Tax policy for innovation

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Introduction – some questions

- How does taxation affect innovation?
- Why are there special tax incentives for innovative activity?
- How should R&D tax credits be designed?
- Are reduced taxes on patent income a good way to spur innovation?
- Do countries provide enough resources to support private R&D?
- Should there be coordination across countries?

Taxation and innovation

- Two broad topics:
  1. Via personal and corporate taxes imposed for other purposes, see Akcigit et al. (2018)
     - Measure incentive effects using cross-state data, negative and stronger for corporate inventors
     - Show that international inventor migration depends strongly on effective tax rates, especially for corporate inventors and those where local research weak
  2. Tax subsidies targetted toward innovation – topic of this talk

Rationale(s) for innovation support

- Innovative activity generates unpriced spillovers to other firms and to the overall economy
  - Some of these may be local to a region or economy
- Resources for innovation may be undersupplied because of
  - (relative) ease of imitation
  - risk and uncertainty that cannot be diversified away or insured against
  - high cost of financing (especially for SMEs)
  - related to the production of public goods (health, environment, defense, etc.)

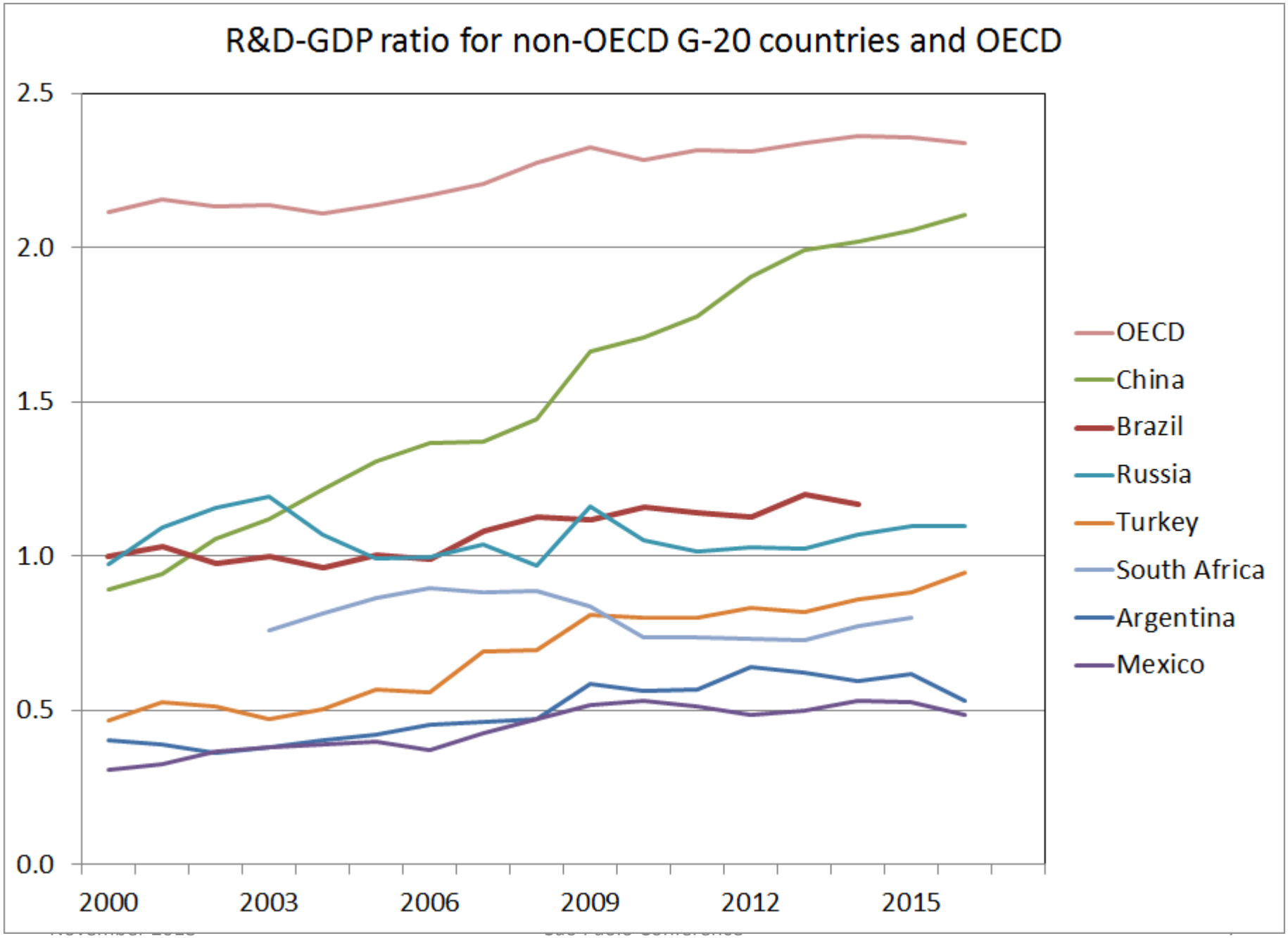
What comprises innovative activity?

- R&D
  - Research – basic and applied
  - Development (sometimes modified by “experimental”)
- Purchase of external IP (patents, knowhow, etc.)
- Purchase, installation, and use of new (technologically advanced) equipment
- Training of employees in new processes, or in supporting new products
- Marketing new goods and services
- Costs of organizational innovation

The extent of potential spillovers varies across the type of spending, as does appropriability via IP protection or other means

Do countries provide enough support for R&D?

- Much evidence that social returns are much higher than private (Kao et al 1999, Keller 1998, Coe and Helpman 1995). Some nuances:
  - Domestic spillovers larger than those from other countries (Branstetter 2001, Peri 2004)
  - Spillovers from foreign R&D more important for smaller open economies than for US, Japan, and Germany (Park 1995, van Pottelsberghe 1997)
  - Absorptive capacity of recipient country important for making use of R&D spillovers (Guellec and van Pottelsberghe 2001)
  - Typical social rates of return are quite large, but imprecise
- Jones and Williams (1998) – using endogenous growth model, argue that socially optimal R&D investment 2-4 times actual in US


R&D-GDP ratio for non-OECD G-20 countries and OECD
2.5
2.0
1.5
1.0
0.5
0.0
2000
2003
2006
2009
2012
2015
OECD
China
Brazil
Russia
Turkey
South Africa
Argentina
Mexico

Possible remedies for low R&D spending

- Property rights (IPRs)
  - at the cost of restricted output; cumulative invention
  - under TRIPS, less variation across countries possible
- Subsidies
  - often targetted to particular type of firm or project
  - high administrative costs
- Direct government spending
  - Especially for R&D towards public goods
- Tax credits of various kinds
  - firm chooses projects
  - some audit costs

Corporate tax and innovation

- What special features of the tax system support innovation?
  - R&D tax credit – widely used
    - Sometimes targetted toward basic research - university cooperation, use of PROs, etc.
  - Various IP "boxes"
    - Reduced corporate tax rates on income from IP (patents, design rights, copyright, trademarks, etc.)
  - Investment tax credits; accelerated depreciation
    - reducing the cost of acquiring new equipment and IT
  - Relative treatment of debt vs equity finance.
    - If debt favored, cost of intangible non-securable finance relatively more expensive

(Innovation) tax policy design

- Some issues in design
  - Is the policy instrument visible to the firm's decision-makers?
  - Does the time horizon of benefits match that of investment?
    - Does it reduce cost or increase profits in the near term, when they may have losses?
    - Is the system stable enough to allow forward planning?
  - Does it target activities with spillovers?
  - Is it comparatively easy to audit?

R&D tax incentives & IP boxes

- R&D tax incentives
  - Reduces cost of R&D input
  - Does not cover other innovation inputs
- IP boxes
  - Reduced tax rate on income from intellectual property (patents, copyrights, designs, etc.)
  - Broader coverage, but rewards more appropriable innovation

Which countries have R&D tax relief?

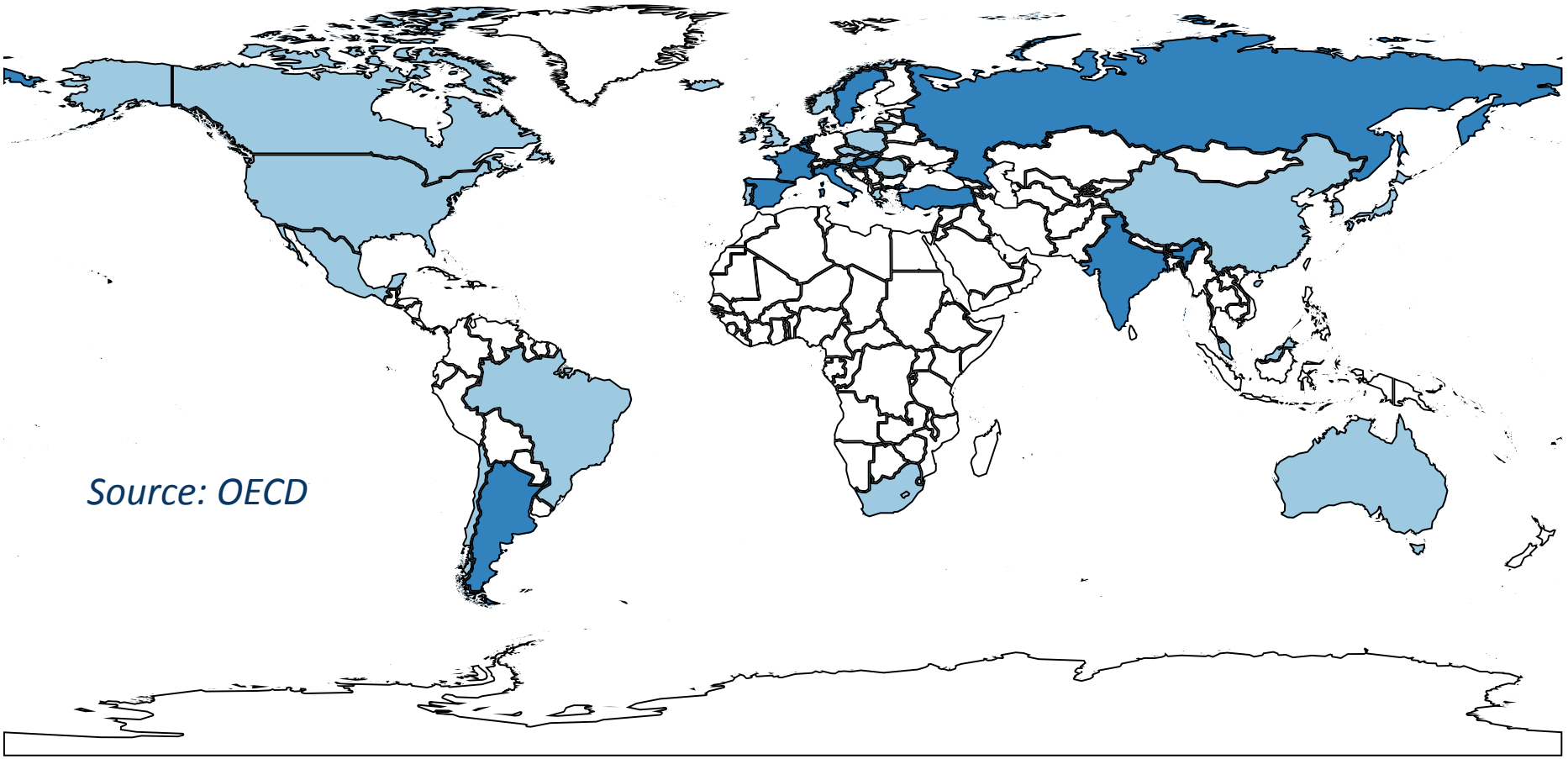
- 2000: 16 OECD countries.
- 2017: 30 out of 35 OECD countries
  - Also Brazil, China, and the Russian Federation
- B-index = level of pre-tax profit a "representative" company needs to generate to break even on a marginal expenditure of one unit on R&D

Per cent reduction in B-index for OECD and Brazil

	OECD average		Brazil	
	2000	2017	2000	2017
Profitable SME	6	17	0	17
Loss-making SME	4	15	0	0
Profitable Large firm	4	14	0	27
Loss-making Large firm	3	12	0	0

Source: Warda and Lester 2018, OECD 2017

Which countries have R&D tax relief?



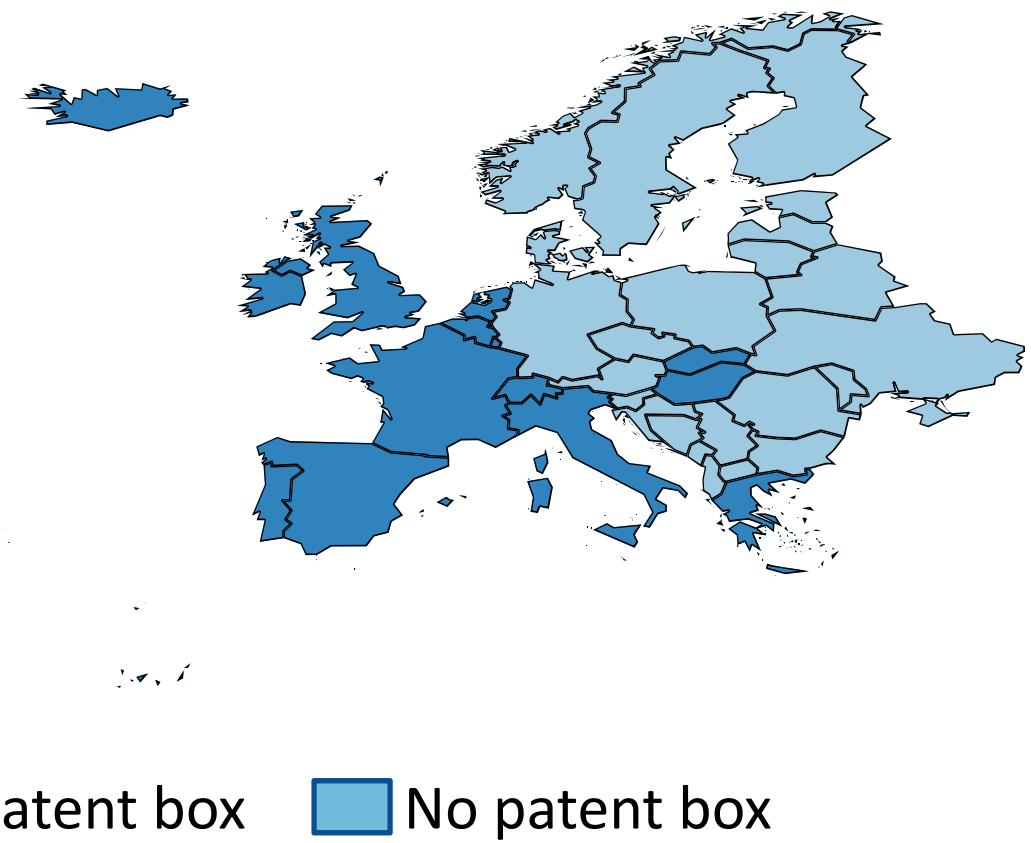
Tax relief & social charge reduction

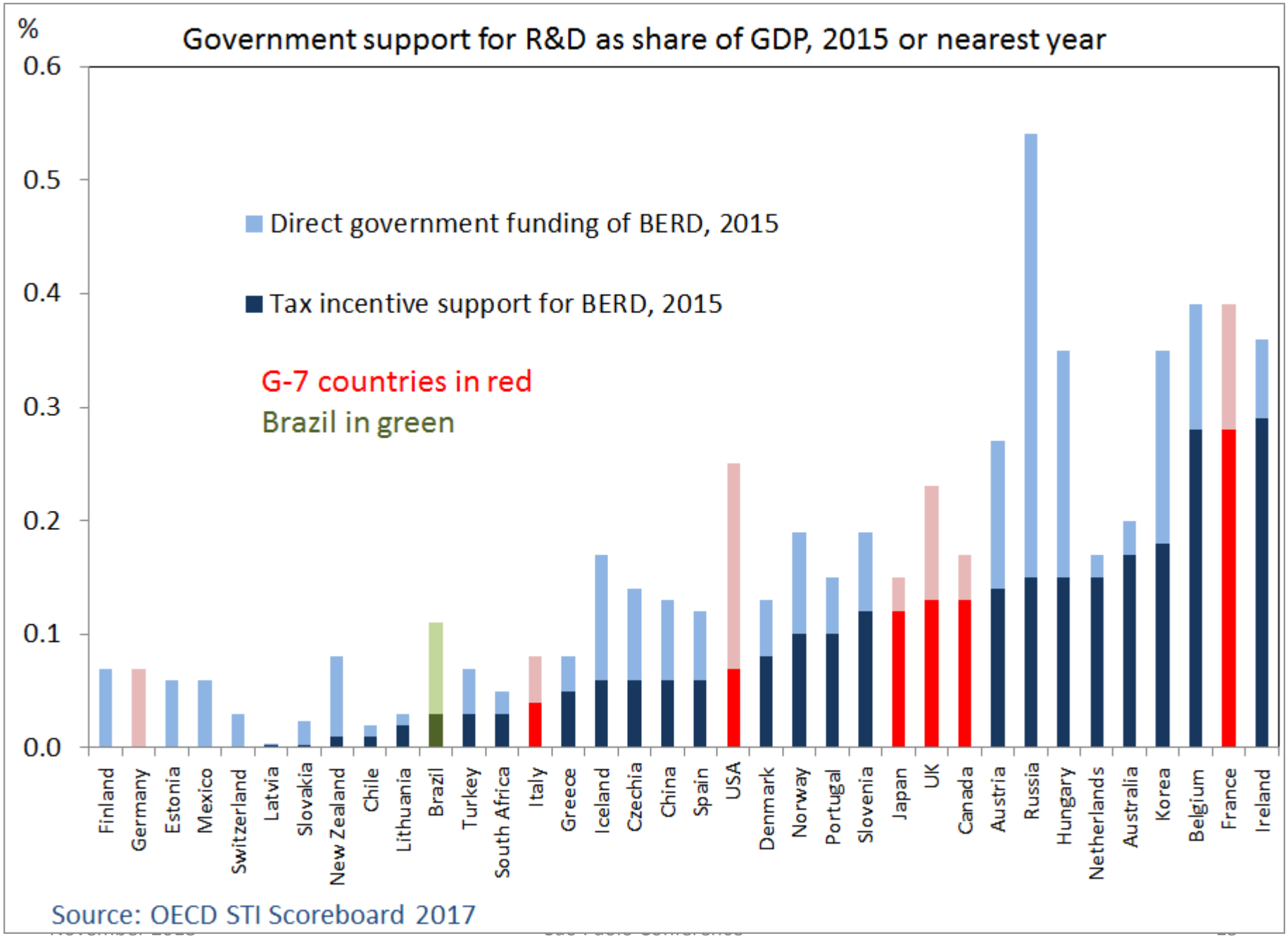
Tax relief only

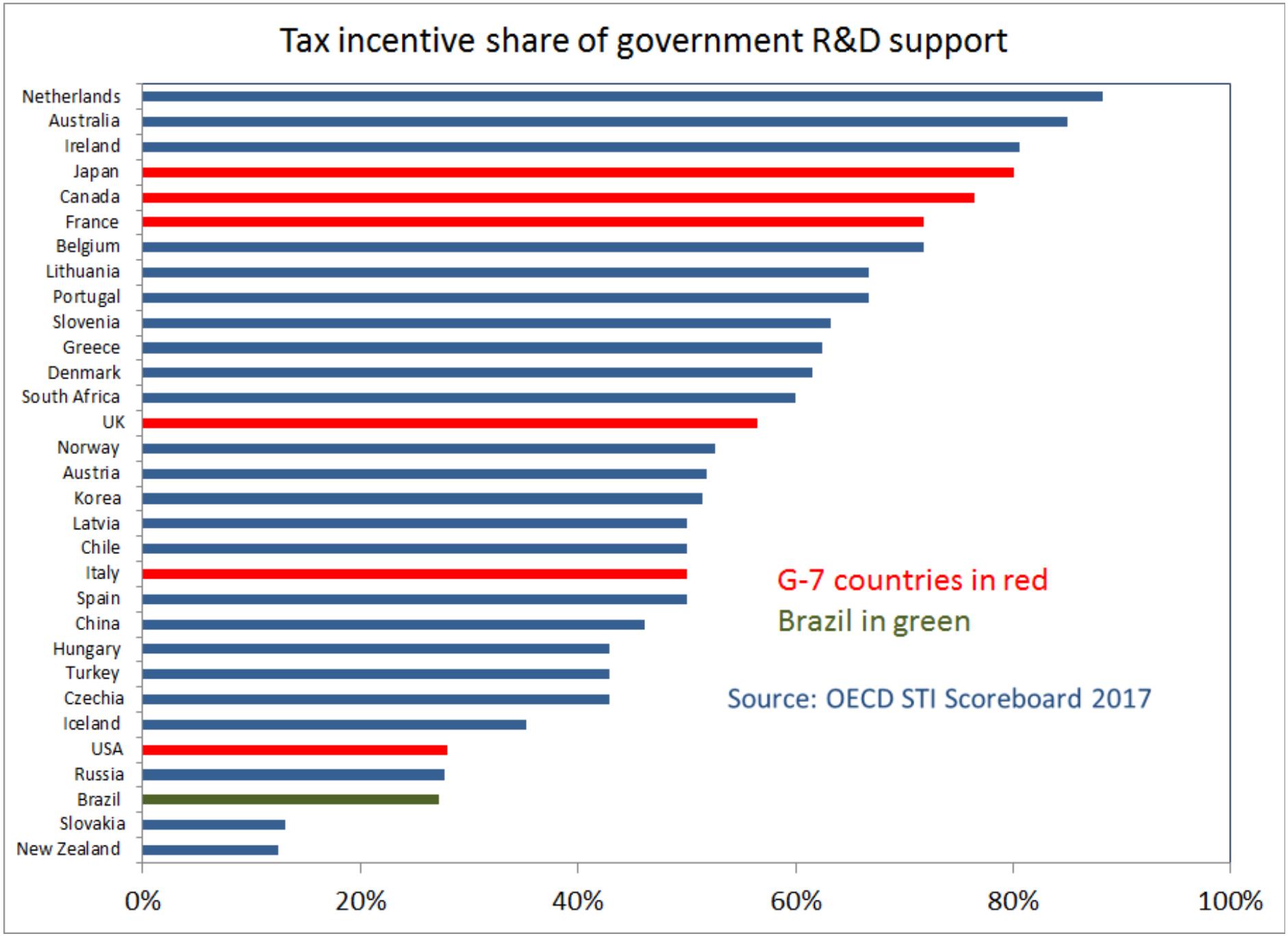
Which countries have IP boxes?

Mostly European (+ Japan):

Belgium	Luxembourg
Cyprus	Malta
France	Netherlands
Greece	Portugal
Hungary	Slovakia
Iceland	Spain
Ireland	Switzerland
Italy	Turkey
Liechtenstein	UK




%
Government support for R&D as share of GDP, 2015 or nearest year
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Direct government funding of BERD, 2015
Tax incentive support for BERD, 2015
G-7 countries in red
Brazil in green
Finland
Germany
Estonia
Mexico
Switzerland
Latvia
Slovakia
New Zealand
Chile
Lithuania
Brazil
Turkey
South Africa
Italy
Greece
Iceland
Czechia
China
Spain
USA
Denmark
Norway
Portugal
Slovenia
Japan
UK
Canada
Austria
Russia
Hungary
Netherlands
Australia
Korea
Belgium
France
Ireland
Source: OECD STI Scoreboard 2017


Tax incentive share of government R&D support
Netherlands
Australia
Ireland
Japan
Canada
France
Belgium
Lithuania
Portugal
Slovenia
Greece
Denmark
South Africa
UK
Norway
Austria
Korea
Latvia
Chile
Italy
Spain
China
Hungary
Turkey
Czechia
Iceland
USA
Russia
Brazil
Slovakia
New Zealand
0%
20%
40%
60%
80%
100%
G-7 countries in red
Brazil in green
Source: OECD STI Scoreboard 2017

R&D tax incentive design

- Incremental schemes can be cheaper but more difficut to design and administer
  - Avoid basing on recent firm R&D spending
- If targeted, should be towards larger spillovers or credit constraints:
  - Collaboration with universities or non-profit research institutions
  - Small or new firms
- Loss carry-forwards, especially for new firms
- Alternative form – reduced social charges on S&E employment for R&D
  - Avoids carry-forward problem, an immediate subsidy
  - Somewhat easier to audit

Incremental tax credits

- Currently used by
  - Czech Republic, (Ireland), Italy, Portugal, Spain
  - Mexico, Korea, Japan, USA
- Rate is generally higher than level tax credit
- Good idea in principle, but problem determining increment when firms are heterogeneous

Special tax credits for SMEs

- Currently used by
  - Level: Australia, Canada, Norway
  - Incremental: Japan, Korea
  - Payroll-based: Poland, UK
  - Startups or young firms: Belgium, France, Netherlands, Portugal, Spain
- Difference between large and SME subsidy rate varies from 20% in UK to 1% in France

Source: Warda and Lester 2018

R&D tax credit evaluation

- Does it increase business R&D as intended?
  - Well studied – generally yes
- Do private rates of return fall? - as they should, theoretically
  - Not studied as much, and sometimes misintepreted
- Do spillovers to other firms increase?
  - Not much studied at all

Evidence on R&D tax credits

- Hall and Van Reenen (2000) – cross-country survey finds credits are effective
  - Estimated price elasticity about one or even higher
  - Increased R&D spending by the amount of lost tax revenue (on the margin)
- Recent research generally confirms above results
  - Chang (2018) – IV estimates using US state data give high elasticites of 2.8-3.8
  - Mairesse-Mulkay (2012) for France – 2008 reform, elasticity of 0.4, higher in their newer work
  - Dechezlepretre et al. (2016) for UK – RD study obtains elasticity of 2.6 (SMEs, financially constrained)
  - Acconcia & Cantabene (2017) – Italian R&D tax credit 2009 - higher response if firm has cash available; elasticity 0.8

R&D tax incentives & patent boxes

- Is the widespread adoption of patent boxes a good development to spur innovation?

  my answer: NO!

- Why are R&D tax credits preferred?
  - Directly related to cost and location of activity (firm decisions)
  - No incentives to transfer patents to low tax jurisdictions
  - No tax subsidy for patent trolling
  - No incentive to keep zombie patents alive to reduce taxes
  - Patent boxes target the most appropriable part of innovation
  - Much higher audit cost for patent box income; depending on box design,
    - Relative size of non-R&E budget can affect credit
    - Incentive to choose projects with high non-R&E expenses

Gaessler, Hall, & Harhoff 2018

- Our questions:
  - Do patent boxes induce transfers of patent ownership to lower tax countries?
    - How is this affected by features of the patent box and other tax regulations?
  - Do patent boxes increase patentable invention in a country?

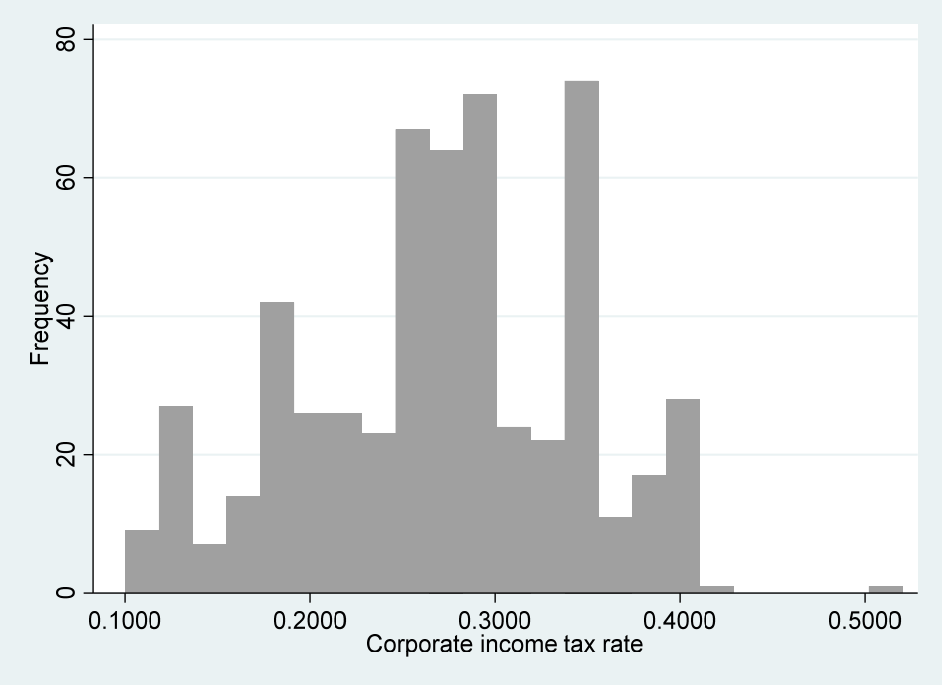
Details on patent box incentives

- Variations in IP covered (sometimes even informal IP)
- Variations in treatment of income and expense
  - Gross income in some countries, rather than net
  - Recapture of past R&D expense deductions in some cases
- Use affected by CFC rules (home country taxes income received in low tax country at domestic rate)
  - However, the ECJ has limited the application of CFC rules within the EEA area.
- In practice, variation in patent box features
  - Use of patent box as a "natural experiment" somewhat imprecise
  - Accounting for the features leaves little variation for identification
- Note: can transfer patent income to low tax jurisdiction even without a patent box (subject to CFC rules)

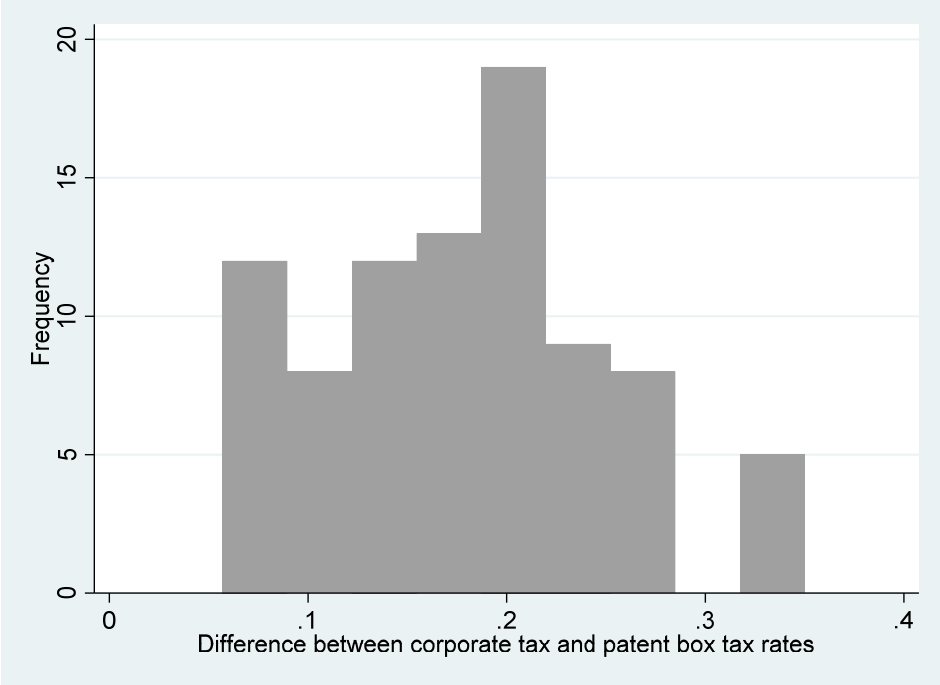
Summary of evidence on patent boxes

- Do firms transfer patents to patent box countries?
  - Evidence that patent location responds to corporate tax rates even before the boxes
  - Some additional transfer from patent boxes
  - Griffith et al. 2014 - empirical model of patent location and taxes to simulate introduction of a patent box.
    - Attracts patent income, lose large amounts of revenue
- Do patent boxes increase domestic invention?
  - Mixed evidence, mostly no
- Also, some evidence of international spillovers and profit shifting to lower tax areas

Tax variables

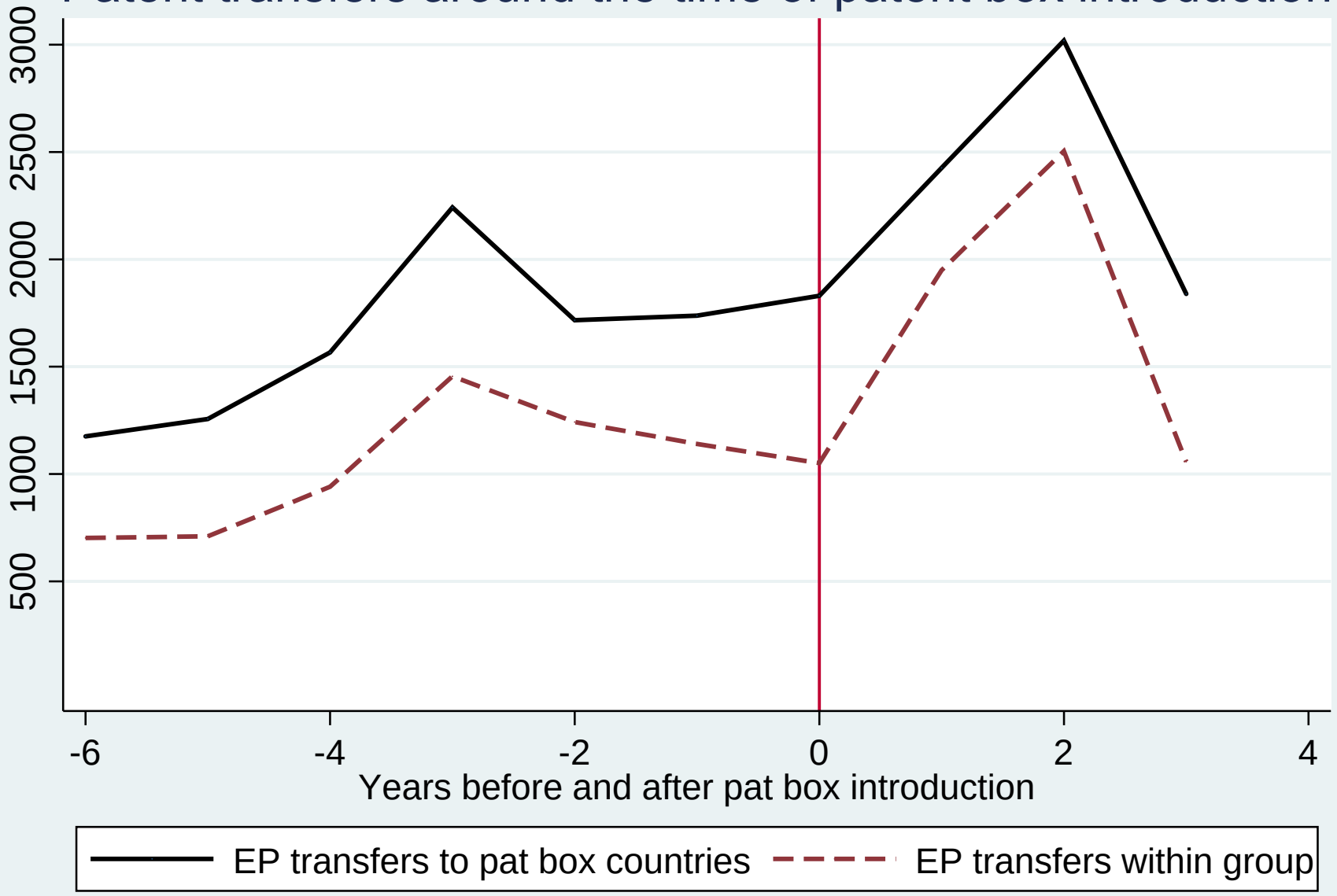


Statutory corporate tax rate



Corporate tax rate less patent box rate

Patent transfers around the time of patent box introduction



Summary of aggregate results

- Seller corporate tax rate remains a strong influence on patent transfer, regardless of the presence of a patent box
- Patent boxes do not seem to encourage transfer to a country unless existing and/or acquired patents are included without a development condition
  - A 10 per cent increase in patent tax advantage associated with 14 per cent increase in transfers in this case
  - Intra-group transfers respond to patent box wedge if there is also a CFC restriction

Patent boxes and invention

- Does the presence of a patent box increase patentable invention in a country?
  - Difficult to see because all countries have an upward trend in patents
  - We estimate regressions for the log (EP filings in a country-year) on the patent box, corporate tax rates, log population, log GDP per capita, log R&D per GDP, country and year dummies.
  - We find a *negative* impact of the patent box on patented invention.
  - Similar but insignificant results for R&D.

Patent boxes and invention

Dependent variable: Log (EP filings by inventor country and year)		
D (patent box)	-0.13* (0.06)	
Patent box tax wedge		-0.48** (0.24)
Corporate tax rate	-1.47 (1.09)	-1.44 (1.10)
Log population	-0.94 (1.18)	-0.97 (1.20)
Log GDP per capita	1.54*** (0.34)	1.51*** (0.35)
Log R&D per GDP	0.70*** (0.19)	0.72*** (0.19)
Standard error	0.255	0.256

555 observations on 37 countries, 2000-2014

All regressions include a complete set of country and year dummies
Standard errors are robust and clustered on country.

Development/existing/acquired patent restrictions are insignificant.

Summary

- Do patent boxes induce transfers of patent ownership to lower tax countries?
  - Transfers respond to seller country corporate tax
  - Also respond to patent boxes, but only if existing/acquired patents without development condition included
  - CFC rules do impact transfer by MNEs
- Do patent boxes increase patentable invention in a country?
  - Controlling for country characteristics, patented invention falls!
  - Controlling for country characteristics, R&D does not change
- Are more valuable patents transferred internationally?
  - Yes, as expected.

International coordination

- Should these policies be better coordinated between countries?
  - To exploit cross-border spillovers? Maybe
  - To avoid wasteful tax competition? YES
- Evidence
  - Bloom & Griffith (2001) find domestic R&D responds to foreign cost of R&D with an elasticity of ~unity (roughly equal and opposite to domestic cost response) – 8 large OECD economies, 1981-1999
  - Corrado et al. (2016) find similar results for 10 EU countries, 1995-2007
  - Wilson (2009) finds similar, but even larger, results for US states
  - Note that equal and opposite elasticities does not imply zero-sum

Some questions, answered

- How does taxation affect innovation? Mostly negatively
- Why are there special tax incentives for innovative activity? Externalities, financing constraints
- How should R&D tax credits be designed? Carefully
- Are patent boxes a good way to spur innovation? No
- Do countries provide enough resources to support private R&D? Probably not
- Should there be coordination across countries? Yes