

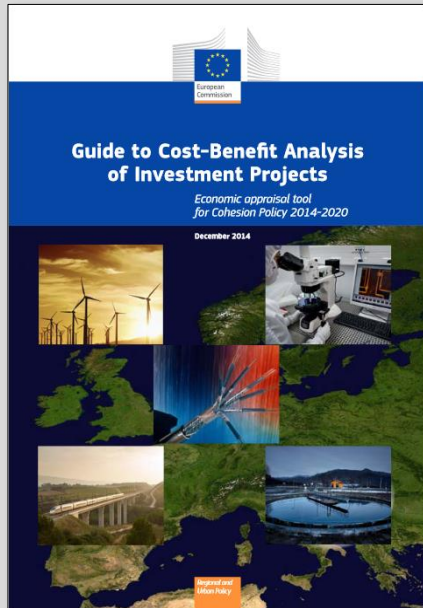


SOCIAL COST-BENEFIT ANALYSIS OF LHC AND HL-LHC

**Massimo Florio
with Andrea Bastianin
University of Milan
Cern Council 11 December 2020**

WHY A SOCIAL COST-BENEFIT ANALYSIS?

Because governments and international organizations are interested



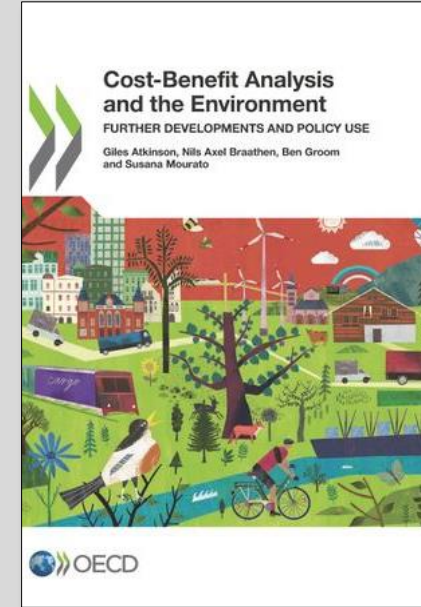
EC
European
Commission



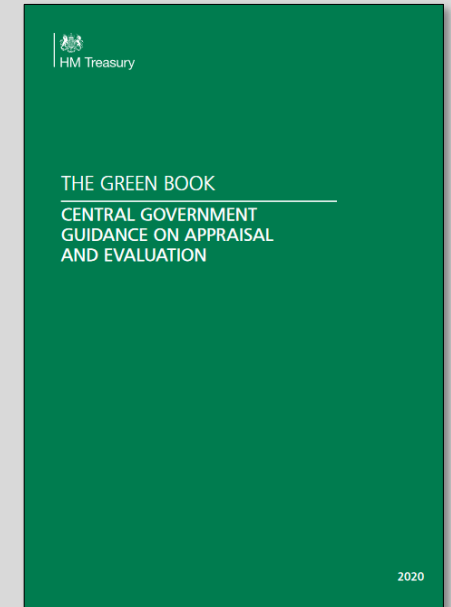
EIB
European
Investment
Bank



ESFRI
European
Strategy Forum
on Research
Infrastructures



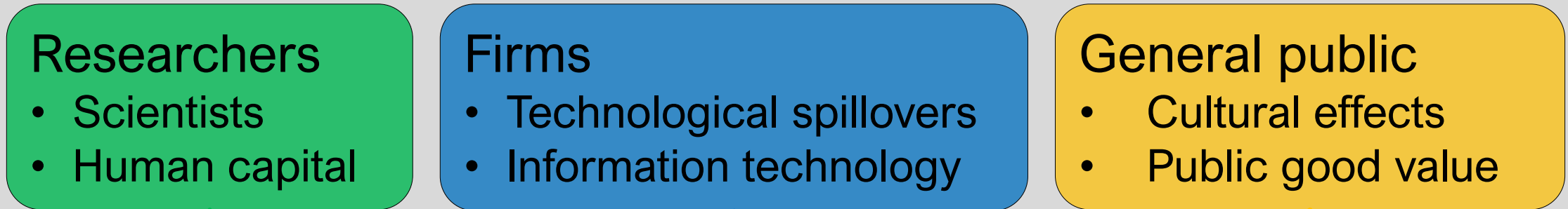
OECD
Organization for
Economic
Co-operation and
Development



UK
HM Treasury
and many more
governments...

SOCIAL BENEFITS OF THE LHC → HL-LHC PROGRAMME

- Integrated costs including construction and operation over full life time 1993 – 2038
- Integrated benefits 1993 – 2038 and beyond
- Swiss Francs (2016), discount rate 3%



$$Benefits = (S + H + T + C) + PGV$$

Benefit/Costs Ratio

$$\frac{B}{C} > 1?$$

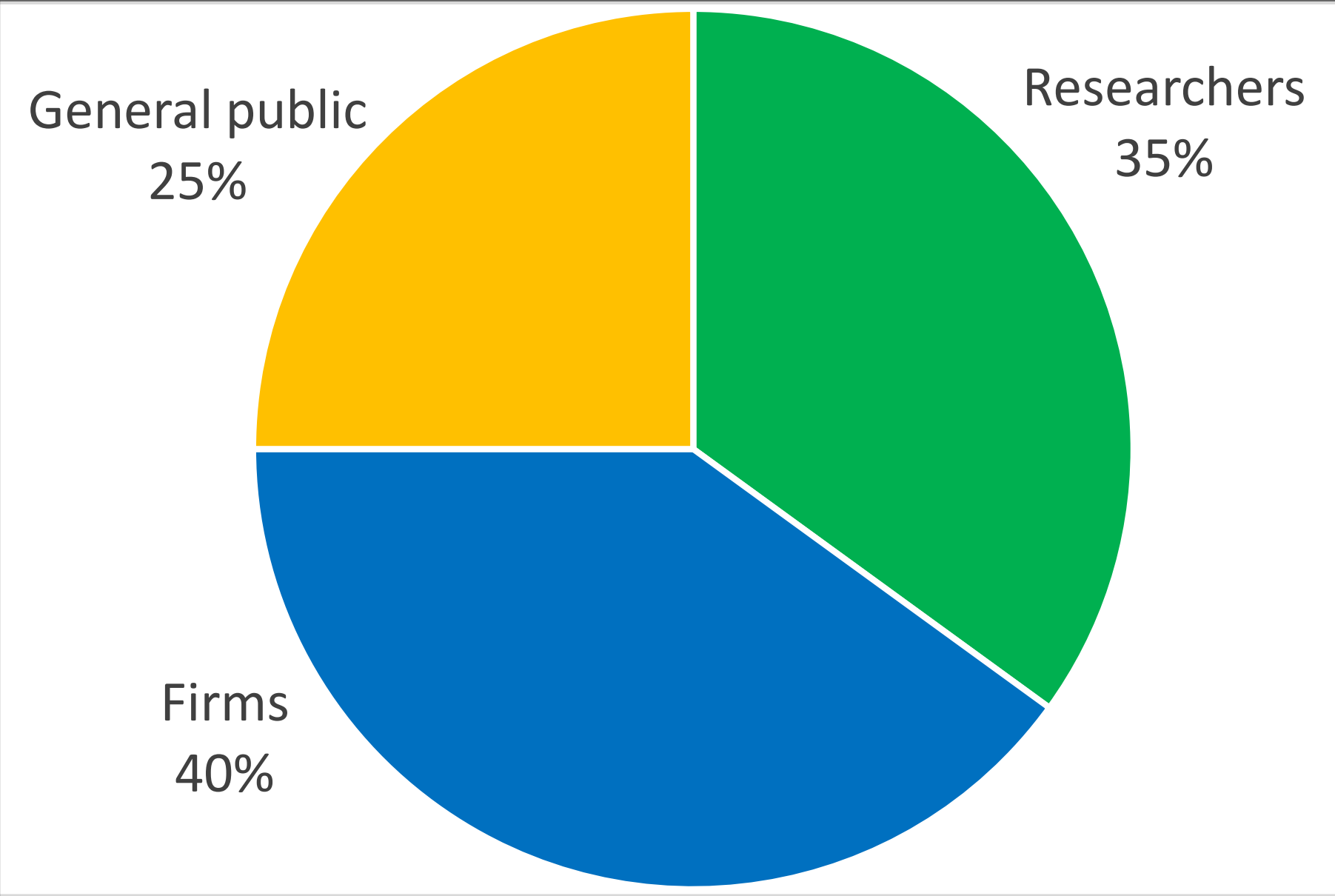
PV_{B_u}

PV_{B_n}

Present Value of benefits for users

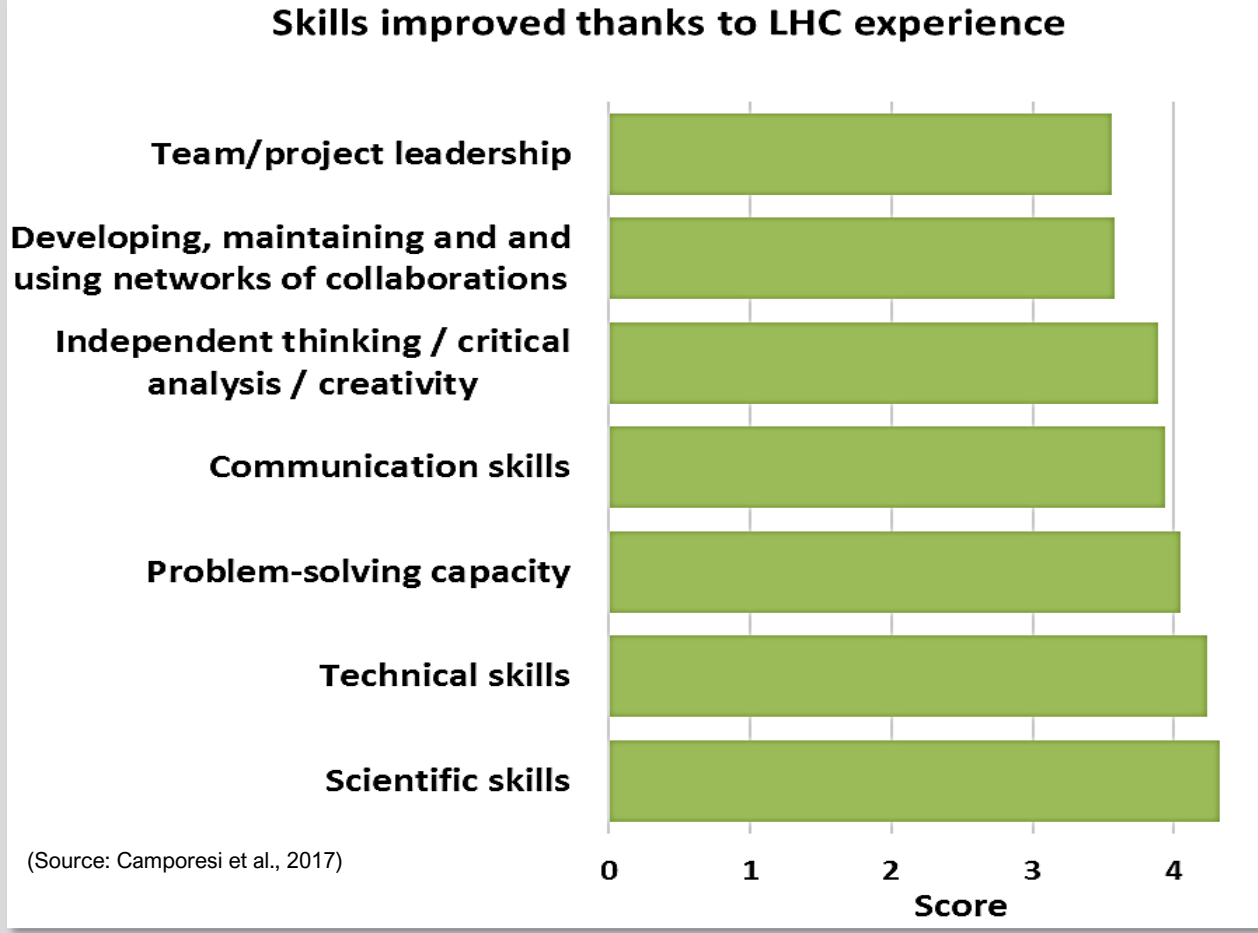
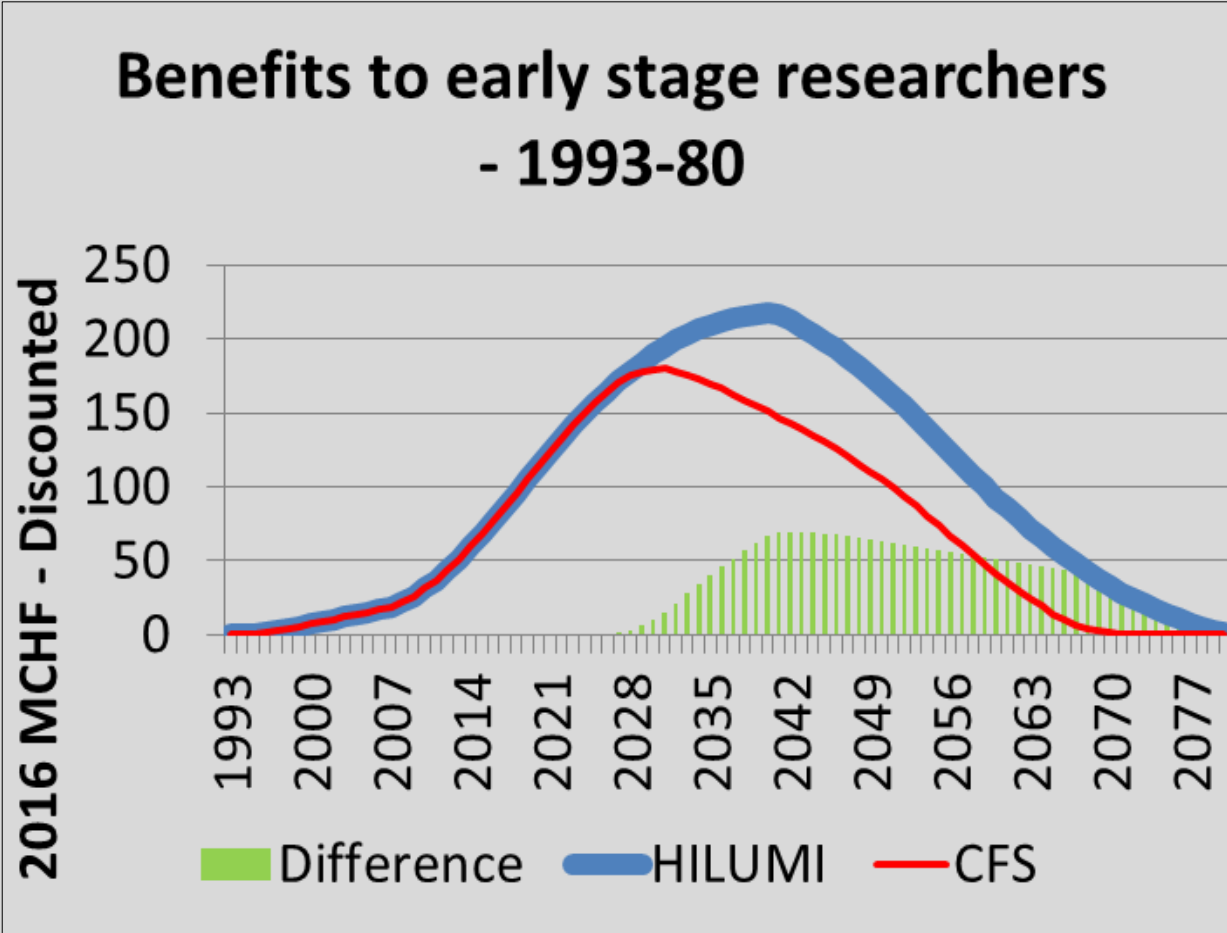
Present Value of benefits for non-users

THE SOCIAL BENEFITS OF LHC → HL-LHC TO 2038 AND BEYOND



EARLY STAGE RESEARCHERS (H) - HUMAN CAPITAL EFFECTS (1993-2080)

- CFS=Counterfactual scenario without HILUMI



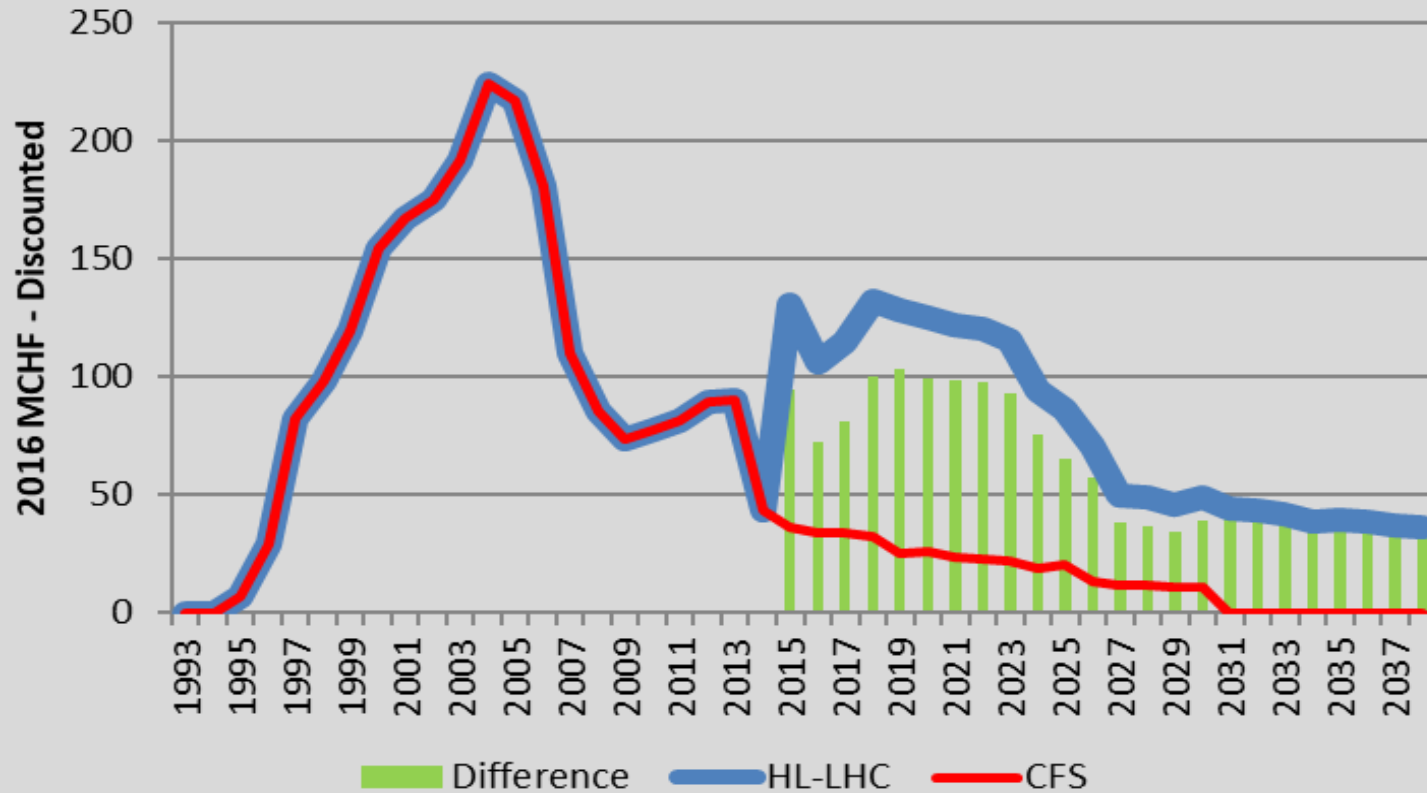
Data and methods:

- Surveys of current students
- Former students
- Team leaders
- Literature on returns education

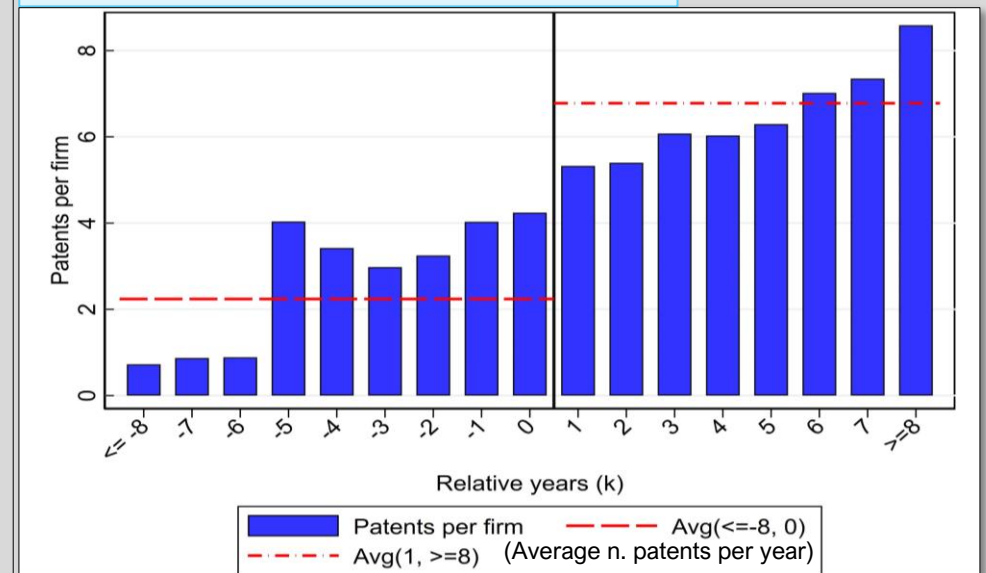
Long life salary premium 7-13%

TECHNOLOGICAL SPILLOVERS – FIRMS (1993-2038)

HT suppliers



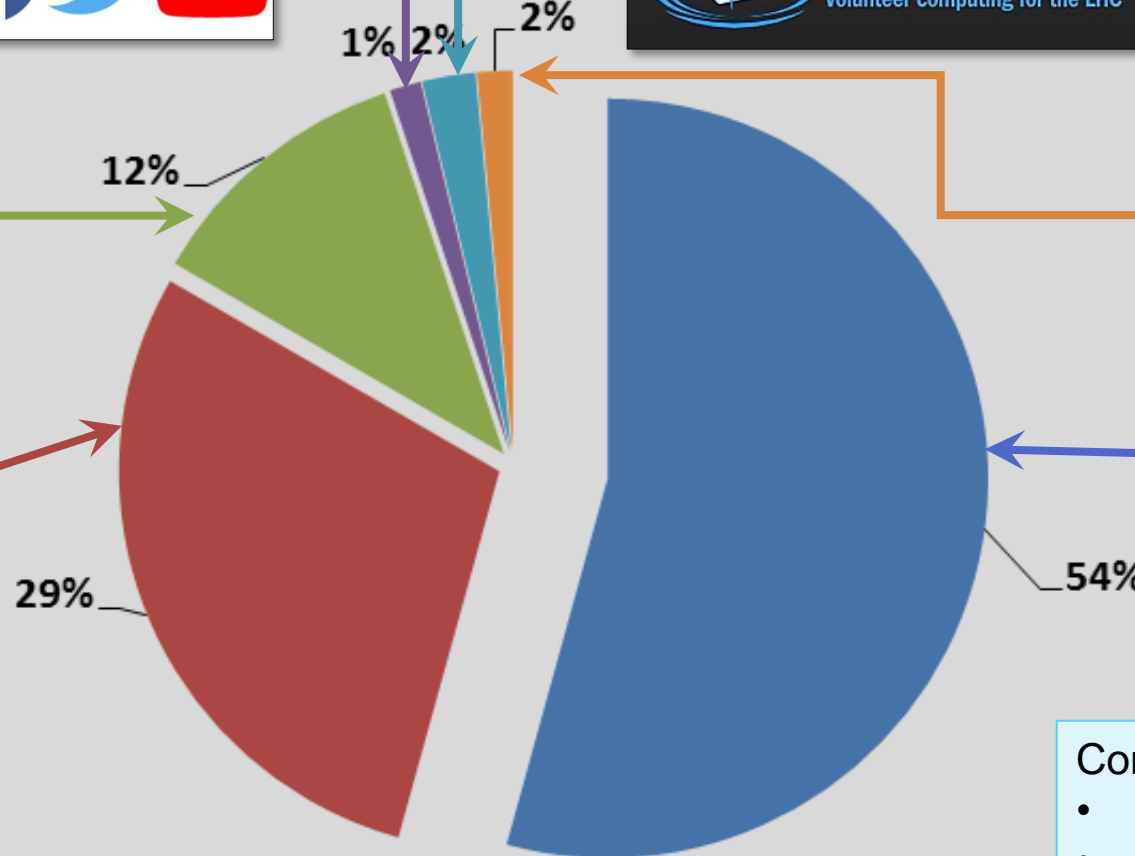
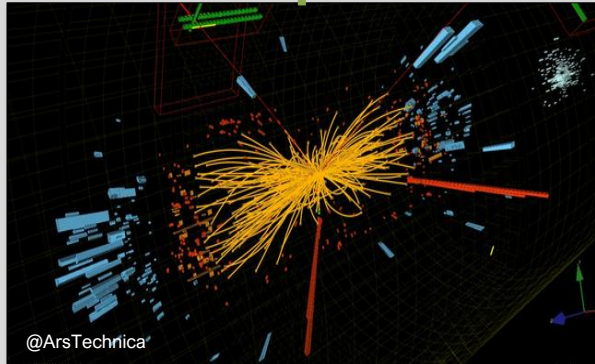
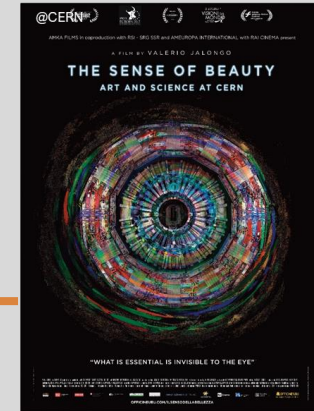
- Surveys and Bayesian network
- Case studies
- Balance sheet data
- Around 1000 firms



- Data and methods:
- $PROC(t) \times Share^{HT\ PROC} \times S^{Mult} \times DP$
- $PROC(t)$ = total yearly procurement

- $Share^{HT\ PROC}$ = share of hi-tech procurement $PROC(t)$ and S^{Mult} = sales multiplier
- DP = average incremental expected gross profit of a representative sample of collaborating firms

CULTURAL EFFECTS (C) – GENERAL PUBLIC (1993-2038)



Data and methods:

- Travel cost methods for online visitors
- Value of time for virtual visitors

- Personal visitors
- Website visitors
- Volunteer computing
- Mass media on the public
- Social media users
- Other Cultural Benefits

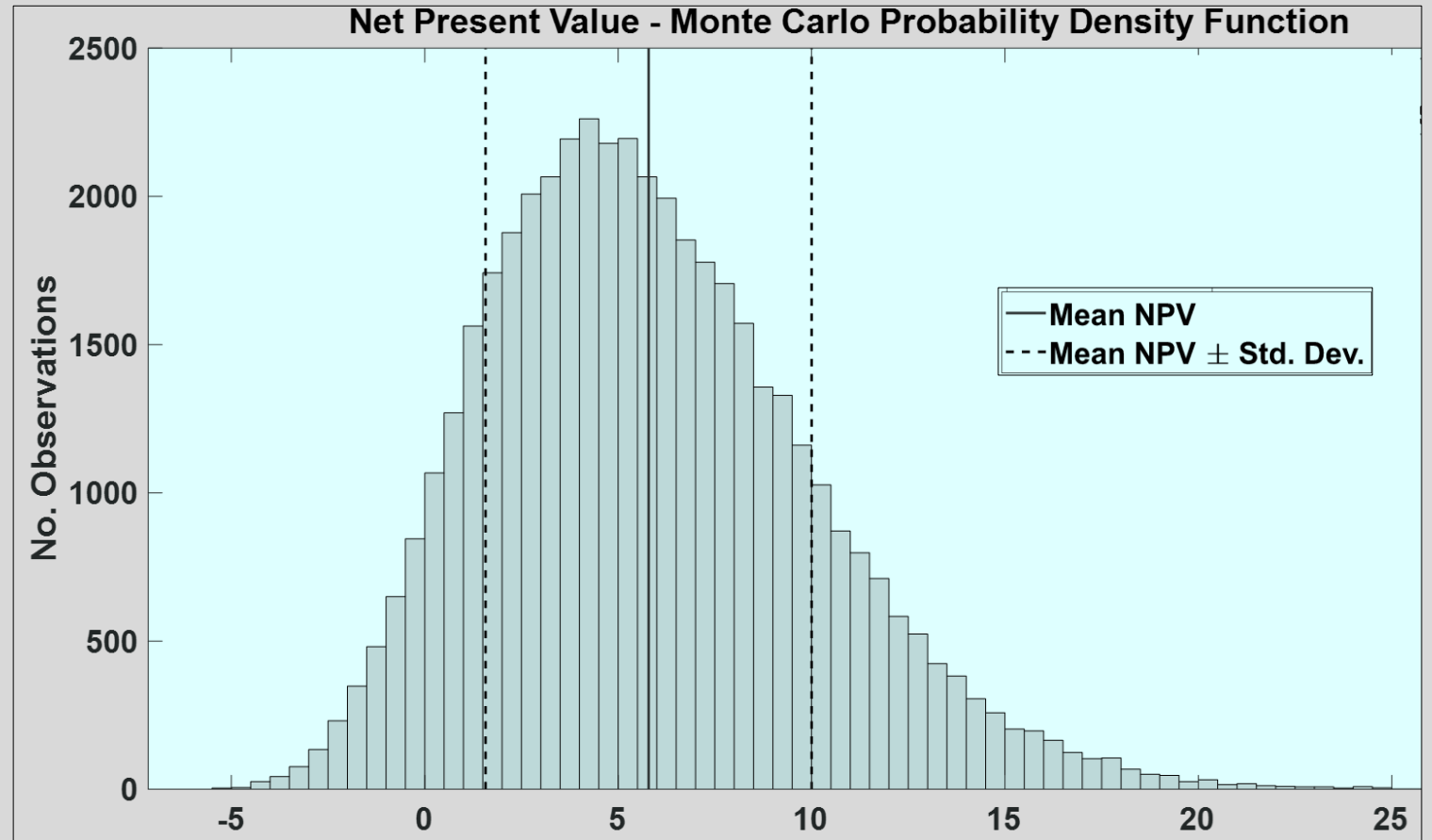
Contingent valuation experiments

- 1000 French citizens
- 1000 Swiss citizens
- 1022 students in five countries
- Willingness to pay for future investments at CERN

SUMMING UP: BENEFITS AND COSTS

STOCHASTIC NET PRESENT VALUE OF LHC + HIGH LUMINOSITY LHC

Benefits baseline	25.7
Scientific publications	0.6
Human capital	8.5
Technological spillovers	10.2
Cultural benefits	3.3
Public good value	3.1
Costs baseline	22.3
Net Present Value	3.4

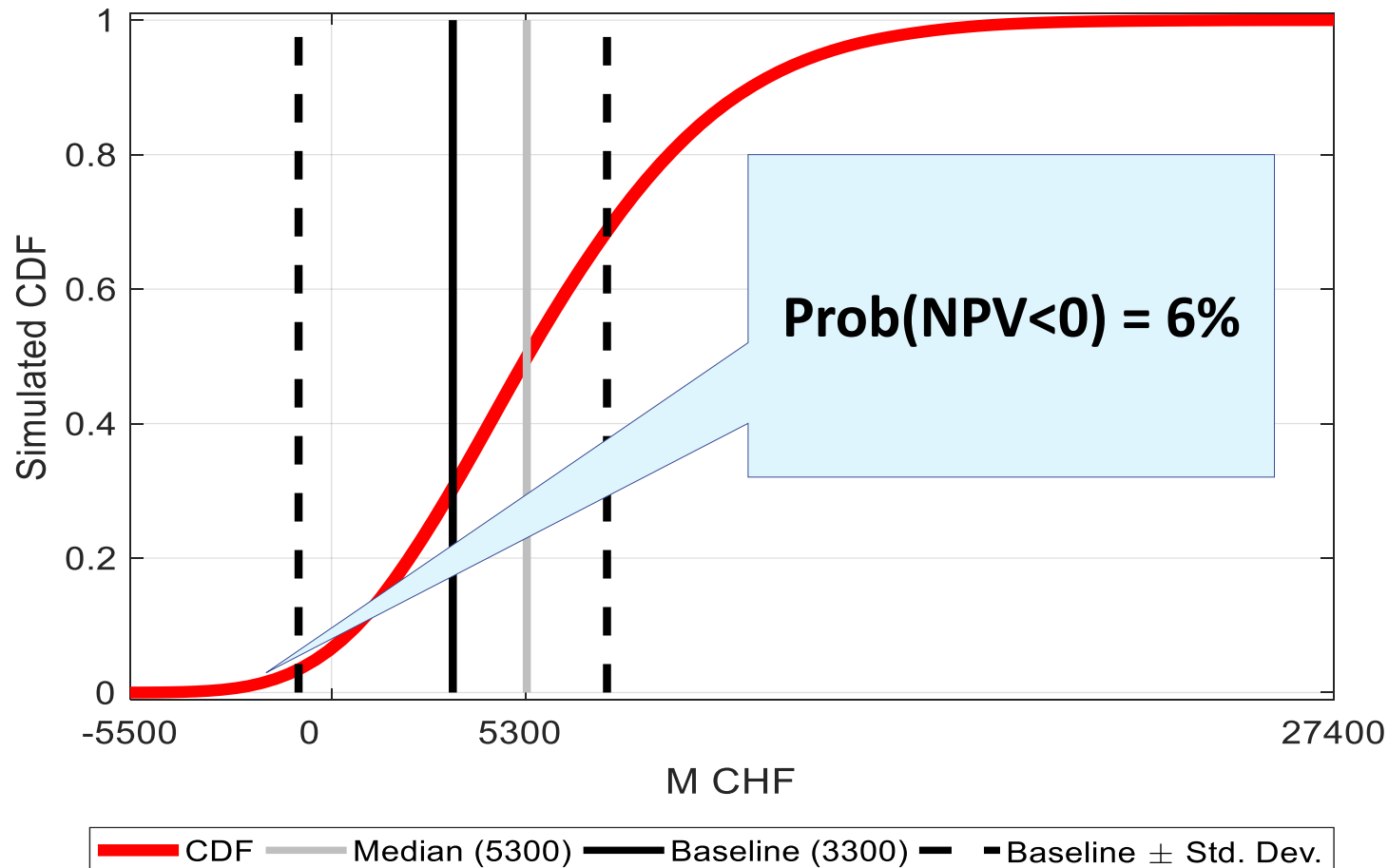


Source: Bastianin, Florio (2018)

Billion CHF 2016

$$NPV = (PV_{B_u} + PV_{B_n}) - PV_C$$

LHC → HL-LHC NET PRESENT VALUE: 1993-2080



- Benefit/Cost ratio integrated LHC – HL-LHC : **1,16**
- Benefit/Cost ratio HL-LHC: **1,80**

- NPV cumulative distribution function
- Probability that NPV < x
- 50.000 Montecarlo runs

THANK YOU

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