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RIO Country Report 2017: Ireland

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RIO Country Report 2017

The R&I Observatory country report 2017 provides a brief analysis of the R&I system covering the economic context, main actors, funding trends & human resources, policies to address R&I challenges, and R&I in national and regional smart specialisation strategies. Data is from Eurostat, unless otherwise referenced and is correct as at January 2018. Data used from other international sources is also correct to that date. The report provides a state-of-play and analysis of the national level R&I system and its challenges, to support the European Semester.

Summary

The Irish economy continued its strong growth (4-5%) in 2015-16. Growth prospects are robust for 2017-18 (3.3-3.4%). Government deficit and debt are expected to continue falling in 2017-18. Unemployment continued to fall in 2015-16 and is expected to reach its lowest level in a decade of 6.7% in 2018. Foreign-owned MNCs that dominate highly productive sectors increased their share in the economy. GVA from indigenous firms also grew significantly but there is still a large gap between productivity growth in indigenous firms and MNCs (DG ECFIN 2017 Autumn Forecast). The country's performance in competitiveness and innovation indicators is mixed (worsening: [World Bank Doing Business](#), [Global Innovation Index](#); improving: [World Economic Forum Global Competitiveness Index](#), [Digital Economy and Society Index](#), [Small Business Act](#), [European Innovation Scoreboard](#)). As a proportion of GDP, GBAORD (2015: 0.29%), government funded GERD (2014: 0.41%), BERD (2014: 1.09%) and GERD intensity (1.51%) are slightly decreasing.

Main R&I policy challenges

1. **Enhancing collaboration between enterprise and academic research.** In 2017 this is addressed by [SFI establishing four further research centres](#) in order to support leading basic and applied research with strong industry engagement, economic, and societal impact. Funding for a fifth research centre (which will bring the total to 17) was also approved.
2. **Developing a sustainable funding model for the higher education sector.** The decade long decline in state funding of HEIs, coupled with increasing staff-student ratios, threatens to compromise quality. A consultation between the Parliamentary Committee on Education and Skills and various stakeholders started in 2017 based on the [Cassels report](#). However, a new funding model will not be completed by 2018.
3. **Improving the level and performance of R&D by indigenous enterprises.** BERD is dominated by foreign-owned MNCs. [Enterprise Ireland's Strategy for 2017-2020](#) seeks to support SMEs increasing R&D investment by 50% to €1.25 billion by 2020 and to increase the level of innovation and entrepreneurship across Irish regions. The recent [review of capital expenditure on RD&I from 2000 to 2016](#) points also to the importance of whole-of-government approaches to supporting RD&I in indigenous businesses. Further engagement in RD&I is being facilitated through supports such as the [Agile Innovation Fund](#) and the online [Find R&D Funding Tool](#).
4. **Increasing R&D and embeddedness of multinationals in the research system.** The focus of policymakers is to strengthen collaboration between Irish operations of foreign-owned MNCs and the research system. The most significant recent development in this respect is the establishment of a [further four SFI research centres](#) in 2017 and approval for funding another – see also challenge 1, above.

General R&I policy developments in 2017

- [Ireland Connected: Trading and Investing in a Dynamic World](#): the government's strategy for trade and investment to 2020.
- [SFI Gender Strategy 2016-2020](#) roadmap to achieve the stated goal of 30% female award holders within SFI's portfolio by 2020 and to improve the representation and progression of women in STEM careers.
- [Annually issued detailed action plan for education](#) The 2017 document outlines over 400 actions to be implemented during the year.

- [Creative Ireland Programme 2017-2022](#) promotes creative culture, collaborative efforts and aims to facilitate effective creativity initiatives for enterprises.
- [Enterprise Ireland Strategy 2017 - 2020](#) sets out the actions and targets to support indigenous Irish firms extend into overseas markets, enhance innovation, and improve competitiveness.
- [Review of the Allocation Model for Funding Higher Education Institutions](#) recommended reforms to the model by which funding is currently allocated to higher education institutions, to ensure alignment between institutions' objectives and national innovation and socio-economic needs.
- [Higher Education System Performance Framework 2018-2020](#) sets out the key performance objectives of the Higher Education Sector for coming years, establishing the requirements of the sector in achieving national education and innovation goals.
- [Knowledge Development Box \(Certification of Inventions\) Act 2017](#) is enabling legislation for the Knowledge Development Box initiative that allows a preferential tax rate on income from IP resulting from R&D carried out in Ireland. The Act provides for the KDB Certificate to be issued by the Irish Patent Office.
- [Building Stronger Business - Responding to Brexit by competing, innovating and trading](#) sets out the strategic response of the Department of Business Enterprise and Innovation (DBEI) to the risks and opportunities posed by Brexit. It sets out a range of supports and initiatives to assist Irish businesses in dealing with Brexit.
- [Irish Research Council Laureate Awards 2017/18](#) is a frontier research funding programme, addressing targets set out in Ireland 2020 and administered by the Irish Research Council, to provide opportunities for exceptional researchers to conduct frontier basic research across all disciplines beyond postdoctoral level.

Smart specialisation implementation

The [national research prioritisation exercise \(RPE\)](#) undertaken in 2012 is Ireland's Smart Specialisation Strategy, according to the partnership agreement with the European Commission in November 2014. It identified 14 priority areas following a process of consultation with stakeholders, including industry, the Higher Education Sector, and government agencies. [Innovation 2020](#) launched by the Irish government in 2015 is a whole-of-government strategy for innovation. It positions the 14 priority areas within 6 broad enterprise themes: ICT, health and medical, food, energy, manufacturing and materials as well as services and business processes.

The Second Progress Report on Innovation 2020 was published in December 2017 (DBEI, 2017a). An action in the progress report was to put in place a new cycle of Research Prioritisation (DBEI 2017a: page 7). Revised research priority areas for 2018 to 2023 were published in March 2018 (DBEI, 2018a).

The RPE has been instrumental in focusing Irish public funding for RD&I and there is evidence that a critical mass in the priority areas has emerged or is emerging. The SFI Research Centres are closely aligned with the RPE and have established close links with industry. However, to date there is no published evaluation of the RPE, setting out, for example, the relative success of each priority area and the additionality and impact of funding in each area.

In 2015/2016 the Irish government published [Regional Action Plans for Jobs](#), based on NUTS 3 regional categories, aimed at building on sectoral strengths and enterprise

potential within each region in collaboration with regional stakeholders from the public and private sectors (DBEI, 2017b). In addition, the [National Planning Framework](#) will develop regional spatial and economic strategies at NUTS2 level, in alignment with national enterprise policy, national infrastructure investment planning and the national specialisation strategy. RD&I policy in Ireland is a national competence. Regional innovation performance will be conditioned by regional competences based on relative strengths of HEIs and businesses in different locations.

Foreword

The **R&I Observatory country report 2017** provides a brief analysis of the R&I system covering the economic context, main actors, funding trends & human resources, policies to address R&I challenges, and R&I in national and regional smart specialisation strategies. **Data is from Eurostat, unless otherwise referenced and is correct as at November 2017.** Data used from other international sources is also correct to that date. The report provides a state-of-play and analysis of the national level R&I system and its challenges, to support the European Semester.

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Contents

Main R&I policy challenges	4
General R&I policy developments in 2017	4
Smart specialisation implementation	5
Contents.....	8
1 Economic context for R&I	9
1.1 Structure of the economy	9
1.2 Business environment.....	10
2 Main R&I actors.....	11
3 R&I policies, funding trends and human resources	13
3.1 Public allocation of R&D and R&D expenditure.....	16
3.2 Private R&D expenditure	17
3.3 Supply of R&I human resources.....	19
4 Policies to address innovation challenges	20
4.1 Challenge 1: Enhancing Collaboration between Enterprise and Academic Research	20
Description.....	20
Policy response	21
Policy Assessment.....	21
4.2 Challenge 2: Developing a Sustainable Funding Model for the Higher Education Sector	22
Description.....	22
Policy response	22
Assessment	23
4.3 Challenge 3: Improving the level and performance of R&D&I by indigenous enterprises.....	24
Description.....	24
Policy response	25
Policy Assessment.....	25
4.4 Challenge 4: Increasing RD&I and embeddedness of multinationals in the research system	26
Description.....	26
Policy response	27
Policy Assessment.....	27
5 Focus on R&I in National Smart Specialisation Strategy	28
References.....	31
Abbreviations	35
Factsheet.....	36

1 Economic context for R&I

After the remarkable recovery of 2014 (8.3% GDP growth) the Irish economy continued its strong **growth** in 2015-16. The mainly domestic demand but also exports driven growth continued to be at 4-5.1% in 2015-16 (without the distorting effect of the US tax inversions, EC, 2016a) and expected to be 4.8% in 2017 (EC, 2017a). Growth prospects are robust for 2018-19 (3.9-4.8%) but external risks are increasing, mainly due to uncertainty prompted by Brexit and future US tax policy. **Government deficit and debt** are expected to decline further in 2017-19. However, the increasing reliance on corporate tax revenues to finance permanent increases in current expenditures is a worrisome budgetary development. **Unemployment** continued to fall in 2017 and is expected to reach its lowest level in a decade of 5.5% in 2018 and 5.3% in 2019. Besides economic growth, employment activation policies also played a role. Despite both long-term and youth unemployment continuing to fall, labour market participation has increased only marginally due to net inward migration and sizeable natural population growth of 0.8%.

Foreign-owned multinationals, which dominate in highly productive sectors of the Irish economy, increased their share of the country's economy. As a result **gross value added** (GVA) and profits are still generated mainly by them. However, their disproportionate contribution exposes the economy to cyclical swings and external shocks. GVA grew significantly in the "domestic" sectors¹ of the Irish economy (+4.4% in 2015, more than twice the EU28 average) and was well distributed across all enterprise sectors. However, there is still a large gap between the **productivity** growth of domestic firms and MNEs².

1.1 Structure of the economy

With €58,800 of GDP per capita (2016) Ireland is one of the wealthiest countries in the OECD³. Services account for almost three quarters of GDP and employment, and industry for almost all of the remaining GDP and 20% of remaining employment. The role of agriculture is marginal. As one of the most open economies in the EU, its total exports were 122% of GDP in 2016 and total imports were 99.6% of GDP. The country exports mainly pharmaceuticals, medical devices and software-related goods and services. The overwhelming majority of exports are goods and services produced by foreign-owned firms. About one quarter of the exports are made towards non-EU countries.

The country's economic strength stems from its well-developed knowledge intensive services (KIS) and medium and high-tech (M&HT) manufacturing sectors. These sectors tend to outperform the EU28 in terms of value added (VA) (Table 1). However, the steadily decreasing shares of VA and employment from these sectors may raise concerns.

Table 1 Main value added indicators

		2009	2010	2011	2012	2013	2014	2015	2016
VA of KIS	IE	63.8	63.4	61.1	60.4	58.8	59.9	59.3	60.7
(% of total VA of serv.)	EU28	34.7	34.7	34.2	34.1	34.0	33.9	n.a.	n.a.

¹ Sectors dominated mainly by domestic enterprises

² Profits of MNEs are generated often by production outside of Ireland and hence they do not reflect domestic productivity developments. Estimations done by DG ECFIN show that, although at more moderate levels, productivity is growing rapidly even after controlling for the impact of MNEs.

³ However, its GNP is significantly lower (below the OECD average) due to the repatriation of profits and royalty payments by the very large number of multinational firms based in Ireland.

VA of HT and MHT manuf. (% total VA of manuf.)	IE	57.9	57.9	53.1	48.0	46.6	48.0	n.a.	n.a.
	EU28	43.7	45.7	46.2	46.1	46.3	47.4	n.a.	n.a.
Empl. in KIS (% of total empl. in serv.)	IE	56.8	57.5	54.8	55.3	55.2	55.4	55.5	55.1
	EU28	52.9	53.2	53.2	53.3	53.5	53.6	n.a.	n.a.
Empl. in HT&MHT (% of total empl. in manuf.)	IE	42.5	44.2	33.3	31.8	30.7	31.9	32.4	30.8
	EU28	31.9	31.9	32.3	32.8	33.2	33.4	33.6	n.a.

Source: Eurostat

In 2015 the number of active enterprises in Ireland increased by 4.4% y-o-y, to 249,000 (CSO Ireland 2015). This was outpaced by the growth in the number of persons engaged by them (+5.1%), indicating an overall slight increase in average company size. SMEs accounted for 99.8% of the total number of companies and 69.1% of total persons engaged (CSO Ireland 2015). Despite the fact that large companies⁴ represent only 0.2% of the total number of companies, they have 30.9% of persons engaged. The picture has practically not changed in the last 7-8 years: in 2008 the proportion of companies that were SMEs was 99.8%, hiring 71.1% of workers (CSO Ireland 2015).

R&D spending is highest in ICT, wholesale & retail trades, technical & scientific activities, manufacturing of computer, electronic, and optical products, and pharmaceuticals. SMEs continue to face development challenges. Foreign owned MNEs are active mostly in pharmaceuticals, medical and dental instruments, computer, electronic and optical equipment and internationally traded services. In 2017 the number of workers employed in IDA Ireland⁵ supported MNEs was 210,443 people, representing an annual increase of 5.3% (199,877 in 2016) (IDA Ireland, 2018).

1.2 Business environment

According to the **World Bank's Doing Business** 2018 report, indicators for 2017 Ireland ranks 17th overall up by one place compared to 2017 (World Bank Doing Business 2017). It improved considerably its ranking dealing with construction permits (rank 30, 18 places up) and starting a business (rank 8, 2 places up). However, it worsened slightly in its distance to frontier⁶ in enforcing contracts, and resolving insolvency. Concerning other indicators (e.g. getting credit, paying taxes, etc) there are no changes since last year.

Ireland's **Small Business Act** (SBA) profile and performance has been strong and improving in recent years (EC, 2016b). Ireland features among the top performers with regard to "Skills & innovation of SMEs" and the "Single market", and is above the EU average for "Entrepreneurship", "Second chance" and "Responsive administration". Key priorities are to improve SMEs' access to finance and competitiveness as well as to increase new business and job creation through enhancing Entrepreneurship.

Ireland ranks the tenth on the **Global Innovation Index** (GII) list, down by two positions from the previous year. According to the GII report (GII, 2017) its key strengths are IP payments, ICT services exports, and FDI net outflows. Its main weaknesses are in domestic credit to the private sector, market capitalization, intensity of local competition, industrial designs by origin, and cultural and creative services exports. Progress has been made in PISA results, researchers, global R&D companies, gross capital formation, and GDP per unit of energy use.

⁴ Hiring at least 250 employees

⁵ Formerly known as the Industrial Development Authority (IDA) of Ireland

⁶ The distance to frontier (DTF) measure shows the distance of each economy to the "frontier" economy, which is the best performing country on an indicator across all economies in the DB sample since 2005 (World Bank).

In the **WEF GC Index 2017-2018** Ireland kept its previous overall ranking (24th). While goods market efficiency (8th), health and primary education (16th) and technological readiness (18th), are the strongest pillars, the weakest are financial market developments (69th), market size (45th), and macroeconomic environment. The latter pillar is considered weak despite the further remarkable improvement in the macroeconomic performance (in 2017-2018 the 24th after being the 43rd in 2016-17). The country's **Digital Economic and Society Index (DESI)**⁷ score is slightly higher than last year (0.59 vs. 0.55), but its ranking has not changed (8th) (EC 2017b). It performs significantly better than the EU average in the integration of digital technology as well as digital public services. However, in relation to connectivity the difference between IE and the EU28 is practically insignificant.

2 Main R&I actors

The Irish R&I system is centralised with the bulk of R&I budgets being controlled by ministries, known as Government Departments. RD&I policies are considered a national competence, and are implemented on a national basis by Departments and statutory agencies. The basis for RD&I policies is set out in Innovation 2020 (DJEI, 2015a). The second Innovation 2020 Progress Report was published in December 2017 (DBEI, 2017a).

The **government** is involved in R&I policy development and implementation through two key ministries: the Department of Business, Enterprise and Innovation (DBEI)⁸ and the Department of Education and Skills (DES). Innovation 2020 led to the creation of the Innovation 2020 Implementation Group through the merger of the Inter-Departmental Committee on Science, Technology and Innovation, the Prioritisation Action Group and the Horizon 2020 High Level Group. The Chief Scientific Advisor⁹ is a member of the Group.

The HEA is an agency of the DES charged with effective governance and regulation of the **higher education sector (HES)**. It is also the funding body for the universities and Institutes of Technology. The main actors in the HES are the seven universities, accounting for approximately 80% of research funding in the HES. The Irish Universities Association is a representative body for the universities. The Technological Higher Education Association (THEA) represents the 14 Institutes of Technology. Knowledge Transfer Ireland is the central Technology Transfer Office. It provides a process that delivers effective commercialisation and makes it simpler for business and investors to benefit from publicly-funded research. Science Foundation Ireland is the statutory body responsible for funding oriented basic and applied research in the areas of Science, Technology, Engineering, and Mathematics (STEM) with a strategic focus. Enterprise Ireland is the government agency responsible for supporting Irish businesses in the manufacturing and internationally traded service sectors. The Irish Research Council (IRC) funds research across all disciplines and research areas from humanities, social sciences, business, law and STEM.

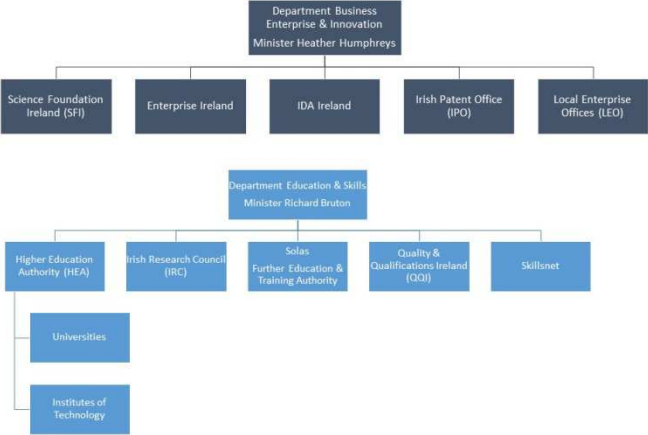
⁷ The Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU member states in digital competitiveness.

⁸ The Department of Jobs, Enterprise and Innovation was renamed the Department of Business, Enterprise and Innovation effective from September 1, 2017. The Minister's title was also changed in a similar way.

⁹The Chief Scientific Advisor to the Government of Ireland, Mark Ferguson, is also the Director General of Science Foundation Ireland.

The **Public Research Organisation (PRO)** sector is small by EU standards (4.5%).

Figure 1 Structure of Irish Agencies and Reporting Lines for RD&I Policies and Strategies



Source: Author’s own

Business sector R&D (BERD) is dominated by a very small number of mainly foreign owned MNEs concentrated in a number of high tech sectors. The research activity of the indigenous business sector is small but growing. Ibec, American Chamber of Commerce Ireland, Irish SME Association (ISME), Small Firms Association (SFA), and the Industry Research & Development Group (IRDG) are the main representative bodies for the business sector in Ireland. The **private non-profit sector** in Ireland does not undertake research activity of any significance.

Concerning the latest 7 years' trends in funding and performing R&D we can observe that businesses have the key and increasing role both in funding and performing R&D in Ireland (Table 2). The second most important performer of R&D is the HES. The government sector (GOV) sector performs little R&D. It is still an important source of funding despite its declining share.

Table 2 Trends in Funding and performing of GERD in Ireland

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Performing GERD, % of total									
BES	64.7	68.3	68.7	69.8	71.8	71.9	72.1	71.3	70.7
GOV	6.5	5.0	4.8	4.9	4.8	4.6	4.5	4.3	4.1
HES	28.8	26.6	26.5	25.3	23.4	23.5	23.4	24.4	25.2
PNP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Funding of GERD, % of total									
BES	48.8	52.1	52.2	48.9	50.2	52.6	52.8	48.4	n.a.
GOV	33.7	29.8	29.4	29.4	27.5	27.5	27.3	25.9	n.a.
HES	1.4	1.1	0.9	0.7	0.7	0.7	0.7	1.5	n.a.
PNP	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.4	n.a.
Abroad	15.6	16.5	17.0	20.3	21.0	18.6	18.6	23.8	n.a.

Data source. Eurostat

Each year since 2012, the Irish government has published an annual Action Plan for Jobs. Between June 2015 and January 2016, the Department published eight Regional Action Plans for Jobs, aimed at raising employment levels in the regions

and facilitating them to achieve their economic potential. The initiative is a central pillar of the Government's ambition to create 200,000 new jobs by 2020, 135,000 of which are outside of Dublin.

3 R&I policies, funding trends and human resources

Main R&I policy developments in 2017

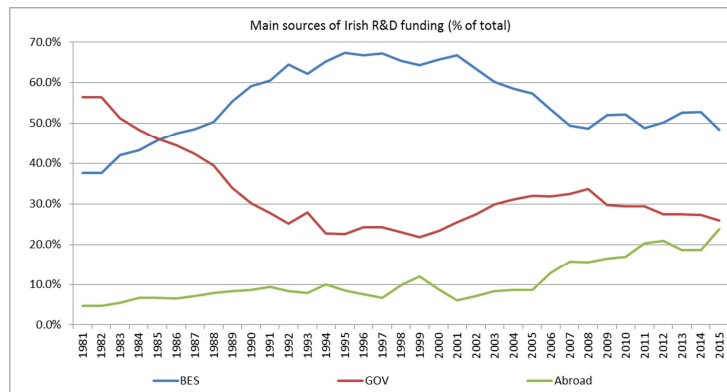
Research Priority Areas 2018 to 2023 (March 2018)	This report presents 14 revised research priority areas to reflect scientific, commercial and developments since their establishment in 2012.
Review of Capital Expenditure on Research, Development and Innovation (2000-2016) – Input to the Review of Expenditure 2017 (DJEI, 20 July 2017a)	The report is a review of the Capital Expenditure on RD&I. It traces expenditure from its objectives to inputs, outputs, outcomes and impacts from 2000 to 2016.
Ireland Connected: Trading and Investing in a Dynamic World (DJEI, 8 March 2017b)	The report sets out the government's strategy for trade and investment to 2020. It includes targets and actions to strengthen international relationships and deepen enterprise resilience. The strategy includes measures to diversify and grow export markets in the context of Brexit and globalisation challenges.
Science Foundation Ireland Gender Strategy 2016-2020 (SFI, November 2016)	The strategy sets out the agency's roadmap to achieve the stated goal of 30% female award holders within SFI's portfolio by 2020 and to improve the representation and progression of women in all aspects of STEM careers in Ireland.
Five SFI Research Centres Approved (7 September 2017 and 11 October 2017)	Five new SFI Research Centres, adding to existing 12, (four established in 2017 and one with funding approved) to address critical and emerging areas of the economy, including advanced additive and smart manufacturing, neurological diseases, the bio economy, and agri-food.
Action Plan for Education 2016-2019 (DES, February 2017)	The Action Plan for Education 2016-2019 required the DES to issue detailed action plans annually during the term of the strategy. The 2017 document outlines over 400 actions and sub-actions to be implemented during the year by the Department, its agencies and others across government.
Creative Ireland Programme 2017-2022 (Heritage Council of Ireland, 3 November 2016)	This is a strategy coinciding with commemoration of the centenary of the foundation of the state that promote creative culture and integrate support existing initiatives in the creative industries and promote further collaborative efforts involving agencies such as Enterprise Ireland and The Design & Crafts Council of Ireland. Part of its remit is to facilitate the best and most effective creativity initiatives for enterprise.
Enterprise Ireland Strategy 2017-2020 (January 2017)	This strategy sets out the actions and targets to support indigenous Irish firms extend into overseas markets, enhance innovation, and

	improve competitiveness.
Review of Allocation Model for Funding Higher Education Institutions (January 2018)	This review was conducted by an independent expert panel and recommended reforms to the model by which funding is currently allocated to higher education institutions. This is designed to ensure alignment between institutions' objectives and national innovation and socio-economic needs.
Higher Education System Performance Framework 2018-2020 (January 2018)	This framework sets out the key performance objectives of the Higher Education Sector for coming years, establishing the requirements of the sector in achieving national education and innovation goals.
Innovation 2020 Second Progress Report (December 2017)	The Second Progress Report on the implementation of Innovation 2020, Ireland's cross-Government strategy for research and development, science and technology. The report outlines the progress made on the actions contained in the strategy.
Knowledge Development Box (Certification of Inventions) Act 2017 (May 2017)	Enabling legislation for the Knowledge Development Box initiative that allows a preferential tax rate on income from IP resulting from R&D carried out in Ireland. The Act provides for the KDB Certificate to be issued by the Irish Patent Office.
Irish Research Council Laureate Awards 2017/18 (April 2017)	A frontier research funding programme, addressing Ireland 2020 targets and administered by the Irish Research Council, to provide opportunities for exceptional researchers to conduct frontier basic research across all disciplines beyond postdoctoral level.

R&I funding trends

Prior to 1985 the government was the main funder of Irish R&D. Since then there has been a shift towards businesses. The gap between the two widened up to 1995. Between 2001 and 2008 the gap declined, but the 2008-09 economic crisis marked another turning point in the financing structure. Since the Irish economy was severely hit by the crisis, government investment in R&D fell in line with other current and capital expenditure areas. Since 2008 the share of government financing is on a steady declining path, and ways to increase it again represents one of the greatest challenges of the Irish R&I system. External financing increased gradually as a share of total R&D spending over the last decade or so. However, data limitations mean a more detailed analysis of this category is problematic (Figure 2).

Figure 2 Development of funding of the total GERD in Ireland



Data source: Eurostat, November 2017

Considering the sectoral breakdown we observe that businesses mainly provide funding to themselves (Table 3). However, they receive a significant and increasing share of government funding as well (7-10% in early 2000 and 15-16% more recently). This is not surprising, since more than 70% of total Irish research is carried out by businesses. Similarly, although relatively low in magnitude, the most important share (above 80%) of external financing goes also to businesses. The higher education sector absorbs close to 70% of direct public funding from the government and a decreasing, but still two digits (16%), share of external funding. Its contribution to financing research is negligible, though Ireland's model of public research is based almost exclusively on research undertaken by academics within HEIs.

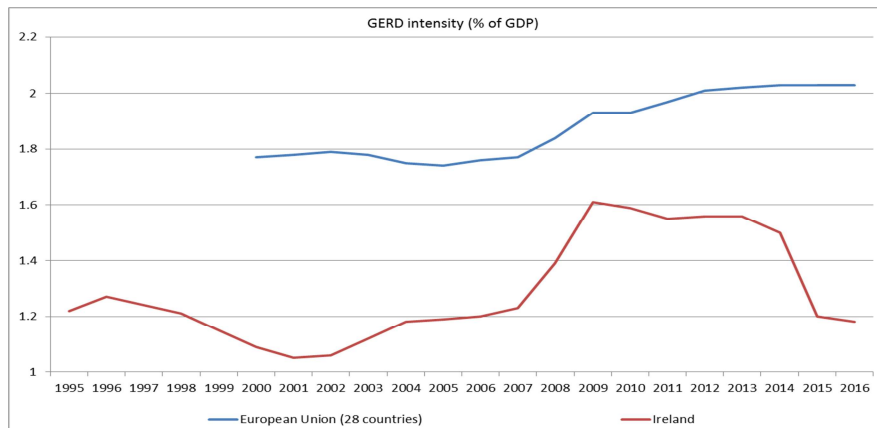
Table 3 Funding developments by main funding sectors

%	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
BES -> BES	97	97	98	99	98	98	98	98	98	98	99	99	99	99	99	98
BES -> GOV	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0
BES -> HES	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2
GOV -> BES	10	8	7	7	6	8	10	11	11	10	10	14	15	16	16	14
GOV -> GOV	30	28	29	26	23	21	17	19	18	16	15	16	16	16	15	16
GOV -> HES	60	65	64	68	71	71	73	70	71	74	75	70	68	69	69	70
Abr. -> BES	61	53	68	73	72	74	80	86	86	86	84	85	85	83	83	85
Abr. -> GOV	3	3	2	1	2	2	4	2	2	1	1	1	1	1	1	1
Abr. -> HES	36	44	30	26	26	23	15	12	13	13	15	14	14	16	16	15

Data source: Eurostat, November 2017

Irish GERD intensity fluctuated over the last 20 years, but its overall level has not changed dramatically: from approximately 1.2% of GDP in the middle of the 1990s it increased marginally to 1.5% of GDP currently, after a mild decline in the early 2000s. The sharp increases during the crisis are due mainly to GDP losses, without lower proportionate falls in the nominal level of GERD (Figure 3). The sharp decrease in 2015 is due to the distorting effects on the Irish GDP mentioned in section 1 of the present report. The development of the EU average GERD intensity is even less spectacular, but a steadier increase can be observed, from around 1.8% (early 2000s) to above 2% by 2014, which is significantly higher than the Irish figure of the same year.

Figure 3 Longer trend development of GERD intensity in Ireland



Data source: Eurostat, November 2017

3.1 Public allocation of R&D and R&D expenditure

The 2016 GBAORD figure (€719.3m) proved to be the lowest of the last decade decreasing from €930.4m in 2008, which nominally corresponds to its 2005 level. Government funded GERD reached its last decade trough in 2012 (€753m), which has been followed by a moderate increase of 2.5% on average per year, reaching €812m in 2015. The public sector (GOV+HES) continues to be the main recipient of government funded GERD, with a total share of 86% in 2015 (Table 3). It is notable that, while businesses also get around €110-120m from direct public funding, representing around 14% of total GOV funding in 2015 (Table 3), their contribution to public research funding (GOV+HES) is much lower €15-25m in the last 4-5 years, which represents an almost negligible share of total business funded R&D.

Public R&D capital expenditure declined strongly between 2008 and 2012 both in absolute terms (2008: €139m, 2012: €80.7m – Eurostat) and also as a share of total (direct) government funding of R&D (2008: 15.9%, 2012: 10.7%). Since 2012 the trend seems to have changed, but only nominally (2015: €92m), as in terms share of total (direct) government funding it has stabilised around 10-11% (2015:11.3%). This share is somewhat below the EU28 average (2015:12.8%), but on the third place in the "strong innovators" group.

The R&D tax credit scheme is a corporate profit tax credit of 25% of qualifying R&D expenditure. The Finance Act 2013 provided that the first €200,000 spending on R&D qualifies for the credit on a full volume basis. The 2015 Budget removed the base year restriction, effective from 1 January 2015. Since then the credit has applied to all qualifying R&D expenditure. The cost of the R&D tax credit to the Exchequer, in terms of tax revenues foregone, amounted to €707m in 2015 (an increase of 28% on the 2014 figure of €553m). In October 2016 the Irish Government Economic and Evaluation Service (2016) published an economic evaluation of the R&D tax credit for 2016 (IGEES, 2016). It finds that the tax credit achieves reasonable additionality, with 60% of the R&D conducted by firms since 2009 would not have occurred in the absence of the tax credit policy. It also finds that, on average, the "bang-for-the-buck" for the Irish R&D tax credit is 2.4¹⁰, which is at the higher end of values in the existing literature.

Ireland's Knowledge Development Box (KDB) was introduced on 1 January 2016. Its total estimated exchequer cost for 2016 is €50m. The KDB involves the

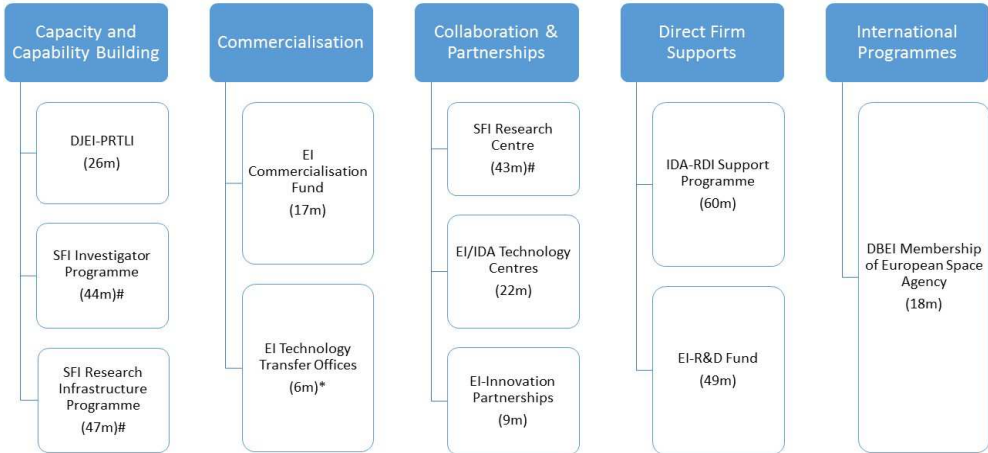
¹⁰ i.e. a leverage of 2.4

application of a preferential corporate tax rate of 6.25% (half of the prevailing corporate tax rate) on income from IP resulting from R&D carried out in Ireland. The amount of profits against which tax relief is available is determined by the proportion that the Irish company’s R&D costs bear to the total R&D costs incurred in developing the qualifying assets. The KDB is partly a response to the OECD’s call that the Irish government rebalance its innovation policies towards direct support for domestic businesses (OECD, 2015). Ireland was the first country to introduce a KDB in line with the OECD Nexus Approach, based on establishing a link between expenditure, IP assets and income. The KDB initiative has not been in place for a sufficient period to evaluate its effectiveness.

The total indirect funding to R&D has significantly expanded its share of the overall public support to the Irish R&D in the years from 2006 to 2012. The annual costs of the tax incentive scheme in terms of foregone tax revenues are estimated to have risen from €71m in 2004 to €708m in 2015 (Revenue Commissioners, 2017).

The Review of Capital Expenditure (DJEI, 2017a) provides a summary of the main programmes funded by the Irish government in RD&I across five categories of intervention. This is presented in Figure 4 for illustration. It provides information on total spend for programmes with a total spend of more than €5mIn.¹¹

Figure 4 Main Programmes by Theme and Expenditure for RD&I in DBEI



Source: DBEI (2018b), SFI (2017a), and DJEI (2017a)

3.2 Private R&D expenditure

BERD in Ireland has been growing in the aftermath of the 2008-09 economic crisis with an average nominal growth of 3.0% in 2009-2010 (3.7% between 2010 and 2016) and was around €2,300m in 2016. BERD intensity was stable at around 1-1.1% of GDP in the post 2008-09 crisis period up until 2015 when a sharp decline to 0.85% of GDP occurred. However, this figure is heavily influenced by the distorting effects on the Irish GDP mentioned in section 1 of

¹¹ Note – All figures relate to budget for 2017 (DBEI, 2018b p68), except those marked # which relate to commitments and payments in 2016 (SFI, 2017a, p81) and those marked * which refer to 2015 payment (DJEI, 2017a)

the present report. In 2015 services and manufacturing accounted for 99% of BERD expenditure. Services are the leading macro-sector of the Irish BERD with almost constant intensity in the last seven years of approximately 0.65% of GDP, except for 2015, when it declined to 0.51% due to the above mentioned distorting effects BERD intensity in manufacturing has been around 0.4-0.5% of GDP during the same period, declining to 0.33% in 2015 due to the same reason.

The business sector is the main funder of BERD, but the gap between total BERD intensity and the business sector (BES) contribution has been increasing over time. This is a consequence of both the stagnation of the business contribution (at close to 0.8% of GDP since 2009) and the increasing contributions from the government and especially from abroad (mainly EU funding).

In 2015 R&D spending of both foreign and indigenously owned enterprises increased slightly. However their shares in the totals remained stable. The investment of foreign owned enterprises (approximately €1.4b) was around 64% of total R&D expenditure. Current expenditure is approximately €1.3b (93% of total) and capital expenditure accounts for the balance (€98-100m or 7% of the total). In comparison, indigenous enterprises spent about €810m on R&D, with current expenditures of €751m (CSO, 2015-2016).

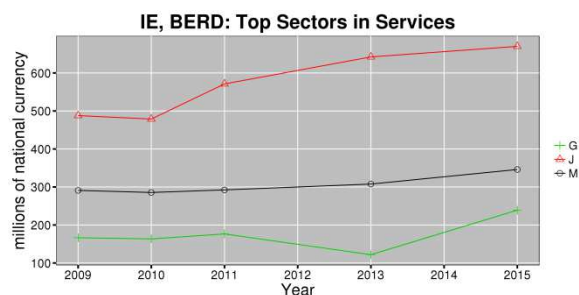
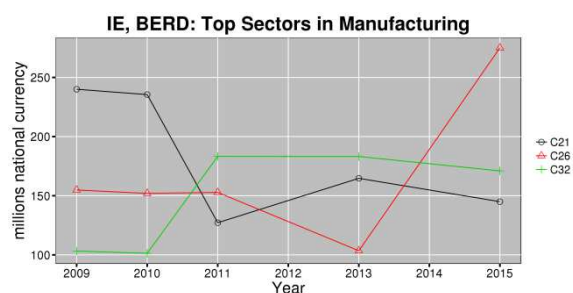
There is a polarisation between Irish and foreign owned enterprises also in terms of the number of R&D active companies, size, and level of expenditure. In 2015 there were 1,488 Irish owned enterprises engaged in R&D activities (2013: 1574) which is 79% of all R&D active enterprises (2013: 80%). This compares to 387 foreign owned enterprises (2013: 405), accounting for the residual 21%. Over 80% of all Irish owned enterprises spent less than €500,000 on R&D compared to 44% of all foreign owned enterprises (CSO, 2015-2016). Businesses with more than 250 employees accounted for 55% or €1.2b of BERD in 2015. The largest 100 enterprises in terms of R&D expenditures accounted for over €1.6b (73% of the total R&D expenditure in 2015). Total spend of enterprises outside of the top 100 was about €608m. Out of these top 100 enterprises, 76% of the expenditures can be attributed to foreign owned enterprises (CSO, 2015-2016).

Even more striking is the analysis of the data included in the EU Industrial R&D Scoreboard (EC, 2016c). 24 Irish-registered companies appear in the 2016 ranking of top-1000 EU R&D investors (2015: 25). Irish BERD is by orders of magnitude less than the sums of the total R&D spend by top R&D performers registered in Ireland¹², showing – similarly to last year – that a great deal of research done by companies active in R&D and headquartered in Ireland is in fact still performed outside the country.

According to Figure 5, below, computer, electronic and optical products, and pharmaceutical manufacturing industries are the top R&D performing sectors in Ireland. In services ICT, wholesale and retail trade, and technical and scientific activities are the top R&D performing sectors. The business expenditure for research related to wholesale and retail trade decreased significantly in 2011-2013.

Figure 5 Top sectors in manufacturing and services BERD in Ireland

¹² In 2015 BERD in Ireland was €2,233m, whereas the total R&D spend by top R&D performers registered in Ireland was €8,841.6 (up from €6,389m in 2014).



(C21: manufacture of basic pharmaceutical products and pharmaceutical preparations; C26: manufacture of computer, electronic and optical products; C32: other manufacturing; G=wholesale and retail trade; repair of motor vehicles and motorcycles, M=professional, scientific and technical activities)

Data source: Eurostat, November 2016.

In terms of gross value added (GVA), manufacturing is the leader with 20% contribution to Irish GVA, thanks mainly to the manufacture of pharmaceuticals, as well as food and beverage products, which in recent years has been comparable in value to wholesale and retail trade – the leading sector in services).

3.3 Supply of R&I human resources

Recent developments in Ireland's supply of R&I human resources (Table 4) are promising. There remain concerns about the level of funding for the teaching role of the third level sector. While the government announced a €100mIn increase in recurrent allocation to the higher education sector in Budget 2018 relative to 2016 funding, this should be considered in the context of the 38% decline in state funding for third level education between 2009 and 2016 (from €2bln to €1.3bln) (HEA, 2017; page 8). Both the existing and new "stock" of people aged 25-34 with a tertiary education degree, including those with a degree in STEM, is growing and high when compared to both the EU28 and the Innovation Leaders (InL) group. The 36% share of females in the total researcher population registered in 2015 is higher than both the EU28 (33.4%) and InL group average (31.7%). Public expenditure on education and tertiary education as a share of GDP is lower than the EU and InL average and the recent (5 years) decreasing trend is a cause for concern. Employment rates of population aged 25-64 with a tertiary degree are increasing and they are comparable to the EU average, but lower than the InL average, though. Similarly, the share of mobile graduates with tertiary education is growing, which indicates the improving attractiveness of the Irish labour market.

Table 4 Supply of human resources for the Irish R&I system

Indicator		2010	2011	2012	2013	2014	2015	2016
Population age 25-34 having completed tertiary education (ISCED 5-8) (%)	IE	48.3	47.4	49.2	51.1	50.8	52.0	51.8
	InL*				42.9	43.8	44.7	43.9
	EU28	33.3	34.4	35.5	36.4	37.2	37.9	38.2
Number of researchers per thousand of population	IE		4.89	2.57	5.53		7.2	
	InL				9.1	8.7	8.9**	
	EU28		5.03		5.36		5.6	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	IE	1.2	1.3	1.4	1.6	1.8	1.8	
	InL				1.7	1.8	1.8	
	EU28		1.02	1.11	1.07			
Scientists and engineers aged 25-64 as % of active population	IE	8.3	9.3	9.7	9.4	9.2	9.3	9.5
	InL				10.5	10.5	10.7	10.5
	EU28	5.4	6.9	6.9	7	7.1	7.2	7.4
New graduates in science, maths, computing, engineering, manufacturing, construction per 1000 population	IE	3	3.09	3.11	2.81	3.04	3.62	
	InL				1.7	1.9	2.7	
	EU28	1.99		2.17		2.31	2.32	
Public expenditure on education (% GDP)	IE	5	5.6	5.3	5	4.8	3.7	

	InL				6.1	6.2	6.0	
	EU28	5.3	5.1	5.0	5.0	5.0	4.9	
Public expenditure on tertiary education (% GDP)	IE	0.9	1.3	1.2	1.0	1.0	0.7	
	InL				1.3	1.4	1.3	
	EU28	0.8	0.8	0.8	0.8	0.8	0.7	
Employment rates of population age 25-64, having completed tertiary education (%)	IE	81.0	80.5	80.0	80.1	81.1	82.1	82.6
	InL				86.4	86.3	86.4	87.1
	EU28	83.9	83.7	83.5	83.4	83.7	84.1	84.8
Share of tertiary degree mobile graduates from abroad (%)	IE				6.2	7.8	8.4	
	InL				13.6	13.5	12.9	
	EU28	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	

*InL: Innovation Leaders (European Innovation Scoreboard)

** : average computed without the Swiss data (missing)

Data source: Eurostat

Innovation 2020 commits to increasing the number of research masters and PhD enrolments. It also sets a target of increasing the share of PhD researchers transferring from SFI research teams to industry from 25% in 2014 to 35% by 2020. The HEA reports that as of March 2017 there were 3,009 students enrolled on full-time doctoral programmes in STEM subjects in Irish universities and institutes of technology (from a total PhD enrolment of 6,086). This compares to 3,082 (out a total 6,806) in March 2016 and 3,002 (out of 6,800) in March 2015 (HEA Statistics). The failure to sustain the 2016 growth in PhD enrolments might be a source of concern for the achievement of the Innovation 2020 target. It is welcome therefore that, in Budget 2018, a new PHD and Research Masters Programme to meet enterprise skills needs was announced. The programme will provide funding for 150 new enrolments in disciplines aligned to enterprise needs. This programme will address a key action of Innovation 2020 to increase the enrolment of postgraduate researchers by 500 places by 2020.

The Expert Group on Future Skills Needs published the Regional Labour Market Bulletin in October 2016 (SOLAS, 2016). It shows that the Dublin region dominates in terms of labour force participation rates, employment rates, and the share of employment in KIS and the ICT sector. Dublin accounted for more than half of the total employment in ICT in the state. Dublin also has the highest share of workers employed in relatively high skilled occupations. The expert group projects employment to grow by 2% each year from 2012 to 2020, though there would be regional disparities in the rate of employment growth. Regional projections suggest that not all regions will have employment passing the levels seen before the start of the recession in 2008. The report also shows that in each region there is a need for more engagement of young people with the education and training system. All regions have a sizeable group of young people not in employment, education or training (NEET), with the highest rate of 1 in 5 in the Midlands region. Also, the share of early leavers from education was above the national average in the Border, Midland, West, and South-East regions.

4 Policies to address innovation challenges

4.1 Challenge 1: Enhancing Collaboration between Enterprise and Academic Research

Description

The low levels of collaboration between enterprise and academic-based researchers have been consistently identified as a challenge for the Irish research system. It is a particular problem for Irish SMEs. Though it would be

preferable to have current data, the most recent available data that is comparable across the EU on the extent of interaction between Irish businesses and academics is from the 2014 Community Innovation Survey. The survey showed that 11% of Irish innovating SMEs cooperated with universities or other HEIs. This lagged behind the EU-28 average of 13.2%, and is substantially lower than comparator countries such as Finland (23%), the UK (18.9%) and Denmark (15%).

Indigenous companies show a lower rate of collaboration with academia compared to foreign MNC. This may be explained by a combination of factors including weak absorptive capacity within indigenous SMEs, mismatches in incentive structures and working methods between business and academia, a lack of awareness of the range of research and supports being undertaken in Irish HEIs, and/or a lack of knowledge in businesses about how to begin working with HEIs, including uncertainty on the allocation of intellectual property rights. Most Irish SMEs are not in high-technology sectors and these SMEs may not consider academic research to be relevant to them.

Policy response

Over the last decade there has been a substantial shift in the proportion of public investment in R&D for HEIs dedicated to knowledge exchange through collaboration between businesses and HEIs. As a result the proportion of public investment in R&D for HEIs dedicated to collaboration has increased from 7% in 2005 to 26% in 2015 (DJEI, 2016b, page iv).

SFI established a further 4 large research centres in September 2017, to add to the 12 already in place. These new research centres will involve €74 million public investment over 6 years, with an additional €40 million investment from industry. The research centres will have over 80 industry partners. The existing research centres have been successful in developing and exploiting strong industry links. Funding was allocated in Budget 2018 to develop a new SFI research centre, the SFI FutureMilk Centre, bringing the total number of research centres to 17.

Irish HEIs continue to be very active in promoting business incubation services, with every university and institute of technology now hosting a start-up centre, providing in most cases non-financial supports to spin-offs and graduate micro-enterprises.

Policy Assessment

Irish policy makers have clearly attempted to address the challenge of improving the extent of knowledge transfer from publicly funded research to enterprises. More funding has been made available to HEIs for this objective. However, there is evidence that these attempts are less successful with Irish indigenous enterprises, who are less likely to collaborate and less likely to turn that collaboration into innovation outputs. Doran and O'Leary (2016) find that for Irish indigenous businesses there is no positive effect on innovation of collaboration with HEIs, unless SMEs are already engaged in R&D.

This means that attempts to enhance collaboration with Irish businesses that are focused on the HEI element of the system may be sub-optimal at best and potentially wasteful, without simultaneously addressing R&D expenditure within the businesses themselves.

There continues to be a need to streamline and promote the range of small scale grant-based schemes, such as innovation vouchers, available for business-academia collaboration. In addition, while teaching is one of the three core roles of higher education identified in the Strategy for Higher Education to 2030 (with research and commercialisation), policymakers should be careful to ensure funding cuts to HEIs over the last number of years do not do lasting damage to the traditionally important teaching roles of HEIs. This is critical for RD&I as the most common method of knowledge transfer between HEIs and businesses is through the hiring of skilled, trained graduates.

Doran and Jordan (2016) demonstrate that businesses differ by sector in the drivers of innovation, and the relative importance of collaboration with publicly-funded research varies by sector. Since there is a substantial difference in the sectoral composition of indigenous and foreign-owned businesses, policy should reflect the needs and challenges of each to avoid once-size-fits-all approaches to supporting academic-industry collaboration. This is reflected in the suite of supports offered by Irish state agencies.

4.2 Challenge 2: Developing a Sustainable Funding Model for the Higher Education Sector

Description

The Irish HES is funded primarily through a combination of direct state subvention, undergraduate student registration fees, postgraduate tuition fees, EU undergraduate student registration fees (the level of which is set by the government), EU postgraduate tuition fees (the level of which is set by the relevant institution), and international non-EU tuition fees (the level of which is set by the relevant institution). Irish HEIs have seen state funding decline substantially since the start of the economic recession in 2008. The Expert Group on Future Funding of Higher Education (2016), popularly referred to as the Cassells Report after its chairperson, shows that state grants to publicly funded HEIs fell from €1.4bn in 2008 to €923m in 2015, a decline of one third. There has been a reversal of some of this decline in 2017 and 2018 to bring the figure to just over €1bn. Simultaneously student numbers rose over the same period by just under one quarter. Private student contributions have risen since 2008, to partially offset the public funding reductions.

The decline in public funding, which coincided with a rise in student numbers and a freeze on hiring new staff as part of the national Employment Control Framework for the public sector, has raised staff-student ratios and threatens to compromise quality in the third level sector. This has medium to long-term implications for meeting the skills needs for economic and social objectives.

In addition, a perceived decline in the quality of Irish third-level institutions, arising from lower institutional rankings for Irish universities across major international ranking schemes, may have adverse effects on those institutions' ability to attract leading international researchers and, in turn, to secure international competitive research funding.

Policy response

The Cassells Report was published in July 2016. It highlighted the challenge for the sector from the decline in public funding and proposed three options for future sustainable funding for the third level sector: a fully state funded system

(abolishing all fees), increased state funding with continuing student fees, or increased state funding with deferred payment of fees through an income contingent student loan system. The report clearly ruled out the status quo as an option for sustainable funding of the sector.

As committed to in the Programme for Government, the report has been referred to the Oireachtas Joint Committee for Education and Skills as part of the process for formulating a plan for the future of the sector. The committee requested the Department of Education and Skills (DES) to undertake an economic evaluation of the options presented in the Cassell's report.

The Government has commenced a programme of re-investment in Higher Education to begin to redress the reductions seen over the period of the economic crisis. The investment in higher education in 2018 is more than €100m more than 2016.

The government has stated that this additional funding will allow for targeted initiatives in higher education including skills programmes, performance and innovation funding, technological university development, and apprenticeship costs in the sector. It claims that this will also allow for 2,100 additional students in 2018.

In January 2018 the Minister for Education and Skills published a review of the allocation model for funding Irish undertaken by an international expert panel. The review is welcome, providing a roadmap for transitioning towards a reformed funding model that is more transparent, consistent across higher education institutions, that incentivises actions in key strategic areas, and supports improved accountability while also respecting institutional autonomy. The new funding model will also incentivise higher education institutions to respond to key objectives in relation to research, STEM provision, wider skills needs, and promoting access and lifelong learning.

The recommendations in the Review will also complement and be supported by the new Higher Education System Performance Framework. The Framework, and the process of mission based compacts and strategic dialogue that support it, is a key mechanism for ensuring accountability for funding allocated to the higher education sector

Assessment

The review of the allocation model for funding the third level sector is welcome in enhancing efficiencies, improving governance, and increasing transparency in funding models for HEIs. However, the review did not consider, as it was outside its terms of reference, the more substantive issue of sustainable state funding for Irish higher education. In Budget 2018 the Irish government announced it will invest €100 million more in higher education in 2018 than in 2016. However, this must be placed in the context of a decline in state funding for the sector from €2bln in 2008 to €1.3bln in 2015. After accounting for increased student contributions over the period, HEIs income per student fell by 20%. Staff student ratios in Irish HEIs rose from 1:15.6 in 2008 to 1:19 currently (HEA, 2017; pages 8 and 12).

The HEA (2018; page 20) stated that "the impact of reductions in resources allocated to higher education during the financial crisis, coupled with the increase in demand for places, has seen a decline in the student: staff ratios which has impacted on the ability of institutions to provide for teaching and learning

experiences that benefit students most, for instance small group work, laboratory based projects and retention supports”.

The potential reintroduction of third-level fees or a student loan scheme, even if income contingent, is politically sensitive. Several political parties have stated they are opposed to student fees and loans. In the context of a minority government, it is unlikely that a decision on a sustainable funding model, as recommended in the Cassells Report, will be made in the short-term. This risks prolonging and intensifying the deterioration in staff-student ratios, preventing further declines in international rankings, and further undermining strategy implementation in Irish HEIs.

The Cassells Report emphasises that the status quo is not a sustainable option for funding Irish HEIs. The longer the Irish government continues with the status quo, the more difficult it will be for Irish HEIs to meet the targets in the performance compacts with the HEA. These performance compacts have implications for further strategic funding for HEIs, and so delays in implementing sustainable funding models threatens a vicious cycle of under-performance and funding challenges.

Further decline in the international rankings for Irish HEIs and persistently high student to staff ratios will also threaten their ability to attract and retain academic leaders, undermining their ability to compete for international competitive research funding.

4.3 Challenge 3: Improving the level and performance of R&D&I by indigenous enterprises

Description

While Ireland performs well in terms of innovation outputs in the European Innovation Scoreboard (European Commission, 2017c), the scale and nature of R&D activity is uneven between indigenous and foreign-owned businesses. It has been noted that BERD is dominated by foreign-owned multinationals (MNCs). The 2017 European Semester Report for Ireland (European Commission, 2017) noted that innovation among Irish indigenous firms could be improved, and that greater strategic cooperation with public research centres, universities, and MNCs could help improve those results.

In 2015 small enterprises (less than 50 employees) accounted for 71% of R&D active businesses, though according to the CSO (2017, page 8) only 1% of small businesses in Ireland engage in R&D. Over 80% of all R&D active Irish-owned businesses spent less than €500,000 on R&D in 2015.

In particular it can be expected that there is a lack of R&D activity among SMEs operating only within the Irish market, since exporting businesses are more likely to engage in R&D and be more successful in translating R&D activity into successful innovation. Irish SMEs and foreign MNCs innovate differently, as evidence from Doran, Jordan and O’Leary (2013) and Doran and O’Leary (2016) show that SMEs tend to conduct a greater proportion of R&D in-house and in less formal ways, while MNCs, which spend nearly six times more per worker on R&D, generate greater returns to innovation, but mostly through the purchase or licence of patents. Doran and Jordan (2016) consider differences in innovation activity across sectors in Ireland, while controlling for nationality of ownership. They find that Irish-owned firms tend to be less likely to innovate across all

sectors, even when controlling for the traditional drivers of innovation. This is true for new-to-market, new-to-firm, organisational, and process innovation. There is a lack however of sufficient detail in available data to allow more precise assessment of the innovation performance of indigenous businesses. Nevertheless, the distinction between the RD&I activities of indigenous and foreign-owned businesses is important for effective policy.

Policy-making to support the innovation activities of exporting businesses needs to address new challenges in export markets such as the UK¹³, and the rest of the EU.

Policy response

In January 2017, Enterprise Ireland launched its **Strategy for 2017-2020** (EI, 2017a). The strategy sets targets across four areas: innovation, competitiveness, diversification of exports, and ambition to scale. The strategy seeks to support SMEs increasing R&D investment by 50% to €1.25 billion by 2020, to increase the level of exports from EI client companies to €26 billion per annum by 2020, to achieve exports to non-UK markets of 67% of total exports, to grow Eurozone exports by 50%, and to increase the level of innovation by client companies and entrepreneurship across Irish regions.

As part of the measures to underpin its strategy, EI also launched the **Eurozone Market Strategy 2017-2020** (EI, 2017b). This is to support client companies to diversify export markets away from a reliance on the UK. The targets in the Strategy include increasing exports from its client companies by 6% globally to €21.6 billion. The range of supports to achieve the targets in this strategy include market research and feasibility grants, Eurozone market access grants for market expansion, innovation/R&D grants for product localisation, management development training and access to language supports.

In terms of its cost to the Exchequer, the main RDI support measure for the enterprise sector (SMEs and MNCs) is the **R&D tax credit** (Section 3.1). Another important, albeit less costly measure is the **patent box** (KDB – Section 3.1) introduced in 2016.

DJEI (2017a) published a review of capital expenditure on RD&I from 2000 to 2016, in which evaluations of various supports and investments in business RD&I are presented. The review points to the importance of whole-of-government approaches to supporting RD&I in indigenous businesses, MNCs, and the research system generally.

Policy Assessment

R&I policy directed at indigenous SMEs currently faces an additional challenge from economic and political uncertainty. Irish SMEs currently exporting to the UK market must focus in coming years on diversifying their markets, which is likely to divert resources and attention away from research and product innovation. Policy interventions to assist this market diversification, including financial support for localisation and language changes are appropriate. This will ease the pressure on SMEs at a critical time.

¹³ The adverse economic effects of Brexit are most likely to be felt by indigenous Irish SMEs, and in particular those exporting to the UK.

A particular emphasis in Irish RD&I policy in recent years has been on technology transfer between publicly funded research performing organisations and SMEs. There is evidence of success. In 2017 it was [reported that Irish SMEs are performing very well in securing funding](#) under the Horizon 2020 SME Instrument. Irish firms have a 13% success rate in applications under the instrument. This is the second highest in the EU and over two and half times the EU average.

There is, however, limited evidence of systematic and widespread collaboration for research. This may be explained by the fact that only 1% of small enterprises engage in R&D, according to the CSO survey on BERD. This means SMEs may not be building up sufficient absorptive capacity to identify, evaluate, and exploit public knowledge for innovation. The emphasis therefore in RD&I strategies for SMEs must be on building up research and innovation capability within Irish SMEs. The R&D tax credit and KDB scheme must be targeted at SMEs specifically.

While the research priority areas underpin science policy, the majority of Irish SMEs operate in relatively low to medium-technology sectors. It is important that Irish SMEs perceive RD&I policy as relevant to their businesses. In addition, given the importance of the services sector to the Irish economy, and called out as important in *Innovation 2020* (DJEI, 2015a; page 25), policy-makers should consider the allocation of increased resources to support service innovation. An important consideration for policy formation in this context is the recognition by the OECD (2012) that supports for service innovation cannot be developed using the same approach as technological innovation supports.¹⁴

An important challenge for policy going forward is to generate and share useful data on innovation and productivity by sector, size class, and ownership. Data limitations, conditioned by concerns on business confidentiality, prevent analysis across several categorisations. The availability of such data would greatly enhance understanding of the dynamics of innovation in Irish SMEs and indigenous businesses, and inform evidence-based policy-making.

In addition, greater attention should be paid to the relative importance and potential complementarities of policy interventions to support indigenous businesses. The policy mix requires greater investigation to identify which policy interventions are most effective for different types of indigenous businesses, though there is emerging academic interest in this topic (Mulligan, Lenihan, and Doran, 2017).

4.4 Challenge 4: Increasing RD&I and embeddedness of multinationals in the research system

Description

Large businesses and foreign-owned businesses account for a majority of BERD (see Section 3.2). A particularly important challenge for policymakers is to embed the foreign MNC sector into the research and innovation system. The innovation activities and needs of MNCs and SMEs are likely to be different, not least given the scale of MNCs relative to indigenous enterprises. As noted in the previous challenge, MNCs and SMEs are different in how they engage in R&I. This

¹⁴ The OECD (2012) states that greater quantitative and qualitative data and analysis is needed to inform discussions on how to design new, or to perfect existing, policy instruments to support service innovation. This includes developing appropriate indicators to measure service innovation output.

requires differential policy approaches. The focus of such policies for the MNC sector is to instigate or strengthen collaboration between Irish operations of foreign-owned MNCs and the research system. Success in this would enhance the sustainability of employment and economic contribution of the MNC sector. An important aspect of Ireland's attraction for FDI is the quality of human capital and research infrastructure. Sustained investment in the HES and support for capital investment in R&D is required to maintain Ireland's relative attractiveness in these factors.

Policy response

Ireland has a long-standing policy objective of attracting foreign MNCs to establish operations in Ireland, encouraging them to engage in or expand their R&D, and to embed them in the Irish innovation eco-system.

The most significant development in the last year in MNC engagement with Irish science and research community is the commitment to establish a further five **SFI research centres**. Four centres were established in September 2017 in the areas of advanced additive and smart manufacturing, neurological diseases, and the bio economy. SFI will invest €74 million over six years in these centres; they will work with 80 business partners, providing an additional €40 million. In October 2017, SFI approved the establishment of a further centre in agri-food. Funding for this centre was approved in Budget 2018, and it will have 45 industry partners who have committed €16 million to the new Centre. This is the third phase of funding under the SFI Research Centres Programme, which previously saw seven SFI Research Centres established in 2013 and five established in 2015. The objective of the centres is to support cutting-edge basic and applied research with strong industry engagement, economic and societal impact. SFI is also funding up to 6 projects in the Science Policy Programme to undertake research on critical aspects of science policy and evaluation.

In August 2017, SFI published the Interim Evaluation of the SFI Research Centres Programme, prepared by independent consultants (SFI, 2017b). The evaluation found an impressive performance in meeting or exceeding almost all of the targets set at the initiation of the programme. The report makes positive and constructive recommendations on the need to develop metrics to facilitate assessment of return on investment, the need to continue to adequately resource the programme, and to continue to emphasise the transfer of skills from Research Centres to enterprise.

The **R&D tax credit** (see Section 3.1) designed to incentivise R&D among Irish businesses was predominantly accounted for by large companies., The **KDB** discussed in Section 3.1 has been identified by IDA Ireland as an important element of its offering to foreign MNCs considering the establishment of R&D and innovation activities in Ireland. This scheme is not in place sufficiently long to evaluate its effectiveness.

Policy Assessment

Ireland continues to be successful in attracting new FDI. In its 2016 Annual Report, IDA Ireland asserts that Ireland wins 4.5% of FDI projects in Europe and 7.5% in the sectors targeted by IDA Ireland (2017, page 3). This is despite Ireland's relatively small size. The same report identifies 54 RD&I projects in Ireland in 2016 worth €1.12 billion and a 6.3% increase in total employment in foreign MNCs in Ireland between 2015 and 2016. In the context of Brexit, IDA

Ireland's pipeline of investment and targeting of mobile FDI in the UK wishing to relocate within the EU is important for sustained Irish economic growth.

The Second Progress Report on Innovation 2020 was published in December 2017. A key action contained in that report is the completion of a new cycle of research prioritisation. Revised research priority areas were published in March 2018.

A sixth Programme for Research in Third Level Institutions (PRTLII) has yet to be designed and introduced. SFI has been very active in establishing new Research Centres with strong industry links and in looking to engage with researchers to review science policy effectiveness, through the Science Policy Research Programme.

In October 2016 the Department of Finance published an economic evaluation of *the R&D tax credit scheme* (Department of Finance, 2016b). Using a counterfactual assessment approach, the evaluation focused on the additionality of the credit; that is the extent to which it incentivises R&D that would not have occurred in the absence of the credit. The evaluation finds that, of the R&D supported by the credit since 2009, 60% was new, additional R&D. This means there is some evidence of deadweight attached to the tax credit, as 40% would have occurred in the absence of the credit, though additionality is reasonable by international comparable standards. There is evidence in this evaluation that the structure of the credit does not encourage R&D in younger businesses, though it is significantly positive for older firms. This suggests alternative supports are needed for younger, smaller businesses.

Further assessment on the relative impacts of elements of the R&D policy mix is warranted, such as comparing the relative effectiveness of the tax credit and R&D grants.

The *SFI Research Centre Programme* has demonstrated reasonable success in linking Irish academic researchers with industry partners on larger scale projects. There is still an uneven distribution of research active MNCs however, and Irish HEIs and science agencies must explore ways of engaging with MNCs yet to become involved in R&D activity in Ireland.

5 Focus on R&I in National Smart Specialisation Strategy

In 2012 Irish policy makers undertook a research prioritisation exercise (RPE), the genesis of which was the 1998 Technology Foresight Exercise (DJEI, 2012). The RPE is Ireland's Smart Specialisation (RIS3) Strategy (DJEI, 2015a; page 23), though the RPE pre-dated the RIS3 framework for Ireland. The RPE identified 14 priority areas following a process of consultation with stakeholders, including industry, the HES, and government agencies. Revised Priority Areas for 2018 to 2023 were published in March 2018. These revised priority areas are shown in the second column of Figure 6 below.

Innovation 2020 was launched by the Irish government in 2015 (DJEI, 2015a). This is a whole-of-government strategy for innovation. It identifies other strategies and initiatives that it complements, including the Spring Statement, Action Plans for Jobs (APJ), Enterprise 2025, the National Strategy for Higher Education to 2030, the Policy Statement on Entrepreneurship, and the National Skills Strategy (DJEI, 2015a; page 8). *Innovation 2020* stated that the rationale for research prioritisation remains valid and it positioned the 14 priority areas

within 6 broad enterprise themes. These enterprise themes were also refreshed when the revised priority areas were published. This is shown in Figure 6, below.

Figure 6 Research Priority Areas and Enterprise Themes

Theme	Priority Area
ICT	Future Networks, Communications and Internet of Things
	Data Analytics, Management, Security, Privacy, Robotics and Artificial Intelligence (including Machine Learning)
	Digital Platforms, Content and Applications, and Augmented Reality and Virtual Reality
Health and Wellbeing	Connected Health and Independent Living
	Medical Devices
	Diagnostics
	Therapeutics
Food	Food for Health
	Smart and Sustainable Food Production and Processing
Energy, Climate Action and Sustainability	Decarbonising the Energy System
	Sustainable Living
Manufacturing and Materials	Advanced and Smart Manufacturing
	Manufacturing and Novel Materials
Services and Business Processes	Innovation in Services and Business Processes

Source: DJEI (2015a)

Innovation 2020 is a whole-of-government strategy for RD&I, which includes Ireland’s smart specialisation strategy, the Research Prioritisation Exercise (RPE).

The final dedicated review of the RPE, before it was amalgamated into the *Innovation 2020* strategy was published in July 2015 (DJEI, 2015b). This independent review generally found that aligning public research with 14 areas where the economic opportunities are considered to be greatest and by increasing the focus on economic impacts, there was significant progress towards creating critical mass in research areas of importance to Ireland. It also found that the RPE was positive for national research investment and taking research to market faster than in other jurisdictions. The review argued that there was a significant benefit from a “sharpened focus on outcomes”.

The review found that the introduction of monitoring structures focused on outcomes and impacts, with specified timelines and milestones, helped implementation and management of progress towards objectives. The review pointed to evidence of increased collaboration and consolidation of research effort across the public research system and greater collaboration between enterprise and the public research system.

The RPE was designed to guide economically-motivated RD&I investment in Ireland for the five-year period from 2013 to 2017. The second *Innovation 2020* progress report (DBEI, 2017a) was published in December 2017. This included an action to put in place a new cycle of research prioritisation (DJEI, 2017a: page 7). The action description states that “a market-led horizon-scanning exercise will be undertaken in order to identify strategic areas of commercial opportunity in global markets for Irish-based enterprises as the basis for the next

cycle of RP, due in 2018. The exercise will take into consideration, inter alia, recent and likely future advances in science and technology, as well as the dynamics of international markets and global supply chains and policy developments”.

The 2018 to 2023 priority areas were published in March 2018. They do not represent a significant departure from the original research priority areas. It is unclear, based on the extent of revisions in the priority areas and the published report, the degree to which the second cycle of the RPE is consistent with entrepreneurial discovery, policy learning, and the role in RIS3 of monitoring, targets and outcomes.

The RPE has been instrumental in focusing Irish public funding for RD&I and there is evidence that a critical mass in the priority areas has emerged or is emerging. The SFI Research Centres are closely aligned with the RPE and have established close links with industry. However, with regard to assessment of the RPE, there is a lack of published evidence on the effectiveness of the exercise in generating the desired economic and commercial impacts. Evaluations of public RD&I funding have focused on specific policies, such as the tax credit (IGEES, 2016), or a general review of capital RD&I expenditure (DJEI, 2017a). To date, there is no published evaluation of the RPE, setting out, for example the relative success of each priority area and the additionality and impact of funding in each area. An assessment of the progress on current priority areas will be published in the first quarter of 2018 as part of the new RPE cycle.

While the bibliometric and scientific impacts of publicly funded research in Ireland have been monitored closely and have shown impressive results, Science Foundation Ireland (SFI) has also demonstrated a commitment to evaluating the commercial and economic impact of publicly funded research. For example, in 2017 SFI established a Science Policy Research Programme, which sought proposals for large projects on RD&I policy, including evaluation of policy and funding effectiveness (SFI, 2017c).

From a regional perspective, the European Regional Innovation Scoreboard 2017 states that Ireland’s Southern and Eastern (IE02) region is a ‘Strong + Innovator’, for which performance has increased, and Ireland’s Border, Midland and Western (IE01) region is a ‘Strong Innovator’, for which performance has decreased. It is important to note that Ireland’s research and innovation strategy is a national competence and the Research Prioritisation is developed and implemented on a national basis. In its implementation there will be spatial implications.

The Irish government published Regional Action Plans for Jobs (DBEI, 2015/16), based on NUTS 3 regional categories, aimed at building on sectoral strengths and enterprise potential within each region in collaboration with regional stakeholders from the public and private sectors. In addition, the [National Planning Framework](#) will develop regional spatial and economic strategies at NUTS2 level, in alignment with national enterprise policy, national infrastructure investment planning and the national specialisation strategy. Based on relative strengths of HEIs and businesses in different locations, the RIS3 regional impacts will be conditioned by regional competences.

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Abbreviations

HEA	Higher Education Authority (An Údarás um Ard-Oideachas)
HES	Higher Education Sector
HEI	Higher Education Institution
SFI	Science Foundation Ireland
SMEs	Small and Medium-Sized Enterprises
MNCs	Multinational Corporations
DES	Department of Education and Skills
DJEI	Department of Jobs Enterprise and Innovation (renamed DBEI in September 2017)
DBEI	Department of Business Enterprise and Innovation
ISME	Irish SME Association
SFA	Small Firms Association
HEIs	Higher Education Institutions

Factsheet

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GDP per capita (euro per capita)	37500	36800	37600	38200	39200	42200	56400	58800		
Value added of services as share of the total value added (% of total)	70.9	72.88	70.65	71.09	71.37	71.05	57.68	59.69		
Value added of manufacturing as share of the total value added (%)	22.7	21.57	23.51	22.4	21.58	21.51	36.96	34.69		
Employment in manufacturing as share of total employment (%)	11.73	11.5	10.43	10.23	10.28	10.1	10.2	10.36		
Employment in services as share of total employment (%)	73.61	75.83	77.42	77.75	76.87	76.84	76.14	75.75		
Share of Foreign controlled enterprises in the total nb of enterprises (%)	2.05	2.03	2.24	2.27		1.6				
Labour productivity (Index, 2010=100)	93.7	100	109.6	109.9	108.2	114.5	139.5	142.8		
New doctorate graduates (ISCED 6) per 1000 population aged 25-34		1.15	1.33	1.37	1.55	1.78	1.77			
Summary Innovation Index (rank)	9	10	10	10	10	10	10	10		
Innovative enterprises as a share of total number of enterprises (CIS data) (%)				58.7		61				
Innovation output indicator (Rank, Intra-EU Comparison)			3	4	4	2				
Turnover from innovation as % of total turnover (Eurostat)		9.3								
Country position in Doing Business (Ease of doing business index WB)(1=most business-friendly regulations)						19	17	18	18	17
Ease of getting credit (WB GII) (Rank)						22	27	29		
Venture capital investment as % of GDP (seed, start-up and later stage)	0.027	0.017	0.024	0.043	0.048	0.034	0.041			
EC Digital Economy & Society Index (DESI) (Rank)						10	8	8	8	
E-Government Development Index Rank		21		34		22		26		
Online availability of public services – Percentage of individuals having interactions with public authorities via Internet (last 12 months)	37	37	44	49	45	51	50	52	55	
GERD (as % of GDP)	1.61	1.59	1.55	1.56	1.56	1.5	1.2	1.18		
GBAORD (as % of GDP)	0.52	0.49	0.46	0.43	0.4	0.37	0.28	0.26		
R&D funded by GOV (% of GDP)	0.48	0.47	0.46	0.43	0.43	0.41	0.31			
BERD (% of GDP)	1.1	1.09	1.08	1.12	1.12	1.08	0.85	0.83		
Research excellence composite indicator (Rank)	9	6	7	6	6	6				
Percentage of scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country		11.61	11.28	12.45	11.23	11.91				
Public-private co-publications per million population	24.77	31.65	30.63	34.48	32.45	36.7	23.55			
World Share of PCT applications	0.27	0.24	0.19	0.22	0.19	0.19	0.22			
Global Innovation Index				10	11	8	7	10		

Data sources: various, including Eurostat, European Commission and International scoreboard data.

List of figures

Figure 1 Structure of Irish Agencies and Reporting Lines for RD&I Policies and Strategies.....12
Figure 2 Development of funding of the total GERD in Ireland14
Figure 3 Longer trend development of GERD intensity in Ireland15
Figure 4 Main Programmes by Theme and Expenditure for RD&I in DBEI17
Figure 5 Top sectors in manufacturing and services BERD in Ireland18
Figure 6 Research Priority Areas and Enterprise Themes29

List of tables

Table 1 Main value added indicators 9
Table 2 Trends in Funding and performing of GERD in Ireland12
Table 3 Funding developments by main funding sectors15
Table 4 Supply of human resources for the Irish R&I system.....19

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