OECD Science, Technology and Innovation Outlook 2016

Policy Profile

Government financing of business R&D and innovation

Rationale and objectives

Firms are major drivers of innovation but tend to underinvest in R&D. They engage in R&D to differentiate themselves from competitors, to be more successful in business and to increase profits. However, the costs and uncertainty of R&D, the time required to obtain returns on investment, and the possibility that competitors can capture knowledge spillovers – owing to the non-rival and non-excludable nature of R&D – often reduce their incentives to undertake R&D. The funding of innovative entrepreneurship raises further issues, addressed in the policy profile on "Financing innovative entrepreneurship".

The effectiveness of public financing policies can be questioned on three main grounds (Guellec and van Pottelsberghe, 2000). First, government spending can crowd out private money, for example by increasing the demand for and cost of R&D through higher wages for researchers. Second, governments may support projects that would have been implemented anyway so that firms simply use public money instead of their own. Third, governments often allocate public funds less efficiently than market forces, thereby distorting competition and resource allocation. By trying to "pick winners", they may end up supporting less promising research areas or favour incumbents and lobbying groups to the detriment of new and innovative firms.

Major aspects and instruments

Governments finance business R&D and innovation through a mix of direct and indirect instruments. Governments offer direct support through public procurement for R&D and a variety of grants, subsidies, loans or equity funding (Table 1) (OECD, 2014). They provide indirect support through fiscal incentives, such as R&D tax incentives. Direct funding allows governments to target specific R&D activities and steer business efforts towards new R&D areas or areas that offer high social returns but low prospects for profits, e.g. green technology and social innovation; direct funding instruments depend on discretionary decisions by governments. Tax incentives reduce the marginal cost of R&D and innovation spending; they are usually more neutral than direct support in terms of industry, region and firm characteristics, although this does not exclude some differentiation, most often by firm size (OECD, 2010b). While direct subsidies are more targeted towards long-term research, R&D tax schemes are more likely to encourage short-term applied research and boost incremental innovation rather than radical breakthroughs.

Direct financial support is offered through competitive grants and debt financing, such as loans for R&D projects. Risk-sharing mechanisms are widely used to provide lenders with insurance against the risk of default and improve firms' access to credit. A loan guarantee implies that in the event of a loan default, the credit guarantee scheme will reimburse a pre-defined share of the outstanding loan to the lender.

Some direct support is also linked to public procurement (see policy profile "Stimulating demand for innovation"). In France and the United States, a large share of public support for R&D is provided to firms in the defence industry to develop military equipment and potentially civil applications. While governments retain the intellectual property (IP) of research results developed in the framework of public procurement programmes, the research results belong to R&D-performing firm(s) under other funding schemes (Guellec and van Pottelsberghe, 2000).

Table 1. Financing business R&D and innovation: typology of policy instruments and some country examples

Financing instruments			Key features	Some country examples
Direct public funding	**Grants, subsidies**		Most common funding instruments. Used as seed funding for start-ups and innovative SMEs. Granted on a competitive basis and in some cases, on the basis of private co-funding. No repayment is usually required. Supply-side, discretionary instruments.	National Competitive Grants Programme, Industry Growth Centres Initiative (Austria), Feder Innterconecta (Spain), Enterprise and Competitiveness (Italy), High Growth Business Development Programme (Estonia)
	Debt financing	Credit loans	Government subsidised loans. Require sorts of collateral or guarantee. Obligation of repayment as debt. The investor/lender does not receive an equity stake.	Technological Credit (Poland), Growth Credit Guarantee Lines (Portugal)
		Repayable grants/ advances	Repayment required, partial or total, sometimes in the form of royalties. Could be granted on the basis of private co-funding.	Repayment Assistance Measures for Student Loans Programme (Canada)
		Loans guarantees and risk-sharing mechanisms	Used widely as important tools to ease financial constraints for SMEs and start-ups. In the case of individual assessment of loans, can signal ex ante the creditworthiness of the firm to the bank. Often combined with the provision of complementary services (e.g. information, assistance, training).	SME Loans Guarantees (Austria), Zakura (Czech Rep.), Investment Compact (Italy), Micro Loan Support Programme (Latvia)
	Debt/Equity financing	Non-bank debt/equity funding	New funding channels. Innovative lending platforms and non-bank debt or equity funds.	National Innovation and Science Agenda - crowd-sourced equity funding (Australia), Law on alternative financing and crowdinvesting "Alternativfinanzierungsgesetz" (Austria), Institution for Growth (Greece)
		Mezzanine funding	Combination of several financing instruments of varying degrees of risk and return that incorporate elements of debt and equity in a single investment vehicle. Used at later stage of firms' development. More suitable for SMEs with a strong cash position and a moderate growth profile.	Credit Line Mezzanine Financing (Portugal)
	Equity financing (*)	Venture capital funds and funds of funds	Funds provided by institutional investors (banks, pensions funds etc.) to be invested in firms at early to expansion stages. Tends to increasingly invest at later -less risky- stage. Referred as patient capital, due to lengthy time span for exiting (10-12 years). The investor receives an equity stake.	National Innovation Fund - Venture Capital Fund (Czech Rep.), COSME - Equity Facility for Growth (EU), Corporate Venture Programme (France), Venture Capital Support Programme (Turkey)
		Business angels	Provide financing, expertise, mentoring and network facilities. Tends to invest in the form of groups and networks. Financing at start-up and early stage.	Global Incubator Network (Austria), Business Angels Programme (Spain), European Network of Summer Academies (EU), Business Angels Co-investment Faility (Netherlands)
	Public procurement for R&D and innovation (*)		Create a demand for technologies or services that do not exist, or, target the purchase of R&D services (pre-commercial procurement of R&D). Provide early-stage financial support to high-risk innovative technology-based small firms with commercial promise.	Entrepreneur Growth Strategy (Estonia), Strategy for Public Procurement (Sweden), Small Business Innovation Research (SBIR) Program (US)
	Technology consulting services, extension programmes		Expand the diffusion and adoption of already existing technology, and contribute to increase the absorptive capacity of targeted firms (especially SMEs). Provide information, technical assistance, consulting and training etc. Of particular importance in low income countries.	National Research Agenda (Indonesia), new funding schemes to finance technological extension (Peru)
	Innovation vouchers		Small lines of credit provided to SMEs to purchase services from public knowledge providers with a view to introducing innovations in their business operations.	Innovation Voucher (Austria, Chile, Estonia, France, Hungary, Portugal, etc.)
Indirect public funding	**Tax incentives** (*)	Tax incentives on corporate income tax	Used in most countries. Broad range of tax arrangements on corporate income tax, including tax incentives on R&D expenditure and, less frequently, tax incentives on IP-related gains. Indirect, non-discriminatory.	Knowledge Development Box (Ireland), Stability Law 2015 - tax incentives for enterprises investing in R&D (Italy), Corporate Income Tax Incentive for R&D Investments (Latvia)
		Tax incentives on personal income tax and other taxes	Available in many countries. Broad range of tax incentives on R&D and entrepreneurial investments and revenues that apply to personal income tax, value added tax or other taxes (consumption, land, property ec.). Indirect, non-discriminatory.	National Innovation and Science Agenda (Austria), tax incentives for researchers (Indonesia), tax incentive for individuals for investment in SMEs (Iceland)

(*) See related policy profiles "Start-ups and innovative entrepreneurship", "Stimulating demand for innovation" and "Tax incentives for R&D and innovation".

Source: Based on Kergroach et al. (forthcoming-b) and EC/OECD International Survey on STI Policies 2016.

Many OECD countries have schemes and funds to access early-stage finance, particularly for equity. Support is provided to the venture capital industry, with some governments actively providing equity funding (OECD, 2011b; Wilson et al., 2013). A common approach is to facilitate the growth of venture funding through public venture capital funds, co-investment funds with private investments and "funds of funds" (see policy profile "Start-ups and innovative entrepreneurship").

Technology extension services and extension programmes are often targeted to SMEs and aim to expand the diffusion of already existing technology, and to contribute to increasing the absorptive capacity of targeted firms. Technology extension services usually comprise a diagnostic phase when firm's operations, practices and strategic management are assessed, and an implementation phase when firms are given assistance to

implement their development plan. Whereas governments of both developed and developing economies have long used them, technology extension services are particularly important in low income countries where geographically dispersed firms operate far from international best practices in their industries.

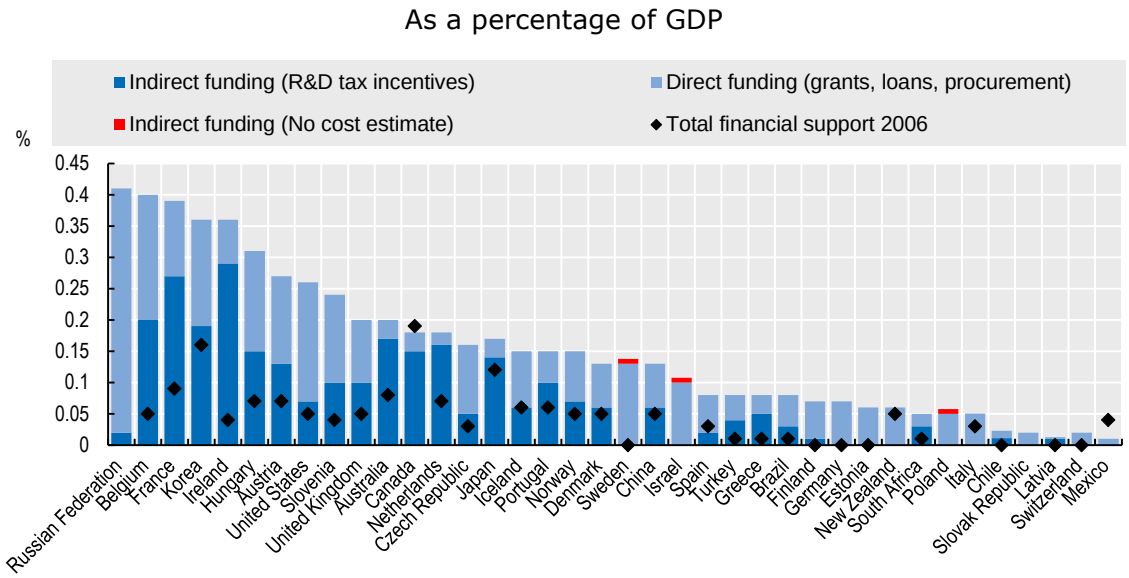
Direct support for innovation, other than R&D-related schemes, includes measures to facilitate the commercialisation of innovation, support the development of networks, promote regional innovation hubs, and ease access to information, expertise and advice (OECD, 2011a). Innovation vouchers or technology consulting services and extension programmes are major policy instruments in this respect.

Tax incentives applicable to different tax arrangements, including corporate and personal income taxes, are also widely used to encourage private investments in R&D and the exploitation of IP assets, to attract business angels and leverage early-stage finance, and to attract foreign talent or foreign multinationals (see policy profiles "Tax incentives for R&D and innovation", and "Start-ups and innovative entrepreneurship").

Recent policy trends

Public funding of business R&D and innovation has increased significantly in most countries over recent years (Figure 1 and see chapter 4 on Recent trends in STI and policies). The policy mix used to finance business innovation has seen growing use of R&D tax incentives and a shift of emphasis in direct support towards new purposes (e.g. knowledge transfer or equity financing). There has also been more focus on evaluation (OECD, 2011a).

Figure 1. Government funding of business R&D, direct funding and R&D tax incentives, 2014 or latest year available



Source: OECD, based on OECD R&D tax incentive data collection, July 2016, and OECD Main Science and Technology Indicators Database, June 2016, www.oecd.org/sti/msti. Data retrieved from OECD IPP.Stat on 8 September 2016.

Notes: For Canada, France, Korea, Latvia, Norway, Portugal, Spain and the United Kingdom, preliminary R&D tax incentive estimates are reported for 2014 (or closest year). Figures are rounded to the second decimal unless rounding would result in a value of zero. For Australia, Brazil, China, France, Iceland, Israel, Italy and New Zealand, figures refer to 2013. For Belgium, South Africa, Switzerland and the United States, figures refer to 2012. For Mexico and the Russian Federation, figures refer to 2011. For Belgium, Denmark, Italy, Korea, Mexico, Slovenia and Sweden, figures refer to 2007 instead of 2006. For Chile, New Zealand, Poland, Turkey and Switzerland figures refer to 200, and for China to 2009, instead of 2006. Estimates of direct funding for Austria, Portugal and Sweden in 2014 (or closest year) are based on imputing the share of direct government-funded BERD in the previous year to the current ratio of BERD to GDP. For Brazil, the 2011 share is used for 2013. For New Zealand, the 2008 figure of direct government support for BERD is an average of 2007 and 2009 values. For Brazil, Greece and the Netherlands, estimates of direct funding in 2006 (or closest year) are based on imputing the share of direct government-funded BERD in the previous year to the current ratio of BERD to GDP. In Austria and South Africa, R&D tax incentive support is included in official estimates of direct government funding of business R&D. It is removed from direct funding estimates to avoid double counting. In the case of South Africa, where the overlap of estimates cannot be identified based on available budget data, this transformation was not undertaken. In 2014, Estonia,

Germany, Luxembourg, Mexico, New Zealand and Switzerland did not provide expenditure-based R&D tax incentives. For Israel, the R&D component of incentives cannot be identified separately at present. No data on the cost of expenditure-based R&D tax incentive support are available for Poland. Estimates do not cover sub-national and income-based R&D tax incentives and are limited to the business sector (excluding tax incentive support to individuals). Data refer to estimated initial revenue loss (foregone revenues) unless otherwise specified. Estimates refer to the cost of incentives for business expenditures on R&D, both intramural and extramural, unless otherwise specified. Direct support figures refer only to intramural R&D expenditures, except for Brazil.

For more technical information about R&D tax data coverage, and country specific notes please see the OECD Directorate for Science, Technology and Innovation webpage on Measuring R&D tax incentives at < www.oecd.org/sti/rd-tax-stats.htm >.

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In most countries, 10% to 25% of business R&D expenditure is funded by public money (see Chapter 4, Figure 7). Belgium, France, Ireland, Korea and the Russian Federation are the most generous, with central government support to business R&D accounting for more than 0.35% of GDP (Figure 1). Overall public funding of business R&D and innovation increased between 2006 and 2014, both in real terms and as a percentage of GDP. The relative increase has been particularly marked in Belgium, Hungary and Ireland, where direct support and tax concessions to firms combined have more than doubled since 2006.

Several countries increased public spending for business R&D and innovation between 2014 and 2016. Most OECD countries and emerging economies ranked the support to business innovation and entrepreneurship among their top national STI policy priorities in 2016 (EC/OECD, forthcoming). A third of them also confirmed the stronger role of R&D tax incentives in the policy mix for business R&D and innovation while more than half see competitive grants and public procurement for innovation gaining importance (Figure 2, Panel 2).

Direct funding instruments, especially competitive grants, remain major levers of innovation policy (Figure 2, Panel 1). Direct support is provided through an increasing variety of tools for an increasing variety of purposes (e.g. to encourage knowledge transfer, growth of high-technology start-ups, venture capital activity, green innovation) (OECD, 2011a).

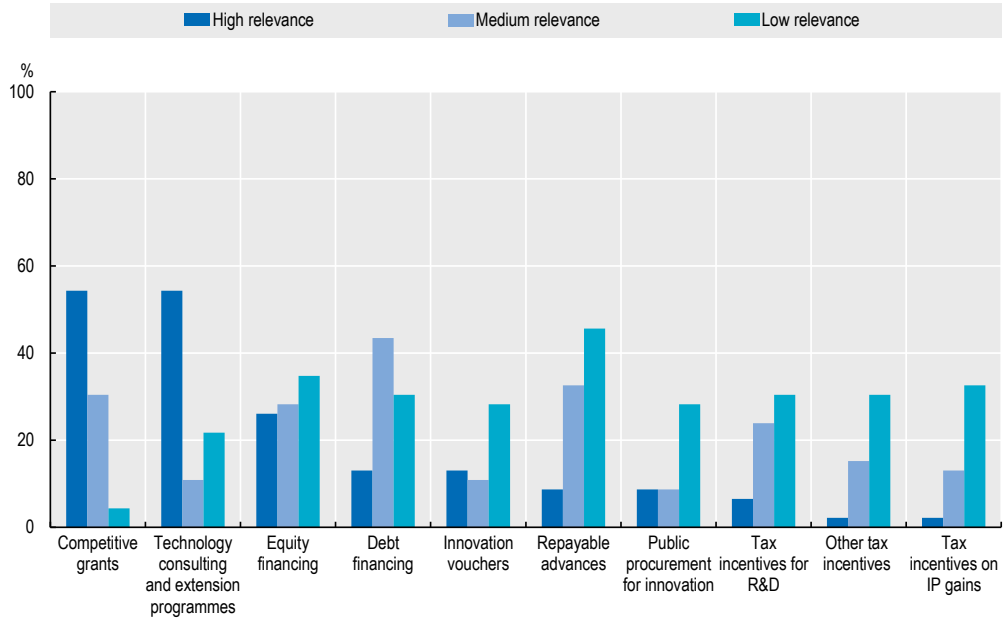
Direct funding instruments for business R&D and innovation have become more market friendly, encouraging competition-based selection and streamlining public support schemes. As part of its joint customer strategy for improving public service delivery; Finland created joint service packages for high-growth enterprises and implemented systematic exchanges of customer data between public services. The Finnish Funding Agency for Innovation, Tekes, also centralises all funding instruments for traditional, fast-growing, young or early-stage firms.

Public budgets for competitive R&D grants have been rising in Iceland, New Zealand and Norway. In addition, in Iceland the amount of tax revenues foregone through the recently implemented R&D tax credit has also increased. Australia's Industry Growth Centres Initiative that was established in 2014 aims to drive innovation by concentrating government investment in the form of grants and subsidies on key industry sectors, such as advanced manufacturing, cyber security, or mining equipment.

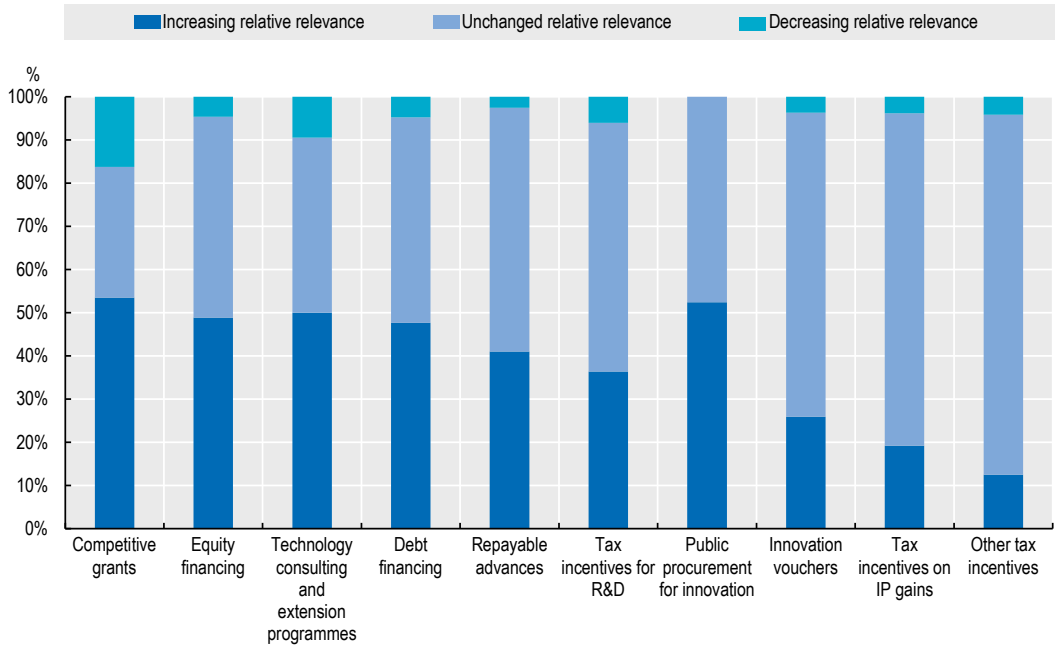
Figure 2. Relevance of major funding instruments in the policy mix for business R&D and innovation, 2016

As a percentage of total country self-reported responses

Panel 1. Relative relevance of funding instruments



Panel 2. Change in the relative relevance of public funding instruments



Note: Simple counts of country responses to the question: "Which of the following are the principal instruments of public funding of business R&D and innovation in your country? How has the relative balance between these instruments changed recently, if at all? Please rate the relative relevance of the following financial instruments in your country's policy mix and indicate whether their share in the total has increased/decreased or is remained unchanged". Responses are provided by country delegates to the OECD Committee for Scientific and Technological Policy and the European Research Area and Innovation Committee (ERAC).

Source: Country responses to the EC/OECD International Survey on STI Policies 2016.

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A large number of countries have also adopted new governance arrangements, revised their legal frameworks and implemented new programmes for improving innovative public procurement (see the policy profile "Stimulating demand for innovation"). Belgium (Flanders) adopted a new Innovative Procurement Action Plan in 2015 and Sweden created the National Agency for Public Procurement. The Czech Republic set up a new Pre-commercial Public Procurement programme (2014-20). The Netherlands and Poland put the emphasis on green procurement.

Technology extension services and extension programmes, and to a lesser extent debt and equity financing, emerge as important and increasingly relevant policy instruments as well (Figure 2, Panel 1) (see the policy profile "Start-ups and innovative entrepreneurship").

In the aftermath of the crisis, countries have increasingly emphasised debt and equity financing in their policy mix for innovation and entrepreneurship in order to compensate for limited private funding (OECD, 2014). The Netherlands has implemented several targeted financing facilities (fund of funds, regional development agencies, growth facility, pre-seed and early stage instrument, and the business angels co-investment facility). France has introduced in 2016 a new Corporate Venture Programme that partially covers corporate losses through tax reduction. Additionally, the programme allows amortizing the stakes a corporate acquires in innovative SMEs and its shares of private equity funds over a period of five years. Iceland has been preparing a tax incentives initiative since 2016 to encourage individuals to purchase stocks in small growing companies. In Turkey, the Venture Capital Funding Programme (TUBITAK 1514) aims at providing grants to venture capital funds, which invest in potential start-ups in need of seed capital, in order to spur technology intensive R&D, as well as production and commercialization activities.

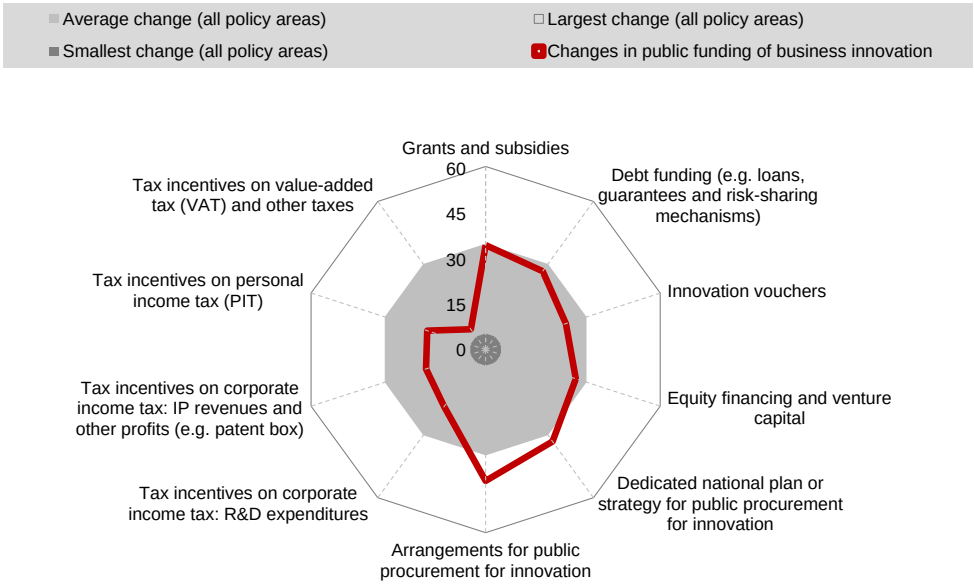
Austria has expanded its loan initiatives for innovative start-ups and SMEs in 2014, with programmes such as the Austrian Economic Development Bank (AWS) Pre-Seed and Seed Financing for high-technology companies and a Frontrunner Initiative for innovation and technology leaders. The government also adjusted its loan guarantee programmes (e.g. reduced guarantee fees) to EU financial instruments and increased its guarantees to SMEs with limited collateral. The United Kingdom have developed new types of financing tools, such as loans, to replace existing grants for a budget set to reach USD 235 million (GBP 165 million) by 2019-20. The United States continues to propose extensions of loan guarantees and other risk-sharing mechanisms to encourage business innovation, particularly in the clean-energy sector.

Use of innovation vouchers has spread across the OECD and emerging economies over the period 2012-14 (OECD, 2014) and less change can be observed since then (Figure 2, Panel 2). Estonia has allocated USD 18.6 million PPP (EUR 10 million) to its business innovation voucher programme, running from 2014 to 2020. Turkey and Sweden are running pilot voucher schemes. Australia and France have introduced innovation vouchers at the state and local level.

National tax policies for R&D have been relatively stable since 2012, as compared to other policy areas that experienced more substantial changes (Figure 3). They have however gone through more changes between 2014 and 2016 than during the previous period (see the policy profile "Tax incentives for R&D and innovation"). Countries with new tax initiatives include for example Ireland, Italy and Latvia. Ireland implemented in 2016 the first OECD-compliant Knowledge Development Box with a 6.25% tax rate on corporate income arising from eligible intellectual property assets. As from 2014 Italy's Stability Law introduced fiscal incentives to promote R&I activities within enterprises, create stable jobs and reduce taxes. All incremental business investments on R&I made during the period 2015-19 will benefit from a 25% tax credit. Recent amendments to Latvia's Corporate Income Tax Law allow applying tax incentive on staff costs, costs for research services and costs related to certification, testing and calibration.

Figure 3. Initiatives to finance business R&D and innovation among other areas of STI policy change, 2014-16

Percentage of policy initiatives that have been newly introduced, revised or repealed over the period



Note: The EC/OECD STI Policy survey 2016 aims to review major changes in national policy portfolio and governance arrangements for STI. The survey builds on the conceptual work carried on under the aegis of the OECD Committee for Scientific and Technological Policy (CSTP) for mapping the policy mix for innovation and therefore covers a broad range of policy areas (Kergroach et al., forthcoming-a). 52 economies participated in 2016, including OECD countries, key emerging economies (e.g. Argentina, Brazil, the People's Republic of China, Colombia, Costa Rica, Egypt, India, Indonesia, Malaysia, Peru, the Russian Federation, South Africa and Thailand), non-OECD EU Member States, and the European Commission. Taken together, the countries covered in the STIP survey 2016 account for an estimated 98% of global R&D. The responses are provided by CSTP Delegates and European Research and Innovation Committee (ERAC) Delegates for EU non-OECD countries.

This is an experimental indicator that accounts for the number of major policy initiatives implemented, repealed or substantially revised during 2014-16 as a share of total policy initiatives active at the beginning of the period. Although simple counts do not account for the magnitude and impact of policy changes, this ratio reflects STI policy focus and activity in specific policy areas and over specific periods of time. The chart above shows the intensity of changes in the policy area(s) under review as compared to the whole policy mix for innovation. Changes in the whole mapping are represented by the smallest, the largest and the average changes observed in all policy areas taken together.

Source: Based on EC/OECD (forthcoming), International Database on STI Policies (STIP); and Kergroach et al. (forthcoming-b).

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Governments have also focused more on non-conventional debt funding. Portugal launched a new credit line mezzanine financing for fast-growth firms, mergers and acquisitions, and capital increase. The EU Equity Facility for R&I aims to improve access to risk finance by early-stage R&I-driven SMEs, by supporting early-stage risk capital funds that invest, on a predominantly cross-border basis, in individual enterprises. The European Investment Fund (EIF) makes and manages equity investments into risk-capital funds. EIF can invest in a wide range of financial intermediaries, including those co-operating with business angels, and those that make venture capital and quasi-equity (including mezzanine capital) early-stage investments in enterprises.

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