0.000	0.001
			(0.003)			(0.003)	(0.004)
Number of ASA countries				0.001			
				(0.001)			
Open Skies with US					0.011		
					(0.030)		
Democratic Index						0.002	-0.000
						(0.009)	(0.008)
Private Credit to GDP							-0.000
							(0.001)
Economic Freedom Index							-0.01
							(0.036)
Property Rights							-0.002
							(0.001)
Corruption							-0.001
							(0.003)
Airline FE	YES	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES	YES
No. of Countries	169	157	153	153	156	138	124
Obs	19,972	19,315	17,066	17,066	15,507	16,549	10,951
Adj R2	0.736	0.745	0.758	0.758	0.729	0.761	0.738

The panel shows how the Convention affects average productivity at *firm* level. The unit of observation is a firm-year. The coefficients are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

where i indexes firm, j indexes country, t indexes time and k indexes region. Firm and region by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. The dependent variable is $ln(average\ monthly\ flying\ hours)$. The sample includes all airlines with available information from 1980 to 2015 in all columns. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 5: Impact of the Convention on Reallocation

Fleet Size and Technology

Panel A: Productivity Measured by Flying Hours

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(# of aircraft)	Age	Tech Age	ln(# of aircraft)	Age	Tech Age
CTC × Productivity	0.128***	-0.902**	-0.649*	0.097***	-1.191***	-0.909***
	(0.043)	(0.389)	(0.337)	(0.035)	(0.289)	(0.253)
CTC	-0.552***	3.433*	2.230			
	(0.205)	(1.961)	(1.775)			
Productivity	0.066***	-1.004***	-1.053***	0.070***	-0.830***	-0.801***
	(0.013)	(0.118)	(0.106)	(0.014)	(0.159)	(0.111)
Macro Controls	YES	YES	YES	Absorbed	Absorbed	Absorbed
Airline FE	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	Absorbed	Absorbed	Absorbed
Country × Year FE	NO	NO	NO	YES	YES	YES
No. of Countries	174	174	174	138	138	138
Obs	22,060	22,060	22,060	21,414	21,414	21,414
Adj R2	0.891	0.83	0.823	0.896	0.849	0.842

Panel B: Productivity Measured by Age-type Adjusted Flying Hours

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(# of aircraft)	Age	Tech Age	ln(# of aircraft)	Age	Tech Age
CTC × Productivity	0.123***	-1.297***	-1.168**	0.088**	-1.382***	-1.355***
	(0.034)	(0.297)	(0.474)	(0.034)	(0.266)	(0.438)
CTC	-0.552***	5.835***	5.178**			
	(0.165)	(1.615)	(2.522)			
Productivity	0.047**	1.450***	1.093***	0.052**	1.451***	1.165***
	(0.021)	(0.175)	(0.209)	(0.026)	(0.176)	(0.195)
Macro Controls	YES	YES	YES	Absorbed	Absorbed	Absorbed
Airline FE	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	Absorbed	Absorbed	Absorbed
Country × Year FE	NO	NO	NO	YES	YES	YES
No. of Countries	174	174	174	129	129	129
Obs	21,224	21,224	21,224	19,543	19,543	19,543
Adj R2	0.894	0.826	0.817	0.899	0.848	0.842

The table shows the impact of the Convention on reallocation. The unit of observation is a firm-year. The coefficients in columns (4) to (6) are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \delta Prod_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country and t indexes time. Firm and country by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{j,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod_{i,t-1}$ measures the pre-convention firm-level productivity and is $ln(average\ monthly\ flying\ hours)$ in Panel A and $ln(average\ monthly\ flying\ hours\ adjusted\ by\ aircraft\ age\ and\ type)$ in panel B. The regression equation in columns (1) to (3) is similarly defined. The dependent variable in columns (1) and (4) is fleet size or $ln(number\ of\ aircraft)$ in the respective firm-year. In columns (2) and (5), the dependent variable is average age of the respective airline's fleet. In columns (3) and (6), the dependent variable is average tech age of the respective airline's fleet. Tech age measures aircraft technological age, defined as the number of years since the introduction of the underlying aircraft's type, similar to Benmelech and Bergman (2011). Macro control variables include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The sample includes all airlines with available information from 1980 to 2015. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 6: Impact of the Convention on Reallocation

Probability of Substantial Downsizing and Exit

Panel A: Productivity Measured by Flying Hours

	(1)	(2)	(3)	(4)
Dep. Var.	Downsizing	Exit	Downsizing	Exit
CTC × Productivity	-0.026***	-0.016***	-0.025***	-0.015**
	(0.006)	(0.006)	(0.009)	(0.007)
CTC	0.134***	0.077***		
	(0.030)	(0.029)		
Productivity	-0.019***	-0.012***	-0.010*	-0.010**
	(0.005)	(0.004)	(0.006)	(0.005)
Macro Controls	YES	YES	Absorbed	Absorbed
Airline FE	YES	YES	YES	YES
Region × Year FE	YES	YES	Absorbed	Absorbed
Country × Year FE	NO	NO	YES	YES
No. of Countries	174	174	138	138
Obs	22,060	22,060	21,414	21,414
Adj R2	0.161	0.135	0.158	0.101

Panel B: Productivity Measured by Age-type Adjusted Flying Hours

	(1)	(2)	(3)	(4)
Dep. Var.	Downsizing	Exit	Downsizing	Exit
CTC × Productivity	-0.048***	-0.044***	-0.046***	-0.047***
	(0.018)	(0.010)	(0.017)	(0.009)
CTC	0.256**	0.226***		
	(0.099)	(0.053)		
Productivity	-0.01	-0.003	-0.003	-0.001
	(0.007)	(0.005)	(0.007)	(0.005)
Macro Controls	YES	YES	Absorbed	Absorbed
Airline FE	YES	YES	YES	YES
Region × Year FE	YES	YES	Absorbed	Absorbed
Country × Year FE	NO	NO	YES	YES
No. of Countries	174	174	129	129
Obs	21,224	21,224	19,543	19,543
Adj R2	0.162	0.139	0.166	0.111

The table shows the impact of the Convention on the probability of substantial downsizing and exit for unproductive airlines. The unit of observation is a firm-year. The coefficients in columns (3) and (4) are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \delta Prod_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country and t indexes time. Firm and country by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{j,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod_{i,t-1}$ measures the pre-convention firm-level productivity and is $ln(average\ monthly\ flying\ hours)$ in Panel A and $ln(average\ monthly\ flying\ hours\ adjusted\ by\ aircraft\ age\ and\ type)$ in panel B. The regression equation in columns (1) and (2) is similarly defined. The dependent variable in columns (1) and (3) is a binary variable which equals one if fleet size decreases by more than 50% in the respective firm-year. In columns (2) and (4), the dependent variable is a binary variable which equals one if the firm exits in the following year. The sample includes all airlines with available information from 1980 to 2015. Macro control variables include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 7: Cross-sectional Heterogeneity

Weak vs. Strong Pre-convention Creditor Protection

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(average monthly flying hours)		ln(# of aircraft)			
CTC × Productivity			0.196***	0.081**	0.182**	0.067***
			(0.066)	(0.032)	(0.071)	(0.022)
CTC	0.186***	0.054	-0.910***	-0.342**		
	(0.066)	(0.077)	(0.319)	(0.165)		
Productivity			0.059***	0.078***	0.064***	0.076***
			(0.017)	(0.016)	(0.020)	(0.018)
Sample	Weak	Strong	Weak	Strong	Weak	Strong
Macro Controls	YES	YES	YES	YES	Absorbed	Absorbed
Airline FE	-	-	YES	YES	YES	YES
Country FE	YES	YES	Absorbed	Absorbed	Absorbed	Absorbed
Region × Year FE	YES	YES	YES	YES	Absorbed	Absorbed
Country × Year FE	NO	NO	NO	NO	YES	YES
No. of Countries	91	39	87	38	72	32
Obs	2,490	1,174	10,710	9,926	10,100	9,764
Adj R2	0.635	0.643	0.871	0.908	0.882	0.908

The table shows how the increase in aggregate productivity and the across-firm reallocation differ in countries with weak pre-convention creditor protection compared to countries with strong pre-convention creditor protection. Creditor protection information is from Djankov, McLiesh, and Shleifer (2007). Subgroup "Weak" ("Strong") includes countries for which the creditor rights aggregate score is below or equal to (above) 2. The unit of observation is a country-year in columns (1) and (2). The regression equation in columns (1) and (2) is the same as in Table 4. The unit of observation is a firm-year in columns (3) to (6). The coefficients in columns (3) to (6) are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \delta Prod_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country and t indexes time. Firm and country by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{j,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise.$Prod_{i,t-1}$ measures the pre-convention firm-level productivity or $ln(average\ monthly\ flying\ hours)$. The dependent variable in columns (1) and (2) is $ln(average\ monthly\ flying\ hours)$ in the respective country-year. The dependent variable in columns (3) to (6) is fleet size or $ln(number\ of\ aircraft)$ in the respective firm-year. In columns (1) and (2), the sample includes all *countries* with available information from 1980 to 2015. The sample includes all *airlines* with available information from 1980 to 2015 in columns (3) to (6). Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 8: What Leads to Across-Firm Reallocation?

Efficient Asset Redeployment

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(average monthly flying hours)					
$CTC \times Transaction$	0.112***	0.116***	0.221***	0.234***	0.023	0.023
	(0.034)	(0.034)	(0.080)	(0.078)	(0.045)	(0.046)
CTC	-0.009		-0.008		-0.009	
	(0.029)		(0.029)		(0.031)	
$Transaction$	-0.305***	-0.319***	-0.317***	-0.381***	-0.304***	-0.304***
	(0.032)	(0.031)	(0.051)	(0.054)	(0.031)	(0.030)
Transactions	All	All	Failing	Failing	Normal	Normal
Macro Controls	YES	Absorbed	YES	Absorbed	YES	Absorbed
Age × Type FE	YES	YES	YES	YES	YES	YES
Country FE	YES	Absorbed	YES	Absorbed	YES	Absorbed
Region × Year FE	YES	Absorbed	YES	Absorbed	YES	Absorbed
Country × Year FE	NO	YES	NO	YES	NO	YES
No. of Countries	177	193	174	162	173	166
Obs	241,532	246,188	207,144	206,513	221,856	221,234
Adj R2	0.196	0.216	0.198	0.215	0.211	0.224

The table shows how asset reallocation becomes more efficient under the Convention. The unit of observation is an aircraft-year. The coefficients in columns (2), (4) and (6) are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_{age\_type}} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Transaction_{i,t} + \delta Transaction_{i,t} + \varepsilon_{i,t}$$

where i indexes aircraft, j indexes country and t indexes time. Age by type and country by year fixed effects are captured by $\boldsymbol{\gamma_{age\_type}}$ and $\boldsymbol{\alpha_{j,t}}$, respectively. The regression equation in columns (1), (3) and (5) is similarly defined. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. The interaction term $CTC_{j,t} \times Transaction_{i,t}$ contains a binary variable $Transaction_{i,t}$, which equals one if the observation is around a transaction and zero otherwise. In columns (3) and (4), the indicator $Transaction_{i,t}$ equals one if the transaction is initiated by a failing airline and zero otherwise. In columns (5) and (6), $Transaction_{i,t}$ equals one if the transaction is initiated by a healthy airline and zero otherwise. The dependent variable is $ln(average\ monthly\ flying\ hours)$ in the respective aircraft-year. The sample includes all *aircraft* with available information from 1980 to 2015 in columns (1) to (2). In columns (3) and (4), the sample excludes aircraft-year around normal transactions. In columns (5) and (6), the sample excludes aircraft-year around transactions initiated by distressed airlines. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 9: What Leads to Across-Firm Reallocation?

Foreign Financiers, Financial Innovations, and Credit Allocative Efficiency

Panel A: Entry of Foreign Financiers and Financial Innovations

	(1)	(2)	(3)	(4)	(5)
Dep. Var.	ln(# of deals foreign)	ln(# of deals local)	share foreign	ln(# of foreign financiers)	ln(# of type)
CTC	0.210***	0.069	0.101***	0.310***	0.220***
	(0.072)	(0.045)	(0.035)	(0.106)	(0.060)
Macro Controls	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES
No. of Countries	141	141	141	141	141
Obs	2,359	2,359	2,359	2,359	2,359
Adj R2	0.665	0.502	0.452	0.649	0.718

Panel B: Credit Allocative Efficiency

	(1)	(2)	(3)	(4)
Dep. Var.	*ln(# of deals)*		*ln(value of deals)*	
CTC × Productivity	0.049***	0.042**	0.213***	0.190***
	(0.018)	(0.017)	(0.061)	(0.059)
CTC	-0.210**		-0.893***	
	(0.083)		(0.288)	
Productivity	-0.001	-0.002	-0.002	-0.003
	(0.002)	(0.002)	(0.011)	(0.012)
Macro Controls	YES	Absorbed	YES	Absorbed
Airline FE	YES	YES	YES	YES
Region × Year FE	YES	Absorbed	YES	Absorbed
Country × Year FE	NO	YES	NO	YES
No. of Countries	167	135	167	135
Obs	13,237	12,801	13,237	12,801
Adj R2	0.418	0.415	0.409	0.403

The table shows how the Convention affects the activities of international financiers (Panel A) and credit allocative efficiency (Panel B). The unit of observation is a country-year in Panel A and a firm-year in Panel B. The coefficients in Panel A are estimated from the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

The coefficients in columns (2) and (4) of Panel B are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \delta Prod_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country, t indexes time, and k indexes region. Country and region by year fixed effects are captured by $\boldsymbol{\gamma_j}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. Firm and country by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{j,t}}$. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod_{i,t-1}$ measures the pre-convention firm-level productivity or $ln(average\ monthly\ flying\ hours)$. The regression equation in columns (1) and (3) of Panel B is similarly defined. The dependent variables in columns (1) to (5) of Panel A are $ln(number\ of\ deals\ with\ foregin\ financiers)$, $ln(number\ of\ deals\ with\ local\ financiers)$, share of deals with foreign financiers, $ln(number\ of\ unique\ foreign\ financiers)$ and $ln(number\ of\ unique\ financing\ types)$. The dependent variable in columns (1) and (2) of Panel B is log number of completed financing deals in the respective firm-year. In columns (3) and (4), the dependent variable is log value of completed financing deals in the respective firm-year. Country level control variables are summarized by $X_{j,t}$ and include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The sample includes all countries with financing deals in which the arranger information is provided. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 10: Impact of the Convention on Industry Dynamics and Competition

Panel A: Industry Dynamics

	(1)	(2)	(3)	(4)	(5)
Dep. Var.	# of carriers	# of carriers (mainline)	# of carriers (specialized)	average size (mainline)	average size (specialized)
CTC	3.733**	-1.346**	5.080***	0.235***	0.136**
	(1.477)	(0.640)	(1.592)	(0.088)	(0.068)
Macro Controls	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES
No. of Countries	182	182	182	161	177
Obs	5,162	5,162	5,162	4,248	4,349
Adj R2	0.981	0.819	0.978	0.823	0.664

Panel B: Competition

	(1)	(2)
Dep. Var.	HHI	top share
$CTC \times HHI\_pre\_entry$	-0.324***	-0.251***
	(0.099)	(0.084)
CTC	0.117***	0.092**
	(0.036)	(0.036)
Macro Controls	YES	YES
Country FE	YES	YES
Region × Year FE	YES	YES
No. of Countries	171	171
Obs	4,025	4,025
Adj R2	0.809	0.795

The table shows how the Convention affects the industry dynamics and competition. The unit of observation is a country-year. The coefficients in Panel A are estimated from the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

The coefficients in Panel B are estimated from the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} \times HHI\_pre\_convention_j + \mu CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

where j indexes country, t indexes time and k indexes region. Country and region by year fixed effects are captured by $\boldsymbol{\gamma_j}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. The interaction term in Panel B, $HHI\_pre\_convention$, measures the Herfindahl-Hirschman Index of a country's airline industry before the Convention. In Panel A, the dependent variables are $number\ of\ carriers$, $number\ of\ mainline\ carriers$, $number\ of\ specialized\ carriers$, average size of mainline carriers, and average size of specialized carriers in columns (1) to (5). Mainline carriers are airlines that offer traditional full-service between large airports while the specialized carriers are low-cost, regional, leisure and cargo carriers. The dependent variable in column (1) of Panel B is Herfindahl-Hirschman Index (HHI) in the respective country-year. In column (2) the dependent variable is the market share of the largest airline. Country level control variables are summarized by $X_{j,t}$ and include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The sample includes all countries with available information from 1980 to 2015. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 11: Impact of the Convention on Consumers

Panel A: Product Variety—Routes, Destinations and Origins

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(# of routes)	ln(# of destinations)	ln(# of origins)	ln(# of routes)	ln(# of destinations)	ln(# of origins)
CTC	0.146***	0.149***	0.051*	0.140***	0.143***	0.049*
	(0.050)	(0.047)	(0.029)	(0.049)	(0.047)	(0.029)
Open Skies with US				0.073**	0.068**	0.019
				(0.031)	(0.030)	(0.022)
Macro Controls	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES
No. of Countries	180	180	180	180	180	180
Obs	4,115	4,115	4,115	4,115	4,115	4,115
Adj R2	0.934	0.924	0.905	0.934	0.924	0.905

Panel B: Product Quality—Safety and Service Rating

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	safety				service rating		
Dep. Var.	# of accidents	# of airlines with accidents	# of cabin fatalities	# of ground fatalities	average rating	low rating share	SD rating
CTC	-0.055**	-0.054**	-0.125	-0.035*	0.270*	-0.096**	-0.146**
	(0.027)	(0.027)	(0.089)	(0.021)	(0.160)	(0.045)	(0.062)
Macro Controls	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES	YES
No. of Countries	182	182	182	182	121	121	121
Obs	5,162	5,162	5,162	5,162	1,078	1,078	1,078
Adj R2	0.572	0.569	0.336	0.198	0.439	0.334	0.53

The table shows how the Convention affects the variety (Panel A) and quality (Panel B) of products offered to consumers. The unit of observation is a country-year. The coefficients are estimated from the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

where j indexes country, t indexes time and k indexes region. Country and region by year fixed effects are captured by $\boldsymbol{\gamma_j}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. The dependent variables are log number of distinct routes (columns (1) and (4)), destination cities (columns (2) and (5)), and originating cities (columns (3) and (6)) in Panel A. In Panel B, columns (1) to (4) examine safety while columns (5) to (7) examine customer service rating. Country level control variables are summarized by $X_{j,t}$ and include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

For Online Publication:

Internet Appendix to "Globally Consistent Creditor Protection, Reallocation, and Productivity"

This appendix has four sections. Section A contains additional information on variable definition and construction. Section B provides evidence that aircraft utilization can capture efficiency and productivity in my setting. Section C shows back-of-the-envelope calculations to decompose the aggregate productivity increase into the within and reallocation components. Section D provides additional results. Section E includes further robustness tests of main empirical results.

A Appendix: Variable Definition and Construction

Table A1: Description of Variables

Variable	Definition
From FlightGlobal	
Age	Number of years since delivery of the aircraft (or since "birth date").
Age at Death	Age when the aircraft was scrapped.
Tech Age	Aircraft technological age, or the number of years since the introduction of the aircraft's type.
Type	Aircraft or asset type, e.g., Airbus 320, Boeing 747.
Average monthly flying hours (raw)	Proxy for productivity or utilization rate. This is first constructed for each aircraft-year and then aggregated at two other levels: - country level: averaged across the entire fleet of a country; alternative measures include aircraft-size weighted productivity. - firm level: averaged across the entire fleet of a firm.
Average monthly flying hours (age-type adjusted)	Adjusted by the age and type of the aircraft. I regress asset utilization rate on aircraft age, with aircraft type fixed effects. I then take the residual and add the mean utilization rate to it. This gives me the age-type adjusted productivity measure.
Fleet Size (# of aircraft)	Number of aircraft operated by a carrier. At country-level, this is defined similarly. Alternative measures include seating capacity weighted fleet size, maximum take-off weight weighted fleet size and wingspan weighted fleet size.
From Airfinance Journal	
# of deals foreign	Number of deals by foreign financiers.
# of deals local	Number of deals by local financiers.
share foreign	Share of deals by foreign financiers.
# of foreign financiers	Number of unique foreign financiers.
# of type	I count the number of structures in the closed financing deals as a proxy for the number of types of financing deals. This webpage (`https://airfinancejournal.com/Data/About`) provides a detailed description on the possible structures.
# of deals	Total of deals by all financiers.
value of deals	Total value of deals by all financiers (in million dollars).
From Bureau of Transportation Statistics	
# of routes	Number of unique direct routes between a given country and the US.
# of destinations	Number of unique destinations in the US that can be directly reached by flight from a given country.
# of origins	Number of cities in a given country that can fly directly to the US.
From Skytrax	
average rating	Average customer ratings (1 to 5) for the flights operated by a given country's airlines.
low rating share	Share of ratings equaling to 1 point (out of 5).
SD rating	Standard deviation of customer ratings for the flights operated by a given country's airlines.
From WTO Air Transport (Air Services Agreements Projector)	
Air Liberalization Index	Measurement of the openness of the air transport policy of a given country. More details can be found on the following webpage: `https://www.wto.org/asap/resource/data/html/methodology_e.htm`
Number of ASA countries	Number of bilateral Air Services Agreements signed by a given country up to a given year .
From World Bank World Development Index	
Air Dprt	Air transport, number of registered carrier departures.
Air Psgr	Air transport, number of passengers carried.
Rail KM	Rail lines (total route-km).
Rail Psgr	Railways, volume of passengers carried (million passenger-km).

B Appendix: Validation of Key Measures

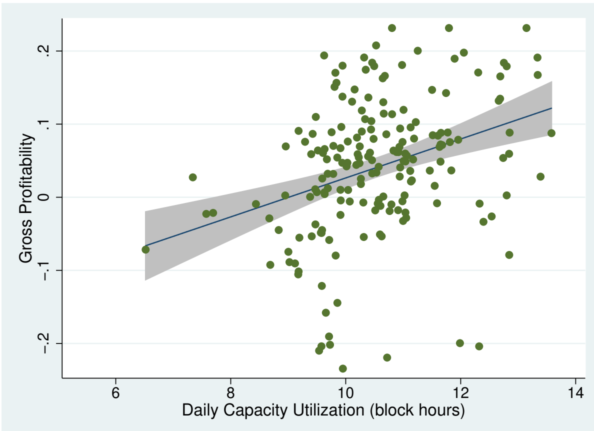
In Appendix B, I provide evidence that aircraft utilization is a reasonable proxy for efficiency and productivity in my setting.

Aircraft utilization, or block hours, represents a key measure of aircraft productivity in the airline industry. It is directly linked to another important productivity measure—available seat miles (ASMs) generated per aircraft per day. Higher utilization results in lower fixed costs per unit and lower cost per available seat mile. To validate this measure, I examine its correlations with other performance measures. Figure B1a and Figure B1b plot each US listed airline's gross and net profitability against daily aircraft utilization. I find that profitability is positively correlated with utilization. An one hour increase in average daily aircraft utilization corresponds to almost 2 percentage points increase in net profitability.

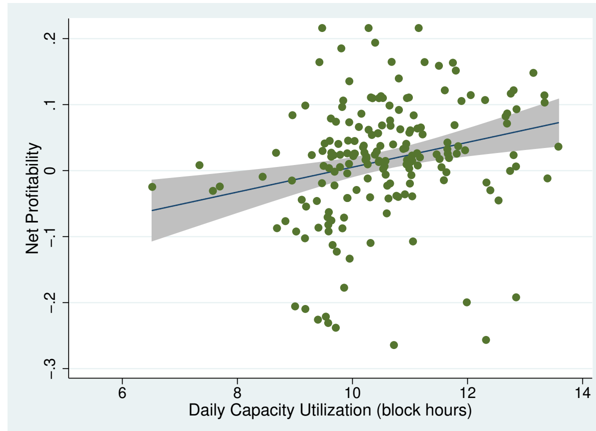
Airlines may face a trade-off between frequency of flights and load factor. One potential concern is that airlines with high daily flying hours may operate empty aircraft and therefore have a lower load factor. Figure B1c shows this is not likely to be true. In fact, there is a slightly positive correlation between load factor and daily aircraft utilization. According to Figure B1d, passenger yield, measured by revenue per passenger-mile, also exhibits a weak positive correlation with aircraft utilization. At the aggregate level, aircraft utilization is also positively correlated with profitability (Figure B3). Aircraft are also parked inactive more in economic downturns than upturns. For example, during the Great Recession, daily aircraft utilization drops by around 8%.

Moreover, an airline's aircraft utilization is substantially lower before entering distress or bankruptcy. I examine the discount in aircraft utilization among failing airlines as compared with healthier airlines. Figure B2a and Figure B2b show that aircraft utilization is almost 40-50% lower when firms are close to exiting or experiencing major downsizing.

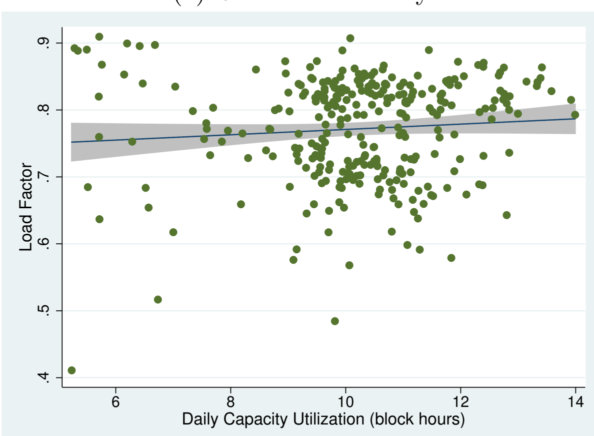
Importantly, Foster, Haltiwanger, and Syverson (2008) documents that the productivity-survival link is more robust using the physical-quantity-based productivity measure rather than the revenue-based productivity measure. They further show that physical productivity is negatively correlated with prices while revenue-based productivity is positively correlated with prices. Therefore, the dispersion in revenue-based productivity among firms would be smaller than that in quantity-based productivity, suggesting that the coefficient estimation in the reallocation analysis (Table 5) is likely to be conservative.



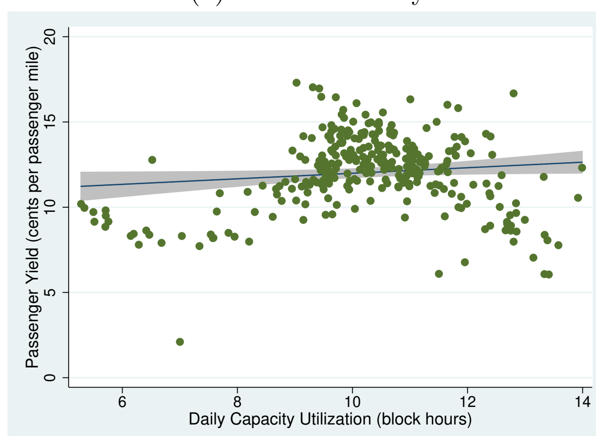
(a) Gross Profitability



(b) Net Profitability



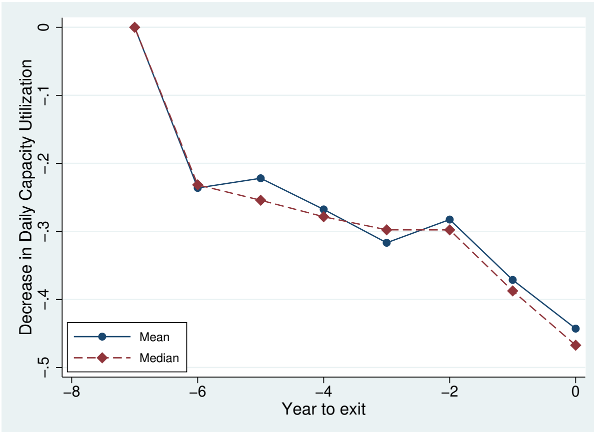
(c) Load Factor



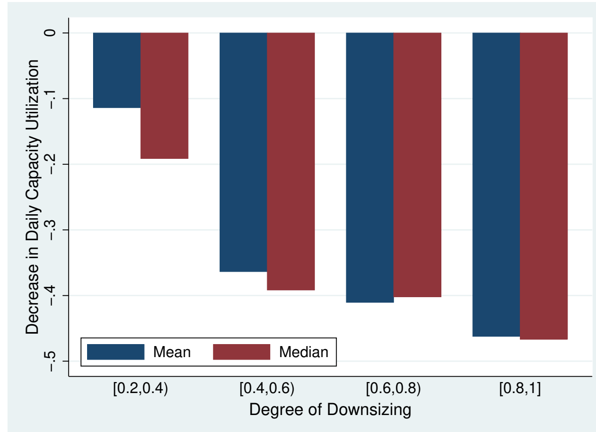
(d) Passenger Yield

Figure B1: Correlation Between Daily Aircraft Utilization and Other Performance Measures

Figure B1 plots other performance measures against daily aircraft utilization using data of US listed airlines from 1995 to 2017. In Figure B1a, y-axis shows gross profitability. In Figure B1b, y-axis shows net profitability. In Figure B1c, y-axis shows load factor. In Figure B1d, y-axis shows passenger yield, measured as cents earned by each revenue passenger mile. X-axis is daily aircraft aircraft utilization (daily block hours average over the entire fleet of each airline) across all figures. Data are from the MIT Global Airline Industry Program.



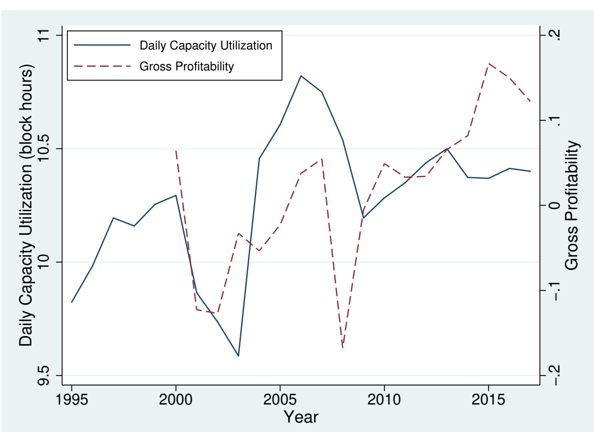
(a) Exiting Firms



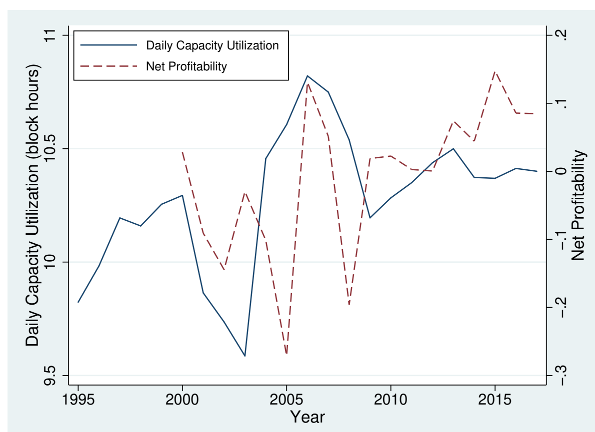
(b) Downsizing Firms

Figure B2: Decrease in Daily Aircraft Utilization in Failing Firms

Figure B2 plots the discount in aircraft utilization among failing airlines against healthier airlines. Figure B2a compares the aircraft utilization in the years close to exit (1 to 6 years before exit) with the aircraft utilization in other years (more than 6 years from exit). X-axis shows the year to exit. Figure B2b compares the aircraft utilization in firms experiencing different degrees of downsizing (20% to 100% downsizing) with the aircraft utilization in firms experiencing less than 20% downsizing or expansion. X-axis shows four bins which indicate different degrees of downsizing.



(a) Operating Profitability and Utilization



(b) Net Profitability and Utilization

Figure B3: Correlation Between Daily Aircraft Utilization and Profitability (Aggregate Level)

Figure B3 plots daily aircraft utilization and profitability overtime, aggregated over US listed airlines. Figure B3a shows operating profitability and daily aircraft utilization. Figure B3b shows net profitability and daily aircraft utilization. Data are from the MIT Global Airline Industry Program.

C Appendix: Decompose Aggregate Productivity Increase

I conduct back-of-the-envelope calculations to decompose the aggregate productivity increase into the within and reallocation components in Equation 4. To do this, I categorize firm productivity into three groups and calculations are based on point estimates in Table E7 and summary statistics. Based on column (1) in Table E7, Panel A of Table C1 calculates the contribution of market share changes between firms to aggregate productivity gain, holding their productivity unchanged. I use fleet size to capture market share. The calculation shows that the documented reallocation effect among existing firms contributes to half of the overall productivity growth, or around 6%.

Table C1: Back-of-the-envelope Calculations—Decompose Aggregate Productivity Increase

Panel A: Reallocation Among Existing Firms

Group	Before CTC			After CTC		
	Productivity	Fleet Size	Share	Δ Fleet Size	Fleet Size	Share
1	3.44	6.66	9.5%	-0.13 (=0.175×1-0.306)	5.79	7.2%
2	4.87	18.2	26.0%	0.044 (0.175×2-0.306)	19.00	23.8%
3	5.49	45.2	64.6%	0.22 (0.175×3-0.306)	55.14	69.0%

Pre-Convention Aggregate Productivity (weighted average): 5.14
Post-Convention Aggregate Productivity (weighted avereage): 5.20
Increase in productvity due to due to shifts in market share: 0.06

Panel B: "Cross" Term

Group	Δ Fleet Age	Δ Productivity	Δ Share
1	1.00 (=-1.726*1+2.7726)	-3.50%	-2.30%
2	-0.73 (=-1.726*2+2.7726)	2.56%	-2.20%
3	2.45 (=-1.726*3+2.7726)	8.58%	4.50%

Increase in productvity due to unbalanced changes in fleet age (technology): 0.0041

We then calculate the contribution of the "cross" term, which is the third term in Equation 4 in Panel B. To do this, we need to compute the change in productivity for each group as a result of technology upgrades. We start with column (2) in Table E7 and calculate changes in fleet age, Then we convert changes in age into changes in productivity by multiplying -3.5% (Column (4) of Table 4 in Gavazza (2011b)). In the end, we multiply these by corresponding changes in market share, which can be calculated from Panel A of Table C1, and sum up. Similarly, we can estimate the contribution due to unbalanced changes in technological age. The calculation reveals that only a small portion, at most 1-2%, can be explained by the "cross" term, or the positive covariance between changes in market share and changes in productivity.

The remaining productivity gain is accounted for by the exit of inefficient airlines. The market share of these exiting airlines is around 9% pre-reform. They are on average 40-50% less productive than the surviving airlines. Hence, their contribution to productivity gain is around 4%.

Adding up the contributions of different components therefore suggests a magnitude in line with the estimated aggregate productivity growth.

D Appendix: Additional Results

Table D1: Impact of the Convention on Fleet Size and Technology
Aggregate Country-level

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(# of aircraft)	ln(# new)	ln(# 2nd hand)	ln(# retired)	Age	Tech Age
CTC	0.195***	0.519***	0.190**	0.181**	-2.215***	-2.591***
	(0.072)	(0.093)	(0.078)	(0.083)	(0.588)	(0.621)
ln(GDP per capita)	0.345***	0.375***	0.034	-0.091	-2.903***	-2.861***
	(0.092)	(0.127)	(0.095)	(0.092)	(0.926)	(1.038)
GDP per capita growth	-0.005**	0.001	0.010***	0.004*	0.058***	0.044**
	(0.002)	(0.002)	(0.003)	(0.002)	(0.019)	(0.017)
ln(Population)	0.981**	0.729	0.434	0.01	0.936	1.841
	(0.413)	(0.448)	(0.322)	(0.259)	(2.265)	(2.369)
Pop growth	0.008	0.002	-0.019	-0.01	0.217*	0.103
	(0.012)	(0.011)	(0.014)	(0.009)	(0.113)	(0.113)
Pop density	-0.000	-0.000	-0.000	-0.001***	-0.003	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)
Country FE	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES
No. of Countries	182	182	182	182	182	182
Obs	5,162	5,162	5,162	5,162	5,162	5,162
Adj R2	0.946	0.761	0.768	0.637	0.699	0.767

The table shows how the Convention affects fleet size and technology at the aggregate industry level. The unit of observation is a country-year. The coefficients are estimated from the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

where j indexes country, t indexes time and k indexes region. Country and region by year fixed effects are captured by $\boldsymbol{\gamma_j}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. Country level control variables are summarized by $X_{j,t}$ and include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The dependent variable in columns (1) is $ln(number\ of\ aircraft)$ in the respective country-year. In columns (2), (3) and (4) the dependent variables are $ln(number\ of\ newly\ built\ aircraft)$, $ln(number\ of\ newly\ obtained\ used\ aircraft)$ and $ln(number\ of\ newly\ retired\ aircraft)$, respectively. The dependent variables in columns (5) and (6) are average age and average tech age of the fleet, respectively. Tech age measures aircraft technological age, defined as the number of years since the introduction of the underlying aircraft's type, similar to Benmelech and Bergman (2011). The sample includes all countries with available information from 1980 to 2015 in all columns. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table D2: Impact of the Convention on Leverage and Interest Rate

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	LEV (Long-Term)			LEV (secured)	LEV (short term)	Average IR
CTC	0.108***	0.106***	0.087***	0.077**	-0.012	0.001
	(0.031)	(0.032)	(0.028)	(0.034)	(0.017)	(0.006)
Size			0.019	0.012	-0.004	0.002
			(0.014)	(0.018)	(0.014)	(0.002)
Profitability			-0.147**	-0.128**	-0.212***	-0.035**
			(0.069)	(0.062)	(0.046)	(0.016)
Tangibility			0.317***	0.333***	0.022	-0.021**
			(0.040)	(0.035)	(0.048)	(0.009)
Tobin's Q			-0.009	-0.021**	-0.005	-0.002
			(0.011)	(0.009)	(0.006)	(0.003)
Leverage						0.011
						(0.007)
Dep. Var. Mean	0.416	0.416	0.416	0.387	0.13	0.072
Macro Controls	YES	YES	YES	YES	YES	YES
Airline FE	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES
No. of Countries	52	52	52	52	52	52
Obs	2,633	2,633	2,633	2,633	2,633	2,488
Adj R2	0.556	0.556	0.582	0.526	0.439	0.475

The table shows how the Convention affects leverage and interest rate using a sample of publicly listed airlines. The unit of observation is firm-year. The coefficients are taken from estimating the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\lambda' F_{i,t-1}} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{i,t}$$

where i indexes firm, t indexes time, j indexes country and k indexes region. Firm and region by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. Country level control variables are summarized by $X_{j,t}$ and include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. Firm level control variables are summarized by $F_{i,t-1}$. The dependent variable in columns (1) to (3) is long term leverage ratio of the firm, or $\frac{long-term\ debt}{total\ assets}$. In columns (4), the dependent variable is the ratio of secured debt to total assets, or $\frac{secured\ debt}{total\ assets}$. In columns (5), the dependent variable is short-term leverage ratio, or $\frac{short-term\ debt}{total\ assets}$. In columns (6), the dependent variable is average interest rate, or $\frac{interest\ expense}{total\ debt}$. The sample includes all listed airlines with available information in Compustat North America and Compustat Global from 1980 to 2015 in all columns. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table D3: Cross-sectional Heterogeneity

North America, Europe (less concentrated, less distorted) vs. Rest of the World

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(hours)		ln(# of aircraft)			
CTC × Productivity			0.064***	0.222***	0.046***	0.208***
			(0.019)	(0.046)	(0.009)	(0.057)
CTC	0.02	0.123**	-0.172*	-1.063***		
	(0.075)	(0.062)	(0.087)	(0.215)		
Productivity			0.085***	0.045***	0.087***	0.044**
			(0.016)	(0.015)	(0.017)	(0.017)
Sample	NA & Europe	Rest	NA & Europe	Rest	NA & Europe	Rest
Macro Controls	YES	YES	YES	YES	Absorbed	Absorbed
Airline FE	-	-	YES	YES	YES	YES
Country FE	YES	YES	Absorbed	Absorbed	Absorbed	Absorbed
Region × Year FE	YES	YES	YES	YES	Absorbed	Absorbed
Country × Year FE	NO	NO	NO	NO	YES	YES
No. of Countries	46	131	46	128	43	95
Obs	1,191	3,025	12,095	9,965	12,122	9,292
Adj R2	0.586	0.673	0.898	0.88	0.900	0.892

The table shows how the increase in aggregate productivity and the across-firm reallocation differ in regions with less concentration and distortion (North America and Europe) compared with regions with more concentration and distortion (the rest of the world). The unit of observation is a country-year in columns (1) and (2). The regression equation in columns (1) and (2) is the same as in Table 4. The unit of observation is a firm-year in columns (3) to (6). The coefficients in columns (3) to (6) are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \delta Prod_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country and t indexes time. Firm and country by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{j,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod_{i,t-1}$ measures the pre-convention firm-level productivity or $ln(average\ monthly\ flying\ hours)$. The dependent variable in columns (1) and (2) is $ln(average\ monthly\ flying\ hours)$ in the respective country-year. The dependent variable in columns (3) to (6) is fleet size or $ln(number\ of\ aircraft)$ in the respective firm-year. In columns (1) and (2), the sample includes all *countries* with available information from 1980 to 2015. The sample includes all *airlines* with available information from 1980 to 2015 in columns (3) to (6). Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table D4: Cross-sectional Heterogeneity

High vs. Low Government Bank Ownership

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(average monthly flying hours)		ln(# of aircraft)			
CTC × Productivity			0.287***	0.082***	0.256***	0.054***
			(0.078)	(0.030)	(0.083)	(0.016)
CTC	0.185**	0.061	-1.335***	-0.319**		
	(0.082)	(0.061)	(0.373)	(0.133)		
Productivity			0.038**	0.081***	0.037*	0.084***
			(0.019)	(0.013)	(0.019)	(0.015)
Sample	High	Low	High	Low	High	Low
Macro Controls	YES	YES	YES	YES	Absorbed	Absorbed
Airline FE	-	-	YES	YES	YES	YES
Country FE	YES	YES	Absorbed	Absorbed	Absorbed	Absorbed
Region × Year FE	YES	YES	YES	YES	Absorbed	Absorbed
Country × Year FE	NO	NO	NO	NO	YES	YES
No. of Countries	87	90	85	89	63	75
Obs	1,878	2,338	7,189	14,871	6,944	14,470
Adj R2	0.674	0.631	0.883	0.896	0.894	0.898

The table shows how the increase in aggregate productivity and the across-firm reallocation differ in countries with high government bank ownership compared to countries with low government bank ownership. Government bank ownership information is from the Bank Regulation and Supervision database. Subgroup "High" ("Low") represents countries with above (below) median government bank ownership. The unit of observation is a country-year in columns (1) and (2). The regression equation in columns (1) and (2) is the same as in Table 4. The unit of observation is a firm-year in columns (3) to (6). The coefficients in columns (3) to (6) are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \delta Prod_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country and t indexes time. Firm and country by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{j,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod_{i,t-1}$ measures the pre-convention firm-level productivity or $ln(average\ monthly\ flying\ hours)$. The dependent variable in columns (1) and (2) is $ln(average\ monthly\ flying\ hours)$ in the respective country-year. The dependent variable in columns (3) to (6) is fleet size or $ln(number\ of\ aircraft)$ in the respective firm-year. In columns (1) and (2), the sample includes all *countries* with available information from 1980 to 2015. The sample includes all *airlines* with available information from 1980 to 2015 in columns (3) to (6). Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table D5: Impact of the Convention on Load Factor, Aviation Traffic, and the Rail Industry

Panel A: Load Factor

	(1)	(2)	(3)	(4)
Dep. Var.	PLF_ew	PLF_vw	WLF_ew	WLF_vw
CTC	-0.001	-0.003	0.003	0.000
	(0.01)	(0.01)	(0.01)	(0.093)
Macro Controls	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES
No. of Countries	180	180	180	180
Obs	4,035	4,035	4,035	4,035
Adj R2	0.599	0.622	0.549	0.576

Panel B: Aviation Traffic and the Rail Industry

	(1)	(2)	(3)	(4)
Dep. Var.	ln(Air Dprt)	ln(Air Psgr)	ln(Rail KM)	ln(Rail Psgr)
CTC	0.177**	0.315***	0.003	-0.025
	(0.082)	(0.087)	(0.025)	(0.093)
Macro Controls	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Region × Year FE FE	YES	YES	YES	YES
No. of Countries	173	173	106	100
Obs	3,476	3,476	1,692	1,698
Adj R2	0.943	0.957	0.992	0.977

The table shows how the Convention affects the aviation load factor (Panel A), traffic, and the rail industry (Panel B). The unit of observation is a country-year. The coefficients are estimated from the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

where j indexes country, t indexes time, k indexes region. Country and region by year fixed effects are captured by $\boldsymbol{\gamma_j}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. Country-level control variables are summarized by $X_{j,t}$ and include GDP per capita growth and population growth. In columns (1) and (2) of Panel A, the dependent variables measure passenger load factor (PLF)—ratio of passenger-kilometers traveled to seat-kilometers available. Column (1) (column (2)) is the equal-weighted (value-weighted) average across the passenger load factor of all flights operated within a country-year. In columns (3) and (4), the dependent variables measure weight load factor (WLF)—ratio of tonne-kilometers traveled to tonne-kilometers available. The dependent variables in columns (1) and (2) of Panel B are $ln(number\ of\ carrier\ departures)$ and $ln(number\ of\ air\ passengers)$ in the respective country. In columns (3) and (4), the dependent variables are $ln(length\ of\ railway\ route)$ and $ln(number\ of\ rail\ passengers)$. The sample is from 1989 to 2015 in Panel A during which ICAO provides load factor data. The sample includes all countries with available information from 1980 to 2015 in the World Bank WDI database in Panel B. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

E Appendix: Robustness Tests

Table E1: Impact of the Convention on Aggregate Productivity

Controlling for Group-specific Time Varying Trends

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	ln(average monthly flying hours)							
CTC	0.117**	0.130**	0.149***	0.118**	0.117**	0.103**	0.117**	0.109**
	(0.049)	(0.051)	(0.051)	(0.053)	(0.050)	(0.047)	(0.049)	(0.050)
Group-specific Trends	-	creditor rights	democ	size	rel size	growth	HHI	cov(size, prod)
Macro Controls	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES	YES	YES
No. of Countries	177	177	154	175	175	177	177	177
Obs	4,216	4,216	3,722	4,206	4,206	4,216	4,216	4,216
Adj R2	0.656	0.653	0.66	0.654	0.651	0.662	0.66	0.66

The table shows how the Convention affects aggregate industry level productivity, after controlling for different group-specific time varying trends. The unit of observation is a country-year. The coefficients are estimated from the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \boldsymbol{\phi_{g,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

where j indexes country, t indexes time and k indexes region. Country and region by year fixed effects are captured by $\boldsymbol{\gamma_j}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. Group-specific time varying trends are summarized by $\boldsymbol{\phi_{g,t}}$. To facilitate comparison, column (1) shows the results of the baseline specification (column (1) of Panel A, Table 4). Columns (2) to (8) control for different group-specific trends: column (2) allows for time-varying trends for countries with different levels of creditor protection (0-4); column (3) allows for time-varying trends for countries with different levels of democracy index (0-10); column (4) (column (5)) allows for time-varying trends for countries with different size (relative size) of the aviation sector (4 groups); column (6) allows for time-varying trends for countries with different growth rates of the aviation sector (4 groups); column (7) allows for time-varying trends for countries with different levels of concentration in the aviation sector (4 groups); column (8) allows for time-varying trends for countries with different levels of distortion, as measured by the covariance between firm size and productivity, in the aviation sector (4 groups). Country level control variables are summarized by $X_{j,t}$ and include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The dependent variable is $ln(average\ monthly\ flying\ hours)$ of all aircraft in the respective country. The sample includes all countries with available information from 1980 to 2015. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table E2: Impact of the Convention on Aggregate Productivity
Alternative Specifications and Samples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	ln(average monthly flying hours)							
CTC	0.117**	0.117**	0.117**	0.123**	0.118**	0.092**	0.147***	0.074***
	(0.049)	(0.047)	(0.050)	(0.051)	(0.050)	(0.046)	(0.049)	(0.028)
Robust to:	-	EIF	excl. US	excl. BRIC	excl. small	from 1990	22 regions	weighted
Macro Controls	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES	YES	YES
No. of Countries	177	177	176	173	160	175	174	174
Obs	4,216	4,216	4,181	4,089	4,043	3,497	4,171	4,171
Adj R2	0.656	0.656	0.657	0.652	0.63	0.692	0.651	0.792

The table shows how the Convention affects aggregate industry level productivity using alternative specifications and samples. The unit of observation is a country-year. The coefficients are estimated from the following specification:

$$Y_{j,t} = \boldsymbol{\gamma_j} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

where j indexes country, t indexes time and k indexes region. Country and region by year fixed effects are captured by $\boldsymbol{\gamma_j}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. To facilitate comparison, column (1) shows the results of the baseline specification (column (1) of Panel A, Table 4). Column (2) uses the Convention's *entry into force date* as the event date. Column (3) excludes the US from the sample. Column (4) excludes Brazil, Russia, India and China. Column (5) excludes the bottom decile of countries in terms of fleet size. Column (6) drops observations before 1990. In column (7), regions defined at a more granular level are used (22 regions according to United Nations groupings). The regression in column (8) is weighted by fleet size in each country-year. Country level control variables are summarized by $X_{j,t}$ and include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The dependent variable is $ln(average\ monthly\ flying\ hours)$ of all aircraft in the respective country. The sample includes all countries with available information from 1980 to 2015. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table E3: Impact of the Convention on Reallocation

Controlling for Group-specific Time Varying Trends

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	ln(# of aircraft)							
$CTC \times Productivity$	0.128***	0.131***	0.124***	0.131***	0.124***	0.119***	0.129***	0.128***
	(0.043)	(0.045)	(0.043)	(0.045)	(0.042)	(0.040)	(0.044)	(0.043)
CTC	-0.552***	-0.573***	-0.525**	-0.597***	-0.534***	-0.478**	-0.564***	-0.575***
	(0.205)	(0.214)	(0.207)	(0.217)	(0.198)	(0.192)	(0.211)	(0.209)
$Productivity$	0.066***	0.068***	0.071***	0.069***	0.067***	0.065***	0.067***	0.066***
	(0.013)	(0.012)	(0.013)	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)
Group-specific Trends	-	creditor rights	democ	size	rel size	growth	HHI	cov(size, prod)
Macro Controls	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Region X Year FE	YES	YES	YES	YES	YES	YES	YES	YES
No. of Countries	174	174	155	173	173	174	174	174
Obs	22,060	22,060	21,189	22,050	22,050	22,060	22,060	22,060
Adj R2	0.891	0.892	0.893	0.892	0.891	0.893	0.891	0.891

This table shows the impact of the Convention on reallocation, after controlling for different group-specific time varying trends. The unit of observation is a firm-year. The coefficients are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{k,t}} + \boldsymbol{\phi_{g,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \mu CTC_{j,t} + \delta Prod_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country, k indexes region, t indexes time. Firm and region by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod_{i,t-1}$ measures the pre-convention firm-level productivity or $ln(average\ monthly\ flying\ hours)$. Group-specific time varying trends are summarized by $\boldsymbol{\phi_{g,t}}$. To facilitate comparison, column (1) shows the results of the baseline specification (column (1) of Panel A, Table 5). Columns (2) to (8) control for different group-specific trends: column (2) allows for time-varying trends for countries with different levels of creditor protection (0-4); column (3) allows for time-varying trends for countries with different levels of democracy index (0-10); column (4) (column (5)) allows for time-varying trends for countries with different size (relative size) of the aviation sector (4 groups); column (6) allows for time-varying trends for countries with different growth rates of the aviation sector (4 groups); column (7) allows for time-varying trends for countries with different levels of concentration in the aviation sector (4 groups); column (8) allows for time-varying trends for countries with different levels of distortion, as measured by the covariance between firm size and productivity, in the aviation sector (4 groups). Country level control variables are summarized by $X_{j,t}$ and include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The dependent variable is fleet size or $ln(number\ of\ aircraft)$ in the respective firm-year. The sample includes all countries with available information from 1980 to 2015. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table E4: Impact of the Convention on Reallocation

Alternative Specifications and Samples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	ln(# of aircraft)							
CTC × *Productivity*	0.128***	0.126***	0.190***	0.106***	0.127***	0.120***	0.117***	0.083**
	(0.043)	(0.044)	(0.040)	(0.037)	(0.043)	(0.044)	(0.039)	(0.037)
CTC	-0.552***	-0.603***	-0.855***	-0.455***	-0.551***	-0.510**	-0.476**	-0.380**
	(0.205)	(0.204)	(0.185)	(0.172)	(0.204)	(0.211)	(0.189)	(0.190)
Productivity	0.066***	0.069***	0.056***	0.070***	0.066***	0.059***	0.064***	0.077**
	(0.013)	(0.013)	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)	(0.031)
Robust to:	-	EIF	excl. US	excl. BRIC	excl. small	from 1990	22 regions	weighted
Macro Controls	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES	YES	YES
No. of Countries	174	174	173	170	161	173	173	173
Obs	22,060	22,060	17,621	20,448	21,881	19,637	22,024	22,024
Adj R2	0.891	0.891	0.875	0.892	0.89	0.894	0.893	0.958

This table shows the impact of the Convention on reallocation using alternative specifications and samples. The unit of observation is a firm-year. The coefficients are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{k,t}} + \boldsymbol{\phi_{g,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \mu CTC_{j,t} + \delta Prod_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country, k indexes region, t indexes time. Firm and region by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod_{i,t-1}$ measures the pre-convention firm-level productivity or $ln(average\ monthly\ flying\ hours)$. To facilitate comparison, column (1) shows the results of the baseline specification (column (1) of Panel A, Table 5). Column (2) uses the Convention's *entry into force date* as the event date. Column (3) excludes the US from the sample. Column (4) excludes Brazil, Russia, India and China. Column (5) excludes the bottom decile of countries in terms of fleet size. Column (6) drops observations before 1990. In column (7), regions defined at a more granular level are used (22 regions according to United Nations groupings). The regression in column (8) is weighted by fleet size in each country-year. Country level control variables are summarized by $X_{j,t}$ and include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The dependent variable is fleet size or $ln(number\ of\ aircraft)$ in the respective firm-year. The sample includes all countries with available information from 1980 to 2015. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table E5: Impact of the Convention on Average Productivity

Alternative Individual Firm-level Regression Specification (Weighted by Lagged Size)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.	ln(average monthly flying hours)						
CTC	-0.027	-0.007	0.016	0.01	0.003	0.016	-0.009
	(0.033)	(0.028)	(0.029)	(0.030)	(0.035)	(0.029)	(0.028)
ln(GDP per capita)	0.178***	0.130**	0.152**	0.181***	0.134**	0.149**	0.206***
	(0.054)	(0.059)	(0.061)	(0.060)	(0.059)	(0.059)	(0.076)
GDP per capita growth	0.003	0.006***	0.002	0.002	0.006***	0.002	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln(Population)	0.278	0.231	0.051	0.06	0.221	0.03	0.625***
	(0.206)	(0.224)	(0.236)	(0.239)	(0.226)	(0.236)	(0.191)
Pop growth	-0.031**	-0.017	-0.013	-0.014	-0.018	-0.014	-0.01
	(0.014)	(0.014)	(0.014)	(0.015)	(0.014)	(0.014)	(0.012)
Pop density	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Export to GDP		0.002	0.000	-0.000	0.002	-0.001	0.000
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Import to GDP		0.004	0.006**	0.006**	0.004	0.008***	0.003
		(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Investment to GDP		0.003	0.002	0.002	0.002	0.001	-0.000
		(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.002)
Inflation		-0.000	-0.000	-0.000	-0.000	-0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Air Liberalization Index			-0.009***			-0.009***	-0.011**
			(0.003)			(0.003)	(0.005)
Number of ASA countries				-0.001**			
				(0.001)			
Open Skies with US					-0.027		
					(0.025)		
Democratic Index						0.002	-0.004
						(0.008)	(0.007)
Private Credit to GDP							0.000
							(0.000)
Economic Freedom Index							-0.024
							(0.024)
Property Rights							0.000
							(0.001)
Corruption							0.001
							(0.002)
Airline FE	YES	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES	YES
No. of Countries	169	157	153	153	156	138	124
Obs	19,967	19,311	17,064	17,064	15,505	16,547	10,949
Adj R2	0.71	0.72	0.741	0.74	0.702	0.74	0.763

The table shows how the Convention affects average productivity at firm level. The unit of observation is a firm-year. The coefficients are estimated from the following specification, weighted by lagged firm size:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} + \boldsymbol{\theta' X_{j,t}} + \varepsilon_{j,t}$$

where i indexes firm, j indexes country, t indexes time and k indexes region. Firm and region by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. The dependent variable in is $ln(average\ monthly\ flying\ hours)$. The sample includes all airlines with available information from 1980 to 2015 in all columns. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table E6: Impact of the Convention on Reallocation

Alternative Dependent Variable: Different Size Measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.	ln(# of seats)	ln(total mtow)	ln(total wingspan)	ln(# of aircraft)	ln(# of aircraft)	ln(# of aircraft)	ln(# of aircraft)
$CTC \times Productivity$	0.121**	0.122**	0.129***	0.115**	0.116**	0.176***	0.114**
	(0.049)	(0.051)	(0.048)	(0.050)	(0.056)	(0.042)	(0.054)
CTC	-0.519**	-0.540**	-0.574**	-0.497**	-0.504*	-0.713***	-0.493*
	(0.243)	(0.257)	(0.232)	(0.242)	(0.281)	(0.195)	(0.263)
$Productivity$	0.103***	0.104***	0.085***	0.084***	0.107***	0.056***	0.087***
	(0.017)	(0.018)	(0.015)	(0.020)	(0.027)	(0.012)	(0.021)
Sample	-	-	-	excl. small	excl. small	narrowbody	mainline
Macro Controls	YES	YES	YES	YES	YES	YES	YES
Airline FE	YES	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	YES	YES	YES	YES
No. of Countries	174	174	174	156	130	155	173
Obs	22,060	22,060	22,060	17,711	13,837	13,654	13,239
Adj R2	0.911	0.913	0.894	0.85	0.822	0.865	0.888

This table shows the impact of the Convention on reallocation, using alternative size measures as the dependent variable in columns (1) to (3) and alternative samples in columns (4) to (7). The unit of observation is a firm-year. The coefficients are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{k,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \mu CTC_{j,t} + \delta Prod_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country, k indexes region, t indexes time. Firm and region by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{k,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod_{i,t-1}$ measures the pre-convention firm-level productivity or $ln(average\ monthly\ flying\ hours)$. The dependent variables in columns (1) to (3) are log total number of seats provided by an airline's fleet, log total maximum take-off weight, and log total wingspan in the respective firm-year. The dependent variable in columns (4) to (6) is fleet size or $ln(number\ of\ aircraft)$ in the respective firm-year. Macro control variables include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The sample includes all airlines with available information from 1980 to 2015 in columns (1) to (3). In column (4) (column (5)), small airlines with a fleet size under 5 (10) are excluded. In column (6), only airlines operating narrowbody aircraft are included. In column (7), only traditional mainline business (e.g., legacy full service airlines) are included. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table E7: Impact of the Convention on Reallocation

Alternative Productivity Measure: Non-continuous (Three Groups)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(# of aircraft)	Age	Tech Age	ln(# of aircraft)	Age	Tech Age
$CTC \times Prod\_Tercile$	0.175***	-1.726***	-1.148**	0.143***	-2.232***	-1.619***
	(0.043)	(0.465)	(0.540)	(0.035)	(0.293)	(0.397)
CTC	-0.306***	2.726***	1.523			
	(0.092)	(1.045)	(1.252)			
$Prod\_Tercile$	0.071***	-1.238***	-1.346***	0.079***	-0.987***	-0.990***
	(0.017)	(0.158)	(0.144)	(0.018)	(0.197)	(0.145)
Macro Controls	YES	YES	YES	Absorbed	Absorbed	Absorbed
Airline FE	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	Absorbed	Absorbed	Absorbed
Country × Year FE	NO	NO	NO	YES	YES	YES
No. of Countries	174	174	174	138	138	138
Obs	22,060	22,060	22,060	21,414	21,414	21,414
Adj R2	0.891	0.831	0.823	0.896	0.851	0.843

This table shows the impact of the Convention on reallocation, using a non-continuous measure of productivity. The unit of observation is a firm-year. The coefficients in columns (4) to (6) are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Prod\_Tercile_{i,t-1} + \delta Prod\_Tercile_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country and t indexes time. Firm and country by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{j,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod\_Tercile_{i,t-1}$ captures the pre-convention firm-level productivity tercile group. The regression equation in columns (1) to (3) is defined similarly. The dependent variable in columns (1) and (4) is fleet size or $ln(number\ of\ aircraft)$ in the respective firm-year. In columns (2) and (5), the dependent variable is average age of the respective airline's fleet. In columns (3) and (6), the dependent variable is average tech age of the respective airline's fleet. Tech age measures aircraft technological age, defined as the number of years since the introduction of the underlying aircraft's type, similar to Benmelech and Bergman (2011). Macro control variables include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The sample includes all airlines with available information from 1980 to 2015. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table E8: Impact of the Convention on Reallocation

Control for Size-induced Reallocation

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(# of aircraft)	Age	Tech Age	ln(# of aircraft)	Age	Tech Age
$CTC \times Productivity$	0.135***	-0.788*	-0.384	0.125***	-1.156***	-0.691**
	(0.019)	(0.447)	(0.356)	(0.020)	(0.362)	(0.289)
CTC	-0.506***	3.415*	2.23			
	(0.099)	(1.891)	(1.612)			
$Productivity$	0.027***	-1.004***	-1.087***	0.022***	-0.810***	-0.822***
	(0.005)	(0.109)	(0.106)	(0.006)	(0.144)	(0.106)
Macro Controls	YES	YES	YES	Absorbed	Absorbed	Absorbed
Airline FE	YES	YES	YES	YES	YES	YES
Region × Year FE	YES	YES	YES	Absorbed	Absorbed	Absorbed
Country × Year FE	NO	NO	NO	YES	YES	YES
No. of Countries	174	174	174	138	138	138
Obs	22,060	22,060	22,060	21,414	21,414	21,414
Adj R2	0.941	0.83	0.823	0.94	0.849	0.843

This table shows the impact of the Convention on reallocation, controlling for potential size-induced reallocation. The unit of observation is a firm-year. The coefficients in columns (4) to (6) are estimated from the following specification:

$$Y_{i,t} = \boldsymbol{\gamma_i} + \boldsymbol{\alpha_{j,t}} + \beta CTC_{j,t} \times Prod_{i,t-1} + \delta Prod_{i,t-1} + \kappa CTC_{j,t} \times Size_{i,t-1} + \vartheta Size_{i,t-1} + \varepsilon_{i,t}$$

where i indexes firm, j indexes country and t indexes time. Firm and country by year fixed effects are captured by $\boldsymbol{\gamma_i}$ and $\boldsymbol{\alpha_{j,t}}$, respectively. The Convention status is denoted by $CTC_{j,t}$, which equals one once country j introduces the Convention and zero otherwise. $Prod_{i,t-1}$ measures the pre-convention firm-level productivity or $ln(average\ monthly\ flying\ hours)$. $Size_{i,t-1}$ measures the pre-convention number of aircraft operated by each firm. The regression equation in columns (1) to (3) is similarly defined. The dependent variable in columns (1) and (4) is fleet size or $ln(number\ of\ aircraft)$ in the respective firm-year. In columns (2) and (5), the dependent variable is average age of the respective airline's fleet. In columns (3) and (6), the dependent variable is average tech age of the respective airline's fleet. Tech age measures aircraft technological age, defined as the number of years since the introduction of the underlying aircraft's type, similar to Benmelech and Bergman (2011). Macro control variables include ln(GDP per capita), GDP per capita growth, ln(population), population growth and population density. The sample includes all airlines with available information from 1980 to 2015. Robust standard errors clustered at country-level are denoted in parentheses. * indicates statistical significance at the 10% level, ** at the 5% level, and *** at the 1% level.