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Introduction

Research Background:

- Regulations have been implemented at the government level to achieve a high degree of uniformity (Ouellette et al., 2010).
- Aviation industry has adopted a variety of aviation regulations for the regional level harmonization and operational safety.
- Safety in aviation operations (e.g., ValuJet DC-9 explosion)
    - 30% - 90% of accidents are rooted in human error and relevant maintenance failure (Shanmugam and Robert, 2015)
- Harmful emissions and wastes on environment in aviation operations
    - Curbing environmental degradation may not be readily achieved (Gunningham et al., 1999)
- Organizations (ICAO and EASA) have been set up to streamline regulatory activities as well as to manage multilateral aspects of aviation operations.

Introduction

Research Background: (cont.)

- The Bilateral Aviation Safety Agreement between the United States of America and the European Union (hereafter referred to as "*EU-USA BASA*") aims to build upon decades of trans-Atlantic cooperation in civil aviation safety and environmental testing and approvals.
- Tracing corporate compliance behavior after the adoption of a regulation framework is crucial (Chandler, 2014).

Institutional Theory:

Regulation creates an institutional environment that influences managerial decisions such that similar practices and structures are shared and established across organizations.

Voluntary Disclosure Theory (VDT):

Firms disclose information in an effort to showcase their performance and, thereby, not only reduce transaction and legal costs but also manage adverse selection.

Regulatory Context

The EU-USA BASA entered into force on May 1, 2011. The purposes of this agreement are:

1. *to enable the reciprocal acceptance of findings of compliance and approvals issued by the Technical Agents and Aviation Authorities*
2. *to promote a high degree of safety in air transport*
3. *to ensure the continuation of the high level of regulatory cooperation and harmonization betweeh the United States and the European Community*

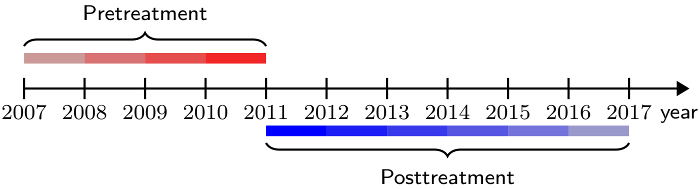

Figure 1. Timeline of Before & After the EU-USA BASA

Operational Coordination & Compliance Behavior

Safety:

'Maintenance' means the performance of any one or more of the following actions: inspection, overhaul, repair, preservation, or the replacement of parts, materials, appliances, or components of a civil aeronautical product to assure the continued airworthiness of such a product [...].

- Safety measures tend to be context-dependent and take *ex post* operational consequences into account (Chang and Yeh, 2004).
- One way that organizations strengthen their maintenance operations is to ensure a strong maintenance, repair and overhaul team.
- Two parties involved in the EU-USA BASA are required to assess standards and systems relating to the approval of repair stations and maintenance organizations each other.

Hypothesis 1 (H1)

Airlines that come under the purview of the EU-USA BASA will expand their direct employment of MRO technicians, as opposed to their counterparts.

Operational Coordination & Compliance Behavior

Environmental Stewardship:

‘Environmental approval’ means a finding that the design or change to a design of a civil aeronautical product meets applicable standards.
‘Environmental testing’ means a process by which the design or change to a design of a civil aeronautical product is evaluated for compliance with applicable standards and procedures.

- With the rising trend of regulation and public awareness of environmental problems, airlines try out various approaches to address environmental issues.
- The scope of cooperation under the EU-USA BASA also incorporates environmental testing as well as environmental certification.

Hypothesis 2 (H2)

Airlines that come under the purview of the EU-USA BASA will reduce the external cost of direct pollutants released to air, as opposed to their counterparts.

Sustainability Reporting

- With an increasing demand for the consistent evaluation and comparability of corporate performance, corporations nowadays have become more engaged in public awareness through reporting activity.
- Compared with poor performers, high performers are more likely to disclose pollution-related environmental information (Al-Tuwaijri et al. 2004; Clarkson et al. 2008).
- VDT predicts that higher performers appear to be more involved in discretionary disclosure channels.
- Corporate social responsibility is often perceived in connection with a compliance issue.

Hypothesis 3A (Hypothesis 3B)

Airlines that not only are under the purview of the EU-USA BASA but also extensively report their corporate sustainability performance have higher direct employment of MRO technicians (lower the external cost of direct pollutants released to air) than their counterparts.

Mediating Effect of Safety and Environmental Stewardship

- Above and beyond the long-standing cooperative relationship, all parties of the EU-USA BASA are expected to minimize overall economic burden on operators by sorting out redundant regulatory oversight and promoting uniform high level of safety.
- Profitability has been shown to be intertwined with various safety measures in aviation operations (Raghavan and Rhoades 2005, Rose 1990, Suzuki 1998).

Hypothesis 4A (H4A)

The relationship between the implementation of the EU-USA BASA and economic performance is mediated by corporate safety compliance.

- Tangible and intangible benefits can be derived from environmental betterment.

Hypothesis 4B (H4B)

The relationship between the implementation of the EU-USA BASA and economic performance is mediated by corporate environmental compliance.

Conceptual Framework

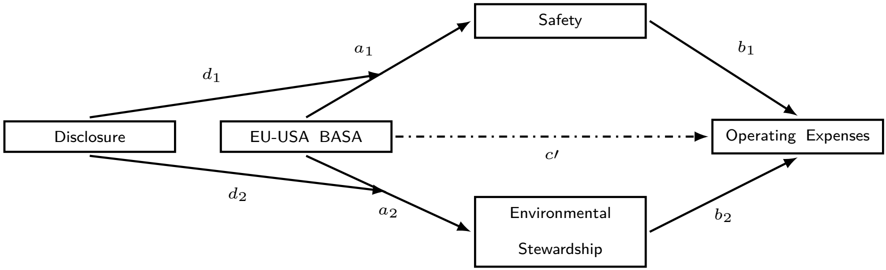

Figure 2. Conceptual Framework

Data

Data sets:

1. World Air Transport Statistics (WATS) (Source: IATA)
2. Trucost Environmental (Source: S&P Global)
3. Supplementary data (Source: EASA)

Variables:

1. Dependent Variables
   1. $ln(MRO_{it})$: using the volume of MRO employees
   2. $ln(APD_{it})$: using the direct air pollutants quantities
   3. $ln(OE_{it})$: using operating expenses
2. Independent Variables
   1. $BASA_i * POST_t$

      $$BASA_i = \begin{cases} 1, & \text{if i = an air carrier under the EU-USA BASA} \\ 0, & \text{otherwise} \end{cases}$$

      $$POST_t = \begin{cases} 1, & \text{if } t > 2010 \\ 0, & \text{otherwise} \end{cases}$$
   2. EVD_{it}: using levels of disclosure data for carbon dioxide and waste emissions
3. Control Variables

Data

Correlation Matrix

Table 1. Correlation Matrix

	1	2	3	4	5	6	7	8	9	10
1. ln(MRO)	1.0000									
2. ln(APD)	0.3840*	1.0000								
3. ln(OE)	0.5998*	0.6581*	1.0000							
4. PH	-0.0861	0.1406*	0.2507*	1.0000						
5. PP	0.2511*	0.0423	-0.0927	-0.5462*	1.0000					
6. PKFI	-0.3045*	0.0504	0.0427	0.5140*	-0.4513*	1.0000				
7. SPLFTS	0.1393	0.2361*	0.2736*	0.0134	0.0018	-0.1248	1.0000			
8. ln(AvgUT)	-0.0918	-0.1605*	-0.2908*	0.2374*	-0.3333*	0.3181*	0.1783*	1.0000		
9. ln(SPAXTS)	0.6175*	0.4449*	0.8146*	-0.1629*	0.1729*	-0.5337*	0.1752*	-0.2870*	1.0000	
10. ln(TE)	0.7894*	0.5661*	0.9082*	0.0470	0.0994	-0.1431*	0.3237*	-0.1251	0.7831*	1.0000

Note: * $p < 0.05$

Model and Estimation

Model Specification

Parallel Trends Assumption (PTA): Callaway and Sant'Anna (2021)

Difference-in-Differences (DiD) Estimation:

$$ln(Y_{it}) = \beta_0 + \beta_1 * BASA_i * POST_t + \beta_{d2} * \mu_{dit} + \alpha_i + \gamma_t + \epsilon_{it} \tag{1}$$

Difference-in-Difference-in-Differences (DDD) Estimation:

$$\begin{aligned} ln(Y_{it}) = \beta_0 + \beta_1 * BASA_i * POST_t + \beta_2 * EVD_{it} \\ + \beta_3 * BASA_i * EVD_{it} + \beta_4 * POST_t * EVD_{it} \\ + \beta_5 * BASA_i * POST_t * EVD_{it} + \beta_{d6} * \mu_{dit} + \alpha_i + \gamma_t + \epsilon_{it} \end{aligned} \tag{2}$$

Mediation Analysis:
To test H4A and H4B, a dual mediation is adopted (Preacher and Hayes, 2008).

Empirical Results

Table 2. DiD & DDD Estimation

		Panel A: MRO Employee			Panel B: Direct Air Pollutant Impacts		
	Label	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
BASA × POST	β_1		0.401***	-0.012		-1.890***	0.639
			(0.139)	(0.110)		(0.675)	(0.753)
EVD	β_2			0.124			1.100
				(0.105)			(0.726)
BASA × EVD	β_3			-0.595*			-3.452**
				(0.322)			(1.646)
POST × EVD	β_4			-0.229**			-0.019
				(0.105)			(0.753)
BASA × POST × EVD	β_5			0.840**			-2.124**
				(0.328)			(0.876)
PH	β_{d2} & β_{d6}	-0.457	-0.692	-0.986*	0.514	1.667	2.498
		(0.467)	(0.441)	(0.494)	(1.446)	(1.602)	(1.738)
PP	β_{d2} & β_{d6}	0.614	0.501	0.242	1.260	2.772	1.884
		(0.621)	(0.521)	(0.526)	(3.419)	(3.110)	(2.305)
PKFI	β_{d2} & β_{d6}	-3.155**	-3.101**	-3.193**	-0.751	-1.311	-0.842
		(1.496)	(1.471)	(1.464)	(4.541)	(5.077)	(4.437)
SPLFTS	β_{d2} & β_{d6}	0.813	1.064	1.375	4.567	3.258	0.711
		(1.244)	(1.318)	(1.228)	(7.737)	(6.447)	(6.372)
ln(AvgUT)	β_{d2} & β_{d6}	0.042	-0.057	-0.046	-0.616	-0.271	-0.430
		(0.193)	(0.171)	(0.183)	(0.717)	(0.706)	(0.739)
ln(SPAXTS)	β_{d2} & β_{d6}	-1.016	-1.012	-0.969	-0.146	-0.231	-0.098
		(0.733)	(0.724)	(0.712)	(0.742)	(0.627)	(0.525)
ln(TE)	β_{d2} & β_{d6}	1.442***	1.376***	1.332***	0.244	0.107	-0.132
		(0.514)	(0.479)	(0.424)	(0.332)	(0.385)	(0.332)
Firm Effects	α_i	Yes	Yes	Yes	Yes	Yes	Yes
Year Effects	γ_t	Yes	Yes	Yes	Yes	Yes	Yes
Observations		183	183	183	199	199	199
R^2		0.278	0.312	0.346	0.105	0.222	0.457

Note: *$p < .1$, **$p < .05$, ***$p < .01$ indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels.

Mediation Effect

Table 3. Mediation Effects of the EU-USA BASA on Operating Expenses

				Bootstrapping 95% Confidence Interval					
	Product of Coefficients			**Percentile**		**BC**		**BCa**	
	Estimate	**SE**	**Z**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**
ln(MRO)	-0.065**	0.028	-2.33	-0.139	-0.014	-0.147	-0.016	-0.147	-0.016
ln(APD)	-0.123**	0.049	-2.50	-0.219	-0.035	-0.238	-0.049	-0.236	-0.048
Total	-0.189***	0.057	-3.27	-0.311	-0.078	-0.321	-0.086	-0.319	-0.085

Note: BC stands for bias corrected; BCa stands for bias corrected and accelerated; 5,000 bootstrap samples.

Robustness Check

1. Robustness to Sample Size
    - Power analysis for DiD estimation (Burlig et al. 2017; Favaron et al. 2022)

2. Robustness to Alternative Response Variables

Table 4. DiD & DDD Estimation

	DiD Model	**DDD Model**	**DiD Model**	**DDD Model**
Dependent Variable	$ln(fracMRO_{it})$		$ln(fracAPD_{it})$	
BASA × POST	0.426***	-0.015	-1.757**	0.740
	(0.147)	(0.118)	(0.720)	(0.765)
EVD		0.137		1.209
		(0.113)		(0.780)
BASA × EVD		-0.656*		-3.639**
		(0.354)		(1.669)
POST × EVD		-0.248**		0.030
		(0.115)		(0.782)
BASA × POST × EVD		0.908**		-2.083**
		(0.360)		(0.883)
Control Variables Included				
Fixed Effects	Yes	Yes	Yes	Yes
Observations	183	183	199	199
R^2	0.326	0.361	0.170	0.426

Note: *p<.1, **p<.05, ***p<.01 indicate statistical significance at the 10%, 5% and 1% levels.

Robustness Check (cont.)

❸ Robustness to Different Employee Classification

Table 5. Employee Classification Type and Definition

Employee Classifications	
Category	**Definition**
Pilots and Copilots	All pilots/copilots including executive/managerial personnel
Other Cockpit Personnel	Flight engineers, radio operator and navigators
Cabin Attendants	Pursers, stewards, stewardesses, and hostesses
Airport Handling	All traffic and aircraft handling, and also flight and cabin crew management, administration, scheduling, planning, training security, catering and ground equipment maintenance staff
Ticketing, Sales, and Promotion	Reservations, ticketing, sales, scheduling, tariffs, marketing customer services commercial and public relations staff
All Others	Personnel not included in the listed above

Table 6. DiD & DDD Estimation using Different Types of Employees

Dependent Variable	$Pilot_{it}$	$Cockpit_{it}$	$Cabin_{it}$	$Handling_{it}$	$Ticketing_{it}$	$AllOthers_{it}$
Main effects						
BASA × POST	-0.098	0.051	-0.117*	0.698**	-0.293	-0.033
	(0.068)	(0.743)	(0.058)	(0.335)	(0.208)	(0.093)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	199	79	199	176	177	193
R^2	0.837	0.564	0.852	0.540	0.393	0.574

Note: *$p<.1$, **$p<.05$, ***$p<.01$ indicate statistical significance at the 10%, 5% and 1% levels.

Robustness Check (cont.)

④ Robustness of Mediation Analysis
- JMB Method for Mediation (James et al. 2006; Rungtusanatham et al. 2014)
- *A priori*: Complete Mediation
  - $lnMRO$: -0.069 (0.028) ($p<0.05$)
  - $lnAPD$: -0.125 (0.046) ($p<0.01$)
  - Total Effect: -0.195 (0.054) ($p<0.01$)

⑤ Robustness to Environmental Stewardship from a Supply Chain Perspective

	DiD Model	**DDD Model**	**DiD Model**	**DDD Model**
Dependent Variable	$ln(APT_{it})$		$ln(API_{it})$	
Main effects				
BASA × POST	-0.742*** (0.149)	-0.015 (0.168)	-0.103 (0.125)	0.011 (0.086)
EVD		0.271 (0.303)		-0.103 (0.072)
BASA × EVD		-0.664 (0.398)		0.311* (0.169)
POST × EVD		0.058 (0.344)		-0.040 (0.063)
BASA × POST × EVD		-0.740** (0.343)		-0.183* (0.098)
Control Variables Included				
Model Specification				
Fixed Effects	Yes	Yes	Yes	Yes
Observations	199	199	199	199
R^2	0.381	0.457	0.632	0.669

Note: *$p<.1$, **$p<.05$, ***$p<.01$ indicate statistical significance at the 10%, 5% and 1% levels.

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Robustness Check (cont.)

⑥ Heterogeneous Time Effects

Table 8. DiD Estimation

	Label	Safety DV: MRO Employee	Environment DV: Direct Air Pollutant Impacts
Entry into force (t+1)	β_1	0.241** (0.090)	-0.888*** (0.297)
Entry into force (t+2)	β_1	0.208* (0.121)	-0.962** (0.429)
Entry into force (t+3)	β_1	0.467** (0.187)	-2.516* (1.262)
Entry into force (t+4)	β_1	0.619*** (0.221)	-2.544* (1.467)
Entry into force (t+5)	β_1	0.731*** (0.249)	-2.238 (1.408)
Control Variables Included			
Model Specification			
Firm Effects	α_i	Yes	Yes
Year Effects	γ_t	Yes	Yes
Observations		183	199
R^2		0.358	0.632

Note: *p<.1, **p<.05, ***p<.01 indicate statistical significance at the 10%, 5% and 1% levels.

Implications

Theoretical Implications

Under the purview of the EU-USA BASA

Airlines agree to cooperate in the following regulatory requirements:

1. Airworthiness approvals and monitoring of civil aeronautical products
2. Environmental testing and approvals of the products
3. Approvals and monitoring of maintenance facilities

Key Takeaways:

1. Collective compliance behavior of airlines located in different geographical regions under the same regulatory framework
2. Corporate environmental disclosure under a regulatory framework
3. Windfall gains via corporate compliance behavior

Implications

Managerial and Policy Implications

Managerial Implications:

1. Corporate operational adjustment after the implementation of an external policy
2. Institutional pressures for environmental issues and managerial concerns
3. Regulatory agreement with multiple objectives and requirements in scope

Policy Implications:

1. Consistent application of the agreed upon standards, rules and procedures
2. Being upfront as a means for internally assessing corporate compliance activities

Limitations

Limitations:

1. Small sample size
2. Data sample interval
3. Varying institutional process
4. Generalizability

THANK YOU