WEBINAR + Q&A

TECHNOLOGICAL INNOVATION AND ECONOMIC GROWTH: A POLICY PERSPECTIVE

Speakers: Prof. Dr. Karin Hoisl and Dr. Leo Schmallenbach

Host: Axel Ferrazzini

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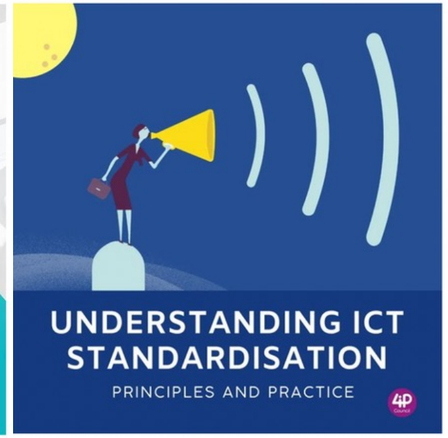

Technological Innovation and Economic Growth: A Policy Perspective

PROF. DR. KARIN HOISL

Professor of Organization and Innovation at the University of Mannheim

DR. LEO SCHMALLENBACH

Habilitation candidate at the University of Mannheim

Key Question:

What is the role of **technological innovation**

as a driver of a nation's **economic growth**,

with a particular focus on the influence of

intellectual property rights (IPR)

Agenda

02

Policy instruments to foster R&D and IPR

04

Sustainable Technologies and Artificial Intelligence

01

Patents and technological innovation

03

Economic Relevance of Patent Quantity and Patent Quality

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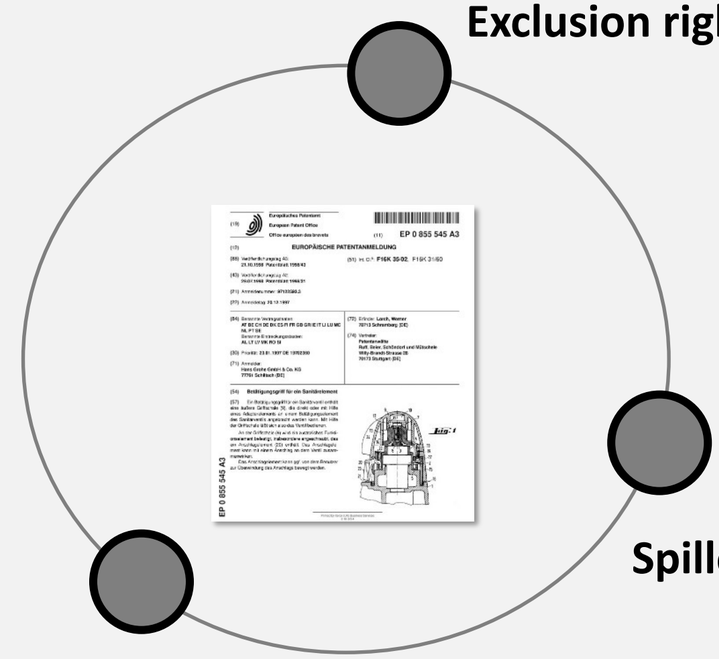
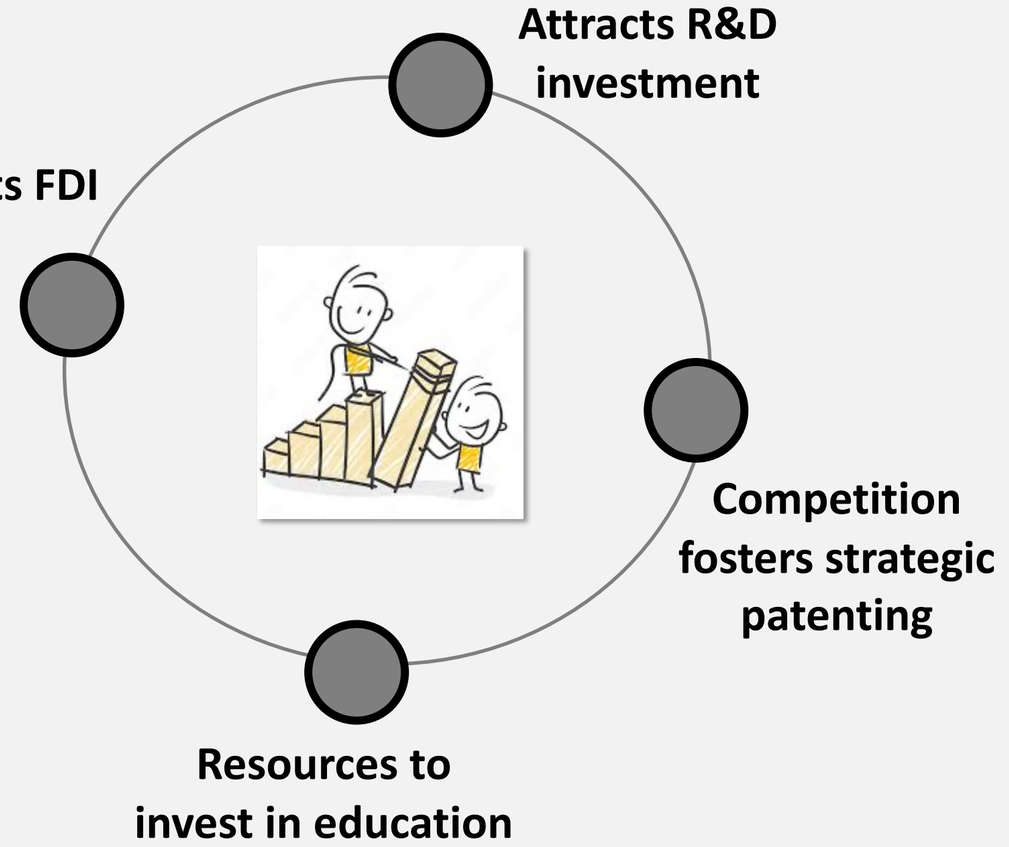
Patents and Technological Innovation

Patents provide incentives to invest in R&D ...



CAUSALITY?

A growing economy encourages patenting ...



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Policy instruments to foster R&D and IPR

1
Direct incentives
-- R&D --

- Tax incentives
  - R&D tax credits, allowances or deductions
- Direct funding and grants

2
Direct incentives
-- IPR --

- Direct financial incentives
  - Reduction of IPR fees
  - Patent box regimes
- Direct non-financial incentives
  - Reduction of legal hurdles

3
Indirect incentives
-- R&D --

- Infrastructure and resource development
- Collaboration, networking, and knowledge
- Market creation and stimulation

4
Indirect incentives
-- IPR --

- Robust enforcement mechanisms
- Cross-border IP protection
- Alternative dispute resolution
- IP licensing and technology transfer frameworks
- IP education and awareness

The Effectiveness of Direct Incentives for R&D and IPR

Incentive	PROs	CONs
Tax incentives	increase R&D spending	- "relabeling“ of non-R&D expenditures as R&D expenditures - relocation of R&D activities to countries with tax incentives - shifting of IP royalties to countries with patent box regimes
Government R&D funding and research grants	positive effect on the patent activity of companies	- public R&D may be a substitute for private R&D (crowd out) - only moderate effect of NIH funding on the number of citations received by publications
Reduction of patent fees	increases the number of patents	- increases the number of low-quality patents
Innovation vouchers for SMEs	positive effect on innovation	- only short-term effects, which fade out after only two years

→ **Policy mix needed**
→ **Policy measures are not enough - we also need other measures, such as less regulation, reduction in bureaucracy, cheaper energy, innovation management skills, a culture of failure, and hiring of creative people**

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Economic Relevance of Patent Quantity and Patent Quality

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dependent variable	annual growth in real GDP per capita						ln patent applications
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
ln patent applications		0.245 (0.235)					
ln granted patents			0.353** (0.174)				
ln granted patents with at least two family members				0.431** (0.204)			
ln patent applications with at least one forward citation within 5 years					0.521** (0.217)		
ln radical inventions						0.553** (0.244)	
annual growth in real GDP per capita (t-1)							-0.0123 (0.009)
real GDP per capita (t-1)	-6.780*** (1.734)	-7.471*** (1.520)	-7.896*** (1.469)	-7.887*** (1.434)	-8.640*** (1.511)	-8.173*** (1.442)	2.810*** (1.029)
other control variables	included	included	included	included	included	included	included
constant	74.21*** (16.680)	79.54*** (14.361)	83.18*** (13.563)	83.09*** (13.357)	89.27*** (13.584)	87.04*** (13.360)	-21.57** (10.059)
observations	814	814	814	814	814	814	814
adjusted R-squared	0.694	0.695	0.696	0.697	0.698	0.698	0.472

*note: standard errors clustered at the country level in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01, country & year fixed effects*

DATA

PATSTAT (version 10/2023), a database provided by the EPO *(bibliographic and legal event patent data from nearly 100 countries worldwide)*

World Development Index (WDI) database provided by the World Bank *(macroeconomic GDP data)*

Scope: OECD countries and China 2000-2021

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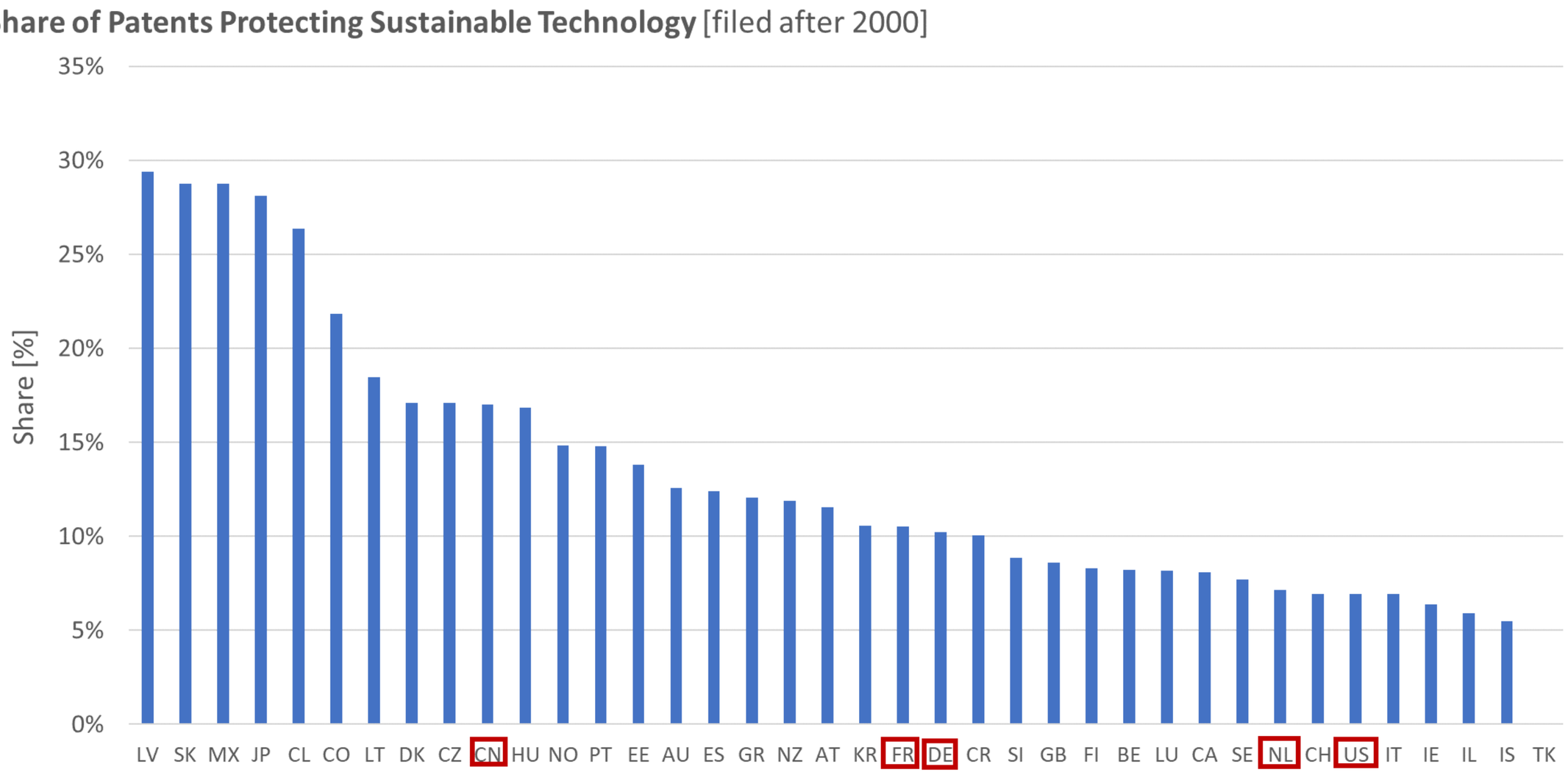
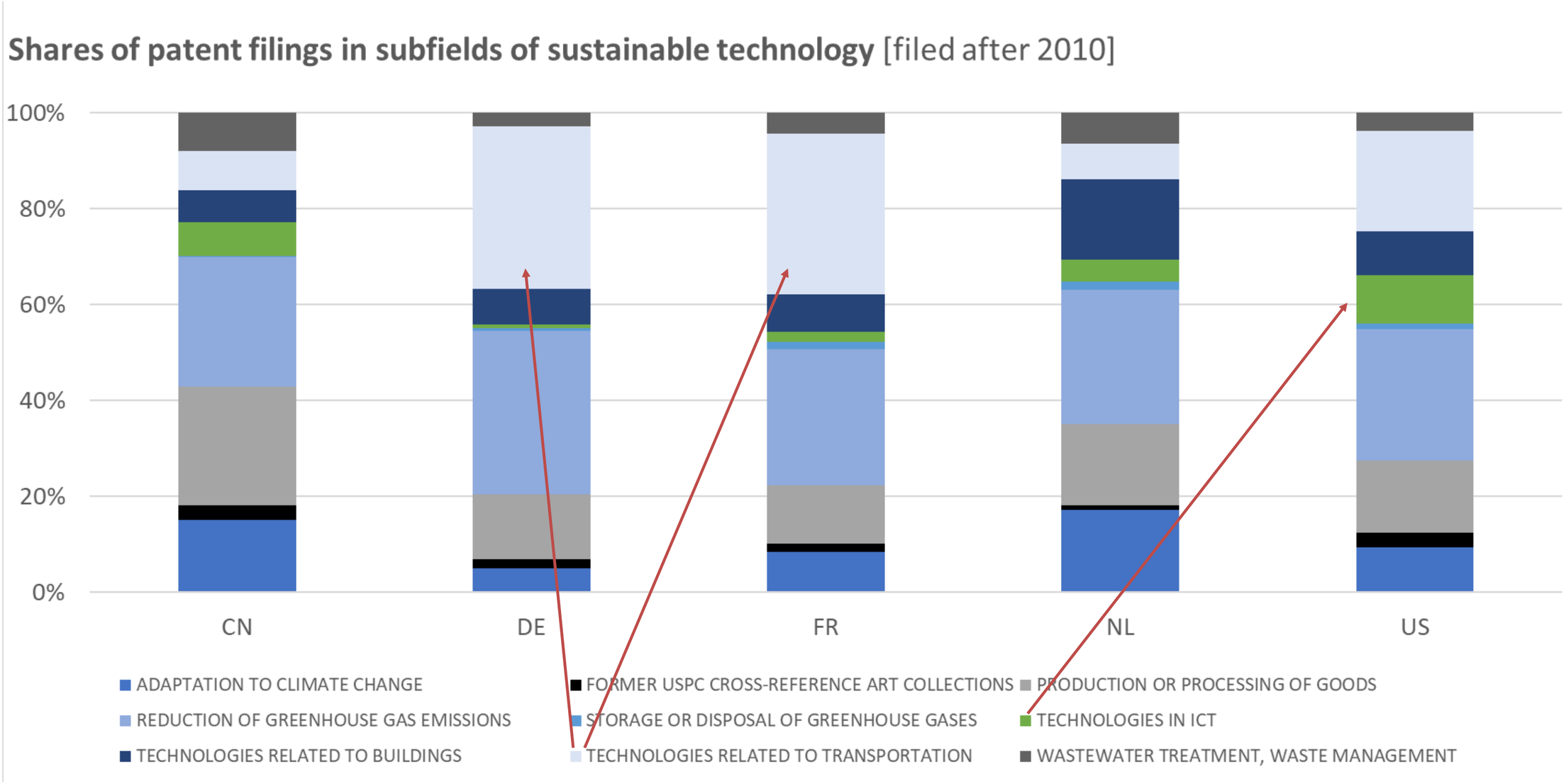
Sustainable Technologies



$N_{>= 2000}$ = 18,737,156 patent applications

Sustainable Technologies



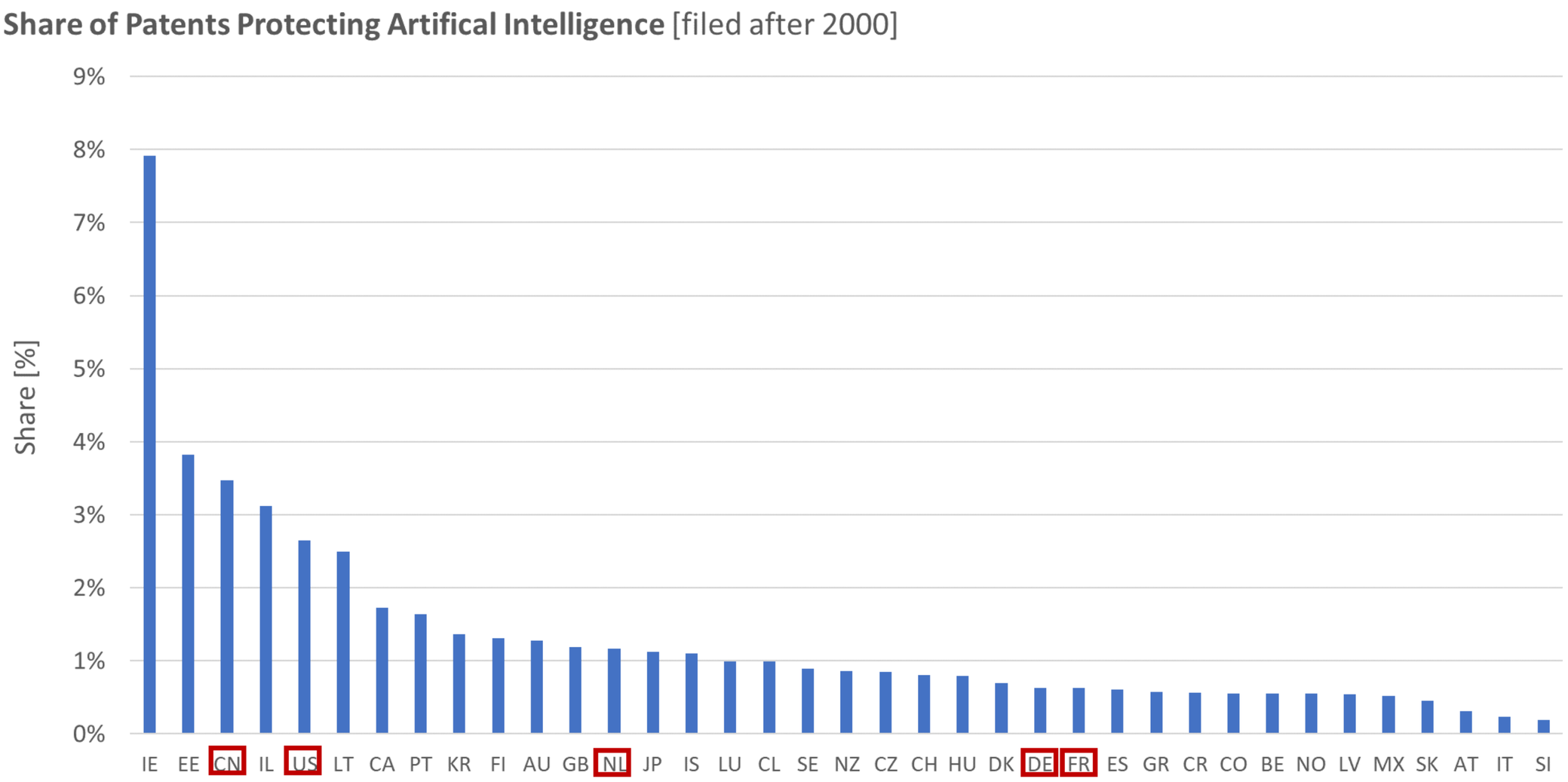
$N_{>= 2010}$ = 2,166,254 patent applications

Sustainable Technologies – raking of countries

country	total number of patents (>=2010)	average number of 5-year citations	average family size	share patents granted by 2023	share radical inventions
CN	1	27	37	11	36
JP	2	20	29	18	34
KR	3	21	34	29	32
US	4	1	18	31	9
DE	5	18	24	5	25
FR	6	22	16	35	20
GB	7	8	10	9	17
IT	8	25	17	3	26
CA	9	3	20	17	4
CH	10	9	7	13	14
ES	11	26	21	34	27
NL	12	12	14	33	24
AT	13	15	13	25	19
SE	14	7	6	27	10
DK	15	10	8	15	13
AU	16	17	19	22	12
FI	17	11	2	24	2
BE	18	13	5	20	22
IL	19	2	11	21	7
NO	20	16	4	26	15
...					

$N_{>= 2010}$ = 2,539,636 patent applications

Artificial Intelligence



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Artificial Intelligence – ranking of countries

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DE	5	23	21	4	19
GB	6	9	7	12	24
CA	7	5	22	18	15
FR	8	26	10	21	11
IL	9	3	19	25	20
IE	10	7	28	28	30
NL	11	19	15	10	28
CH	12	13	14	15	14
SE	13	11	13	17	18
FI	14	14	17	8	13
AU	15	22	23	33	10
ES	16	21	26	19	28
IT	17	24	4	2	22
BE	18	20	6	11	21
DK	19	17	12	6	6
AT	20	15	3	13	5
…					

$N_{>= 2010}$ = 455,476 patent applications

Key Findings

The relationship between IPR and economic growth is **two-sided**.

BUT: It is **not** the quantity of patents that is positively correlated with annual growth in real GDP per capita, but the **value of patents**.

It is difficult, to say which policy is most effective, as different policy **mechanisms** have been **offered in parallel** in most OECD countries.

Policy instruments are primarily aimed at **increasing the quantity** of output.

Sustainable technology & artificial intelligence:

- **China** is far ahead of all other countries in terms of patent applications with extreme annual growth rates – but the value of their patents is low.
- **The Nordic countries** are ahead in terms of patent value.

Economic and Policy Implications

Quantity vs. Quality	The findings advocate for a nuanced approach to policymaking that not only incentivizes R&D investments, but also emphasizes the value and impact of patented inventions.
Innovation-Growth Causality	The two-sided causality between technological innovation and economic growth suggests that a thriving economy stimulates further innovation, and vice versa.
Internationalization	Policy and technological innovation cannot be conceived at the national level. International cooperation should be encouraged to increase knowledge sharing and spillovers across borders.
Role Models	Other countries can learn from the Nordic countries, especially when it comes to identifying further measures to promote innovation in sustainable technologies and AI in addition to the existing policy instruments.

Thank you
for your attention!

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