Clean Industrial Policy

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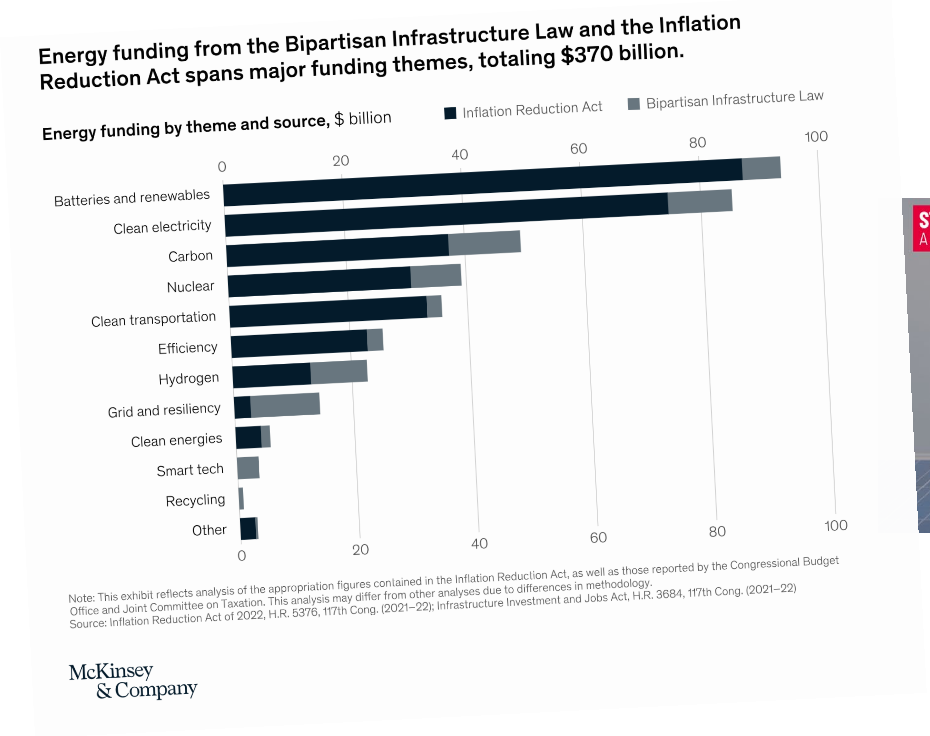
Centre for Economic Performance

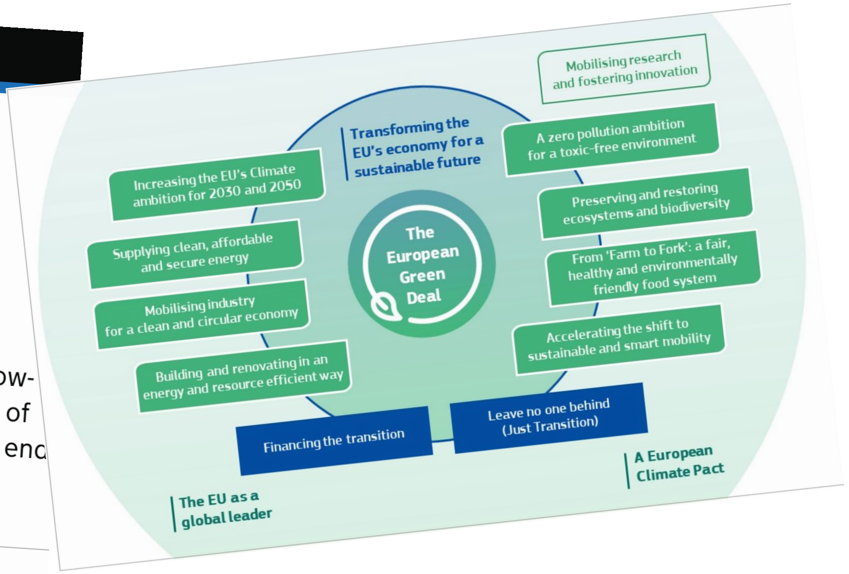
PRINZ

LSE

Context

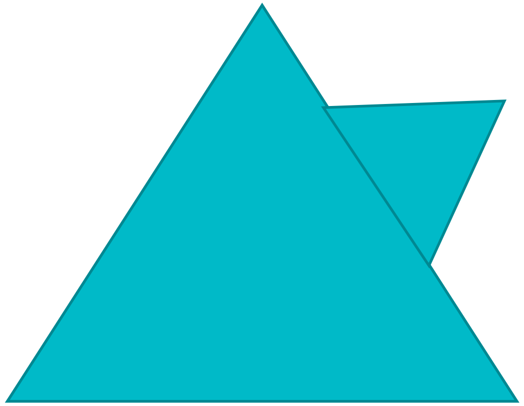
- **Revival of vertical Industrial Policy**
- **IRA: $400 billion over 10 years**
- **EU Green deal €1.5 Trillion**





Policy objectives

Mitigating Climate Emergency

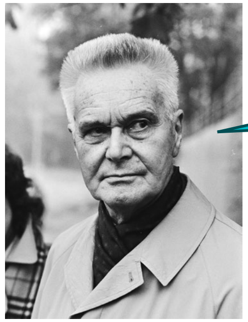


Energy security

Increasing economic growth & incomes

Reducing economic inequality

- Inexorable tradeoffs?
- Or potential for win-win-win-win?
- Spillovers are key



Can we trick Tinbergen?

Our research…

Guillard et al: "Efficient Industrial Policy: Standing on the shoulders of hidden giants"

- *New approach to measure knowledge spillovers and the return to public R&D subsidies from patent data*
- *Compare clean tech to other (trending) technology fields*
- *Examine spillover flows between countries and regions (and how they differ for clean tech vs other tech*

>

?

Questions

And how we try to answer them..

- Can we have both: more and cleaner growth?

  Are knowledge spillovers from clean tech bigger than from other techs?

- Which (clean) areas in particular should we support?

  Do some clean areas generate more spillovers

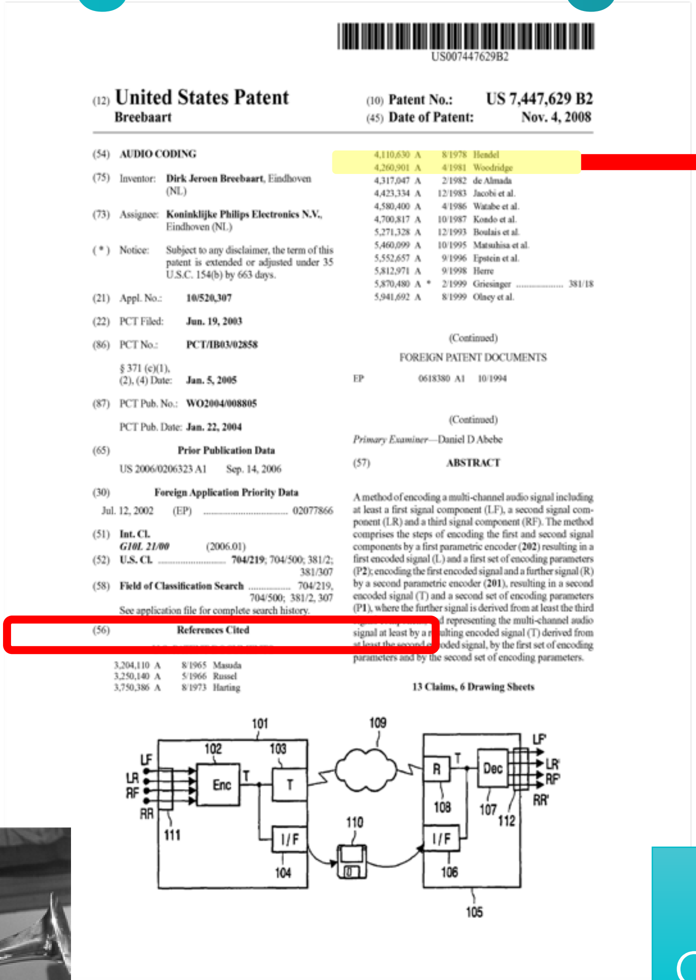
- Should we be worried (e.g. in the UK or Europe) if the US expands subsidies for clean?

  Examine spillover flows between major regions

- How inclusive is “green growth”?

  Examine spillover flows between (and within) leading and lagging regions

Measuring knowledge spillovers from patent data


US007447629B2

(12) **United States Patent**
Breebaart

(10) **Patent No.:** US 7,447,629 B2
(45) **Date of Patent:** Nov. 4, 2008

(54) AUDIO CODING

(75) Inventor: Dirk Jeroen Breebaart, Eindhoven (NL)

(73) Assignee: Koninklijke Philips Electronics N.V., Eindhoven (NL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 663 days.

(21) Appl. No.: 10/520,307

(22) PCT Filed: Jun. 19, 2003

(86) PCT No.: PCT/IB03/02858

§ 371 (c)(1), (2), (4) Date: Jan. 5, 2005

(87) PCT Pub. No.: WO2004/008805

PCT Pub. Date: Jan. 22, 2004

(65) Prior Publication Data

US 2006/0206323 A1 Sep. 14, 2006

(30) Foreign Application Priority Data

Jul. 12, 2002 (EP) 02077866

(51) Int. Cl.
G10L 21/00 (2006.01)

(52) U.S. Cl. 704/219; 704/500; 381/2; 381/307

(58) Field of Classification Search 704/219, 704/500; 381/2, 307

See application file for complete search history.

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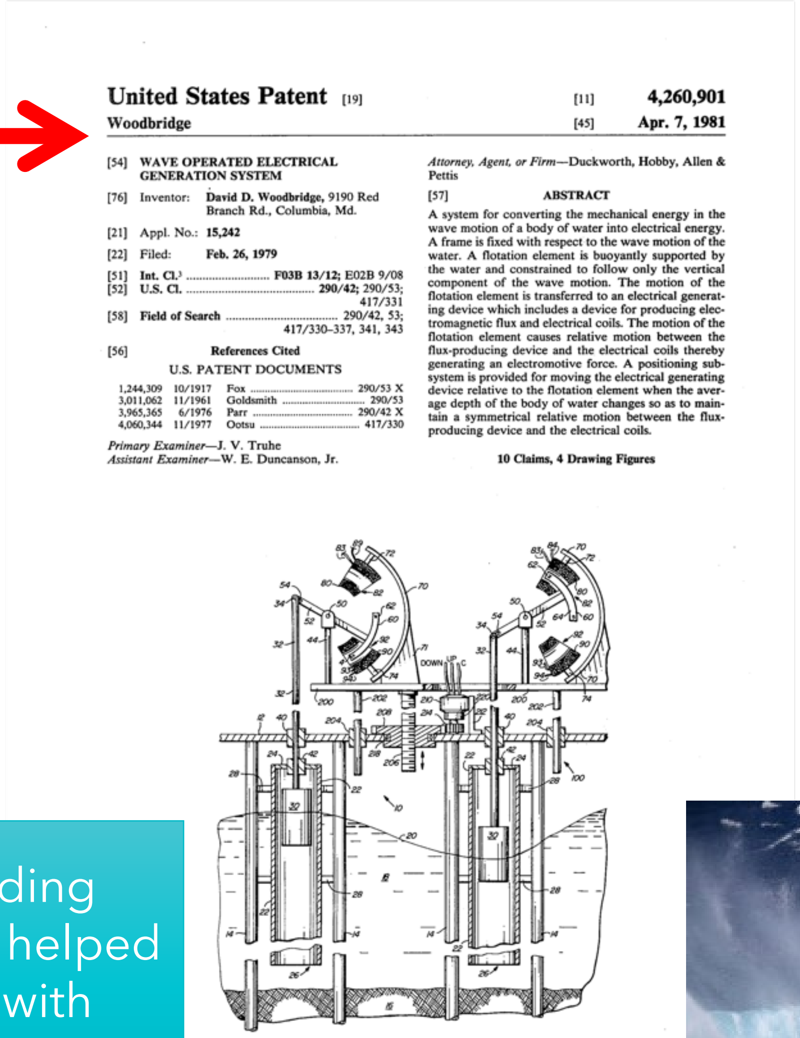
Primary Examiner—Daniel D Abebe

(57) ABSTRACT

A method of encoding a multi-channel audio signal including at least a first signal component (LF), a second signal component (LR) and a third signal component (RF). The method comprises the steps of encoding the first and second signal components by a first parametric encoder (202) resulting in a first encoded signal (L) and a first set of encoding parameters (P2); encoding the first encoded signal and a further signal (R) by a second parametric encoder (201), resulting in a second encoded signal (T) and a second set of encoding parameters (P1), where the further signal is derived from at least the third signal ... representing the multi-channel audio signal at least by a resulting encoded signal (T) derived from at least the second encoded signal, by the first set of encoding parameters and by the second set of encoding parameters.

13 Claims, 6 Drawing Sheets


United States Patent [19]
Woodbridge

[11] 4,260,901
[45] Apr. 7, 1981

[54] WAVE OPERATED ELECTRICAL GENERATION SYSTEM

[76] Inventor: David D. Woodbridge, 9190 Red Branch Rd., Columbia, Md.

[21] Appl. No.: 15,242

[22] Filed: Feb. 26, 1979

[51] Int. Cl.³ F03B 13/12; E02B 9/08

[52] U.S. Cl. 290/42; 290/53; 417/331

[58] Field of Search 290/42, 53; 417/330–337, 341, 343

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Primary Examiner—J. V. Truhe
Assistant Examiner—W. E. Duncanson, Jr.

Attorney, Agent, or Firm—Duckworth, Hobby, Allen & Pettis

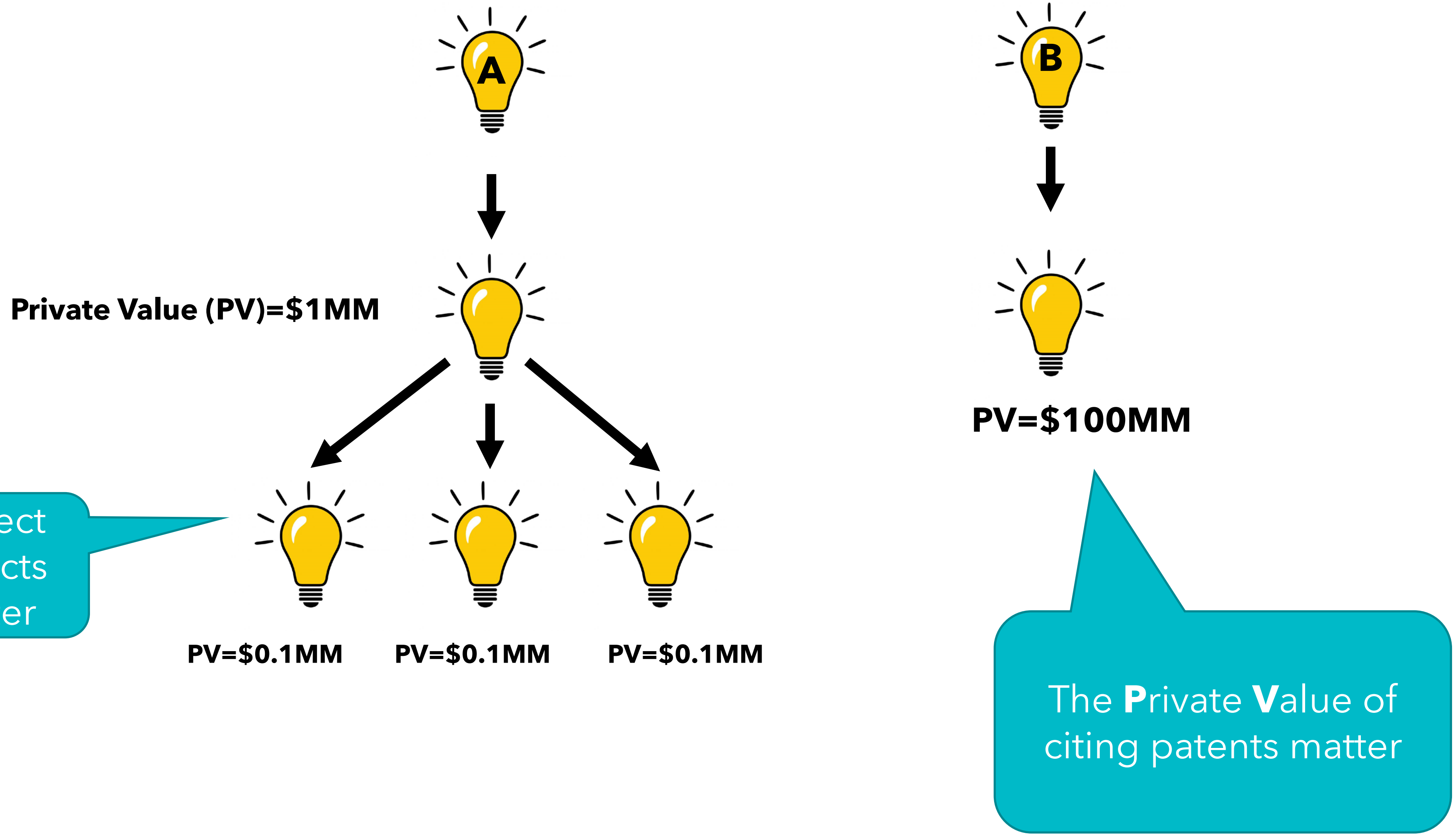
[57] ABSTRACT

A system for converting the mechanical energy in the wave motion of a body of water into electrical energy. A frame is fixed with respect to the wave motion of the water. A flotation element is buoyantly supported by the water and constrained to follow only the vertical component of the wave motion. The motion of the flotation element is transferred to an electrical generating device which includes a device for producing electromagnetic flux and electrical coils. The motion of the flotation element causes relative motion between the flux-producing device and the electrical coils thereby generating an electromotive force. A positioning subsystem is provided for moving the electrical generating device relative to the flotation element when the average depth of the body of water changes so as to maintain a symmetrical relative motion between the flux-producing device and the electrical coils.

10 Claims, 4 Drawing Figures

Understanding Ocean waves helped in dealing with Audio Waves

Hidden Giants vs Illusory Giants



PRANK vs Page Rank

From random surfer to economic value

Social Value of Innovation i

$$PRANK_i = PrivateValue_i + \sum_{j \in B(i)} \phi_{ij}\, PRANK_j$$

Private Value + Share of PRANK of citing innovations

All Innovations citing i

$$\phi_{Sij} = \sigma \frac{1}{BackwardCitations_j} < 1$$

Similar to Google's Page Rank but social value interpretation instead of random surfer

$$PAGE\ RANK_i = \frac{1}{\#Webpages}\alpha + \sum_{j \in B(i)} \phi_{ij}\, PAGE\ RANK_j$$

Motivation: $PRANK_j = A_j \times (BC_j)^{\sigma} \times X_j^{1-\sigma}$

Think of it as a Social value production function

Sum of backward citations of innovations *i*

$\sigma = elassticity\ of\ value\ response\ to\ citations$

From PRANK to spillovers

$$PRANK_i = PrivateValue_i + \sum_{j \in B(i)} \phi_{ij}\, PRANK_j$$

Prank corresponds to the marginal impact of one more backward citation $B_j = \sum_i 1$

$$Spillovers_i = PRANK_i - PrivateValue_i$$

Prank vs counting citations

Let's stop being In-coherent

$$PRANK_i = PrivateValue_i + \sum_{j \in B(i)} \phi_{ij}\, PRANK_j$$

$$CiteCount_i = \sum_{j \in B(i)} 1$$

Innovations are heterogeneous on the LHS

Innovations are homogenous on the RHS

Private Value of an Innovation

- Privat Value: Kogan (QJE2017) et al propose event study

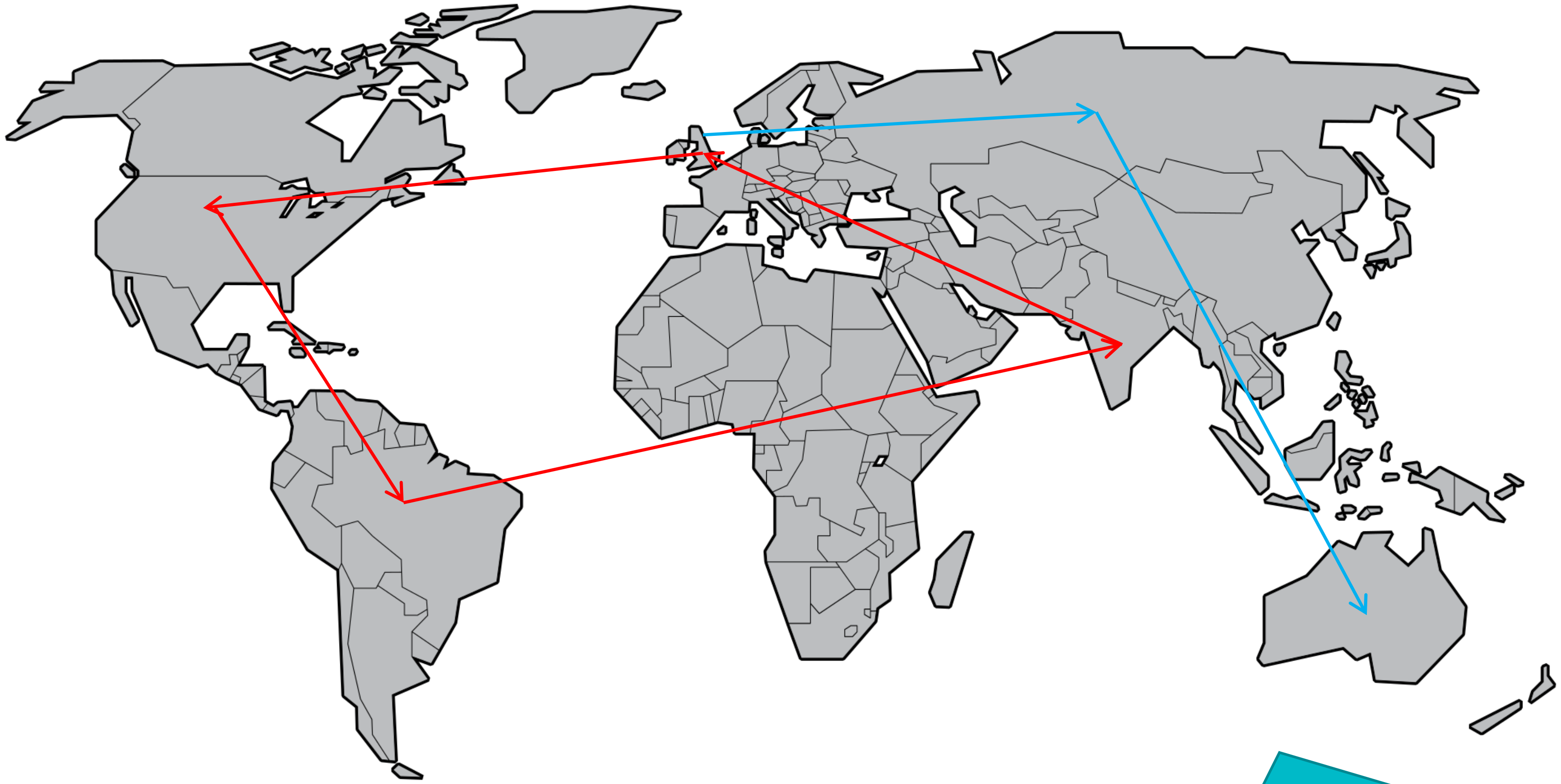
Probability of Success

$$\Delta MarketValue_{Firm(i)} = (1 - \pi_i) \times PatentValue_i$$

For non public firms? → Extrapolate by

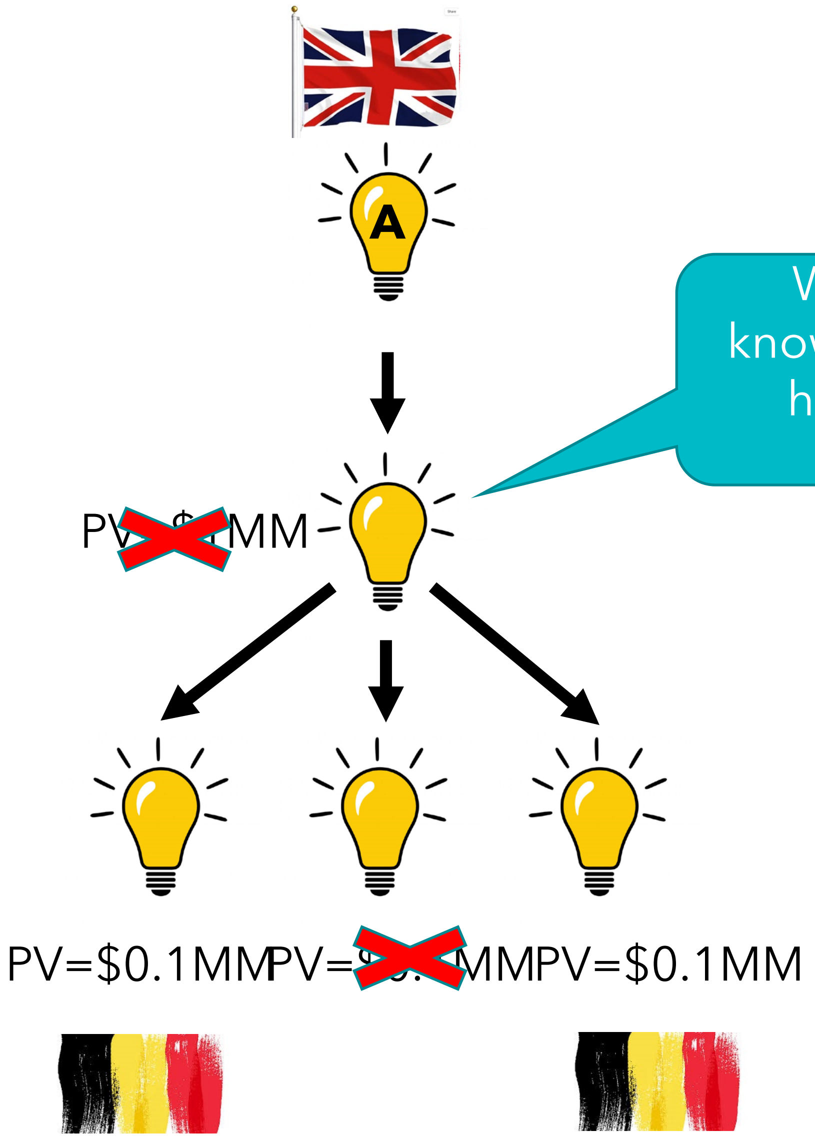
- Technology class
- Claim count
- Family size

National vs Global Spillover



How internalised are spillovers at the level of countries/regions/sectors

National vs Global vs between nations



We can also examine flows of knowledge between countries; e.g. how a non-Belgian innovation contributed to Belgium.

The return on R&D subsidies....

- So far we discussed how we can compute "**social value**" of innovations
- Relevant for investors and government is the return on R&D or R&D subsidies
- Heterogeneity in R&D investment required for an inventive step (patent) across fields
- Heterogeneity in how innovators respond to R&D subsidies

A simple model

R&D

Flow of ideas (Pareto distribution)

Curvature of idea distribution

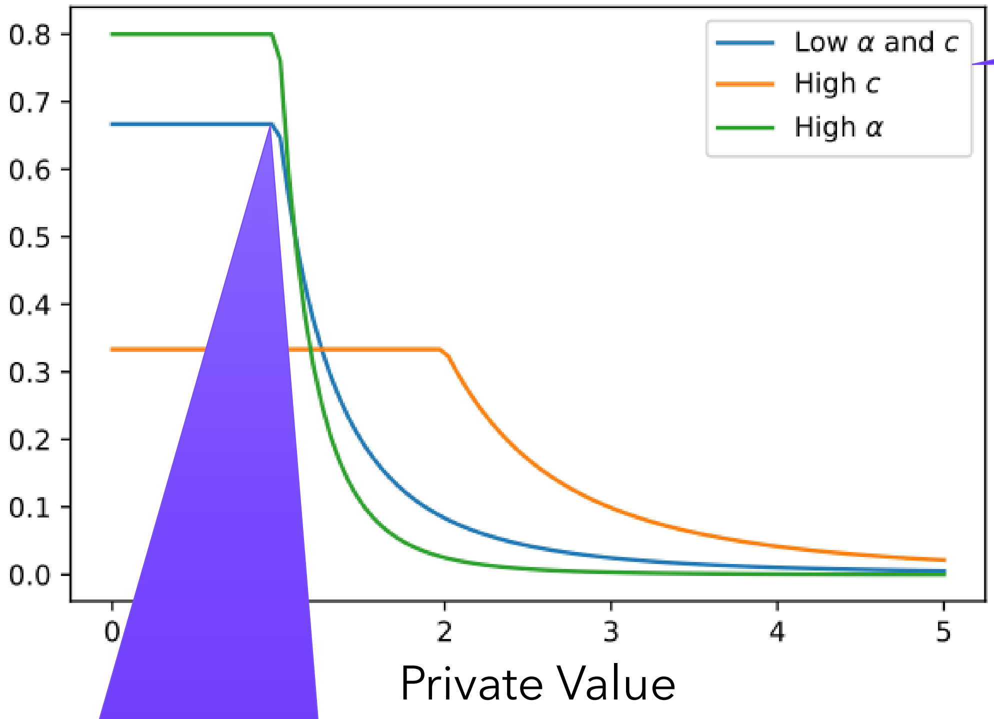
Project cost

$$P(PV_i \leq v|\delta > \lambda) = \Phi^{PV}(v) = \begin{cases} \frac{\alpha v}{(\alpha+1)2c} & \text{if } 2c > v \\ 1 - \frac{2^\alpha c^\alpha}{(\alpha+1)v^\alpha} & \text{if } 2c < v \end{cases}$$

- We calibrate this model using the distribution of private patent values
- Specific parameters for narrow technology fields

Inferring R&D spending from the private value distribution

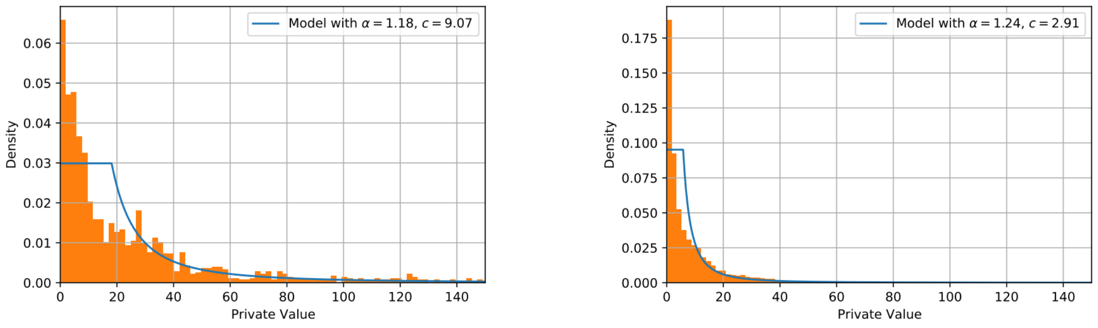
Backing out the innovation response from the curvature of the private value distribution



Backing out the R&D cost from the location of the peak of the private value distribution

Figure 7: Actual vs modeled PV distributions

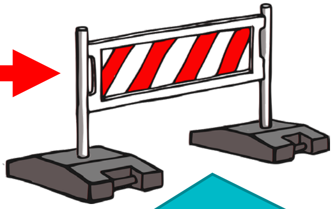
(a) A61K (b) G06F



Notes: Comparison of actual and modeled private value distributions for two prevalent IPC subclasses. Histogram plots actual private value distribution in the class, blue line shows the modeled density. Private values are based on those estimated in KPSS.

[33] A61K: 'Preparations for medical, dental, or toilet purposes' and G06F: 'Electric digital data processing'

The marginal impact of subsidies



R&D

- Subsidy increase implies that barriers are lowered
- Somewhat lower quality ideas get now developed
- Impact depends on tech specific R&D cost and probability density of ideas near threshold
- Also: marginal spillovers might be different from average

ISTRAX Detail

Marginal financial return of increasing per project support *s*

$$
\begin{aligned}
IStraX &= \left(\frac{\partial E\{V\}}{\partial s} - \frac{\partial E\{S\}}{\partial s} \right) \times \left(\frac{\partial E\{S\}}{\partial s} \right)^{-1} && (21) \\
&= \frac{1 + \frac{1}{c} E\{EV(\alpha - \alpha \times \mathbb{I}\{v > 2c\} + \mathbb{I}\{v < 2c\}) | \delta > \lambda\}}{1 - \frac{\alpha}{c} s} - 1 && (22)
\end{aligned}
$$

$$
\begin{aligned}
& E\{EV(\alpha - \alpha \times \mathbb{I}\{v > \hat{2}c\} + \mathbb{I}\{v < 2c\}) | \delta > \lambda\}\Big|_{a,\kappa} \\
&\qquad = \frac{1}{\#A} \sum_{i \in A} EV_i \times (\alpha_a - \alpha_a \times \mathbb{I}\{v_i > 2c_a\} + \mathbb{I}\{v_i < 2c_a\})
\end{aligned}
$$

Data

- PATSTAT (2021 edition)
- Innovation level (patent family) 2000-2018
- Drop own citations of firms (via ORBIS IP)

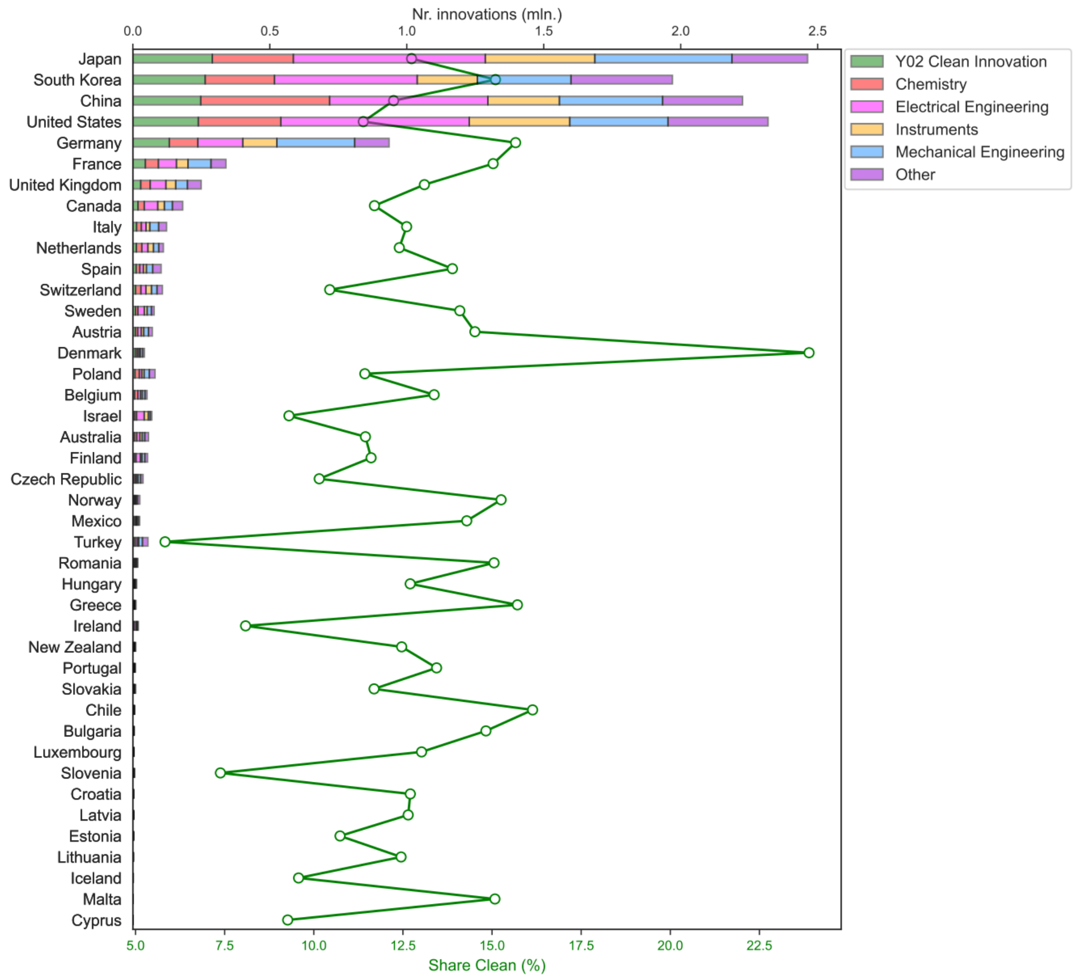
Table 1: Summary statistics

	Obs.	Mean	S.D.	Min.	25th pct.	50th pct.	75th pct.	Max.
Innovations								
PV	7,017,805	17.44	20.24	0.0	2.62	12.83	23.57	590.05
SV	7,017,805	5.09	13.94	0.0	0.0	0.64	4.9	3236.8

What's clean?

- YO2
- BEIS categories

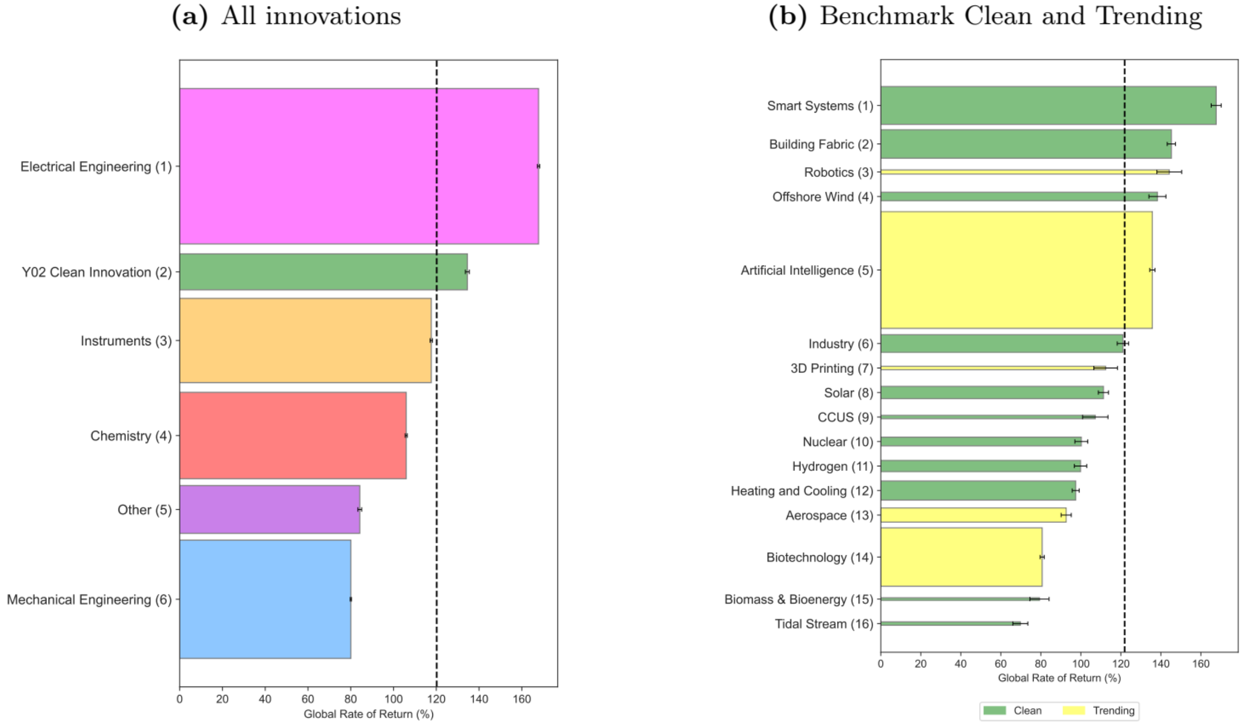
Figure 3: Innovations by country



Our Results.....

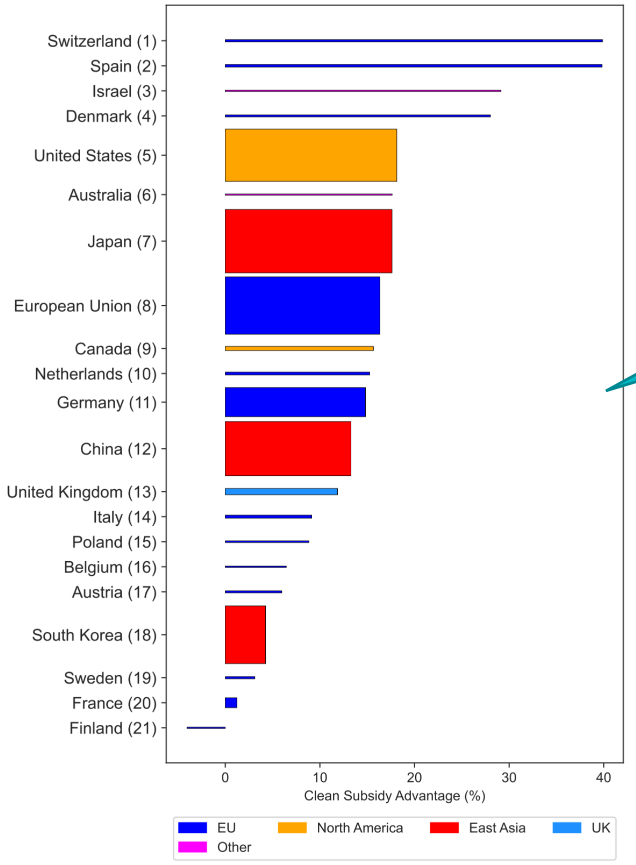
Global returns globally

Figure 4: Global returns – weighted average across countries



Clean advantage varies a lot

Figure 5: Clean Subsidy Advantage by country – Global returns



In most countries clean provides above average returns

Local (national) vs global returns

Figure 7: Local returns – weighted average across countries

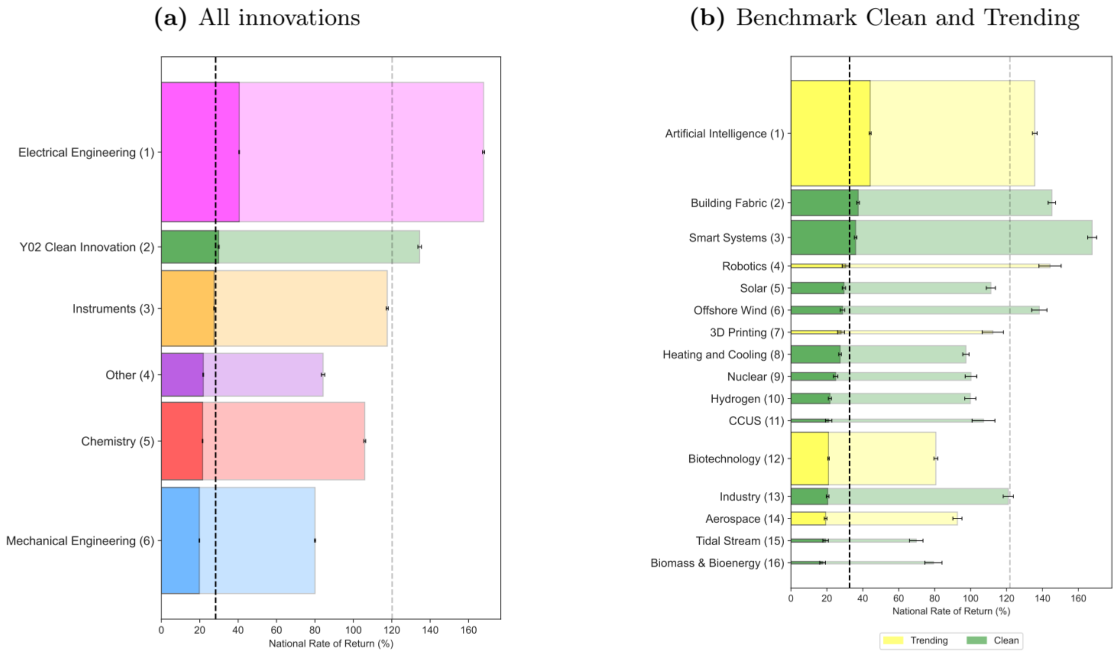
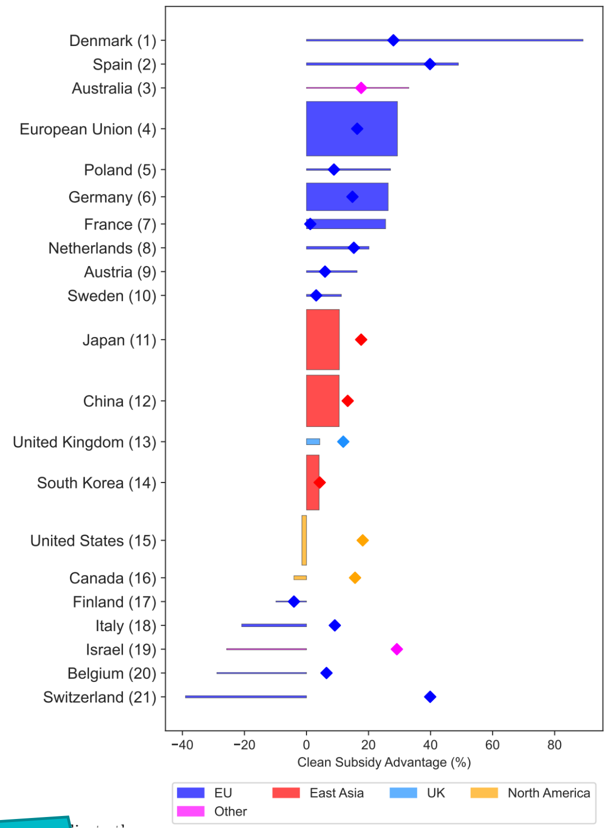
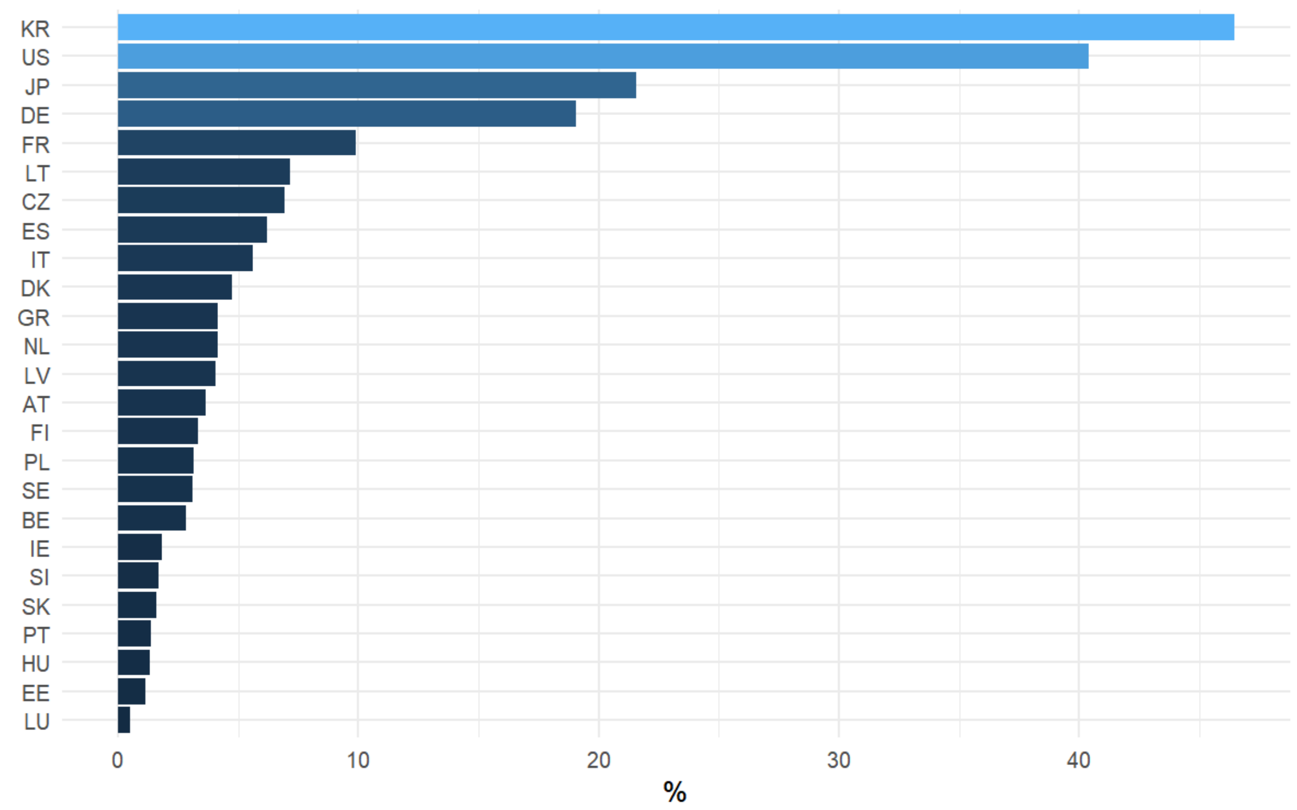


Figure 8: Clean Subsidy Advantage by country – Local returns



Most countries will not have sufficient incentives for clean from a purely national perspective (global clean advantage > national clean advantage)

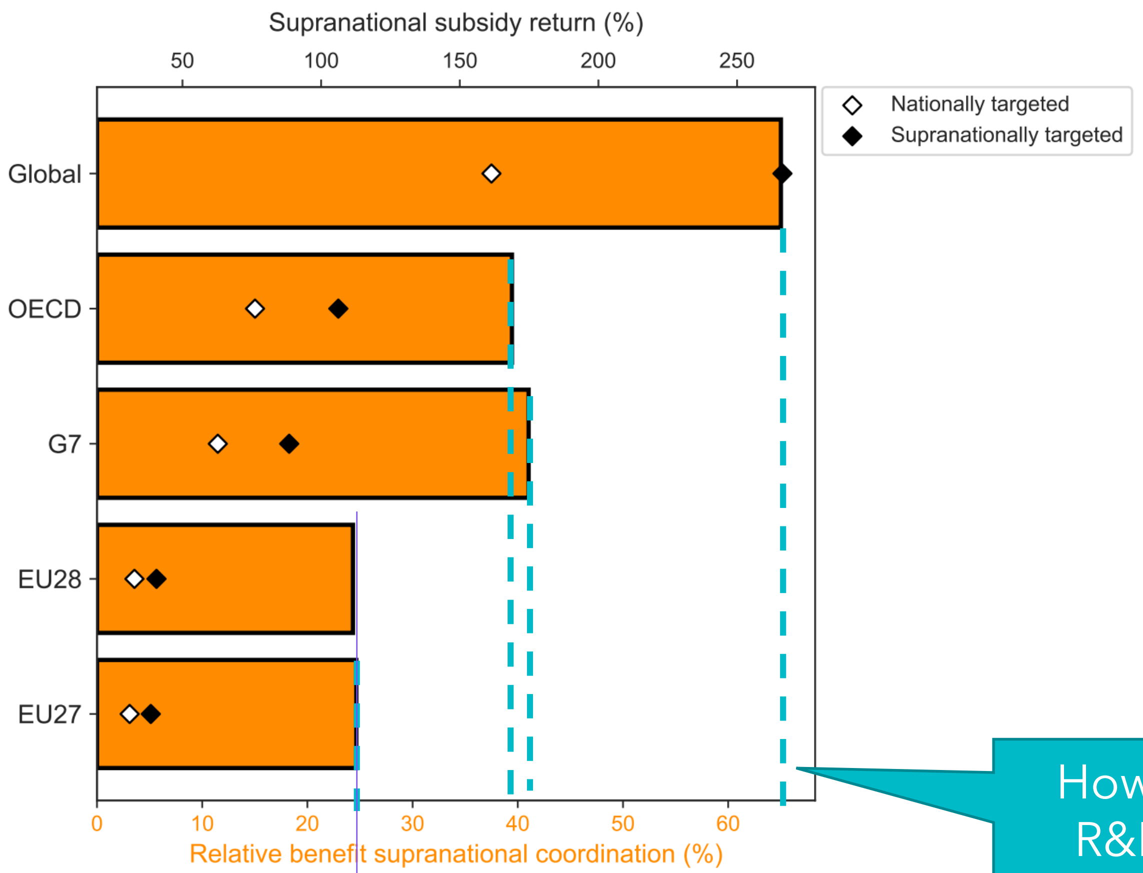
Share of spillover internalised

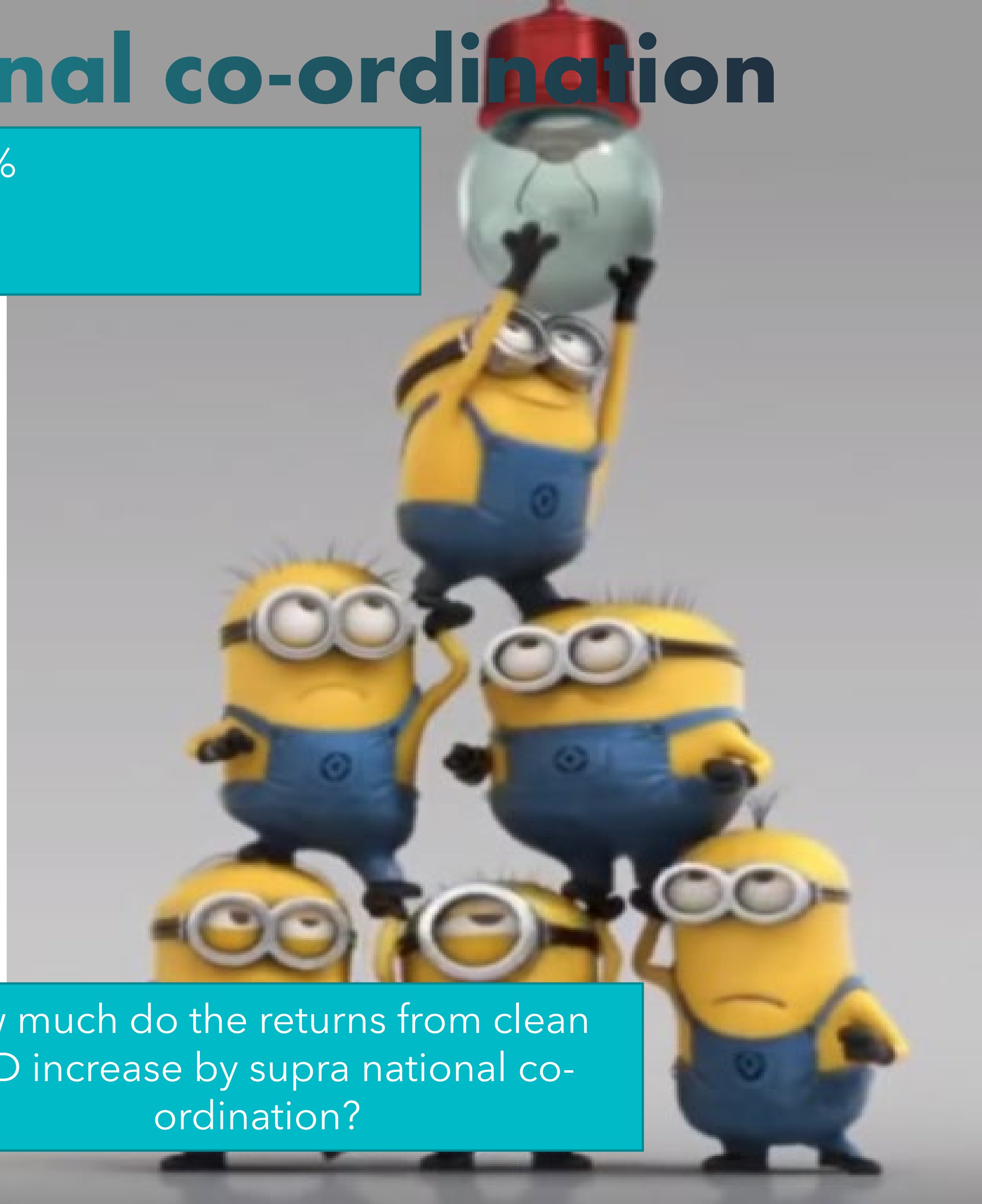


The value of supra national co-ordination

Policy Thought experiment: Increase clean innovation by 1%
A: according to national rank
B: according to supranational grouping rank

Figure 9: Benefits of supranational coordination





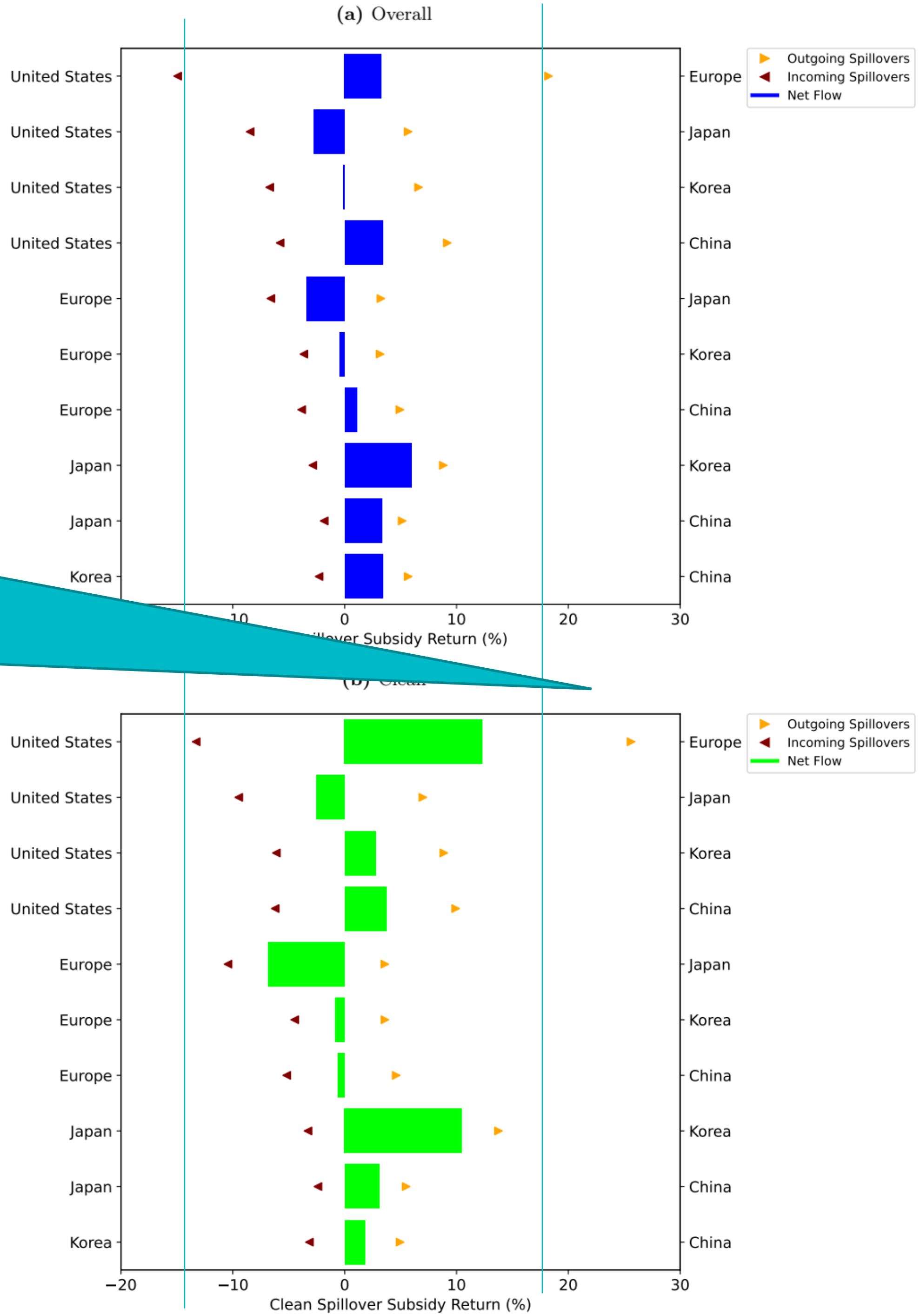
How much do the returns from clean R&D increase by supra national co-ordination?

Spillover flows

US clean subsidy increase = increase of indirect subsidy for EU inventors

Benefit per $ spent in US					
	United Stat	Europe	Japan	Korea	China
Clean	1.47	1.26	1.07	1.09	1.10
All	1.50	1.18	1.06	1.07	1.09

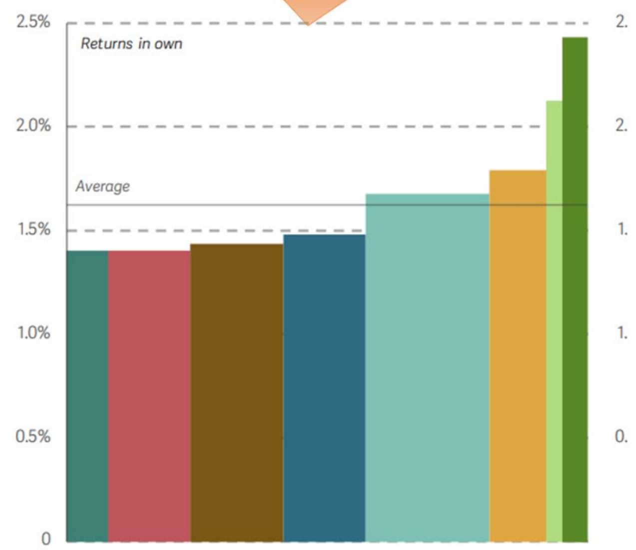
Net effect higher elsewhere compared to US



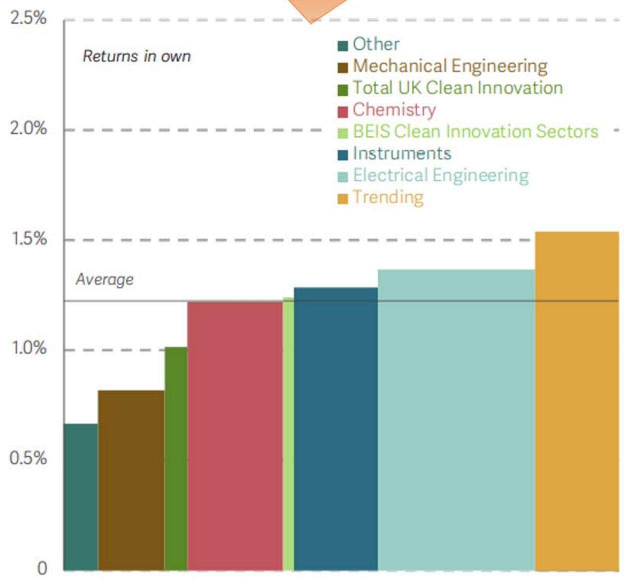
Inside & outside the golden triangle

Lagging on Lagging

Return within lagging regions of the UK



Return within leading regions of the UK



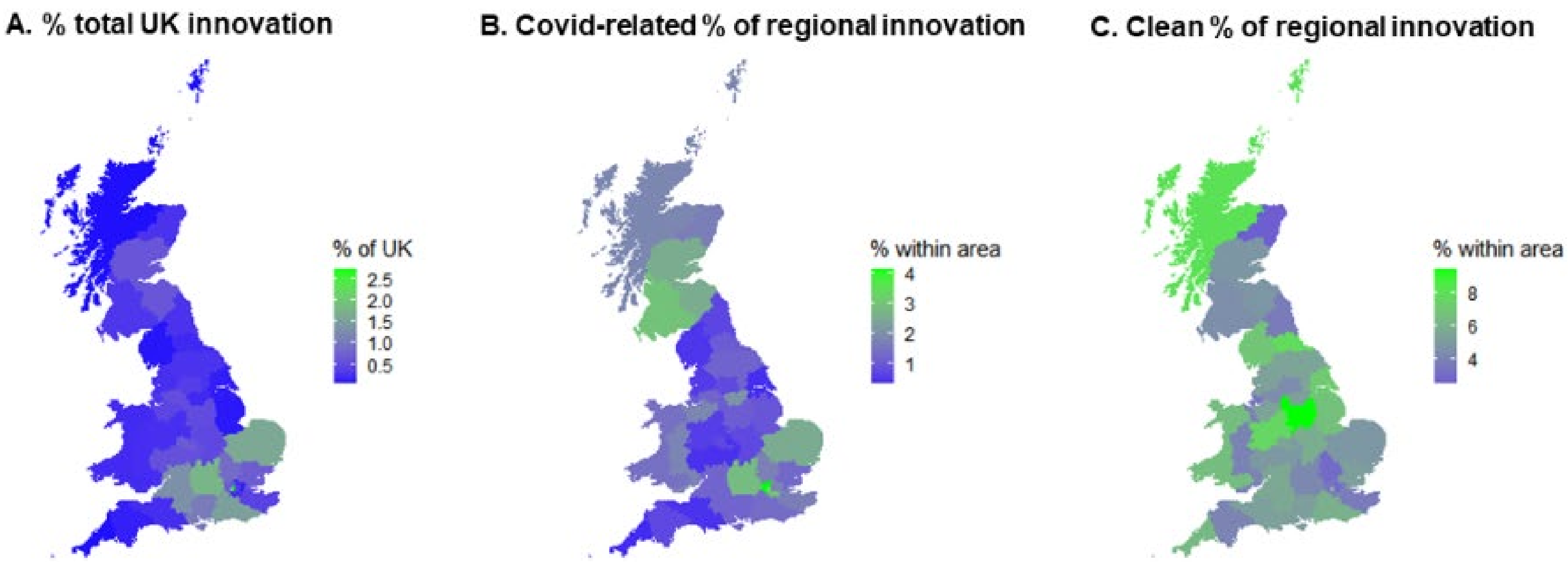
Spillovers to lagging regions

Lagging on lagging average

Clean tech:

- **Creates highest returns within lagging regions**
- **Leads to highest spillovers from leading to lagging regions**

Lagging regions have a clean comparative advantage:



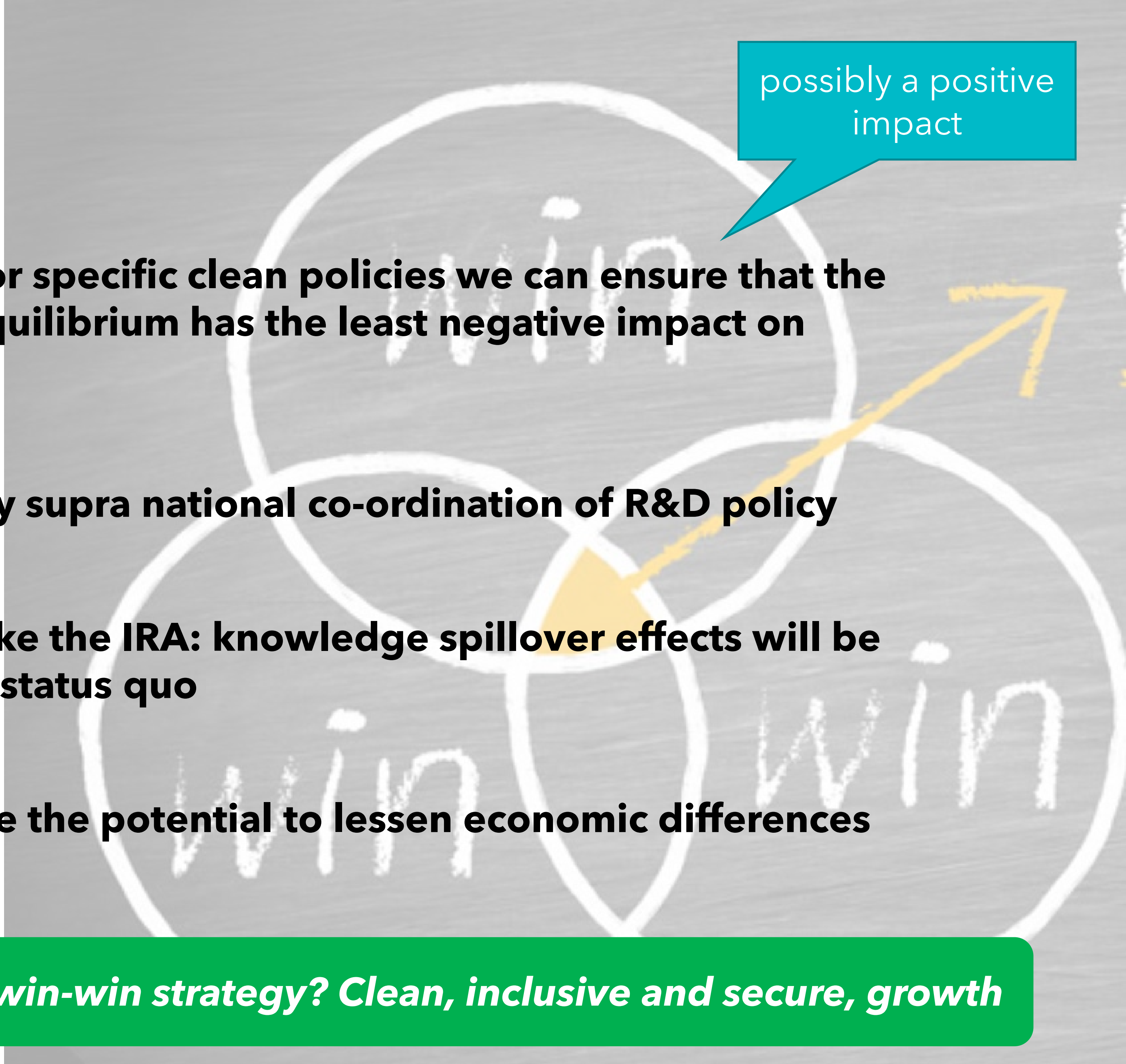
R&D investment in clean disproportionally helps lagging regions:

- Directly
- Indirectly: via spillovers from clean inventors in leading regions

Figure 1: Share of clean in total innovation (in %)

https://mondpanther.github.io/wwwmondpanther/posts/2021-03-03-cleanrta/

Conclusion



possibly a positive impact

- **By providing strategic support for specific clean policies we can ensure that the transition to a clean economic equilibrium has the least negative impact on growth.**
- **These effects can be improved by supra national co-ordination of R&D policy**
- **We should welcome initiatives like the IRA: knowledge spillover effects will be felt everywhere and improve on status quo**
- **The clean transition can also have the potential to lessen economic differences within and between countries.**

Transition to clean: a win-win-win-win strategy? Clean, inclusive and secure, growth


Thanks
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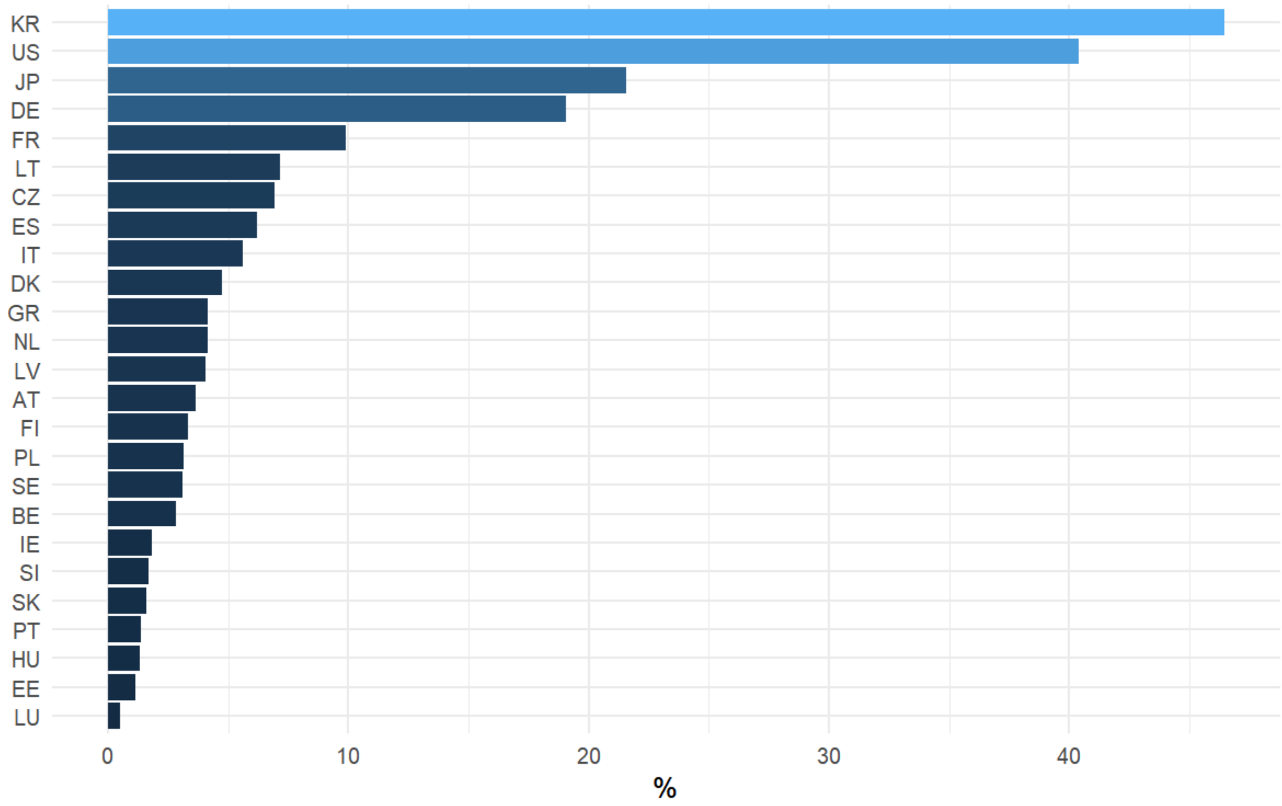
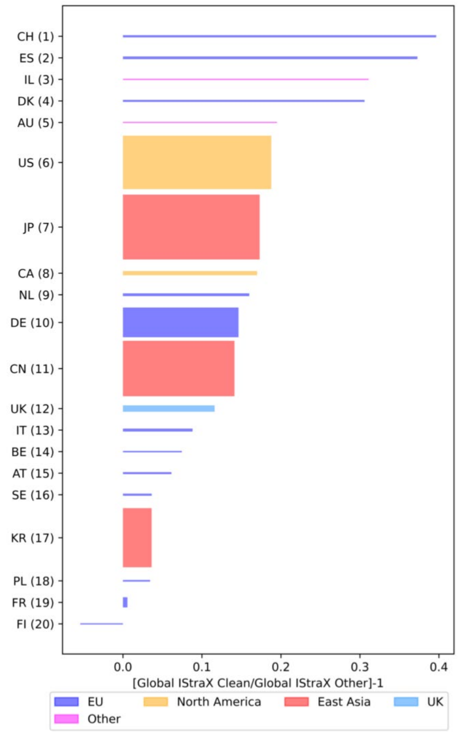
EXTRA!
E TRA!

Share of spillover internalised



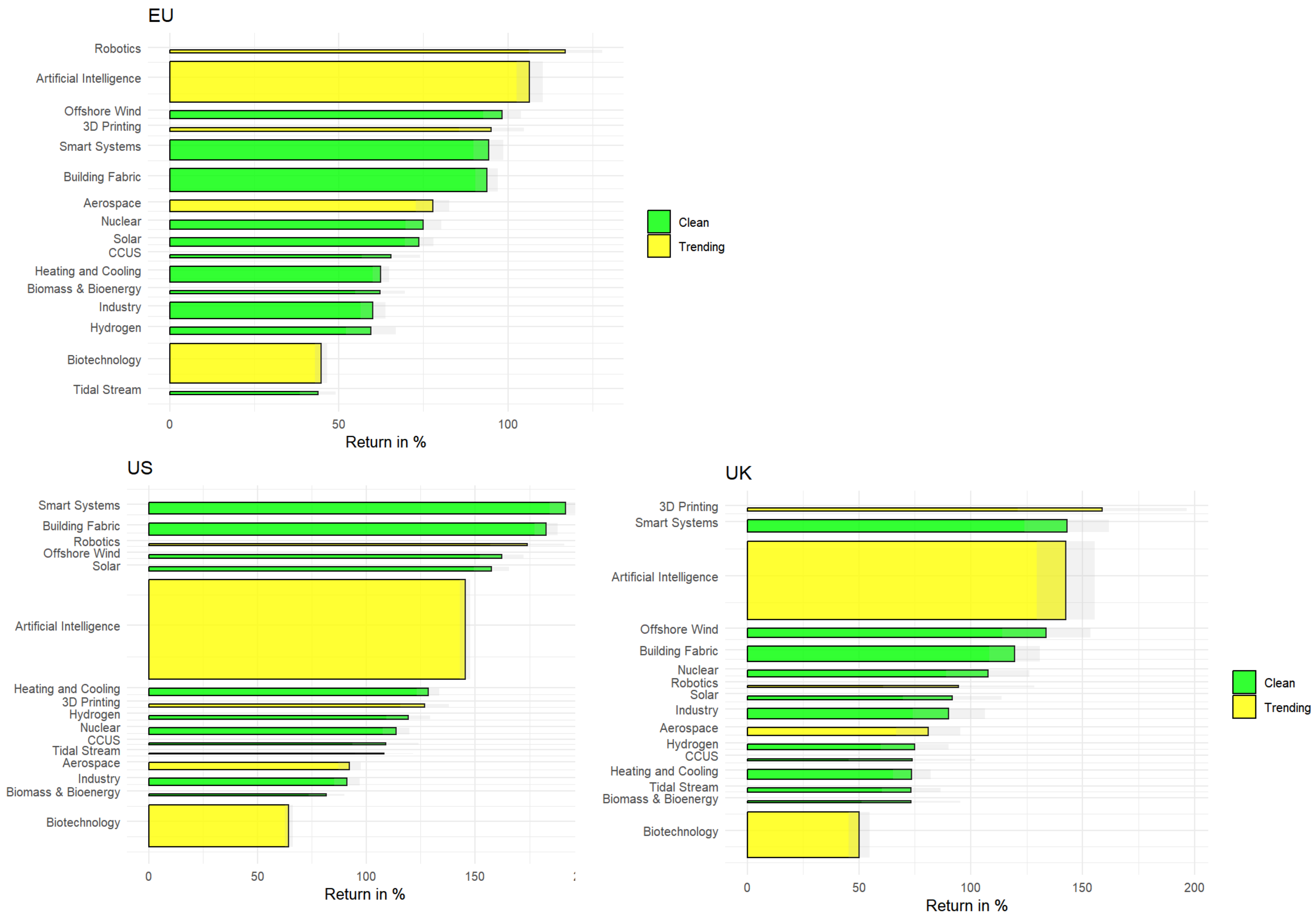
Global social return to R&D subsidies

Relative return clean vs other



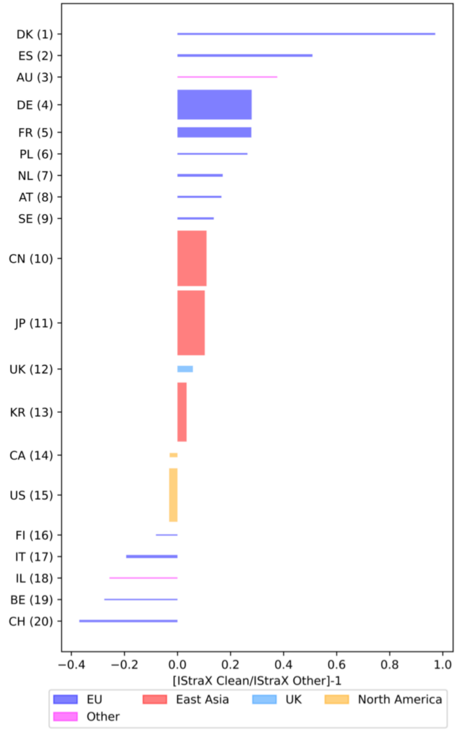
- In almost all countries the return to R&D subsidies is higher for clean tech
- Variation in top sub fields across countries

Relative by detailed field

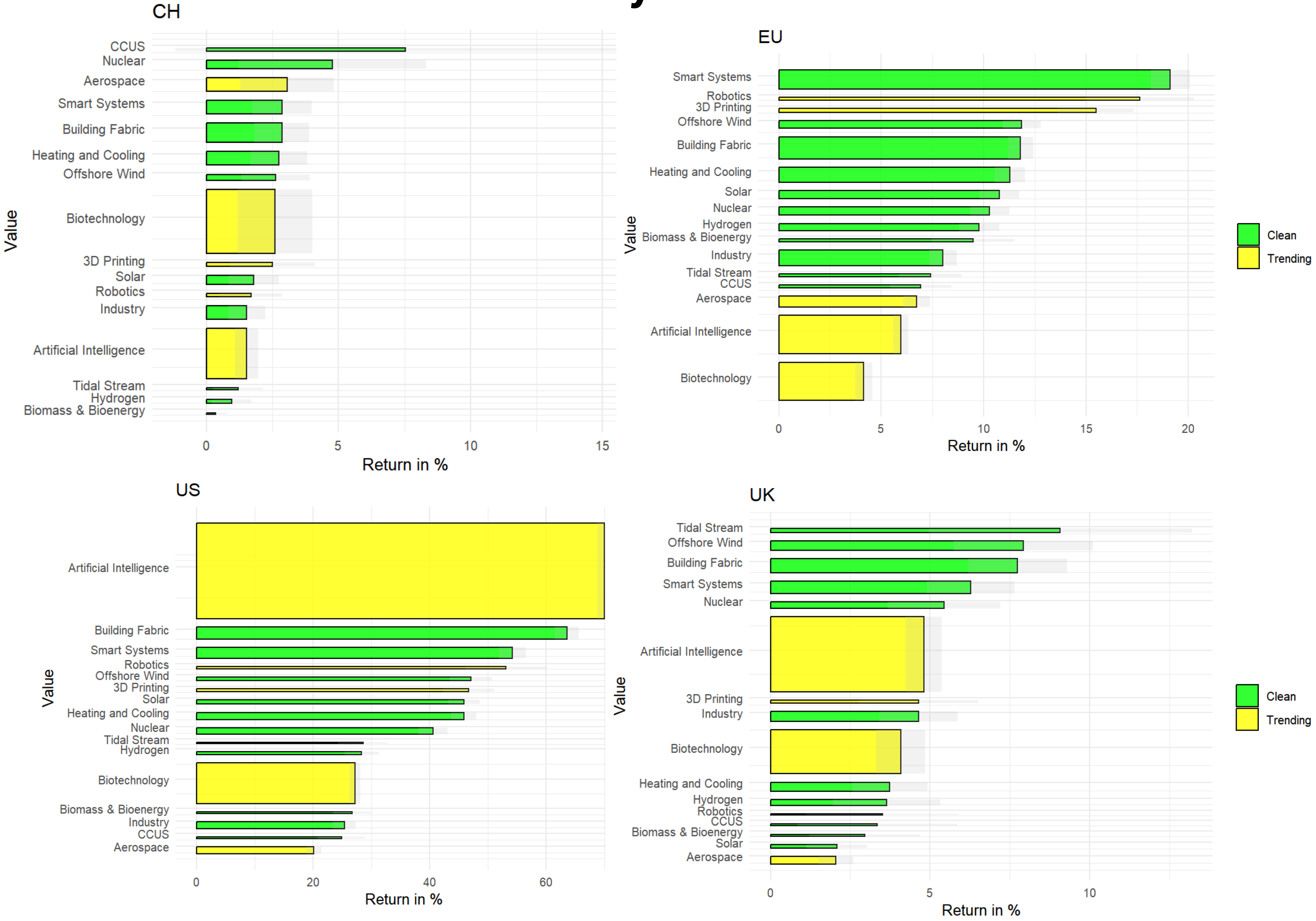


Within country (national) social return to R&D subsidies

Relative return clean vs other



Return by detailed field

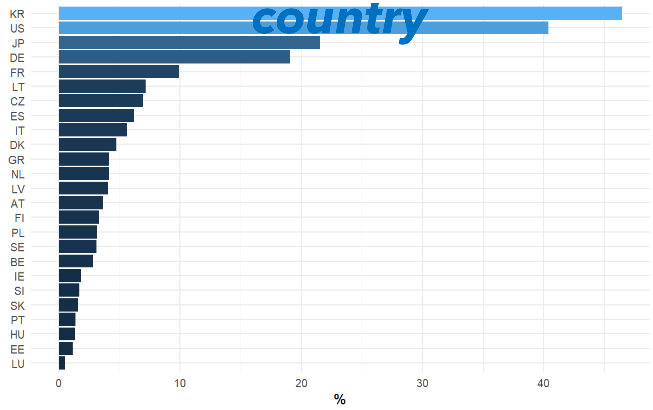


- National returns for clean are also generally larger (big exception CH)
- But different technologies matter from a national point of view

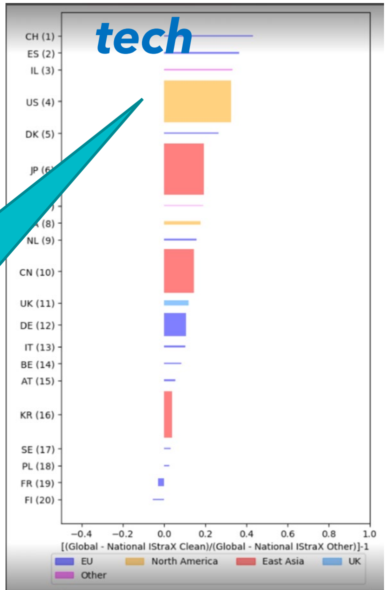
The global vs within country difference

- Reason for difference: Spillovers spill mostly out of countries
- Strong motivation for co-ordination of R&D policy (e.g. at EU level: 25% higher returns of R&D subsidies)
- Implication for how we assess policies such as Inflation Reduction Act (IRA): includes $391 billion for climate change

Share of spillovers internalised within country



Gap between global and national in clean vs other tech



IRA will make the US generate more knowledge spillovers

Gap between global and national is 40% bigger for clean vs other tech in US