

Innovative Competence, How does Ireland fare and does it matter?

**NERI Seminar Series
25th January 2017**

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Research for new economic policies

Part 1

ECONOMIC GROWTH, PRODUCTIVITY AND TECHNICAL CHANGE

Technical progress and economic change

- Stories of economic growth and human history are stories of technological change and changing beliefs and ideas.
 - New ideas and technologies are the fodder for economic growth
 - Diminishing returns to capital and labour make it impossible to sustain economic growth in the absence of productivity improvements.

- Arrow (1962, 1991)
 - Learning by doing raises the marginal productivity of capital over time
 - *“the cost of acquiring knowledge is independent of the scale on which it is eventually used, yet the benefit obtained very much depends on the scale at which it is eventually used.”*
 - Inexhaustibility of knowledge generates increasing returns to scale

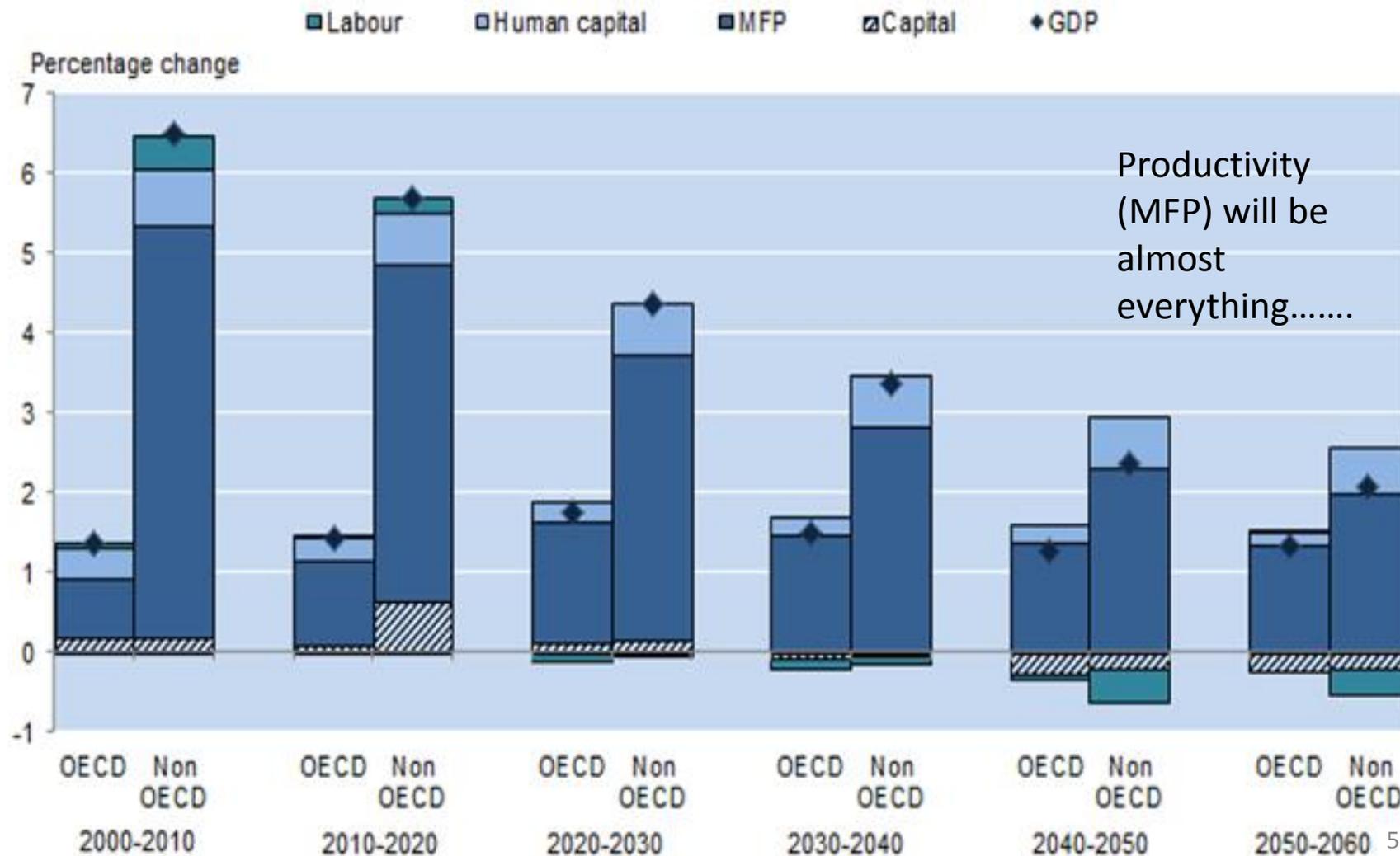
- Cost of knowledge is the main determinant of the rate of technological change
 - Romer (1990): *‘influencing the cost of finding new ideas’* is the key to economic growth

Growth parameters

- The key parameters underlying future prospects for the Irish economy are:
 - The investment rate
 - Demographic changes
 - Participation and unemployment rates
 - Total Factor Productivity

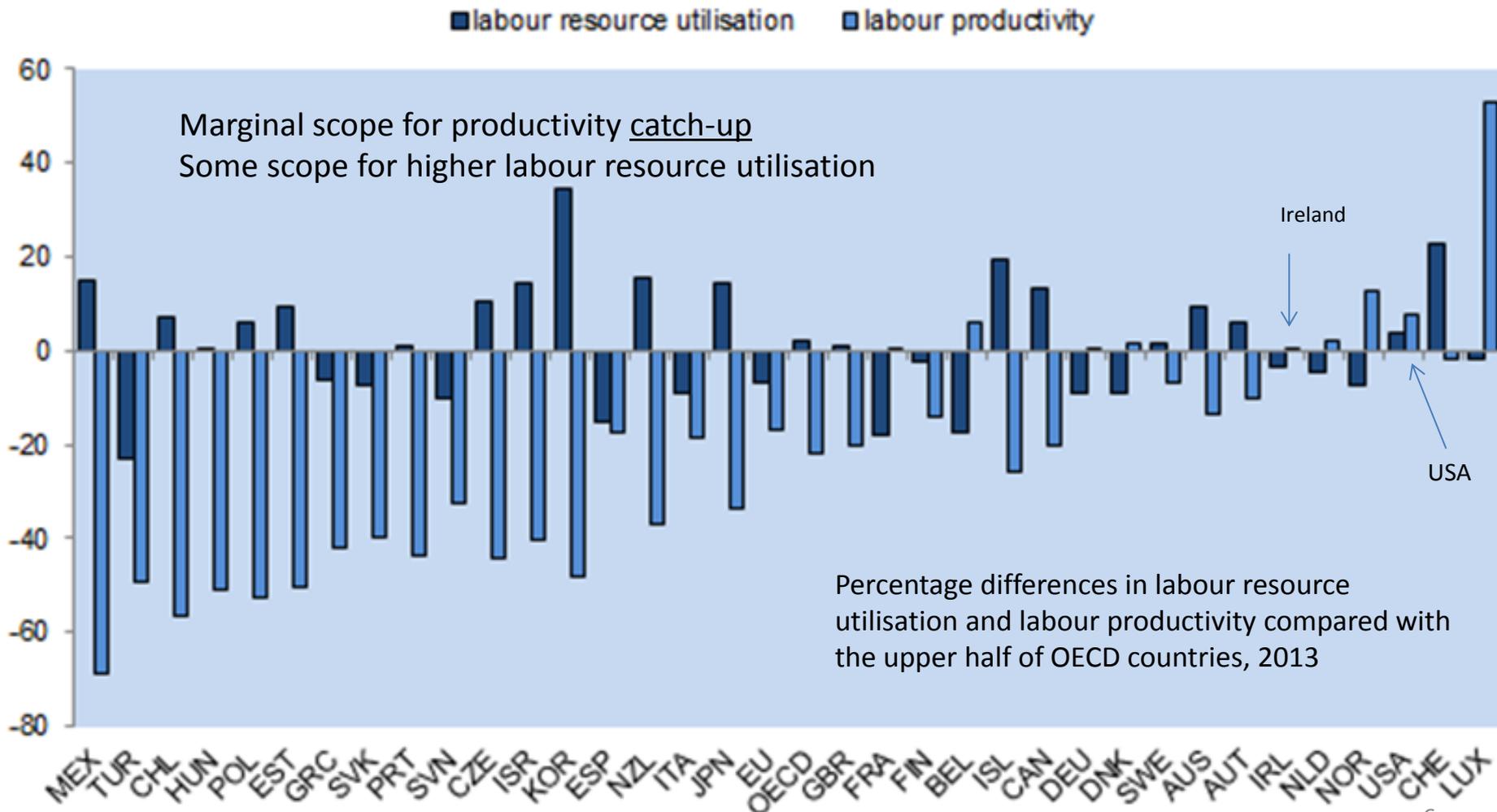
- Ireland's growth potential depends on the economy's ability to generate productivity gains year-on-year.
 - Productivity growth in Ireland has been on a downward trend for over 20 years.
 - Productivity is almost everything.... and policy can influence productivity.

OECD forecasts for contribution to growth in GDP per capita; 2000-2060 (annual average)



Differences in income per capita mostly reflect labour productivity gaps

Source: OECD 2015, Going for Growth Database



Modern growth theory (selected)

- **New growth models:** technological change as endogenous
 - Growth process driven by purposive accumulation of human and physical capital together with the production of new knowledge, often created through R&D activities, and the diffusion of that knowledge.
 - Inability of knowledge producers to fully internalise the benefits of investing in R&D, as well as uncertainty of production, reduces incentive to undertake such activity.
 - *Policy - provides rationale for activist technology policy (R&D subsidies/tax breaks/education spending/fiscal and other supports for enabling technologies, knowledge infrastructure and technology diffusion)*
- **Evolutionary models:** economic change as historically grounded path-dependent process
 - Innovation is blind (stochastic process).
 - Individuals and organisations with bounded rationality learn and search experimentally in uncertain and permanently changing environments and with uncertain outcomes.
 - *Policy - role of government is to create an environment and set of incentives that encourages innovation, removes blockages or barriers, and that supports the diffusion of innovations at the individual, organisational and economic system levels*

Modern growth theory (selected)

- **Complexity models:** economic change through exploitation of increasing returns from new innovations
 - Economy is a complex adaptive system with emergent properties.
 - Optimal outcomes cannot be guaranteed; new possibilities continuously emerging as part of a dynamic process within the system
 - *Policy - innovation is enhanced by having an open society with the rate of innovation a function of the prevailing socio-economic environment, including beliefs, types of knowledge flows, sets of incentives, and legal, political and cultural rules of the game*

- **Neo Schumpeterian models** elements of the new growth framework; technological change as path-dependent process and economy as complex system.
 - Competition between innovations, rather than between firms, is central force propelling economic growth.
 - Process of economic upheaval and change seen as perpetual.
 - *Policy - tries to reconcile the other schools – stresses the importance of innovation inputs – main inputs to innovation are public and private expenditures and the publicly available stock of innovations*

Technology Diffusion

Models of diffusion:

- Epidemic model; Discrete choice model; Complex Network Models; Percolation Models

Enablers

- Transport and communication technologies
 - Connectivity, access to knowledge
- Effective population size and density
 - Proximity and spillover, super-linear scaling
- Education and human capital
 - Competence, creativity, openness to new ideas
- Institutions
 - Rules of the game, cost of knowledge, returns to innovation

Innovative and absorptive capacity.....

National Innovative capacity

- The ability to generate original ideas and communicate and assimilate existing innovations.
 - A function of education levels, compatible institutions, knowledge flows, the quality of capital markets and government policies that support R&D (the innovation system).

- The production and diffusion of innovations can be incentivised through measures to increase the productivity of R&D and other knowledge production activities.
 - E.g. reducing the cost of innovation inputs (subsidies/tax breaks) or improving the quality and efficiency of those inputs (education)

- Increasing the productivity of knowledge production:
 - **Invest in human capital.** This is because human capital is a complement to the production and exploitation of ideas
 - Support and **invest in technologies which themselves reduce the cost of knowledge search and the diffusion of useful ideas** (e.g. broadband)

Part 2

INNOVATIVE COMPETENCE

Innovation Systems

- A system of innovation comprises:
 1. The institutions engaged in innovation related activities (STI Actors)
 2. The environment in which these institutions operate and
 3. The linkages between these institutions
- Policy Evolution:
 - Telesis (1982) – criticised narrow focus of industrial policy
 - Culliton (1992) - highlighted need to move progressively into higher productivity areas
 - Technology Foresight Exercise and the National Development Plan (2000-2006)
 - SST&I 2006-2013 and Research Prioritisation Exercise (2006-15)
 - Innovation 2020

Irish STI Actors

STI Actor Role	Examples	Sample Contributions
Policy Maker	Government Departments (DJEI, Taoiseach, Finance, Expenditure, Education) European Commission	Strategic Direction, Funding
Policy Enactor	Public Agencies (e.g. SFI, HEA, EI, IDA, IRC, KTI)	Coordination, Regulation, Programme funding
Technology Producer	Enterprises, Academia, Research Institutes	Knowledge, Skills, Products
Technology User	Enterprises, Industries, Foreign and domestic markets	Demand, Spillover, Feedback
Technology Lobbyist	Academia, Industry Groups, Business and Consumer Groups	Analysis, Information, Demand

European Innovation Scoreboard – Enablers

(data for indicators ranges from 2011 to 2015)

Category	Indicators	ROI	EU
Human resources	New doctorate graduates per 1000 population aged 25-34	2.1	1.8
	Percentage population aged 30-34 having completed tertiary education	52.3	38.5
	Percentage youth aged 20-24 having attained at least upper secondary level education	92.8	82.6
Open, excellent and attractive research systems	International scientific co-publications per million population	1,080	459
	Scientific publications among the top 10% most cited publications worldwide as percentage of total scientific publications of the country	11.7	10.5
	Non-EU doctorate students as percentage of all doctorate students	14.3	17.8
Finance and support	R&D expenditure in the public sector as a percentage of GDP	0.40	0.72
	Venture capital investment as a percentage of GDP	0.086	0.063

European Innovation Scoreboard – Firm Activities

(data for indicators ranges from 2011 to 2015)

Category	Indicators	ROI	EU
Firm investments	R&D expenditure in the business sector as a percentage of GDP	1.11	1.30
	Non-R&D innovation expenditure as percentage of total turnover	0.39	0.69
Linkages & entrepreneurship	SMEs innovating in-house as percentage of all SMEs	38.8	28.7
	Innovative SMEs co-operating with others (percentage of all SMEs)	12.0	10.3
	Public-private scientific co-publications per million population	34.3	33.9
Intellectual assets	Patent Cooperation Treaty (PCT) patent applications per billion GDP (in PPS€)	2.40	3.53
	Patent Cooperation Treaty (PCT) patent applications in societal challenges per billion GDP (in PPS€)	0.65	1.01
	Community trademarks per billion GDP (in PPS€)	6.03	6.09
	Community designs per billion GDP (in PPS€)	1.59	4.44

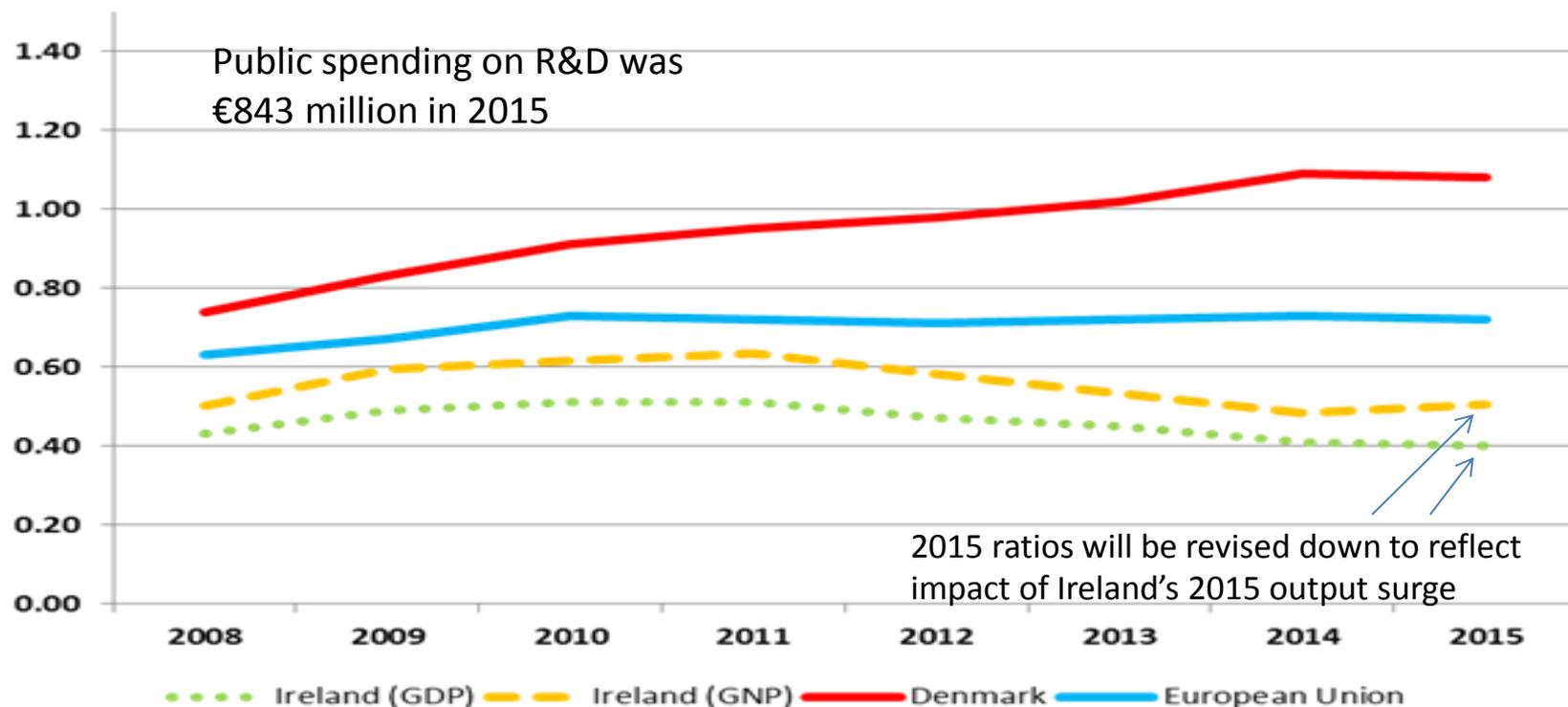
European Innovation Scoreboard – Outputs

(data for indicators ranges from 2011 to 2015)

Category	Indicators	ROI	EU
Innovators	SMEs introducing product or process innovations as percentage of SMEs	35.7	30.6
	SMEs introducing marketing or organizational innovations as percentage of SMEs	49.6	36.2
	Employment in fast growing firms of innovative sectors (percentage of total employment)	23.4	18.8
Economic effects	Employment in knowledge-intensive activities as percentage of total employment	20.2	13.9
	Medium & high tech product exports as percentage of total product exports	52.1	56.1
	Knowledge-intensive services exports as percentage of total services exports	88.5	63.1
	Sales of new-to-market and new-to-firm innovations as percentage of turnover	9.3	12.4
	Licenses and patent revenues from abroad as percentage of GDP	2.53	0.54

Public R&D Expenditures

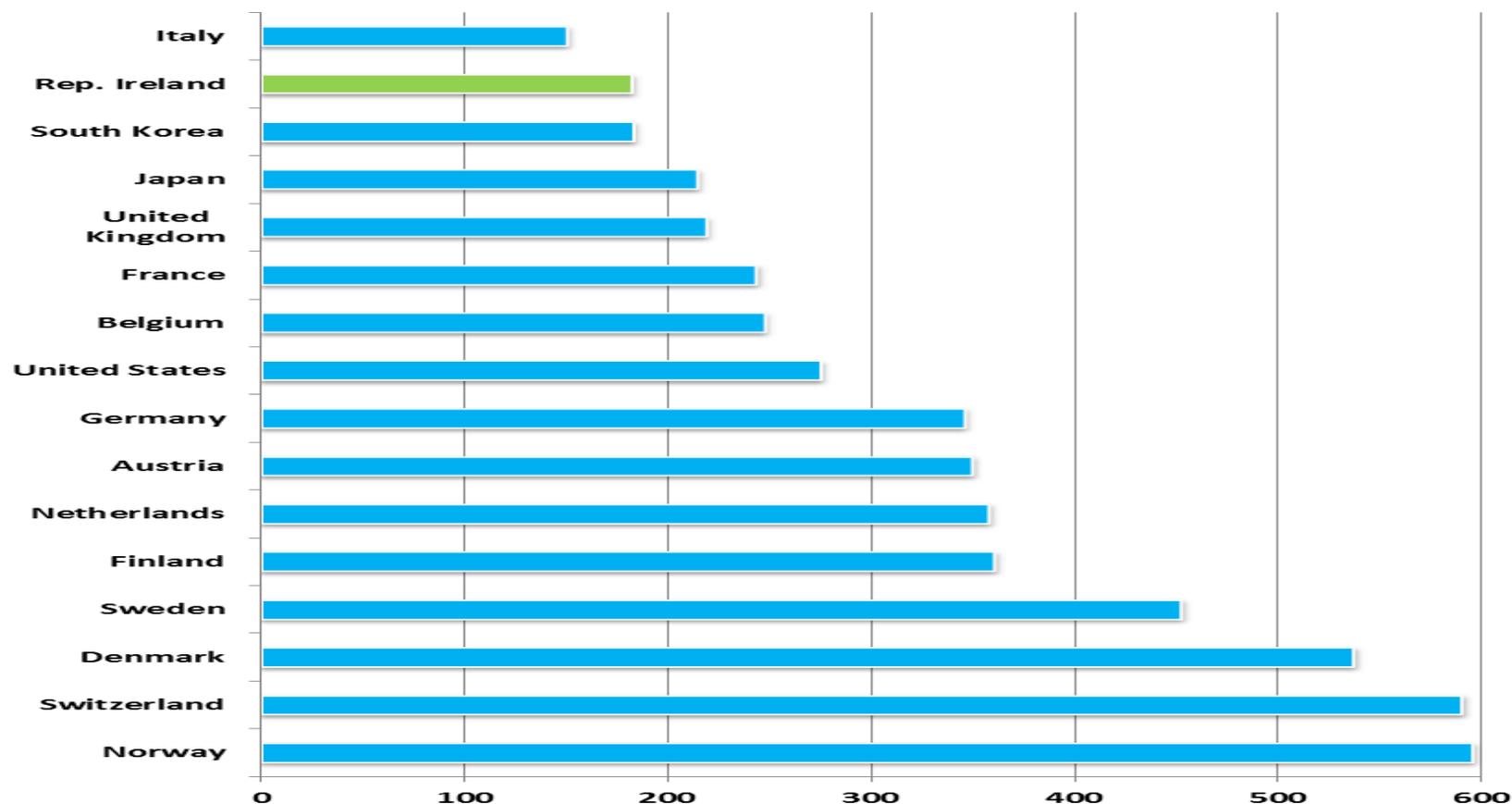
(% of GDP and GNP)
(European Commission, 2016)



Enterprise development agencies provided €149 million to support in-company R&D in 2013.
 An R&D tax credit was introduced in 2004 the cost of which appear to have been circa €500 million in 2014.
 A Knowledge Development Box (KDI) was introduced in Budget 2016 to encourage R&D in Ireland.

Per capita spend on public sector R&D, 2015 selected high income economies, (€)

(Eurostat)



Figures shown are the combined totals for government and higher education R&D expenditure.

Definition differs for Germany, Netherland and the United States.

Data is 2014 for Japan, South Korea and Switzerland and 2013 for the United States.

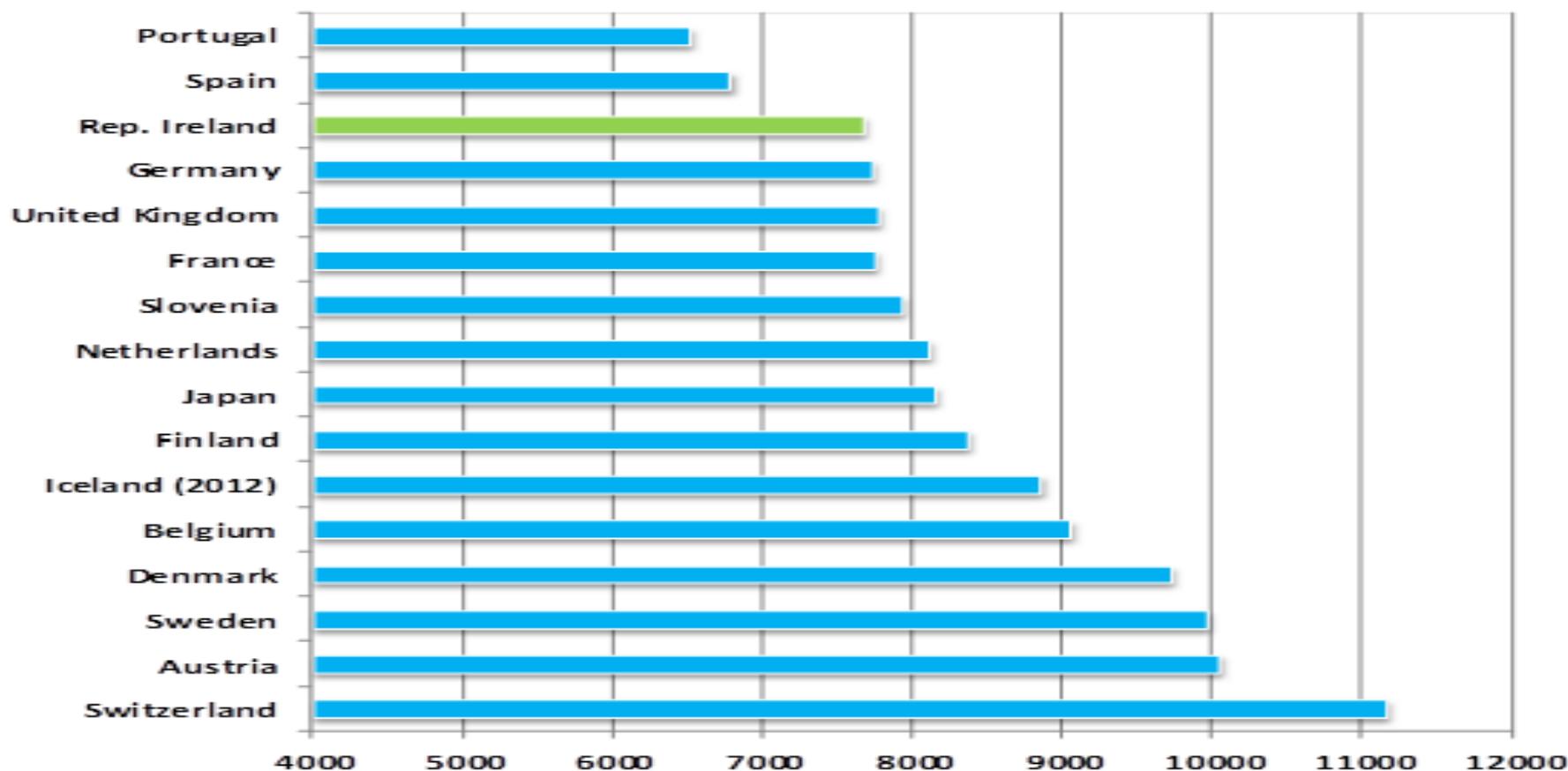
Public and Private R&D expenditure (GERD), % GDP, 2014 or latest data

(Eurostat, 2016; OECD, 2016))

- Ireland 1.5%
 - EU 2.0%,
 - OECD 2.4%
 - UK 1.7%,
 - USA 2.8%,
 - Germany 2.9%,
 - Switzerland 3.0%,
 - Denmark 3.1%,
 - Japan 3.5%
- Berlitz et al. (2015) find that an increase of one percentage point of R&D spending in the economy leads to a short-term average increase in GDP growth of approximately 0.05 to 0.15 percentage points.

Public spending on education institutions per pupil (FTE) in 2013, selected countries (PPS)

(Eurostat)



Seeding Productivity Growth: Education and Skills

- Labour productivity increases as learning and experience increase
- Human capital not only enhances labour productivity but is also a necessary input for innovation and technology adoption
- Strong education systems are empirically associated with increases in the long-run rate of per capita economic growth
- OECD contends half of the growth achieved by OECD countries since WWII has been driven by progress in education

Education spending, % GDP, 2014

(COFOG basis, Eurostat 2016)

Ireland 4.3%

EU 4.9%,

UK 5.2%,

Switzerland 6.0%,

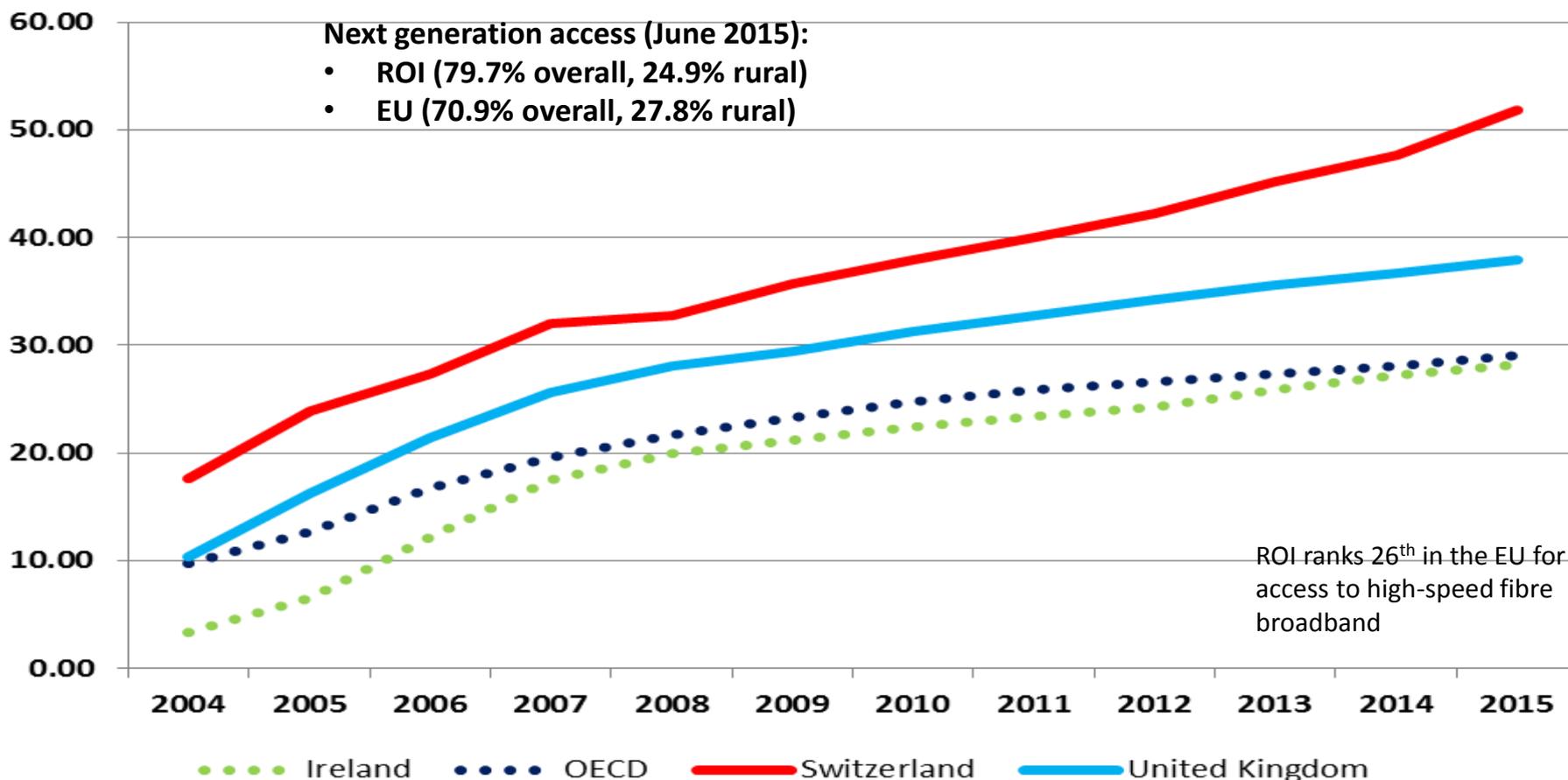
Finland 6.4%,

Sweden 6.6%,

Denmark 7.2%

Fixed Broadband Penetration Rates, Subscriptions per 100 persons

(OECD, 2017)



Ireland's household penetration rate was 65% in 2015 and 54% in rural areas compared to 72% in the EU and 63% in rural areas (European Commission, 2017)

Part 3

SUGGESTIONS

Think long-term

- The world is changing – Brexit/Trump/CCCTB etc.
- There is a danger of reacting with short-term panic responses e.g. subsidies for interest groups or tax cuts to stimulate domestic demand
- This would be a mistake

- Better to focus on the long-run productive capacity of the economy – this is the only strategy with offers even the potential to sustain ongoing quality of life improvements
 - Key to this is the economy’s innovative competence
- Boosting innovative competence is the best response to shifts in the global economy – and shifts are guaranteed!

- Ireland’s innovation performance is reasonably strong but has key weaknesses.
 - Most notably the volume of innovation inputs
- Fiscal space is limited but there is sufficient space to increase public spending on R&D and education
- Innovation 2020 should be more ambitious
- What about indigenous Irish BERD?

Direction of Reforms

1. Increase spending on basic and applied research as % of GDP and on seed funding for high potential start-ups. Increase per pupil spending on education.
2. Incentivise (subsidise) take-up of science, technology, engineering and mathematics (STEM) courses at undergraduate and postgraduate levels and support attractive career paths for STEM workers.
3. Establish a state investment bank to raise affordable and patient funding for innovating enterprise (equity stakes) – the ‘entrepreneurial state’.
4. Explore potential for grants to SMEs for adoption of new technology.
5. Increase support for horizontal linkages between the state, higher level institutes and enterprise – coordinate networks of firms through government schemes - is a ‘one-stop-shop for enterprises’ a good idea?
6. Address market failures in the provision of high speed broadband to rural areas.
7. Have independent and regular evaluation of innovation policy tools (OECD).
8. Provide for multi-year funding envelopes and consolidate funding and actions into a small number of agencies (OECD).

Mazzucato (2013): *“Germany’s competitiveness strategy has been driven by its ability to build a strong innovation system, with patient long-term finance (e.g. KfW), strong science industry links (Fraunhofer institutes) and above average R&D/GDP spending”*