

Spillover Delay Effects of Damaging Wildlife Strike Events at U.S. Airports

**Bird Strike Committee USA Meeting
July 19th, 2022**



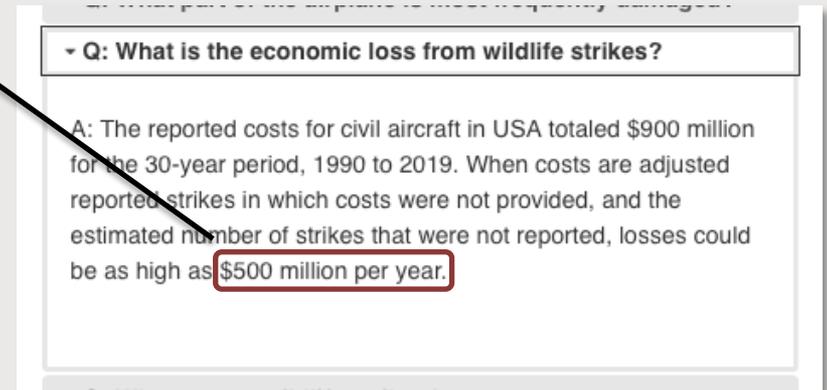
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Motivating Question(s)

What is the economic burden of wildlife-aircraft collisions?

- U.S. civil-side estimates via...
 - National Wildlife Strike Database
 - The Dolbeer et al. (2021) annual report(s).
 - Alternative estimate was given by Altringer et al. (2021)—upper bound estimate closer to \$250 million
- Global estimate via Allen (2000) of 1 to 1.5 billion annually.
- But to what extent have previous estimates considered/studied indirect costs—e.g., spillover delays?



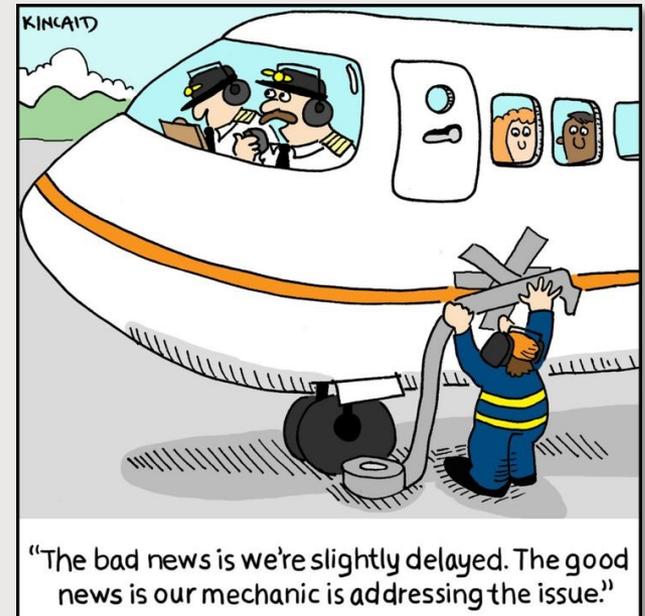
Q: What is the economic loss from wildlife strikes?

A: The reported costs for civil aircraft in USA totaled \$900 million for the 30-year period, 1990 to 2019. When costs are adjusted reported strikes in which costs were not provided, and the estimated number of strikes that were not reported, losses could be as high as **\$500 million per year.**

https://www.faa.gov/airports/airport_safety/wildlife/faq/

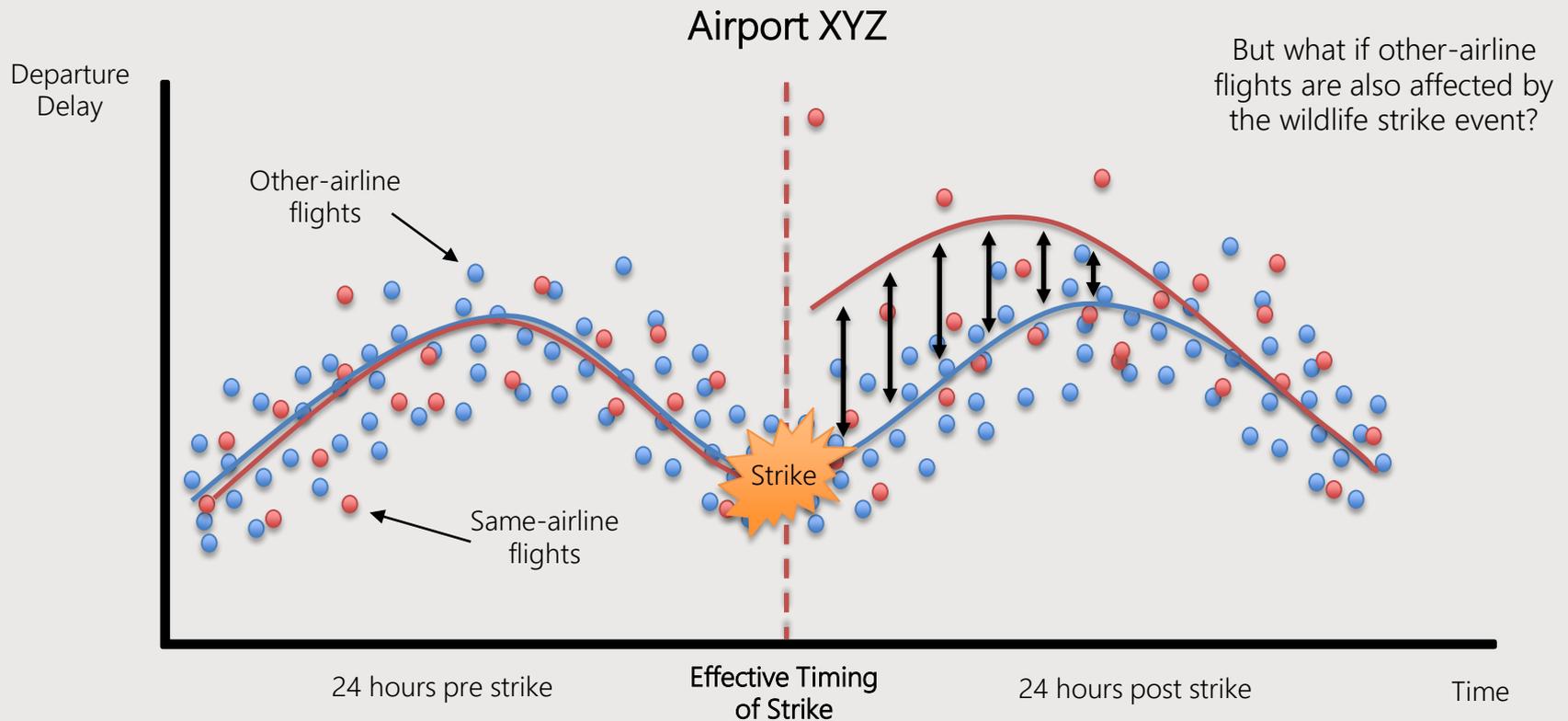
Research Questions

1. Can we identify—i.e., observe—the potential spillover delay effects of damaging wildlife strike events?
2. Can we quantify—i.e., how large?—the potential spillover delay effects of damaging wildlife strike events?



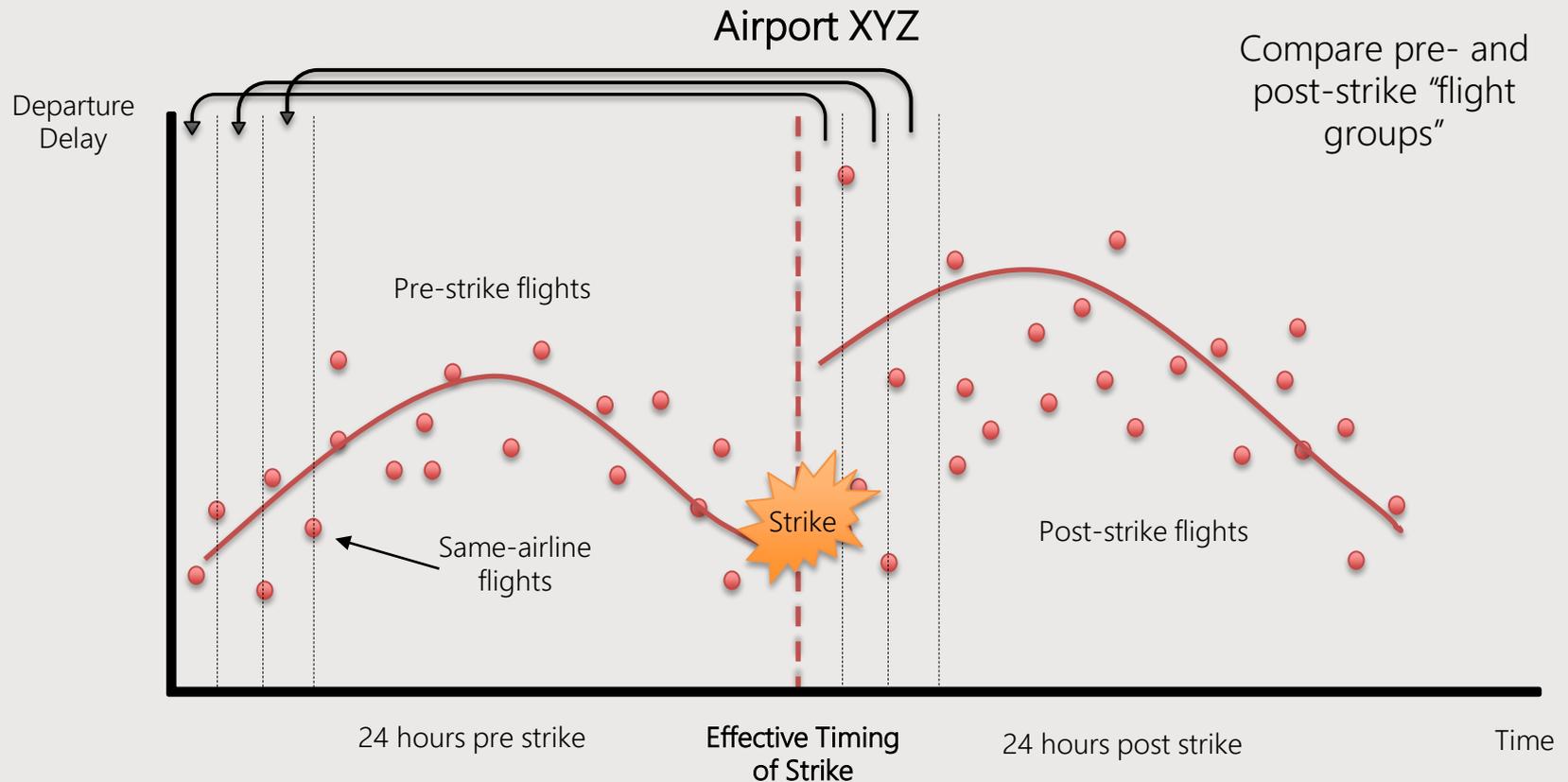
Strategy for Identifying Strike-Induced Delays

“Interrupted Time Series Approach”



Strategy for Identifying Strike-Induced Delays

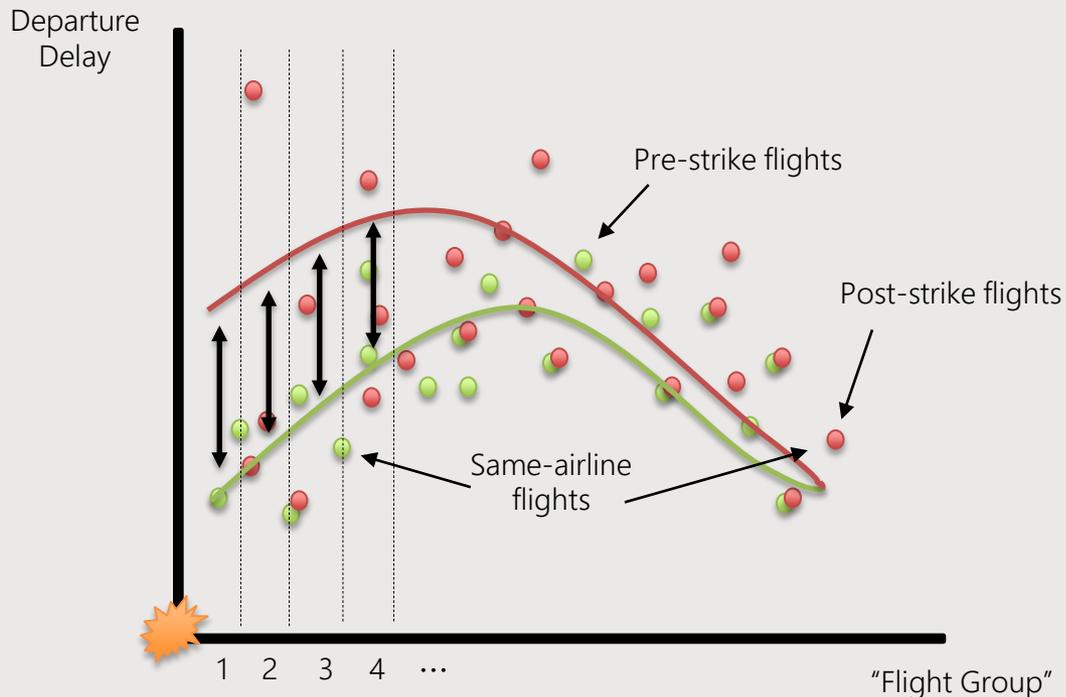
“Counterfactual Approach”



Strategy for Identifying Strike-Induced Delays

“Counterfactual Approach” (cont’d)

Airport XYZ



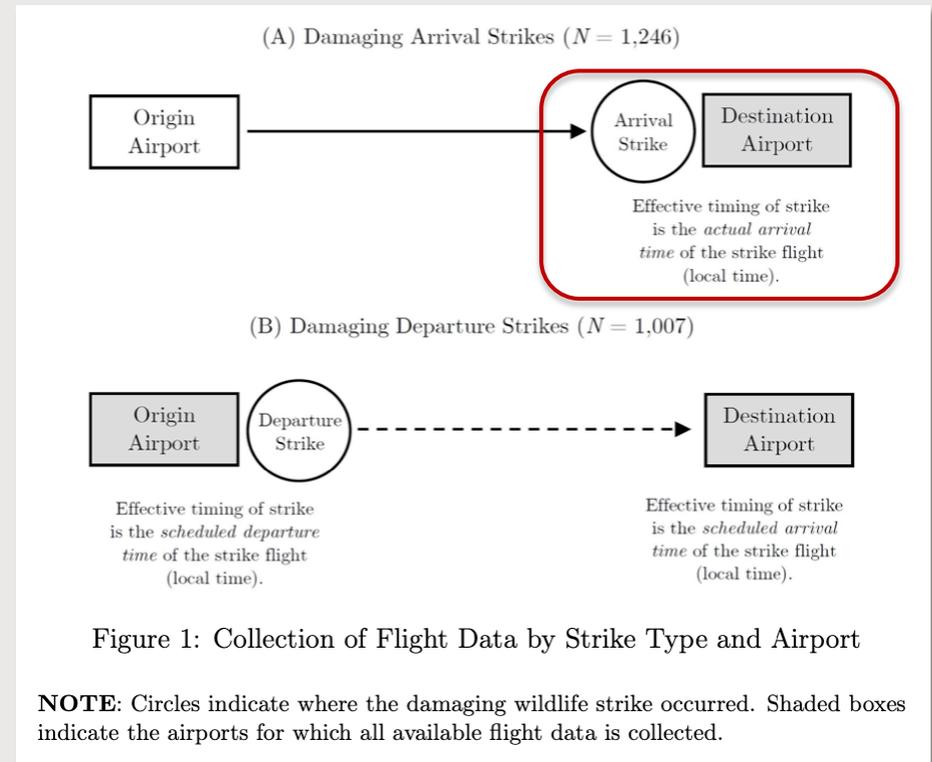
We can utilize this strategy for same- and other-airline flights, separately.

If your interested in the econometric specification (math) behind these strategies:

<https://www.sciencedirect.com/science/article/pii/S221201222200003X?via%3Dihub>.

Collecting the Data

- Damaging wildlife strike events are drawn from the *National Wildlife Strike Database*.
- These events are matched to the own flight in the *BTS OnTime Statistics Database* to get the “effective timing of strike”.
- Flight performance statistics are collected for all flights in the 24 hour pre- and post-strike period.



Describing the Data

Table 1: Linked Flight Observations by Strike, Airport, Airline, and Timing

Linked Flights		Matched Arrival Strikes (<i>N</i> = 1,246)		Matched Departure Strikes (<i>N</i> = 1,007)			
		<i>Destination Airport</i>		<i>Destination Airport</i>		<i>Origin Airport</i>	
		24 Hours Pre-Strike	24 Hours Post-Strike	24 Hours Pre-Strike	24 Hours Post-Strike	24 Hours Pre-Strike	24 Hours Post-Strike
Strike-Airline	Total	108,037	108,126	126,976	126,901	95,007	94,957
	Average	86.8	86.8	126.5	126.1	94.4	94.4
Other-Airline	Total	238,515	237,647	237,337	237,518	191,794	192,193
	Average	193.6	193.1	241.2	241.4	195.1	195.5

NOTE: Damaging wildlife strike events are collected from the National Wildlife Strike Database. Flight data is matched and collected from the Bureau of Transportation Statistics Airline On-Time Statistics Detailed Arrival Statistics and Airline On-Time Statistics Detailed Departure Statistics databases.

Results: Summary Statistics

Table 2: Mean Departure Delays by Strike, Airport, Airline, and Timing

Linked Flights		Arrival Strikes		Departure Strikes			
		Destination Airport		Destination Airport		Origin Airport	
		24 Hours Pre-Strike	24 Hours Post-Strike	24 Hours Pre-Strike	24 Hours Post-Strike	24 Hours Pre-Strike	24 Hours Post-Strike
Strike-Airline	Mean	8.34	10.48 ^a	8.91	10.74 ^b	8.68	9.56 ^c
	SD	(29.81)	(38.00)	(29.21)	(32.33)	(29.06)	(31.90)
Other-Airline	Mean	8.35	8.54 ^d	9.39	9.85 ^e	8.78	8.46 ^f
	SD	(34.39)	(35.63)	(35.07)	(35.51)	(33.97)	(32.90)

^a $H_o : \hat{\mu}_{Post} - \hat{\mu}_{Pre} = 0, t = 14.653, p < 0.000$

^b $H_o : \hat{\mu}_{Post} - \hat{\mu}_{Pre} = 0, t = 14.973, p < 0.000$

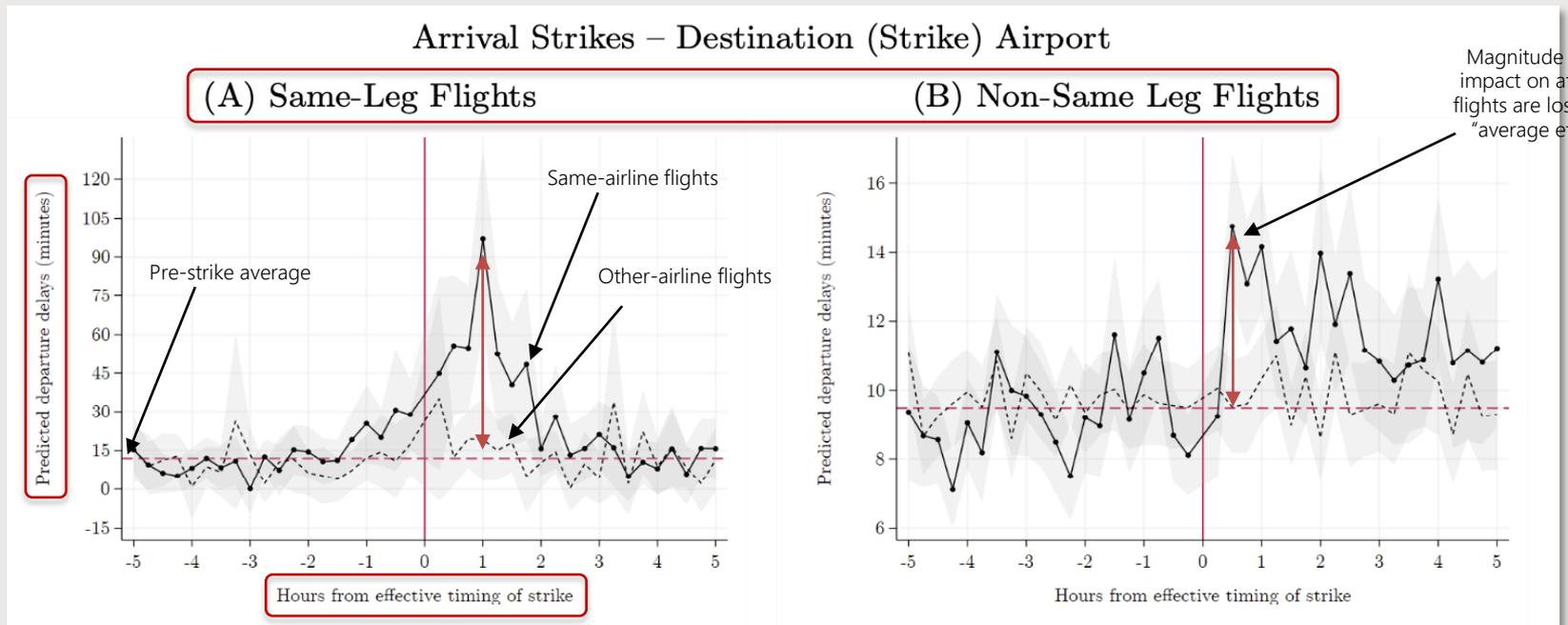
^c $H_o : \hat{\mu}_{Post} - \hat{\mu}_{Pre} = 0, t = 7.682, p < 0.000$

^d $H_o : \hat{\mu}_{Post} - \hat{\mu}_{Pre} = 0, t = 1.912, p = 0.056$

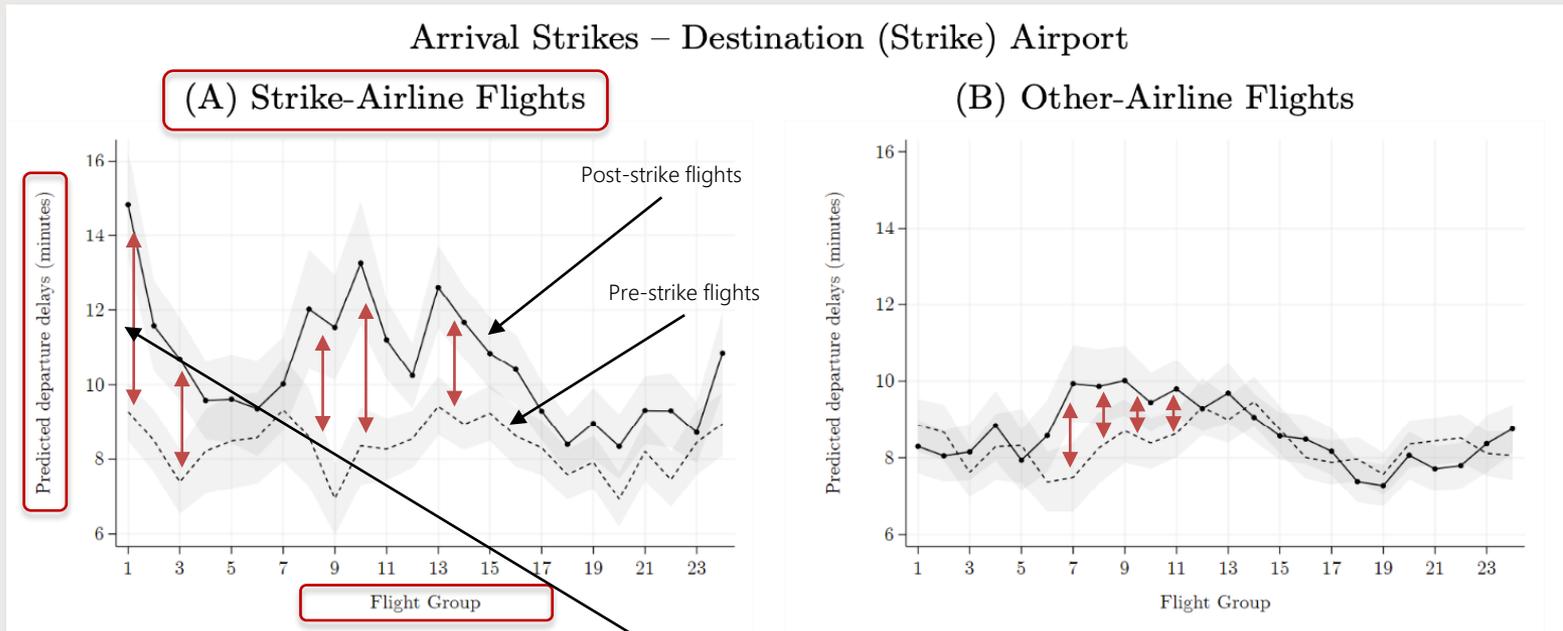
^e $H_o : \hat{\mu}_{Post} - \hat{\mu}_{Pre} = 0, t = 4.482, p < 0.000$

^f $H_o : \hat{\mu}_{Post} - \hat{\mu}_{Pre} = 0, t = -2.993, p = 0.003$

Results: Interrupted Times Series Approach

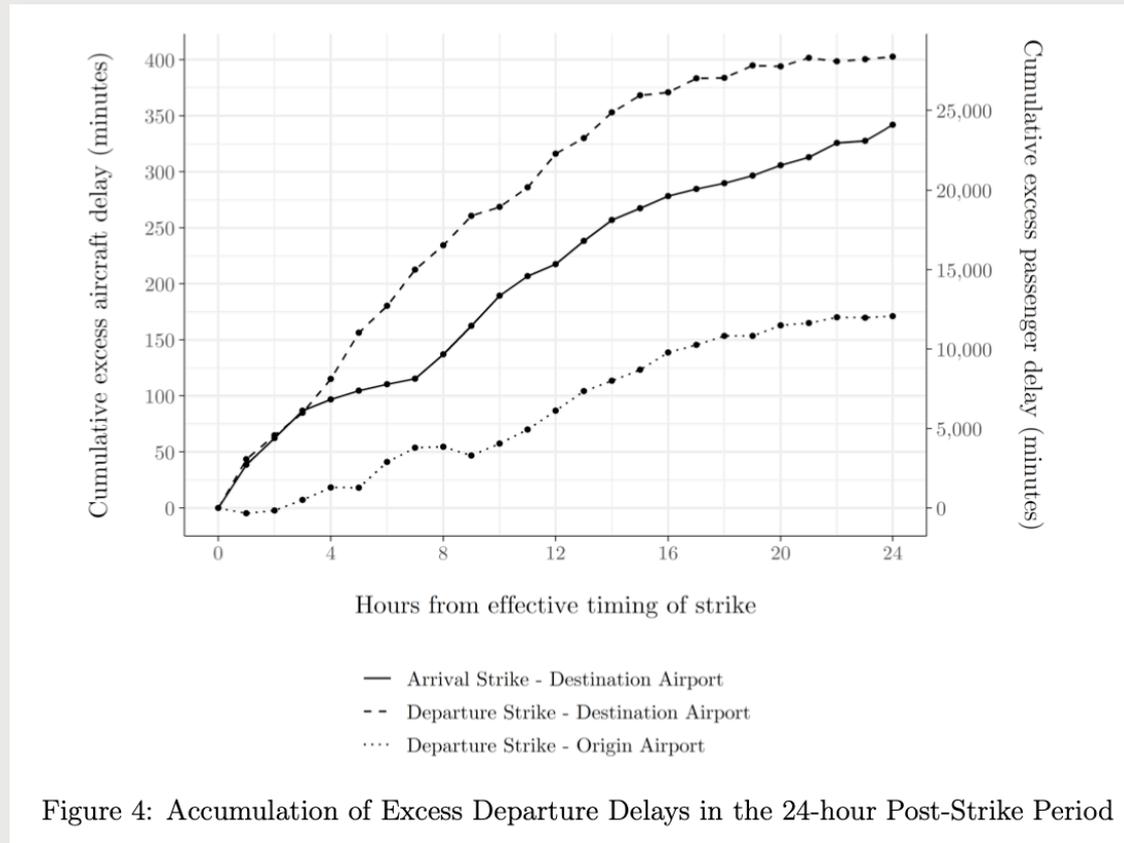


Results: Counterfactual Approach



Again, the magnitude of the estimated impact on affected flights are "hidden" in the "average effect".

Results: Accumulation of Strike-Induced Delay



Results: From Delays to Dollars

Table 5: Estimated Average Cost of Strike-Induced Delays per Damaging Wildlife Strike Event

	Excess Departure Delays per Strike (Minutes)		Excess Departure Delay Costs per Strike (2020 U.S. \$)				Total
	Aircraft	Passenger	Airline	Passenger	Lost Demand	Forgone GDP	
Arrival Strikes: Destination Airport	342	24,111	\$17,596	\$18,806	\$598	\$5,568–\$7,055	\$42,568–\$44,056
Departure Strikes: Destination Airport	403	28,387	\$20,717	\$22,142	\$705	\$6,555–\$8,307	\$50,118–\$51,870
Departure Strikes: Origin Airport	171	12,066	\$8,806	\$9,412	\$300	\$2,786–\$3,531	\$21,304–\$22,048
Departure Strikes: Total	574	40,454	\$28,522	\$31,554	\$1,004	\$9,342–\$11,838	\$71,422–\$73,914

NOTE: Excess departure delays are calculated via Eq. (3) and (4). Excess departure delays are converted into 2020 U.S. \$ using the per-minute cost estimates described in Table 3. See Figure 4.

***These estimates are a lower bound in that (1) we only observe the estimated spillover effects at the origin and destination airports directly linked to the strike flight and (2) we use a conservative estimate of passenger enplanements per flight.

Spillover Delays Costs in Context

- How do our estimates compare to the average cost of a damaging strike?
- Among the airlines in our sample, the average cost of a damaging wildlife strike is \$119,000 to \$393,000 (2020 U.S. \$).
- Our estimates suggest a *minimum 18 to 62 percent* increase in the average cost of a damaging wildlife strike event via delay costs.



Conclusions

- This study documents the spillover delay effects of damaging wildlife strike events.
- Strike-induced spillover delays are largely contained within the airline to which the strike occurred.
- EXTRA: We also show that strike-induced spillover delays appear to be attenuated at hub airports.
- Strike-induced spillover delays constitute a significant share of the economic burden of wildlife strikes—especially if one was to go beyond the origin and destination airports directly involved.
- Opens up areas of future research...

Acknowledgements

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