# Online Appendix for "The Impact of Cartel Dissolution on Prices: Evidence from the Air Cargo Cartel"

Douglas C. Turner

August 16, 2023

## A Data Collection and Sources

Data was collected from the following sources: the Official Airlines Guide (OAG) in-forwarding service,[1] various industry news reports (freightwaves.com, insidelogistics.ca, aviationweek.com, canadianshipper.com and aircargonews.net), reports in prior literature (Appel, 2008), archives of airline websites[2] and antitrust cases against the cartel including the Australian Competition and Consumer Commission's case against Qantas Airlines,[3] the European Commission case[4] and the DHL Case.[5] To illustrate how data collection was conducted and how observations were cross-checked across multiple sources, consider the following examples.

The European Commission case reports that Lufthansa sent an email to other airlines on August 22nd, 2005 stating "the fuel surcharge will be increased to 0.50 euro per kg actual weight as of Monday 05 September 2005" (¶483). Emails between other cartel members stated "we have also received confirmation from Lufthansa that they are going to increase their FSC effective 5 September 2005 as well" (¶487). This data point can be checked against industry news articles which announced the price increase. For example, insidelogistics.ca reported on August 29th, 2005 that[6] "Lufthansa Cargo plans to raise fuel surcharges to EUR0.50 (US$0.61) per kilo of freight weight from EUR0.45 per kilo beginning September 5." These sources both indicate a FSC increase from .45 to .5 on September 5th, 2005 for Lufthansa.

[1] OAG In-forwarding (http://inforwarding.oagcargo.com) provides operational announcements for the air cargo industry. Since data collection, OAG has discontinued its operational announcements service.

[2] Specifically, archives of Lufthansa's website (archive of http://www.lhcargo.com/content.jsp?path=0,2,19195,19222,46737), Northwest Airlines's website (archive of http://www.nwa.com/services/shipping/cargo/surcharge.shtml), American Airlines' website (archive of https://www. aacargo.com/shipping/fuelsurcharge.jhtml) and British Airway's website (archive of http://baworldcargo.com/surcharges/) were used. Throughout the data appendix, an internet archive of a url refers to archived snapshots of a website taken by the Internet Wayback Machine (https://archive.org) at various dates in the past.

[3] Australian Competition and Consumer Commission v Qantas Airways Ltd - [2008] FCA 1976

[4] Case COMP/39258 - Airfreight (Sep 11, 2010)

[5] DHL's Opposition To United's Motion For Summary Judgement. DPWN Holdings (USA), Inc. vs. United Airlines Inc. 1:11-cv-00564-BMC, 08/31/18

[6] https://www.insidelogistics.ca/transportation/lufthansa-raises-fuel-surcharge-again-164916/

An online archive of British Airways' press release[7] states "British Airways World Cargo has announced an increase to its fuel surcharge. The surcharge will be GBP0.75 / USD1.15 / EUR1.15, with effect from 13 June 2008." This increase was confirmed by news reports. For example, freightwaves.com reported "British Airways World Cargo will increase its fuel surcharge to 0.75/$1.15/1.15 euros, effective June 13." Both sources indicate British Airways increased its FSC from 1.10 EUR to 1.15 EUR on June 13th, 2008.

Cargolux increased its FSC from .75 EUR to .8 EUR on December 3rd, 2007. This price increase was reported by freightwaves.com[8] which stated "Luxembourg-based all-cargo airline Cargolux will raise its fuel surcharge on all shipments to 0.80 euros/80 cents per kilogram, or the local currency equivalent, as of Dec. 3. The surcharge has been 0.75 euros/75 cents per kilogram." This increase can be checked against Table 1 in (Appel, 2008) which reports that Cargolux's FSC was .80 USD in December of 2007. Note that Cargolux charges the same fuel surcharge in USD and Euros (i.e., FSCs are not adjusted to account for exchange rate fluctuations). Second, note that news reports often report the previous fuel surcharge level (i.e., the previous level was .75 in the current example).

In some cases, multiple data points could be collected entirely from a single source. For example, an archive of American Airlines' website from April 11th, 2006 lists American Airlines' fuel surcharges for the previous year.[9] Figure A.1 presents a screenshot.

I adhered to the following practices during data collection:

- If FSCs were reported in multiple currencies, I collected data in the currency with the best data availability.
- If there was any conflict or inconsistency between data sources, I coded data for the period and airline in question as missing. For example, suppose two sources indicated an airline increased its FSC from .15 to .20 on January 1st. Next, suppose one news report indicated an airline increased its FSC from .20 EUR to .25 EUR on January 10th and another source reported the airline would increase its FSC from .20 to .30 EUR on January 20th. Additionally, suppose both sources agreed the FSC was increased to .30 EUR on February 1st. In this case, data would be counted as missing from January 2nd to January 31st because the two data sources report conflicting dates for the second fuel surcharge change. As a result, I cannot be certain of the date of the second increase.
- In cases where airlines reported more than one FSC, I used the FSC which was most broadly applicable.

[7] See the internet archive (https://archive.org/web/) of the url "http://www.baworldcargo.com/news/pr180.shtml" on May 31st, 2008. https://web.archive.org/web/20080531154722/http://www.baworldcargo.com/news/pr180.shtml

[8] https://www.freightwaves.com/news/cargolux-raising-fuel-surcharge

[9] See the internet archive (https://archive.org/web/) of the url "http://www.aacargo.com/shipping/fuelsurcharge.jhtml" on April 11th, 2006.

**Historical Fuel Surcharges**

| Historical Fuel Surcharge | Effective Date | Version & Issue Date | Complete List |
|---|---|---|---|
| USD 0.50 per kilo | 15-Apr-06 | v 1.80 29-Mar-06 | view PDF |
| USD 0.50 per kilo | 06-Mar-06 | v 1.79 24-Feb-06 | view PDF |
| USD 0.50 per kilo | 17-Feb-06 | v 1.78 07-Feb-06 | view PDF |
| USD 0.50 per kilo | 17-Feb-06 | v 1.77 07-Feb-06 | view PDF |
| USD 0.50 per kilo | 17-Feb-06 | v 1.76 06-Feb-06 | view PDF |
| USD 0.45 per kilo | 16-Jan-06 | v 1.75 13-Jan-06 | view PDF |
| USD 0.45 per kilo | 13-Dec-05 16-Dec-05 | v 1.74 02-Dec-05 | view PDF |
| USD 0.45 per kilo | 13-Dec-05 | v 1.73 30-Nov-05 | view PDF |
| USD 0.50 per kilo | 01-Dec-05 | v 1.72 21-Nov-05 | view PDF |
| USD 0.50 per kilo | 01-Dec-05 | v 1.71 17-Nov-05 | view PDF |
| USD 0.50 per kilo | 01-Dec-05 | v 1.70 17-Nov-05 | view PDF |
| USD 0.55 per kilo | 16-Nov-05 | v 1.69 02-Nov-05 | view PDF |
| USD 0.60 per kilo | 29-Oct-05 | v 1.68 28-Oct-05 | view PDF |
| USD 0.60 per kilo | 26-Oct-05 | v 1.67 25-Oct-05 | view PDF |
| USD 0.60 per kilo | 26-Oct-05 | v 1.66 18-Oct-05 | view PDF |
| USD 0.55 per kilo | 19-Oct-05 | v 1.65 05-Oct-05 | view PDF |
| USD 0.50 per kilo | 12-Sep-05 | v 1.64 12-Sep-05 | view PDF |
| USD 0.50 per kilo | 05-Sep-05 | v 1.63 01-Sep-05 | view PDF |
| USD 0.50 per kilo | 05-Sep-05 | v 1.62 31-Aug-05 | view PDF |
| USD 0.50 per kilo | 05-Sep-05 | v 1.61 25-Aug-05 | view PDF |
| USD 0.45 per kilo | 05-Aug-05 | v 1.60 05-Aug-05 | view PDF |
| USD 0.45 per kilo | 02-Aug-05 | v 1.59 02-Aug-05 | view PDF |
| USD 0.45 per kilo | 12-July-05 | v 1.58 01-July-05 | view PDF |
| USD 0.45 per kilo | 12-July-05 | v 1.57 29-June-05 | view PDF |
| USD 0.40 per kilo | 02-June-05 | v 1.56 02-June-05 | view PDF |
| USD 0.40 per kilo | 05-May-05 | v 1.55 02-May-05 | view PDF |
| USD 0.40 per kilo | 20-Apr-05 | v 1.54 20-Apr-05 | view PDF |
| USD 0.40 per kilo | 06-Apr-05 | v 1.53 08-Apr-05 | view PDF |
| USD 0.40 per kilo | 06-Apr-05 | v 1.52 01-Apr-05 | view PDF |
| USD 0.40 per kilo | 06-Apr-05 | v 1.51 30-Mar-05 | view PDF |

Figure A.1: American Airlines Fuel Surcharge History between April 2005 and April 2006. Source: Archive of AA's Website

For example, in some cases, an airline must first receive government approval before increasing the FSC in a particular country and, as a result, changes to the airline's FSC in that region are delayed. In this case, I would use the airline's FSC for regions where government approval was not necessary (i.e., the most up to date FSC).

- When airlines differentiated their FSC by short and long haul, I used the long haul surcharge.

Table A.1 presents summary statistics for the 41 airlines included in the dataset. Table A.1 presents the number of observations available for each airline (in the column titled "Num. Obs."). Data availability varies across airlines. The sample consists of a total of 4017 days (January 1st, 2002 through December 31st, 2012). Table A.1 presents (in the column titled "Per. Avail.") the percentage of days an airline appears in the sample (out of the maximum possible of 4017). The column titled "Avail. Both." indicates if a firm has at least one observation before and after the cartel's dissolution (i.e., the dawn raids on February 14th, 2006). The majority of airlines (36/41) are present before and after the cartel's detection. Table A.1 also presents information on government fines in the US and EU. Data on government fines are from the Connor's Cartel Database (Connor, 2020), the European Commission decision (EU Case), and plea agreements between airlines and the US Department of Justice.[10]

## A.1 Mergers and Acquisitions

Lufthansa's Acquisition of Swiss Air: Lufthansa acquired Swiss Air on March 22nd, 2005.[11] The two airlines' FSCs differ slightly after the acquisition date which suggests the cargo divisions continued to set FSCs separately (at least during the dates where data is available). Thus, I do not make any adjustments to either airline's FSCs as a result of the acquisition.

Air France-KLM Merger: Air France and KLM merged in 2005. Their cargo divisions were combined in October of 2005.[12] KLM and Air France have distinct FSCs prior to October 2005. From October 2005 onwards, the carriers FSCs are the same (reflecting the merger).

KLM's acquisition of Martinair: KLM acquired Martinair in December of 2008.[13] No changes are necessary as no data is available for MartinAir after November of 2008.

Al Nippon Airways' stake in Nippon Cargo: Al Nippon Airways (ANA) held a stake in Nippon Cargo prior

[10] EU fine amounts are from the original 2010 European Commission decision. The EU General Court later annulled this decision in 2015 due to procedural errors. The European Commission later adopted a new decision in 2017 which closely matched the 2010 decision. After an appeal by airlines, this revised decision was, for the most part, upheld by the General Court in 2022. See https://www.clearyantitrustwatch.com/2022/03/airfreight-cartel-general-court-partially-annuls-commission-decision-and-reduces-fines/ for details.

[11] https://www.swiss.com/corporate/EN/media/newsroom/press-releases/press-release-20050322

[12] https://www.airfranceklm.com/sites/default/files/publications/reference-document_2005-06_en.pdf

[13] https://ec.europa.eu/commission/presscorner/detail/en/IP_08_1995

Table A.1: Summary Stats

| | Num. Obs. | Per. Avail. | Avail. Both | US Fine ($) | EU Fine (€) |
|---|---|---|---|---|---|
| Aer Lingus Cargo | 2331 | 58 | NO | | |
| Aeroflot | 2682 | 66.8 | YES | | |
| Aerolineas Argentinas | 2037 | 50.7 | YES | | |
| Air Baltic | 777 | 19.3 | YES | | |
| Air Canada | 2676 | 66.6 | YES | | €21 million |
| Air China | 1700 | 42.3 | YES | | |
| Air France | 1995 | 49.7 | YES | $210 million | €183 million |
| Air India | 484 | 12 | YES | | |
| Alitalia | 239 | 5.9 | NO | | |
| American | 3117 | 77.6 | YES | | |
| Asiana Airlines | 3653 | 90.9 | YES | $50 million | |
| British Airways | 1838 | 45.8 | YES | $200 million | €104 million |
| Cargolux | 1733 | 43.1 | YES | $119 million | €80 million |
| China Airlines | 1768 | 44 | YES | $40 million | |
| China Southern | 3281 | 81.7 | YES | | |
| DAS | 301 | 7.5 | NO | | |
| DHL | 2910 | 72.4 | YES | | |
| EVA Air | 2928 | 72.9 | YES | $13 million | |
| Emirates | 3385 | 84.3 | YES | | |
| Etihad | 1256 | 31.3 | NO | | |
| Finnair | 2925 | 72.8 | YES | | |
| Japan Airlines | 2393 | 59.6 | YES | $110 million | €36 million |
| KLM | 1601 | 39.9 | YES | $140 million | €127 million |
| Korean Air | 2547 | 63.4 | YES | $300 million[a] | |
| LAN | 932 | 23.2 | YES | $109 million | €8 million |
| Lufthansa | 1158 | 28.8 | YES | | |
| Malaysian Airlines | 1931 | 48.1 | YES | | |
| Martinair | 1459 | 36.3 | YES | $42 million | €30 million |
| Nippon | 3467 | 86.3 | YES | $45 million | |
| Northwest | 1525 | 38 | YES | $38 million | |
| Polar Air | 3787 | 94.3 | YES | $17 million | |
| Qatar Airways | 1458 | 36.3 | NO | | |
| SAS | 1528 | 38 | YES | $52 million | €70 million |
| Singapore | 249 | 6.2 | YES | $48 million | €75 million |
| Saudi Arabian Airlines | 3774 | 94 | YES | | |
| Swiss Air | 1344 | 33.5 | YES | | |
| TAP Portugal | 2776 | 69.1 | YES | | |
| Turkish Airlines | 1208 | 30.1 | YES | | |
| US Airways | 2217 | 55.2 | YES | | |
| United | 1240 | 30.9 | YES | | |
| Virgin Atlantic | 883 | 22 | YES | | |

[a] *This amount also includes a penalty for a separate offense involving passenger air travel.*

to 2005.[14] No data is available for ANA's cargo division so no adjustments to the data are necessary to account for the sale of ANA's stake in Nippon Cargo.

LAN Airlines-TAM Airlines Merger: LAN Airlines merged with TAM Airlines in 2012.[15] No changes to the data are necessary as data is only available for LAN Airlines before 2012.

# B Fuel Surcharge Index

Lufthansa's fuel surcharge index methodology is presented in Table B.1. The methodology was recovered from internet archives of Lufthansa's website.[16] Certain trigger points in LH's methodology are unavailable. I imputed these trigger points by adding 25 to the previous trigger point because 25 is the standard difference between trigger points in the methodology.

[14] https://www.ana.co.jp/eng/aboutana/press/2005/050712.html

[15] https://www.reuters.com/article/uk-tam-lan-idUSLNE85L02P20120622

[16] See internet archives (https://web.archive.org/) of http://www.lhcargo.com/content.jsp?path=0,2,19195,19222,46737. The methodology is from March 24th, 2006.

Table B.1: Lufthansa's Fuel Surcharge Methodology

| Increases | | Decreases | |
|---|---|---|---|
| Trigger Point | Fuel Surcharge Level | Trigger Point | Fuel Surcharge Level |
| 115 | 0.05 | 100 | 0 |
| 135 | 0.1 | 120 | 0.05 |
| 165 | 0.15 | 145 | 0.1 |
| 190 | 0.2 | 170 | 0.15 |
| 215 | 0.25 | 195 | 0.2 |
| 240 | 0.3 | 220 | 0.25 |
| 265 | 0.35 | 245 | 0.3 |
| 290 | 0.4 | 270 | 0.35 |
| 315 | 0.45 | 295 | 0.4 |
| 340 | 0.5 | 320 | 0.45 |
| 365 | 0.55 | 345 | 0.5 |
| 390 | 0.6 | 370 | 0.55 |
| 415 | 0.65 | 395 | 0.6 |
| 440 | 0.7 | 420 | 0.65 |
| 465* | 0.75 | 445* | 0.7 |
| 490* | 0.8 | 470* | 0.75 |
| 515* | 0.85 | 495* | 0.8 |
| 540* | 0.9 | 520* | 0.85 |
| 565* | 0.95 | 545* | 0.9 |
| 590* | 1 | 570* | 0.95 |
| 615* | 1.05 | 595* | 1 |
| 640* | 1.1 | 620* | 1.05 |
| 665* | 1.15 | 645* | 1.1 |
| 690* | 1.2 | 670* | 1.15 |
| 715* | 1.25 | 695* | 1.2 |
| 740* | 1.3 | 720* | 1.25 |
| 765* | 1.35 | 745* | 1.3 |
| 790* | 1.4 | 770* | 1.35 |
| 815* | 1.45 | 795* | 1.4 |

*Source Internet Archives of Lufthansa's Website. *s denoted imputed data.*

American Airlines' fuel surcharge index methodology is presented in Table B.2. The methodology was recovered from internet archives of American Airlines website.[17] Certain trigger points in American Airlines' methodology are unavailable. I imputed these trigger points by adding 13 to the previous trigger point. 13

[17]See internet archives (https://web.archive.org/) of https://aacargo.com/shipping/fuelsurcharge.jhtml.

is the most common difference between trigger points in the methodology.

The AA and LH indexes differ primarily in their normalization. LH divided the average jet fuel price (across spot markets) by .535[18] and then multiplied by 100. AA simply multiplied the average jet fuel price (across spot markets) by 100.

[18]See ¶103 in the EU Case.

Table B.2: American Airlines' Fuel Surcharge Methodology

| Increases | | Decreases | |
|---|---|---|---|
| Trigger Point | Fuel Surcharge Level | Trigger Point | Fuel Surcharge Level |
| 62 | 0.05 | 54 | 0 |
| 73 | 0.1 | 65 | 0.05 |
| 89 | 0.15 | 78 | 0.1 |
| 102 | 0.2 | 92 | 0.15 |
| 117 | 0.25 | 105 | 0.2 |
| 130 | 0.3 | 119 | 0.25 |
| 145 | 0.35 | 131 | 0.3 |
| 158 | 0.4 | 147 | 0.35 |
| 170 | 0.45 | 159 | 0.4 |
| 184 | 0.5 | 173 | 0.45 |
| 198 | 0.55 | 187 | 0.5 |
| 211 | 0.6 | 200 | 0.55 |
| 225 | 0.65 | 214 | 0.6 |
| 238 | 0.7 | 227 | 0.65 |
| 251 | 0.75 | 240 | 0.7 |
| 264 | 0.8 | 252 | 0.75 |
| 277 | 0.85 | 266 | 0.8 |
| 290 | 0.9 | 279 | 0.85 |
| 303 | 0.95 | 292 | 0.9 |
| 316 | 1 | 305 | 0.95 |
| 329 | 1.05 | 318 | 1 |
| 342 | 1.1 | 331 | 1.05 |
| 355 | 1.15 | 344 | 1.1 |
| 368* | 1.2 | 357 | 1.15 |
| 381* | 1.25 | 370 | 1.2 |
| 394* | 1.3 | 383* | 1.25 |
| 407* | 1.35 | 396* | 1.3 |
| 420* | 1.4 | 409* | 1.35 |
| 433* | 1.45 | 422* | 1.4 |
| 446* | 1.5 | 435* | 1.45 |

*Source Internet Archives of American Airlines' Website. *s denoted imputed data.*

## B.1 Proxy Index

Jet fuel spot price data is only available for the US Gulf Coast spot market. In practice, many airlines (e.g., Lufthansa) used an average or weighted average of jet fuel prices in five spot markets (New York Harbor,

U.S. Gulf Coast, Los Angeles, Rotterdam and Singapore) when calculating their indexes. Thus, I use the US Gulf Coast jet fuel price as a proxy for the average spot price of jet fuel in these five markets when computing the index. To demonstrate that this is a reliable proxy. I plot the proxy index versus LH's true index. LH's true index is available from internet archives of Lufthansa's website but is only available prior to March 2006 (when Lufthansa removed their index from its website).[19] Figure B.1 plots the two series and shows that they are similar.[20] This suggests the proxy is reasonably reliable. Note that the index value in Figure B.1 is revised weekly in response to changes in fuel prices. FSCs were adjusted downward or upward when this index exceeded a specific trigger value for two consecutive weeks.

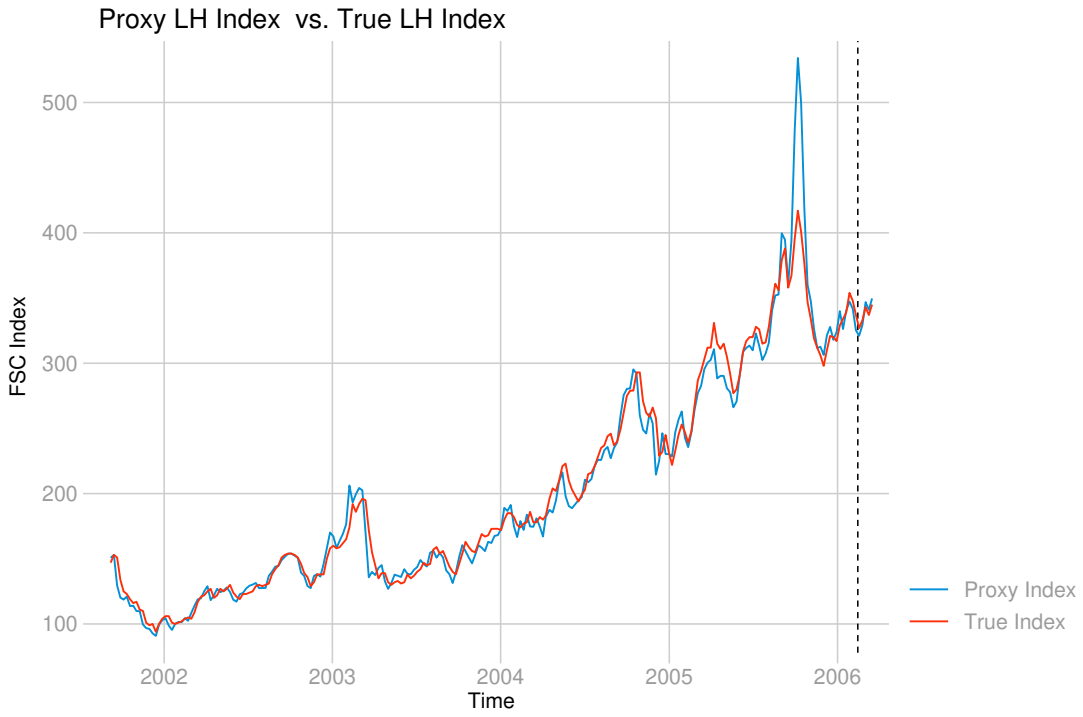


Figure B.1: Proxy LH Index vs. True LH Index

[19] See internet archives (archive.org) of http://www.lhcargo.com/content.jsp?path=0,2,19195,19222,46733.
[20] Graphic scheme source: Bischof (2017).

# C Additional Analysis

## C.1 Fine Date Results

In this section, I explore changes in fuel surcharges after the publication of government fines in the EU and US. The imposition of fines can potentially disrupt post-cartel tacit collusion and result in a return to more competitive behavior. Contrarily, as González and Moral (2019) find, firms may increase prices after the imposition of fines as they are no longer under antitrust scrutiny from the government.

To explore this issue, I estimate the following specification:

$$FSC_{it} = \beta_0 + \beta_{post} post_t + \beta_{postFine} postFine_{it} + \beta_1 fuel_t + \beta_2 fuel_t^2 + \alpha_i + \epsilon_{it} \quad (1)$$

where $postFine_{i,t}$ is an indicator variable which is one if a fine has been previously imposed on firm $i$ on day $t$ in a specific jurisdiction. I estimate Equation (1) separately for the EU and US. As in the main text, $FSC_{it}$ denotes airline $i$'s fuel surcharge on day $t$ (in Dollars). $\alpha_i$ denotes a firm-level fixed effect, and $\epsilon_{it}$ is an error term. $fuel_t$ denotes the U.S. Gulf Coast spot fuel price in dollars per gallon. $post_t$ is an indicator variable which is one in the post-cartel period. Thus, $\beta_{postFine}$ denotes the impact of fines on post-cartel prices. $\hat{\beta}_{postFine} > 0$ (resp. $< 0$) if airlines set higher (resp. lower) FSCs after being fined.

In the EU, fines for all firms were published on November 9th, 2010. See Table C.1 for details.[21] Thus, $postFine_{i,t} = 1$ if firm $i$ was fined in the EU and $t$ is after November 9th, 2010 (and 0 otherwise). In the US, each firm's fine was determined on a different date as plea agreements between airlines and the US Department of Justice were reached at different times.[22] See Table C.1 for details. $postFine_{i,t} = 1$ if the plea agreement determining firm $i$'s fine was filed prior to day $t$, and $postFine_{i,t} = 0$ otherwise. $postFine_{i,t} = 0$ for all $t$ for Lufthansa and Swiss Air (in both the EU and the US) because these firms did not face fines as successful leniency applicants.

Regression estimates are presented in Table C.2. The second column (titled "Post EU Fines") presents results for the EU and the third column (titled "Post US Fines") presents results for the US. In both jurisdictions, airlines increased FSCs modestly after the imposition of fines. This result is consistent with increased post-cartel tacit collusion after fines were set and airlines were free of government antitrust scrutiny (in a specific jurisdiction). FSCs increased by a greater amount after the publication of US fines than EU fines (although this difference is relatively small). These results should be interpreted with caution for two reasons. First, recall that an airline's US fine was typically determined on a different date than an airline's

[21] See https://ec.europa.eu/commission/presscorner/detail/en/IP_10_1487.

[22] See, for example, https://www.carteldigest.com/siteFiles/Corporate%20Pleas/Air%20Cargo%20Plea%20Agreement%20-%20British%20Airways%20-%20US.pdf.

Table C.1: Fine Dates

| | US Fine Date/Plea Date | EU Fine Date |
|---|---|---|
| Aer Lingus Cargo | | |
| Aeroflot | | |
| Aerolineas Argentinas | | |
| Air Baltic | | |
| Air Canada | | November 9th, 2010 |
| Air China | | |
| Air France | July 22nd, 2008 | November 9th, 2010 |
| Air India | | |
| Alitalia | | |
| American | | |
| Asiana Airlines | May 5th, 2009 | |
| British Airways | August 23rd, 2007 | November 9th, 2010 |
| Cargolux | May 12th, 2009 | November 9th, 2010 |
| China Airlines | November 3rd, 2010 | |
| China Southern | | |
| DAS | | |
| DHL | | |
| EVA Air | June 24th, 2011 | |
| Emirates | | |
| Etihad | | |
| Finnair | | |
| Japan Airlines | May 7th, 2008 | November 9th, 2010 |
| KLM | July 22nd, 2008 | November 9th, 2010 |
| Korean Air | August 24th, 2007 | |
| LAN | February 19th, 2009 | November 9th, 2010 |
| Lufthansa | | |
| Malaysian Airlines | | |
| MartinAir | July 22nd, 2008 | November 9th, 2010 |
| Nippon | May 8th, 2009 | |
| Northwest | August 27th, 2010 | |
| Polar Air | October 15th, 2010 | |
| Qatar Airways | | |
| SAS | July 21st, 2008 | November 9th, 2010 |
| Singapore | February 8th, 2011 | November 9th, 2010 |
| Saudi Arabian Airlines | | |
| Swiss Air | | |
| TAP Portugal | | |
| Turkish Airlines | | |
| United | | |
| US Airways | | |
| Virgin Atlantic | | |

*This table presents government fine dates in the US and EU for airlines included in the data. EU Source: https://ec.europa.eu/commission/presscorner/detail/en/IP_10_1487. US Source: https://www.carteldigest.com/cartel-detail-page.cfm?itemID=19. US dates correspond to the date the plea agreement was filed.*

EU fine. For example, British Airways' US fine was determined on August 23rd, 2007 and its EU fine was determined on November 9th, 2010. Thus, British Airways was free on government scrutiny in the US on August 23rd, 2007, but remained under investigation/scrutiny in the EU (as well as other jurisdictions). Second, note that many firms had not yet settled private antitrust damage claims when government fines were announced. For example, Polar Air and Air China did not reach a settlement in the US private class action damage suit against cargo airlines until 2016.[23] Thus, while airlines were no longer subject to government antitrust scrutiny, they remained subject to private antitrust damage claims.

## C.2 Penalization Subsample Results

In this section, I explore whether firms penalized in the EU or US responded differently to cartel dissolution than other firms. The fourth column (titled "Penalized Firms Only") estimates the main specification including only firms which paid government fines, in at least one jurisdiction, for cartel activity. These estimates are reproduced from Table 4 in the main text, for comparison purposes. The fifth column (titled "Penalized in the EU Only") presents estimates including only firms fined in the EU and the sixth column (titled "Penalized in the US Only") presents estimates including only firms fined in the US (see Table A.1).[24] Estimates of post-cartel FSC changes (i.e., the coefficient on $post_t$) in the main specification are similar when the sample includes all firms, only penalized firms, only firms penalized in the EU, and only firms penalized in the US. Thus, firms that were eventually penalized for cartel activity do not appear to have responded to cartel dissolution differently than firms that were not penalized. This result is consistent with the hypothesis that the air cargo cartel included the vast majority of major airlines in the industry, of which only a subset paid government fines.

## C.3 Lagged Jet Fuel Prices

When setting fuel surcharges, airlines sometimes announced upcoming fuel surcharge changes approximately 2 weeks prior to implementation. However, this practice varied considerably across airlines and was not adhered to consistently. Some airlines announced fuel surcharge changes weeks in advance, while others announced changes only a few days prior to implementation. In other cases, FSC changes were effective immediately. Additionally, sometimes airlines canceled pre-announced fuel surcharge adjustments just prior to implementation if jet fuel prices changed unexpectedly after the announcement.

To help account for this issue, I re-estimate all regression results from the main text using $fuel_{t-14}$ and

[23] https://topclassactions.com/lawsuit-settlements/lawsuit-news/more-settlements-reached-in-air-cargo-class-action-litigation/

[24] Note that Lufthansa (and its subsidiary Swiss Air) avoided a fine for cartel activity in both the EU and US due to its leniency applications. However, Lufthansa is included as a penalized firm in these regressions as it was involved in the cartel.

Table C.2: Impact of Cartel Penalization

| | Post EU Fines | Post US Fines | Penalized Firms Only | Penalized in EU Only | Penalized in US Only |
|---|---|---|---|---|---|
| Post | 0.178*** | 0.173*** | 0.153*** | 0.171*** | 0.163*** |
| | (0.00143) | (0.00142) | (0.00186) | (0.00317) | (0.00223) |
| Post Fine (EU) | 0.0158*** | | | | |
| | (0.00306) | | | | |
| Post Fine (US) | | 0.0472*** | | | |
| | | (0.00216) | | | |
| Fuel Price | 0.265*** | 0.262*** | 0.291*** | 0.352*** | 0.292*** |
| | (0.00502) | (0.00498) | (0.00614) | (0.00820) | (0.00688) |
| Fuel Price Sq. | 0.0350*** | 0.0346*** | 0.0346*** | 0.0201*** | 0.0362*** |
| | (0.00143) | (0.00142) | (0.00183) | (0.00237) | (0.00205) |
| Firm FE | YES | YES | YES | YES | YES |
| N | 81,493 | 81,493 | 47,253 | 18,906 | 35,905 |
| R sq. | 0.866 | 0.867 | 0.887 | 0.898 | 0.8910 |

*This table presents estimates of the impact of fines (both in the US and EU) and cooperation with authorities on FSCs. Standard errors are heteroskedasticity robust. *** p<.01, ** p<.05, *p<.1. The dependent variable in all regressions is an airline's FSC in US dollars.*

Table C.3: Impact of Cartel Dissolution (Lagged)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Post | 0.475*** | 0.140*** | 0.157*** | 0.164*** | |
| | (0.00149) | (0.00133) | (0.00135) | (0.00134) | |
| Lagged Fuel Price | | 0.417*** | 0.286*** | 0.272*** | 0.447*** |
| | | (0.00143) | (0.00518) | (0.00524) | (0.00410) |
| Lagged Fuel Price Sq. | | | 0.0349*** | 0.0383*** | -0.0282*** |
| | | | (0.00153) | (0.00151) | (0.00133) |
| Post 2006 | | | | | 0.0994*** |
| | | | | | (0.00112) |
| Post 2007 | | | | | 0.126*** |
| | | | | | (0.00120) |
| Post 2008 | | | | | 0.382*** |
| | | | | | (0.00261) |
| Post 2009 | | | | | 0.204*** |
| | | | | | (0.00152) |
| Post 2010 | | | | | 0.152*** |
| | | | | | (0.00126) |
| Post 2011 | | | | | 0.225*** |
| | | | | | (0.00224) |
| Post 2012 | | | | | 0.214*** |
| | | | | | (0.00227) |
| Firm FE | NO | NO | NO | YES | YES |
| N | 81,493 | 81,493 | 81,493 | 81,493 | 81,493 |
| R sq. | 0.499 | 0.853 | 0.855 | 0.894 | 0.925 |

*This table presents estimates of the impact of cartel dissolution. Standard errors are heteroskedasticity robust. *** p<.01, ** p<.05, *p<.1. The dependent variable in all regressions is an airline's FSC in US dollars.*

Table C.4: Impact of Cartel Dissolution (Lagged): Robustness

| | Baseline | Alt. Detection Date | Cubed Fuel Prices | Firm Specific Fuel Eff. |
|---|---|---|---|---|
| Post | 0.164*** | | 0.164*** | 0.161*** |
| | (0.00134) | | (0.00131) | (0.00134) |
| Post Len. | | 0.153*** | | |
| | | (0.00110) | | |
| Lagged Fuel Price | 0.272*** | 0.360*** | 0.335*** | |
| | (0.00524) | (0.00437) | (0.0212) | |
| Lagged Fuel Price Sq. | 0.0383*** | 0.0161*** | 0.00109 | |
| | (0.00151) | (0.00132) | (0.0136) | |
| Lagged Fuel Price Cub. | | | 0.00659** | |
| | | | (0.00263) | |
| Firm FE | YES | YES | YES | YES |
| N | 81,493 | 81,493 | 81,493 | 81,493 |
| R sq. | 0.894 | 0.898 | 0.895 | 0.915 |

*This table presents robustness checks for Table C.3. Standard errors are heteroskedasticity robust. *** p<.01, ** p<.05, *p<.1. The dependent variable in all regressions is an airline's FSC in US dollars.*

$fuel^2_{t-14}$ (i.e., the 14 day lag of the jet fuel price and its square) in place of $fuel_t$ and $fuel^2_t$ . Table C.3 presents results from the main specification with two week lagged jet fuel prices. Results are qualitatively unchanged from the main text. Airlines increased their FSCs after the cartel's dissolution. Table C.4 provides results from a variety of robustness checks with lagged jet fuel prices. The second column (titled "Baseline") reproduces the result from the main specification for comparison purposes. The third column (titled "Alt. Detection Date") presents results with an alternative detection date (i.e., the date that Lufthansa's leniency application became public). The fourth column (titled "Cubed Fuel Prices") presents results from a specification including the cube of lagged jet fuel prices. The fifth column (titled "Firm Specific Fuel Eff.") presents results form a specification including interactions between carrier fixed effects and lagged jet fuel variables. In all cases, the main qualitative result holds–airlines increased their FSCs after the cartel's detection.

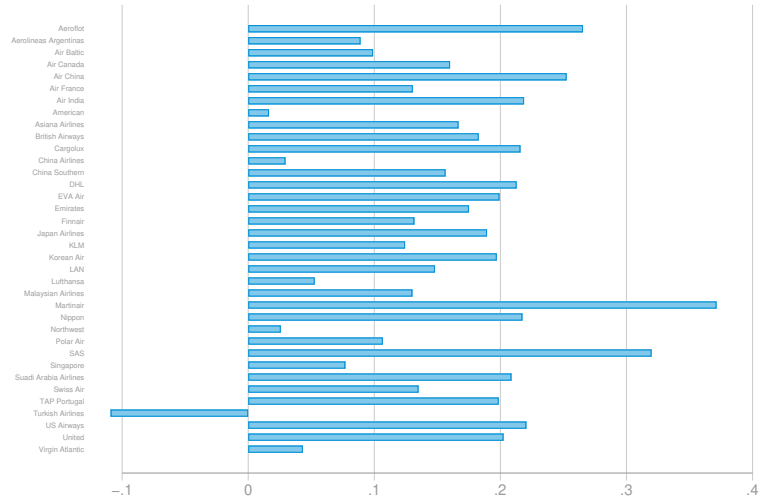


Figure C.1: Change in FSC by Firm with Lagged Fuel Prices ($\hat{\beta}_{i,post}$)

Table C.5 presents subsample robustness checks. The third column (titled "No recession") presents results without any data from the Great Recession. The fourth column (titled "Before Recession") includes only data from before the Great Recession. The fifth column (titled "Appear Before and After Detection") presents results using only carriers with some data availability before and after the cartel's breakdown. The sixth column (titled "Penalized Firms Only") presents estimates of the main specification including only firms which paid government fines in at least one jurisdiction for cartel activity. For all subsamples, the main result holds–FSCs increased significantly after the cartel's dissolution after controlling for jet fuel prices and firm fixed effects.

Next, I analyze the impact of cartel dissolution on FSCs at the firm level. Specifically, I estimate the following specification:

$$FSC_{it} = \beta_0 + \sum_i \beta_{i,post} post_{it} + \beta_1 fuel_{t-14} + \beta_2 fuel^2_{t-14} + \alpha_i + \epsilon_{it} \tag{2}$$

where $\beta_{i,post}$ represents the change in airline $i$'s FSC, after accounting for fuel prices and airline fixed effects. $post_{it} = 1$ for airline $i$ in the post-cartel period. Figure C.1 presents $\hat{\beta}_{i,post}$ by airline. As in the main text, the post-cartel price increase occurs for all firms except Turkish Airlines.

Next, I examine the robustness of regression results from Section 4 to using lagged jet fuel prices ($fuel_{t-14}$ and $fuel^2_{t-14}$) in place of jet fuel prices ($fuel_t$ and $fuel^2_t$). Specifically, I estimate the following specification:

$$\frac{|FSC_{it} - indexFSC_t|}{FSC_{it}} = \beta_0 + \beta_{post} post_t + \beta_1 fuel_{t-14} + \beta_2 fuel^2_{t-14} + \alpha_i + \epsilon_{it}. \tag{3}$$

Table C.5: Impact of Cartel Dissolution (Lagged): Subsample Robustness

| | Baseline | No Recession | Before Recession | Appear Before and After Detection | Penalized Firms Only |
|---|---|---|---|---|---|
| Post | 0.164*** | 0.112*** | 0.0959*** | 0.159*** | 0.137*** |
| | (0.00134) | (0.00116) | (0.000731) | (0.00139) | (0.00171) |
| Lag Fuel Price | 0.272*** | 0.442*** | 0.786*** | 0.259*** | 0.293*** |
| | (0.00524) | (0.00316) | (0.00475) | (0.00543) | (0.00636) |
| Lag Fuel Price Sq. | 0.0383*** | -0.0105*** | -0.151*** | 0.0443*** | 0.0399*** |
| | (0.00151) | (0.00109) | (0.00192) | (0.00158) | (0.00192) |
| Firm FE | YES | YES | YES | YES | YES |
| N | 81,493 | 69,192 | 46,686 | 75,908 | 47,253 |
| R sq. | 0.894 | 0.923 | 0.935 | 0.899 | 0.915 |

*This table presents subsample robustness checks for Table C.3. Standard errors are heteroskedasticity robust. *** p<.01, ** p<.05, *p<.1. The dependent variable in all regressions is an airline's FSC in US dollars.*

Table C.6: Impact of Cartel Dissolution on Price Deviation (Lagged)

| | | No | | No |
|---|---|---|---|---|
| | Baseline | Recession | Baseline | Recession |
| Index Airline | LH | LH | AA | AA |
| Post | 0.0290*** | -0.0482*** | 0.0397*** | -0.00926*** |
| | (0.00173) | (0.00139) | (0.000981) | (0.000641) |
| Lagged Fuel Price | -0.119*** | -0.00836 | -0.0456*** | 0.0368*** |
| | (0.00521) | (0.00630) | (0.00251) | (0.00192) |
| Lagged Fuel Price Sq. | 0.0238*** | 0.0102*** | 0.0119*** | -0.000405 |
| | (0.00119) | (0.00170) | (0.000606) | (0.000574) |
| Firm FE | YES | YES | YES | YES |
| N | 75,864 | 64,576 | 75,864 | 64,576 |
| R sq. | 0.189 | 0.145 | 0.235 | 0.318 |

*This table presents estimates of the impact of cartel dissolution on the price deviation. Standard errors are heteroskedasticity robust. *** p<.01, ** p<.05, *p<.1. The dependent variable in the second and third columns is the percentage absolute deviation from LH's index-based FSC. The dependent variable in the fourth and fifth columns is the percentage absolute deviation from AA's index-based FSC.*

As in the main text, I estimate this regression specification using an index-based FSC calculated from Lufthansa's index and an index-based FSC calculated from American Airlines' index. The second column (titled "Baseline LH") presents results with Lufthansa's index-based FSC. The third column (titled "No Recession LH") presents results with Lufthansa's index-based FSC while excluding data from the Great Recession. The fourth column (titled "Baseline AA") includes results with American Airlines' index-based FSC and the entire sample. The fifth column (titled "No Recession LH") presents results using American Airlines' index-based FSC while excluding data from the Great Recession.

In summary, results using lagged jet fuel prices are consistent with those of the main text. The relationship between FSCs and the index-based FSC did not significantly change after cartel detection (excluding a period of increased jet fuel price volatility during the Great Recession). These results support the conclusion that airlines continued to set FSCs using the FSC index methodology in the post-cartel period.

# References

**Appel, Dustin.** 2008. "Air cargo fuel surcharges and tacit collusion under the Sherman act: what good is catching a few bad guys if consumers still get robbed." *J. Air L. & Com.*, 73: 375.

**Bischof, Daniel.** 2017. "G538SCHEMES: Stata module to provide graphics schemes for http://fivethirtyeight.com." Statistical Software Components S458404, Boston College Department of Economics https://ideas.repec.org/c/boc/bocode/s458404.html.

**Connor, John M.** 2020. "The private international cartels (pic) data set: Guide and summary statistics, 1990-2019." *Available at SSRN 3682189*.

**González, Xulia, and María J Moral.** 2019. "Effects of antitrust prosecution on retail fuel prices." *International Journal of Industrial Organization*, 67: 102537.