

Controller time and delay costs a trade-off analysis

L. Delgado, A. Cook, S. Cristobal and H. Plets

Dr Luis Delgado

Senior Research Fellow

University of Westminster

Innaxis Foundation & Research Institute

Belgocontrol

Overview

- Background
- Methodology
 - Data
 - Costs modelling
 - ATCO availability
 - Adding extra ATCO hours rules
- Analysis and results
 - Regulations costs
 - Mechanism analysis
- Conclusions

Background

- Adding extra ATCO hours
- Dynamic cost indexing
- A-CDM
- Improved airline passenger reaccommodation policies



Background

- Staff capacity shortage (ATCO)
- Industrial actions (ATC)
- Meteorological events with local effects at airports



Mechanism(s)



Indicators



Stakeholders



Airlines
ANSPs
Airports
...



Background

2014

- Average daily en-route ATFM delay increased by 17.4%:
 - ATC Capacity (+27.8%)
 - En-route ATC staffing (+44.9%)
 - En-route weather (+23%)

Background

2014

- Average daily en-route ATFM delay increased by 17.4%:
 - ATC Capacity (+27.8%)
 - En-route ATC staffing (+44.9%)
 - En-route weather (+23%)



- 9 163 aircraft affected
- 88.9 K min delay (average 9.7 min/ac)
- EUR 4.3 M delay

Methodology

- Data

Data



- Demand Data Repository 2 (DDR2)
 - AIRAC 1313 to AIRAC 1413 (12DEC13 to 07JAN15)
 - Traffic data
 - 1 349 217 flights went through a regulation in total
 - 1 304 607 flights in scope
 - MTOW $\geq$ 15 tonnes
 - Military and cargo excluded
 - ATFM regulation data
 - Duration
 - Location
 - Reason
 - ACC data
 - Regulations by ACC
 - ATCO available

Methodology

- Costs modelling

Cost modelling



- Airline delay cost
 - 2014 values for at gate cost [1]
 - Explicit values for 15 *core* aircraft
 - covering 63% movements in ECAC area
 - Other aircraft fit of cost with $\sqrt{\text{MTOW}}$ *

* $r^2_{\min}=0.98$

[1] Cook, A. and Tanner, G. European airline delay cost reference values – updated and extended values (Version 4.1). (In press for December 2015).

Cost modelling



- ATCO costs
 - Only ATCO hours cost considered
 - (pre-)tactical level
 - Values of ATCO duty-hour cost from [2]

[2] EUROCONTROL, 2014. ATM Cost-Effectiveness (ACE) 2013 benchmarking report with 2014-2018 outlook.

Methodology

- ATCO availability

ATCO availability

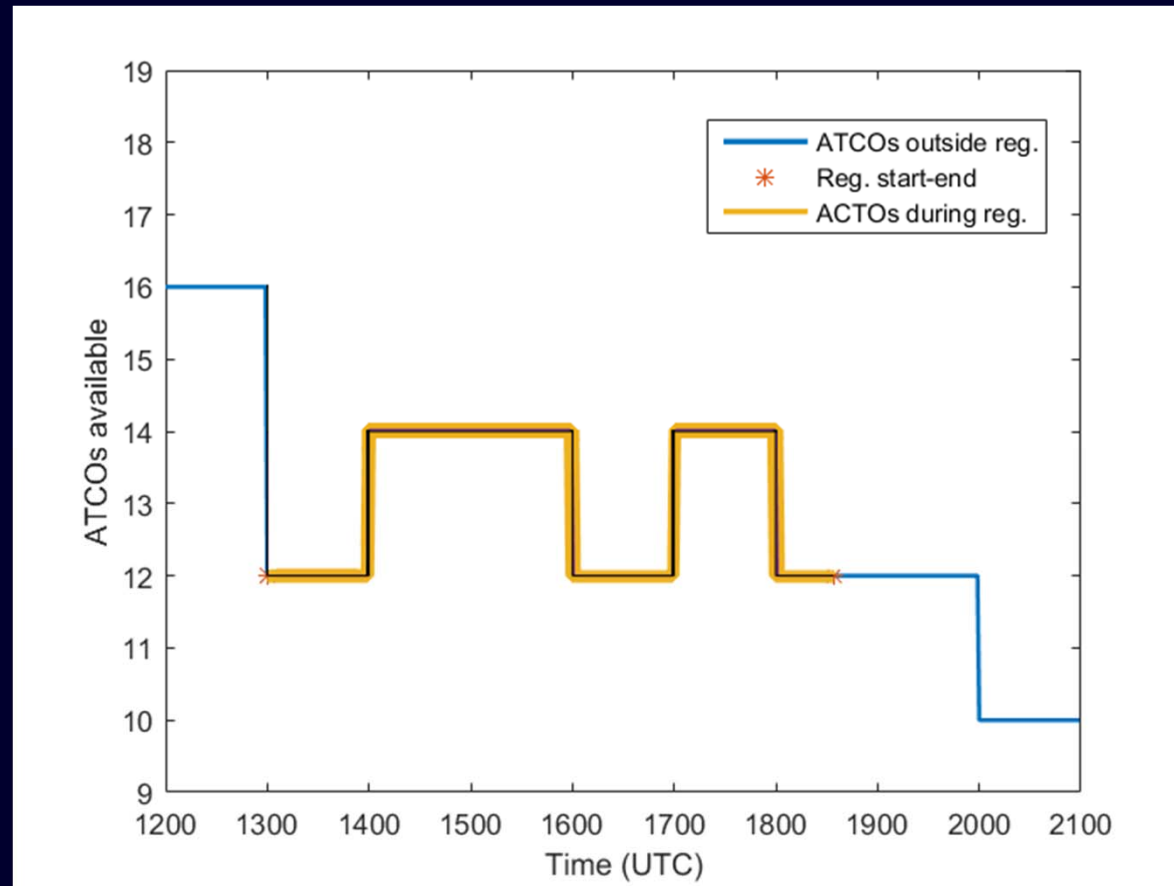


- From a tactical perspective
 - Flexible rostering
 - Controller mobility
- Staff shortages
 - Delays
- Over-staffing
 - Cost inefficiencies

Methodology

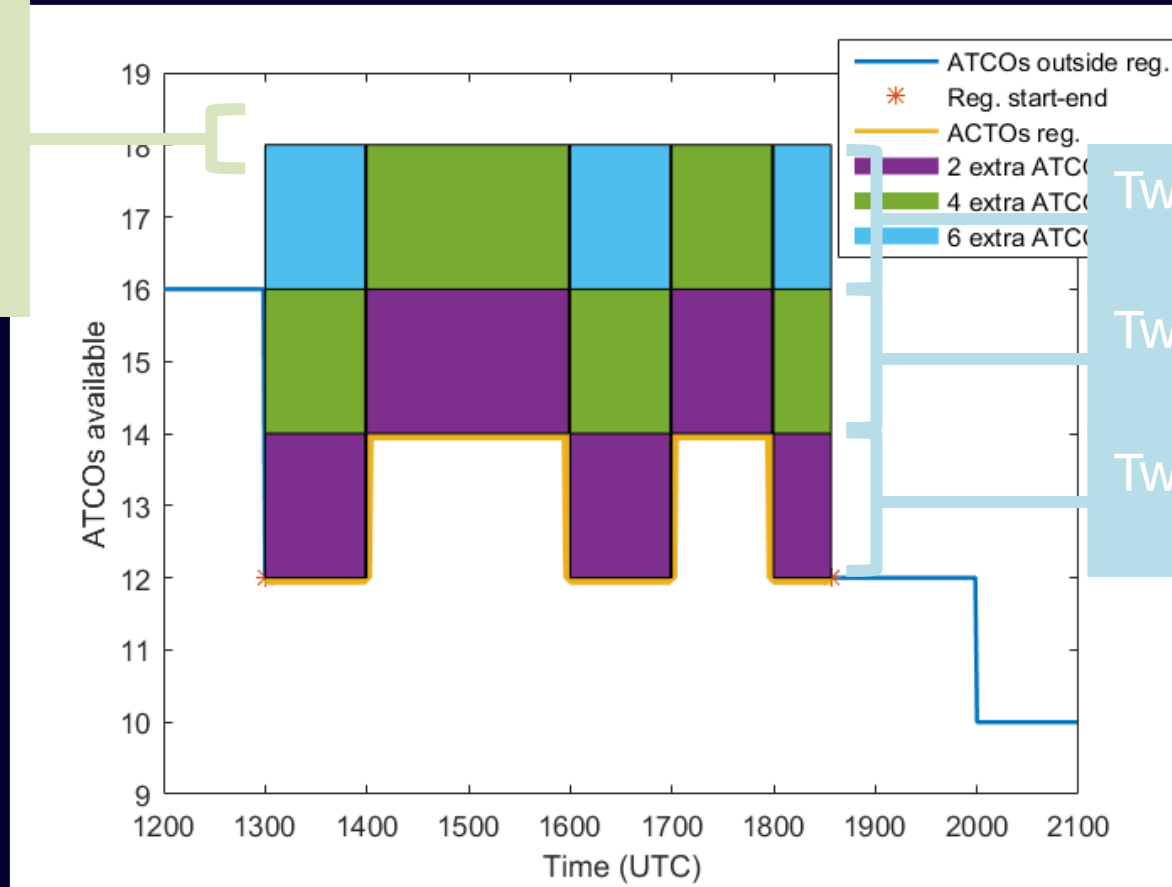
- Adding extra ATCO hours rules

Adding extra ATCO rules



Adding extra ATCO rules

Bounded by
maximum
number of
ATCO for the
ACC



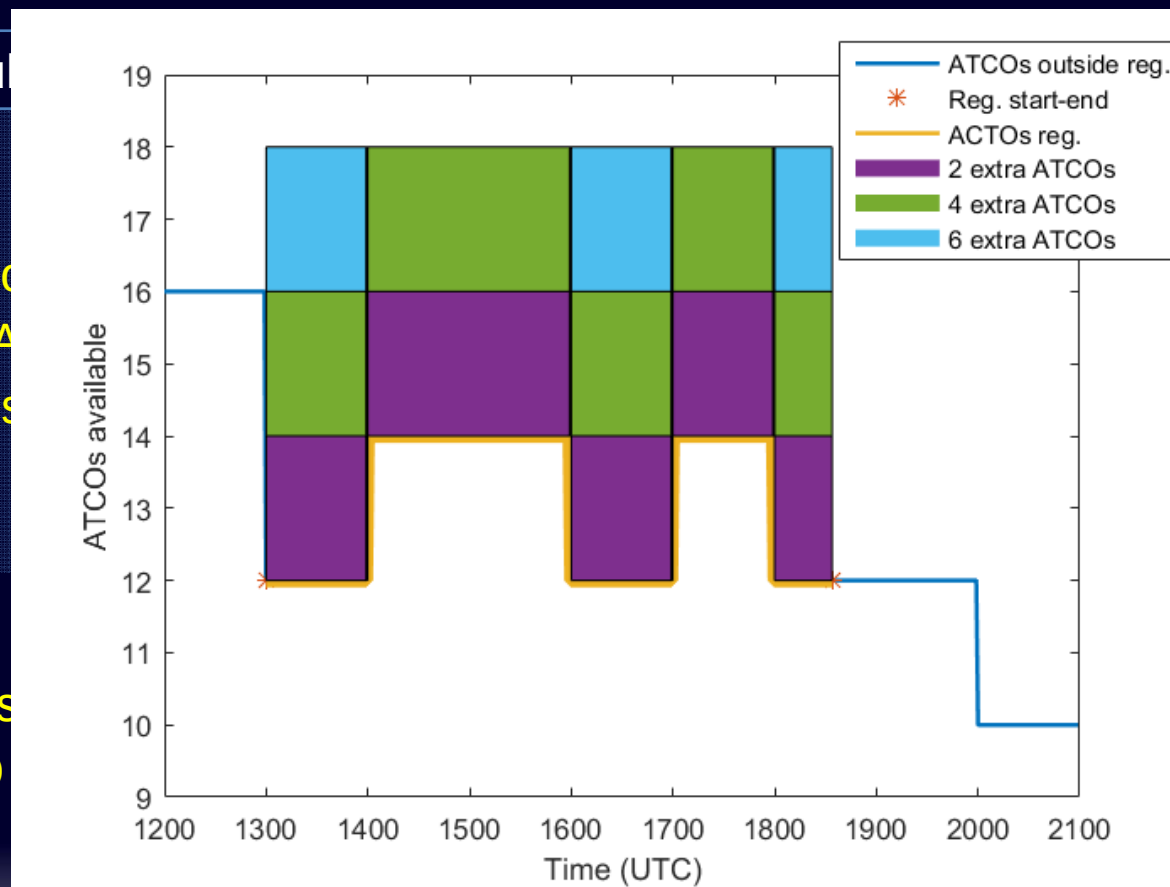
Two-controllers
steps
Two-controllers
steps
Two-controllers
steps

Adding extra ATCO rules

- Two rules:

Rule 1
Fractional shift ATCOs
costs

Rule 2
Full-shift ATCOs



Drawback

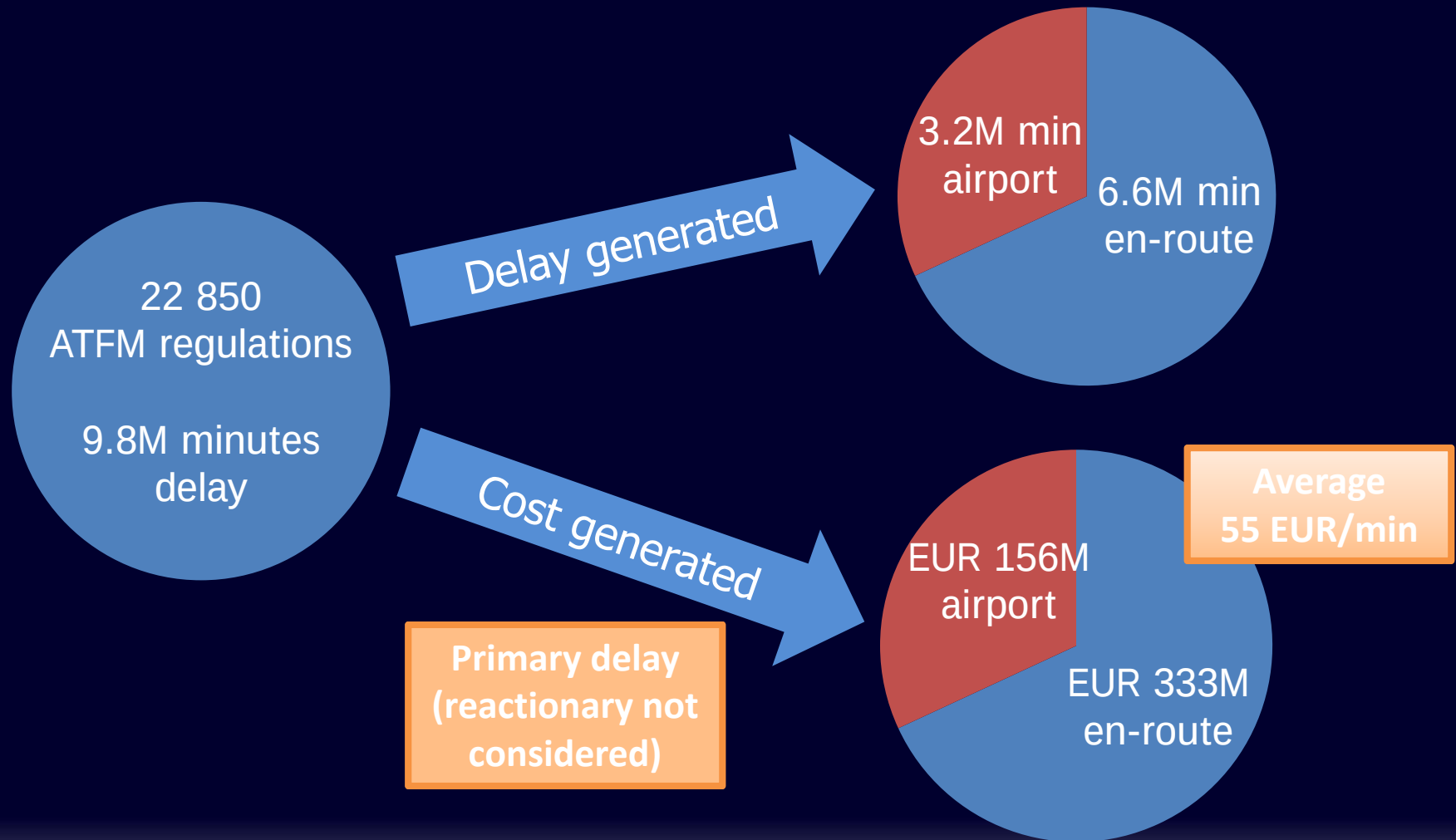
Allows fractional hours to be added

No optimisation of opening schemes/rostering

Analysis and results

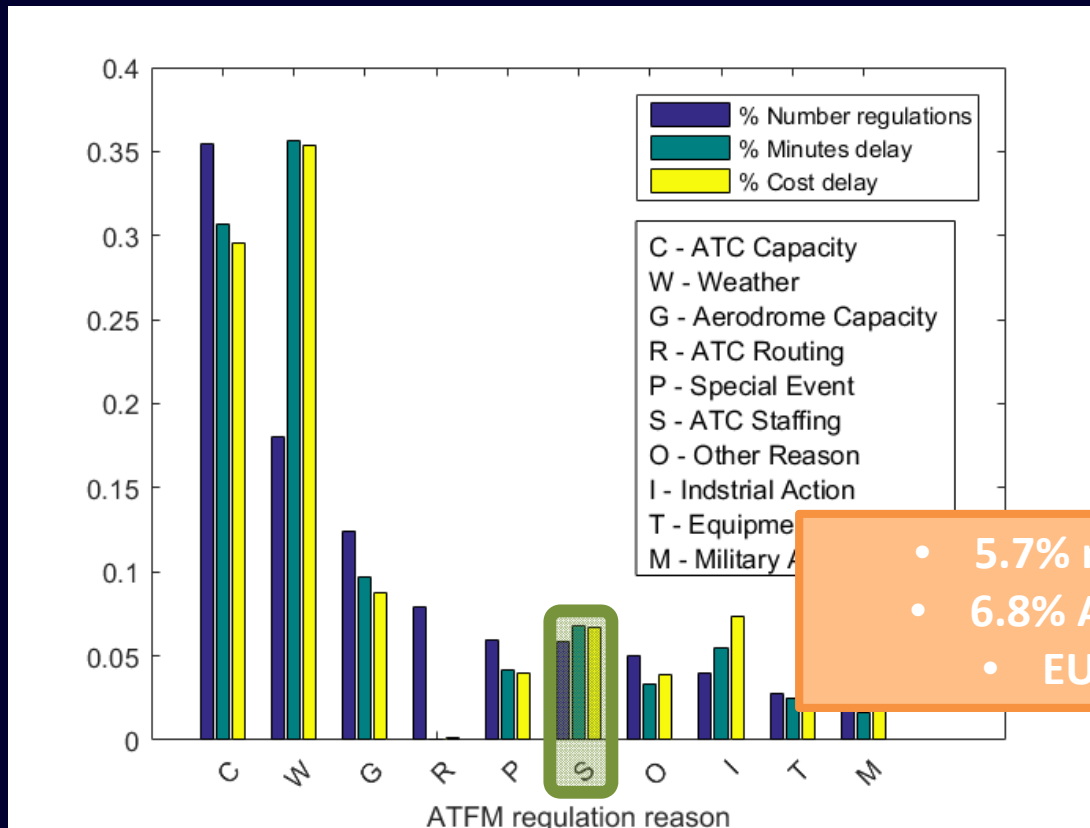
- Regulations costs

Regulation costs



Regulation costs

Most penalising
regulation

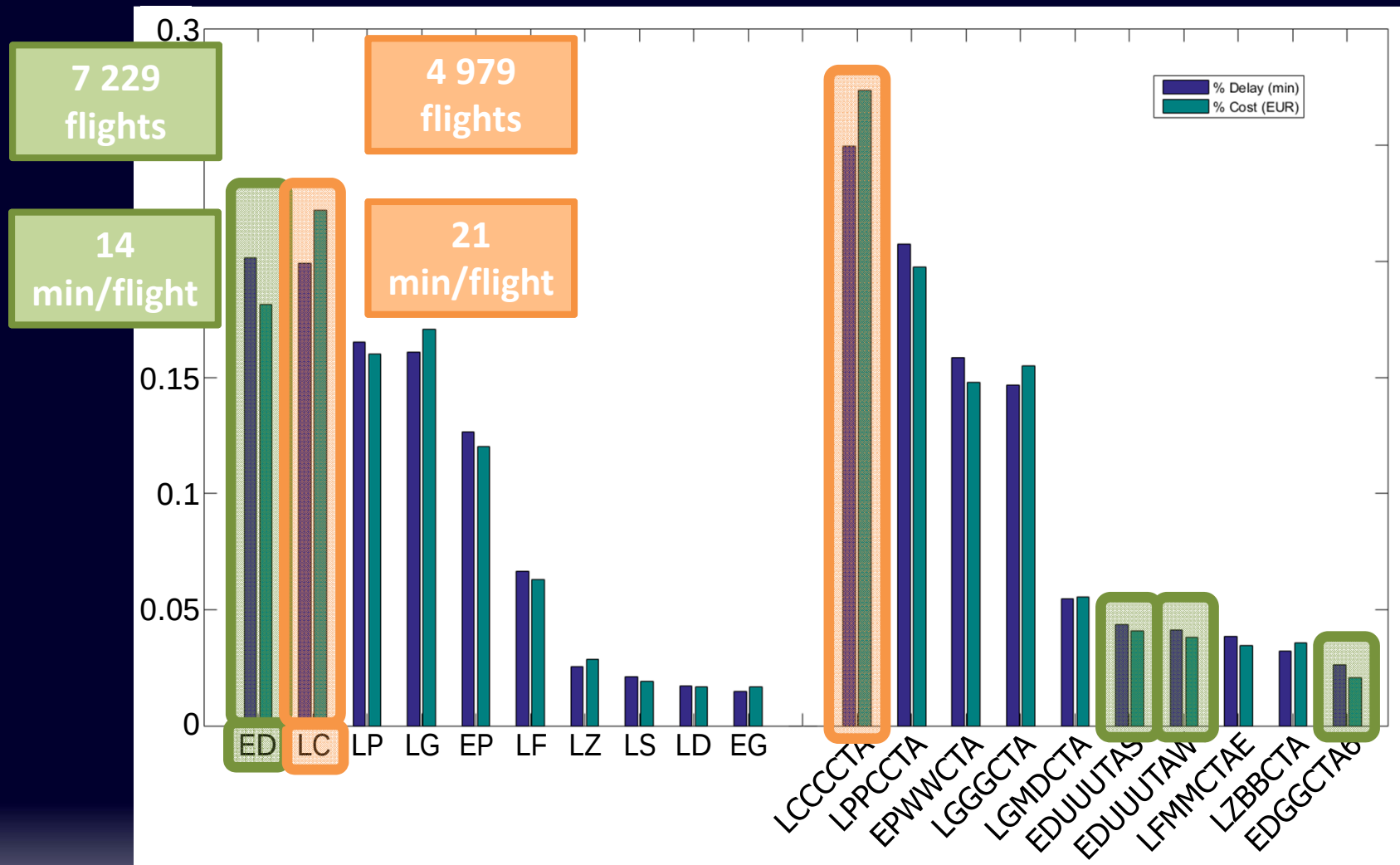


- 5.7% regulations
- 6.8% ATFM delay
- EUR 30 M

Regulation costs

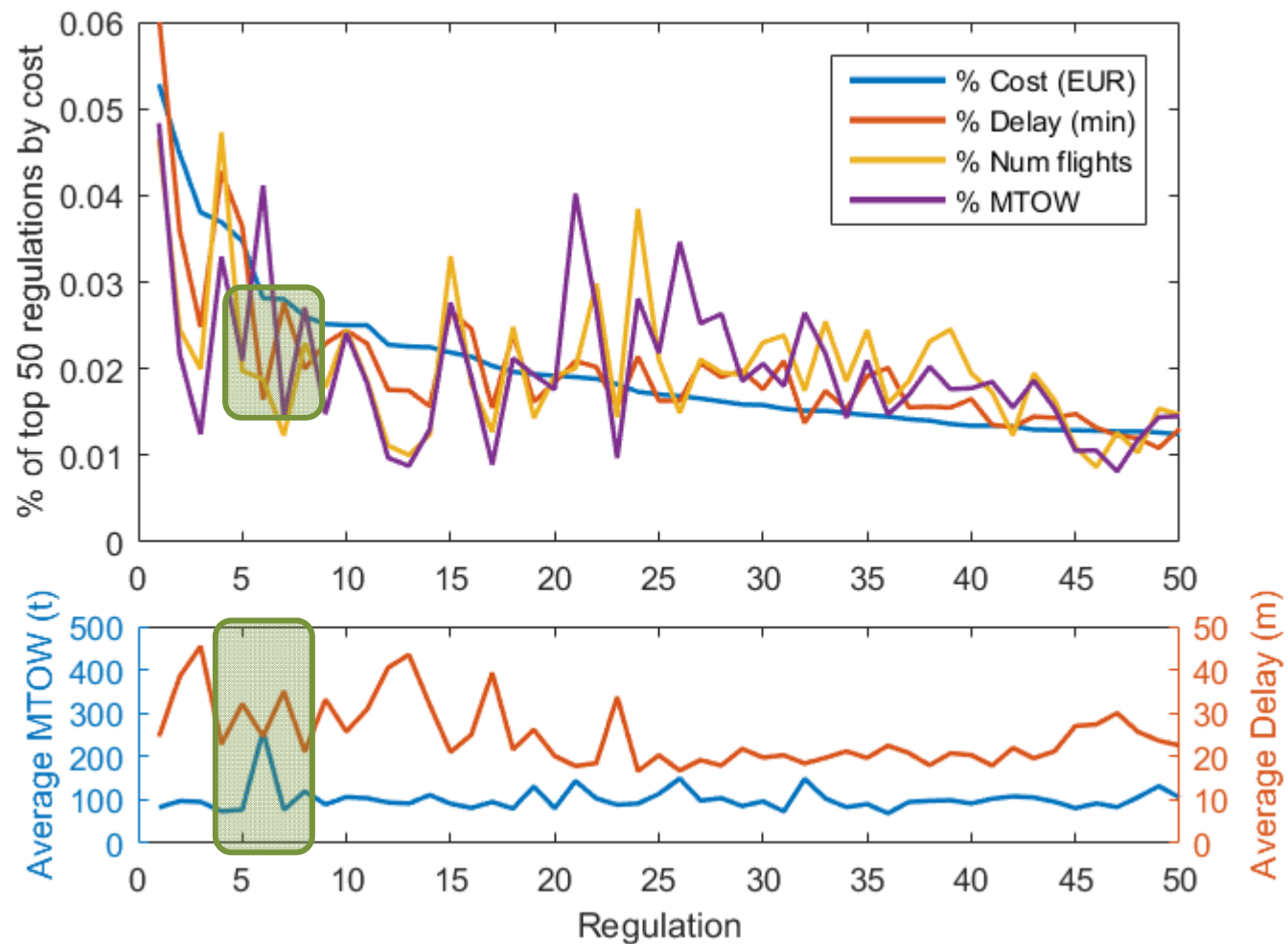
- Regulations applied to airspace with more than one configuration
 - 1 112 regulations due to staff shortage (64 did not generate delay)
 - 80 930 flights
 - 33 648 with delay assigned (30 095 commercial flights)
 - Average 18 min per delayed flight
 - EUR 26M due to delay
 - average 50 EUR/min

Regulation costs



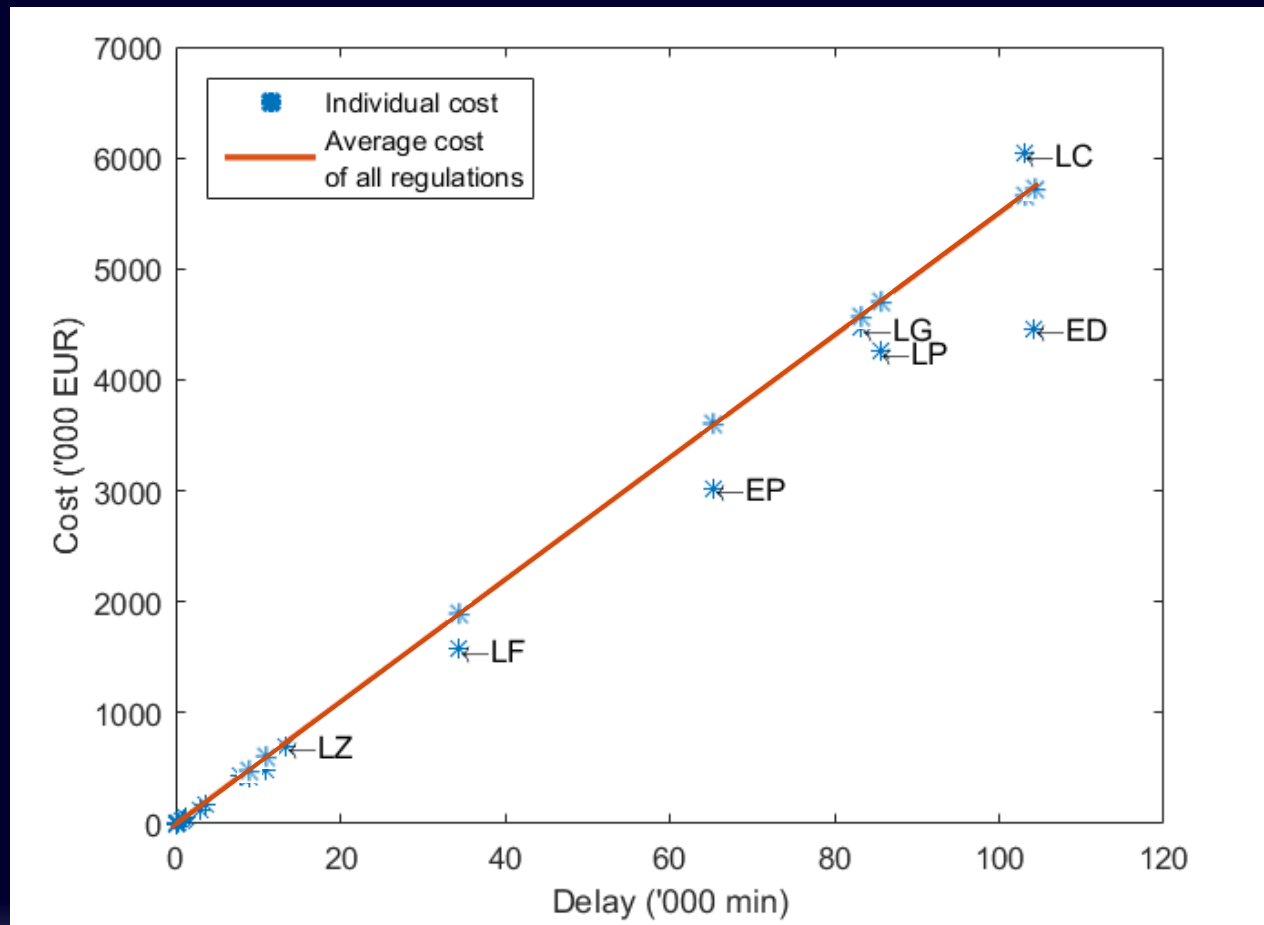
Regulation costs

Top 50 regulations by delay cost



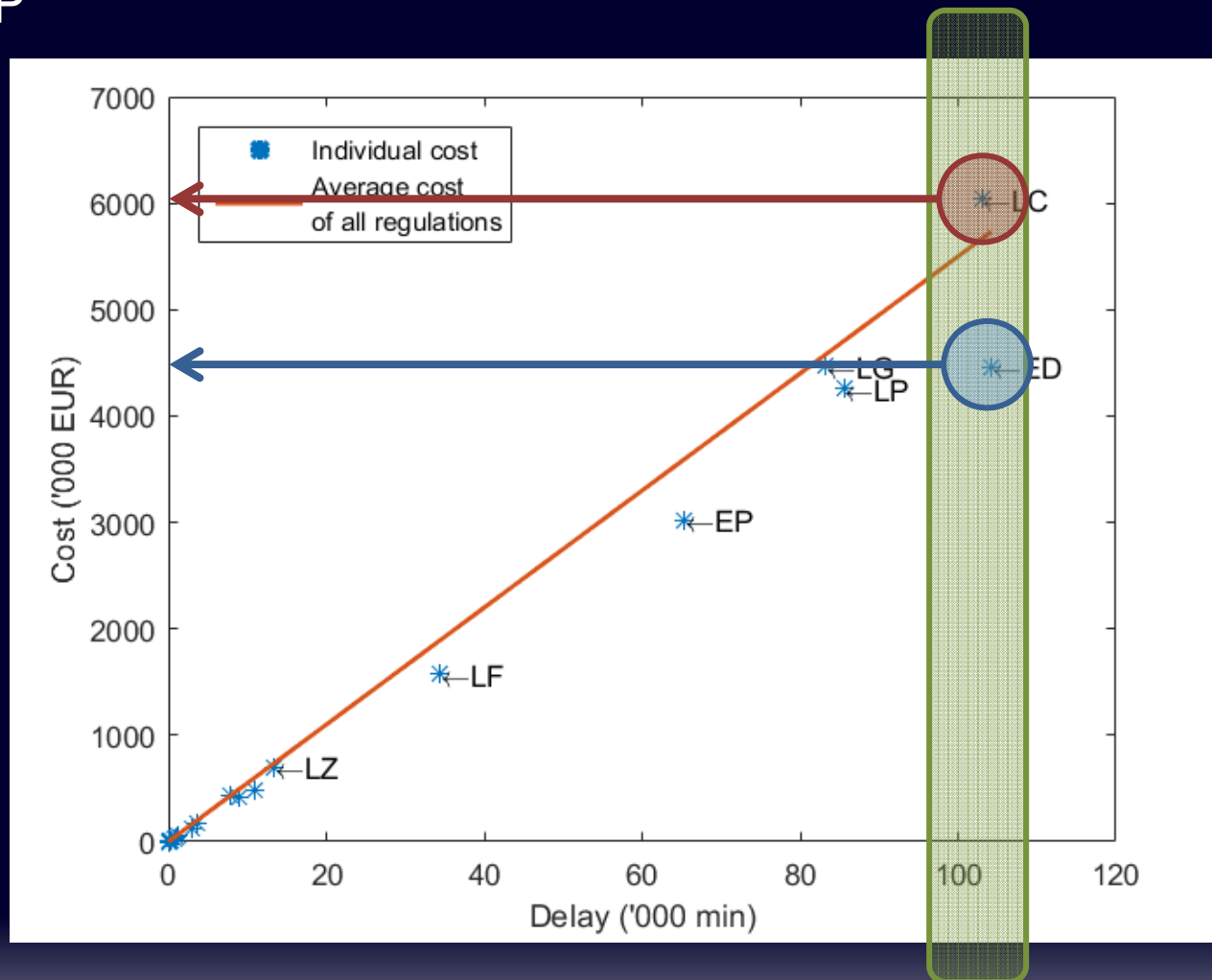
Regulation costs

By ANSP



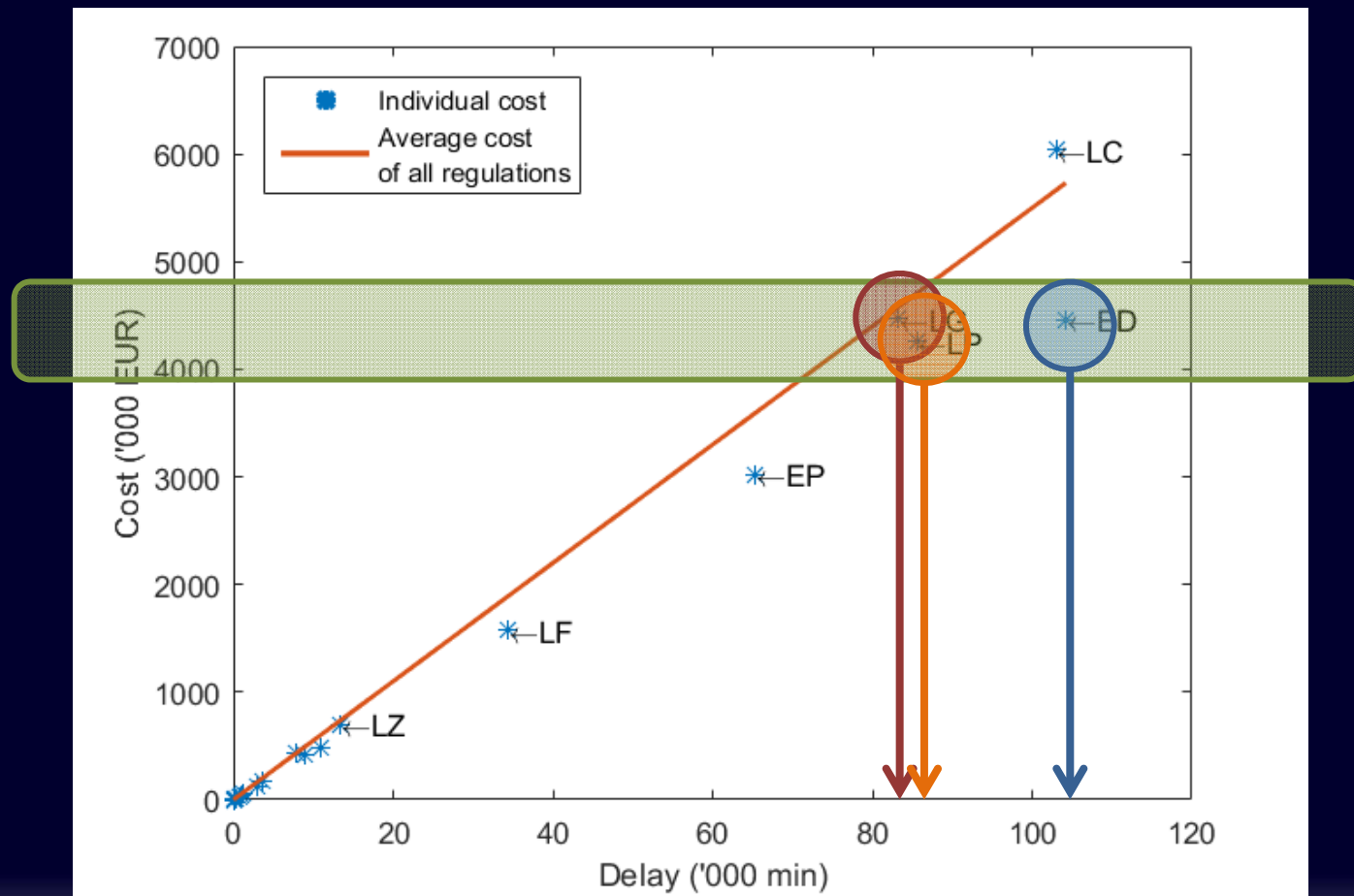
Regulation costs

By ANSP



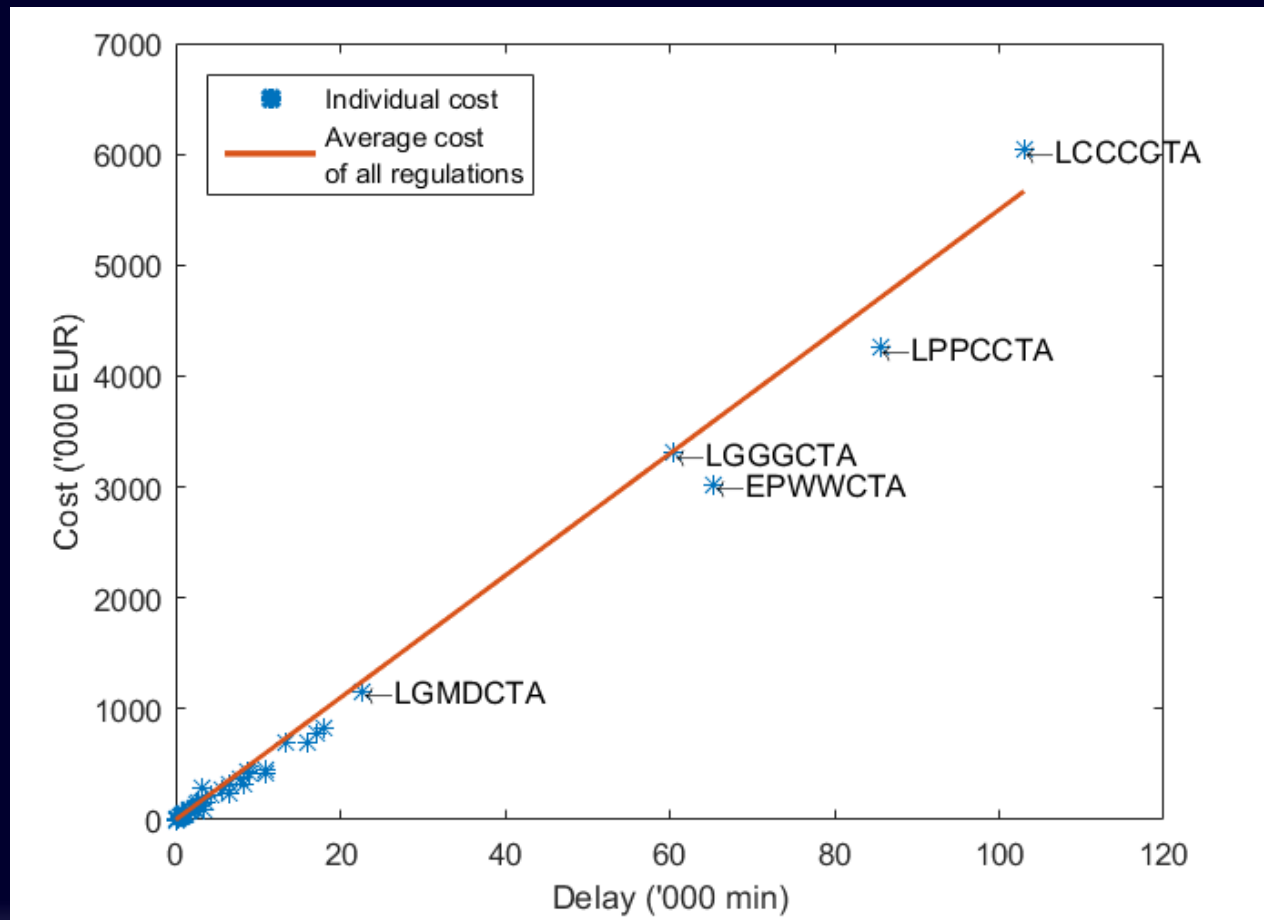
Regulation costs

By ANSP



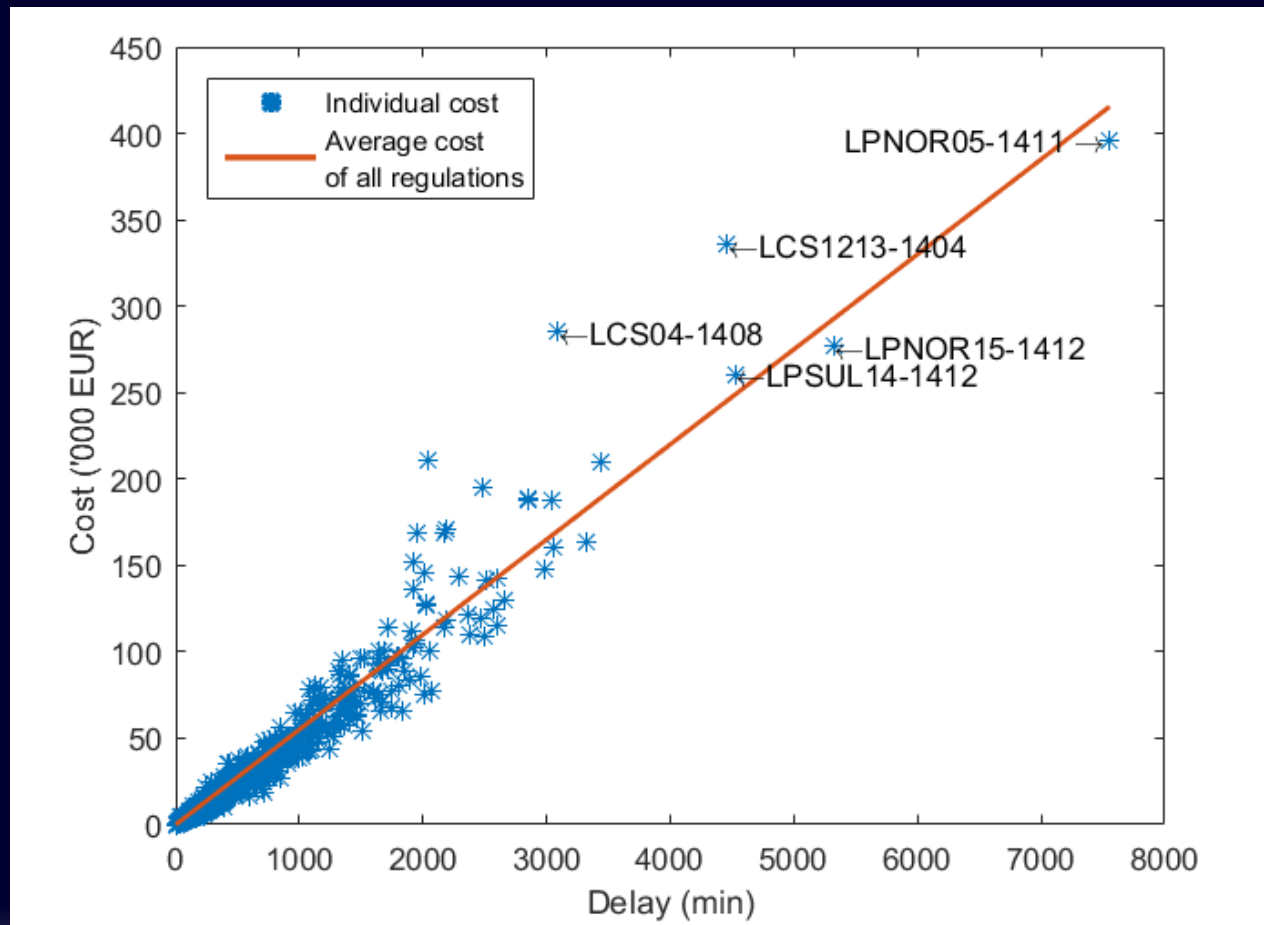
Regulation costs

By ACC



Regulation costs

By regulation

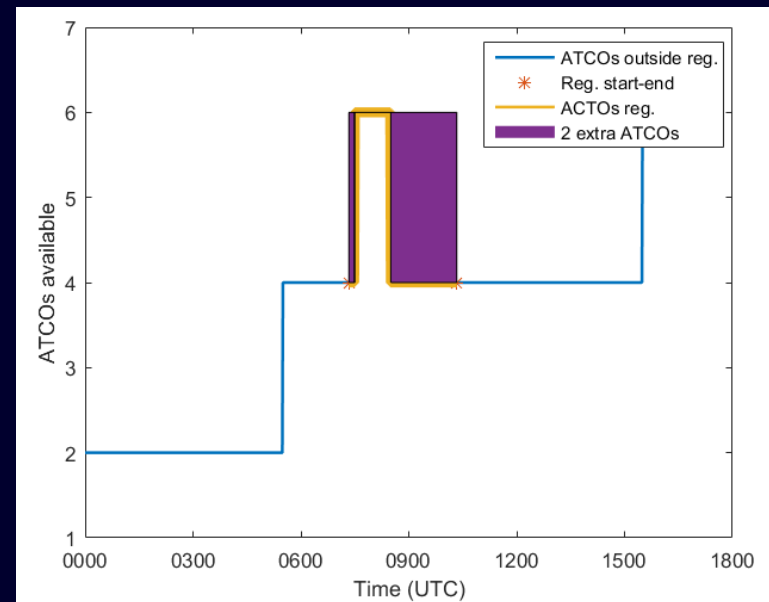


Analysis and results

- Mechanism analysis

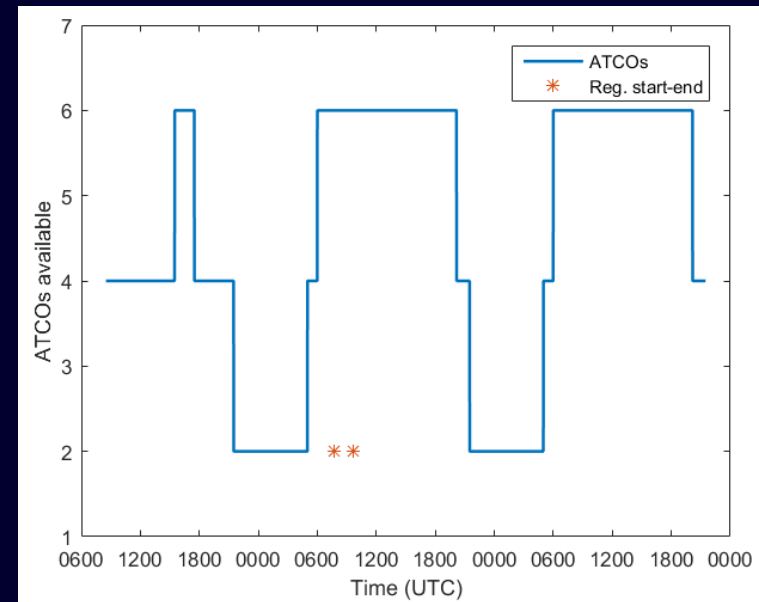
Mechanism analysis

- ATCO available
 - 1 112 regulations under study
- 198 regulations (17.8%)
some period with
maximum ATCOs



Mechanism analysis

- ATCO available
 - 1 112 regulations under study
 - 198 regulations (17.8%)
some period with
maximum ATCOs
 - 60 regulations (5.4%)
maximum number ATCO
during whole regulation



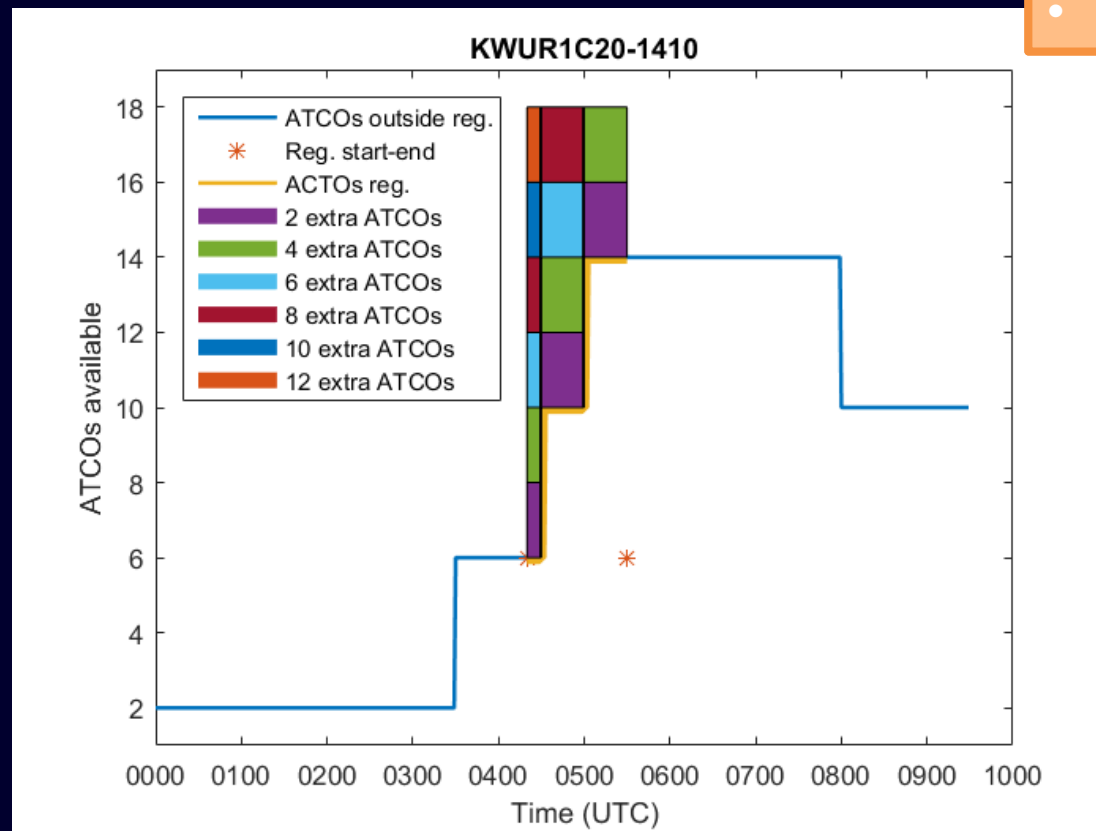
Mechanism analysis

- ATCO available
 - 1 112 regulations under study
 - 198 regulations (17.8%) some period with maximum ATCOs
 - 60 regulations (5.4%) maximum number ATCO during whole regulation
 - 914 regulations (82.2%) below maximum number ATCO
- If controllers added → regulation can be averted

Mechanism analysis

- KUR1C20 – AIRAC 1410

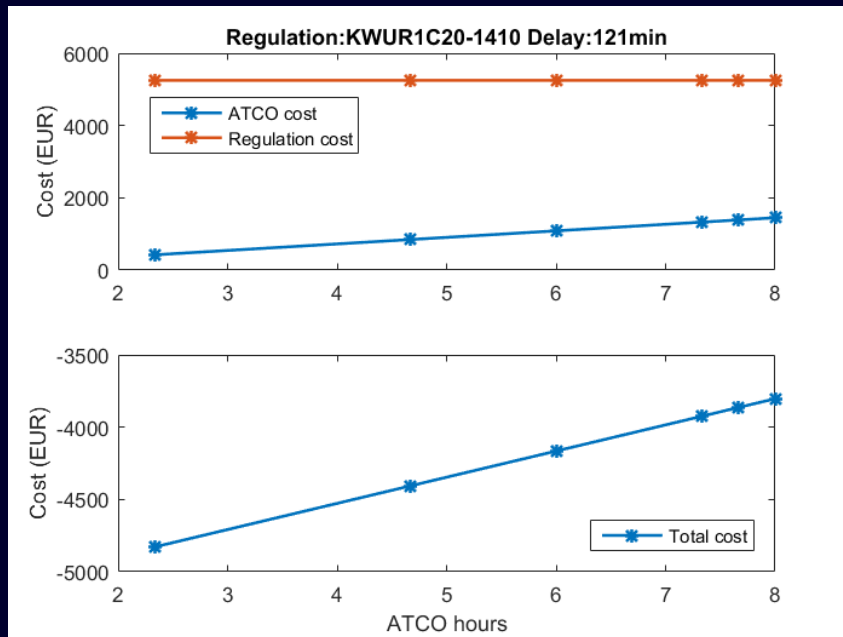
- 121 minutes delay
- EUR 5 251



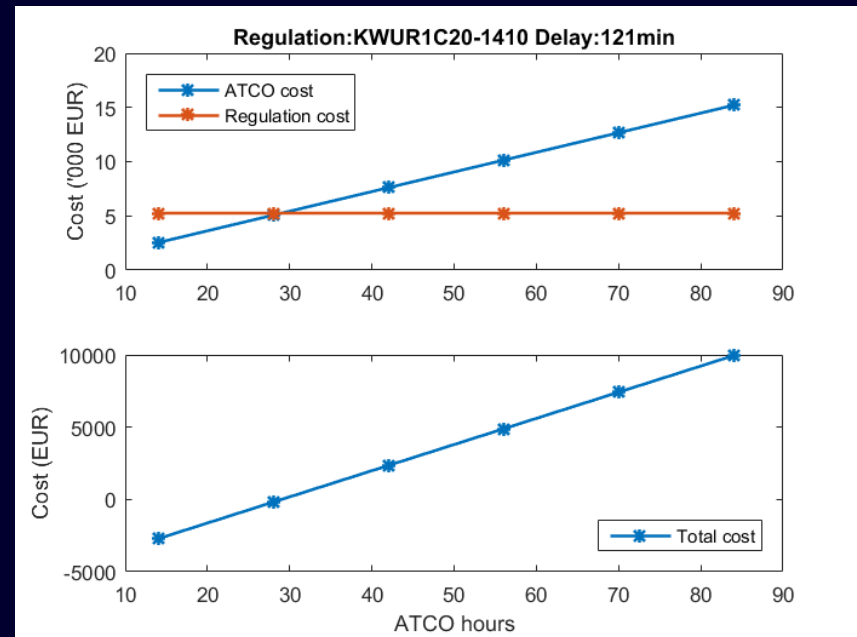
Mechanism analysis

- KUR1C20 – AIRAC 1410

Rule 1



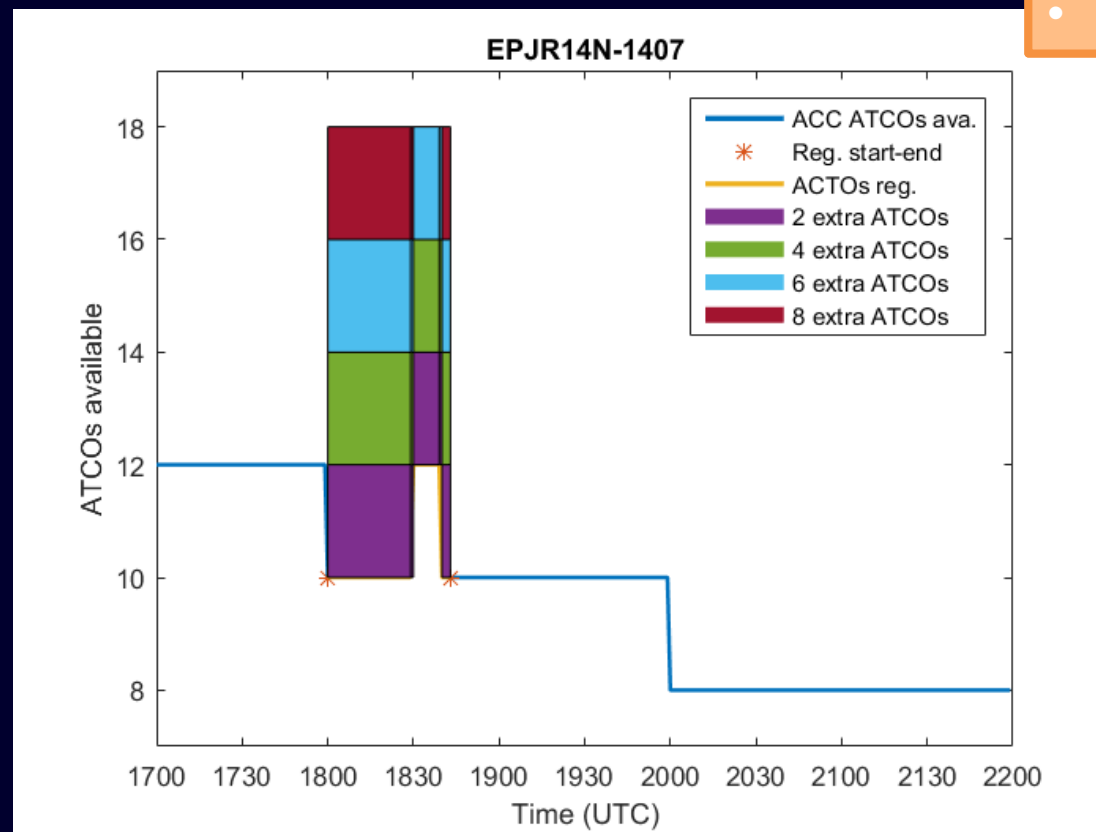
Rule 2



Mechanism analysis

- EPJR14N– AIRAC 1407

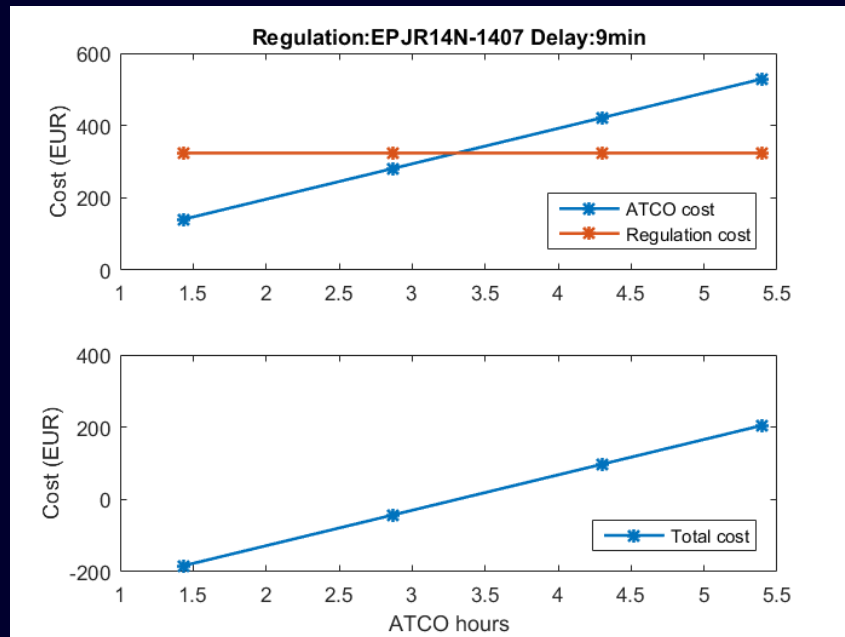
- 9 minutes delay
- EUR 390



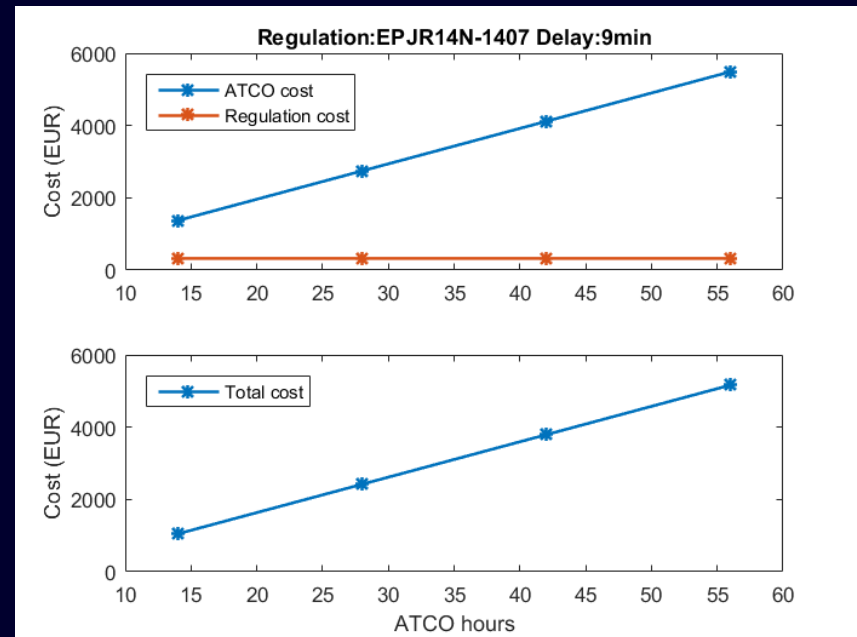
Mechanism analysis

- EPJR14N– AIRAC 1407

Rule 1



Rule 2



Mechanism analysis

- Three possibilities

Possibility	Description
Net gain	Delay cost is high enough as to justify adding ATCOs up to the maximum for the ACC
Net loss	Adding ATCOs leads to higher costs than the delay cost
Trade-off	With smaller number of controllers their cost is off-set by the cost of the delay avoided, whereas adding more controllers leads to higher net cost than the avoided delay

Mechanism analysis

- Results

Rule	Net gain	Net loss	Trade-off
1	87.1% (969)	5.8% (64)*	1.7% (19)
2	72.7% (808)	13.4% (149)*	8.5% (95)

* 56 regulations in these categories do not have delay

Conclusions

Conclusions

- Average cost of delay per minute of ATFM delay useful at aggregated level (e.g. ANSP)
- Characteristics of delay have an impact on cost generated
 - Should be considered when applying mitigation mechanism
 - Even at aggregated level: 48 EUR/min per delay for aerodrome capacity vs. 96 EUR/min per delay for industrial actions
- In majority of cases, cost of delay generated justify adding ATCO resources
- Different stakeholder bearing the cost (ANSPs) than obtaining the benefit (Airlines and Passenger)
- Adding ATCO hours might also impact other KPIs such as productivity

Further work

- Modelling of the capacity increment by adding ATCOs should be carried out
- In some cases regulation might not be completely averted, but reduced in duration and/or intensity
- Further research needed to model characteristics of delay generated by regulations

Thank you

Mechanism analysis

- ATCO available
 - Average 4.3 ATCOs shortage with respect to maximum ACC
 - Average 2.4 ATCOs shortage within 4 h before and after regulation
 - 1 112 regulations under study
 - 198 regulations (17.8%)
some period with
maximum ATCOs

