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Fiscal incentives for R&D and innovation in a diverse world

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ABSTRACT

Fiscal incentives for R&D and innovation in a diverse world

Public policy has an important role to play in promoting research and development (R&D) the development, diffusion, and use of new knowledge and innovations. Fiscal incentives, including tax policies, should be directed at specific barriers, impediments or synergies to facilitate the desired level of investment in R&D and innovations. Without careful design, policies can have unintended consequences such as favouring incumbent firms, encouraging small firms to undertake less efficient activities, or creating arbitrage and rent-seeking activity. R&D tax policy needs to be considered in the context of the country's general tax policies, its broader innovation policy mix and its other R&D support policies. More R&D activity in one country does not necessarily result in an overall increase in global innovation if it is simply shifted from another country. More research is needed to determine the extent to which R&D fiscal incentives in one country increase overall R&D, the quality of that R&D, and its positive spillovers to other sectors of the economy and other countries.

RÉSUMÉ

Les incitations fiscales en faveur de la R-D et de l'innovation dans un monde diversifié

La politique publique a un rôle important à jouer pour promouvoir la recherche et le développement, la création, la diffusion et l'utilisation de nouvelles connaissances et d'innovations. Les incitations fiscales, y compris les politiques fiscales, doivent cibler des obstacles, freins ou synergies spécifiques de manière à obtenir le niveau souhaité d'investissements dans la R-D et dans l'innovation. Si elles ne sont pas soigneusement conçues, ces politiques peuvent avoir des conséquences fortuites, comme favoriser les entreprises en place, inciter les petites entreprises à entreprendre des activités moins efficientes ou ouvrir la voie à l'arbitrage et à la recherche de rentes. Les mesures fiscales en faveur de la R-D doivent être appréhendées dans le contexte des politiques fiscales générales du pays, de l'ensemble des actions menées en faveur de l'innovation et de ses autres politiques d'aide à la R-D. Une intensification des activités de R-D dans un pays n'entraîne pas nécessairement une augmentation globale de l'innovation mondiale si elle correspond à un simple transfert d'un autre pays. Des travaux supplémentaires sont nécessaires pour déterminer dans quelle mesure les incitations fiscales en faveur de la R-D dans un pays augmentent le niveau global de R-D, la qualité de cette R-D et ses retombées positives dans d'autres secteurs de l'économie et dans d'autres pays.

FISCAL INCENTIVES FOR R&D AND INNOVATION IN A DIVERSE WORLD

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FISCAL INCENTIVES FOR R&D AND INNOVATION IN A DIVERSE WORLD

By Tom Neubig, (CTP/TPS), Fernando Galindo-Rueda (STI) and Silvia Appelt (STI)

Public policy has an important role to play in promoting research and development (R&D) the development, diffusion, and use of new knowledge and innovations. Fiscal incentives, including tax policies, should be directed at specific barriers, impediments or synergies to facilitate the desired level of investment in R&D and innovations. Without careful design, policies can have unintended consequences such as favouring incumbent firms, encouraging small firms to undertake less efficient activities, or creating arbitrage and rent-seeking activity. R&D tax policy needs to be considered in the context of the country's general tax policies, its broader innovation policy mix and its other R&D support policies. More R&D activity in one country does not necessarily result in an overall increase in global innovation if it is simply shifted from another country. More research is needed to determine the extent to which R&D fiscal incentives in one country increase overall R&D, the quality of that R&D, and its positive spillovers to other sectors of the economy and other countries.

Main findings

- Government support for business research and development (R&D) seeks to encourage firms to invest in knowledge that can result in innovations that transform markets and industries and result in benefits to society. Most often, support is provided to firms with the intention of correcting market failure such as difficulties appropriating the returns to investment in R&D and difficulties in finding external finance, in particular for small or young firms.

- Fiscal incentives should be directed at specific barriers, impediments or synergies to promote research and development (R&D) among other innovation activities and facilitate innovation within each country and region. Public policy must recognise the heterogeneity of the markets and individual actors involved in developing and using innovations, as well as the heterogeneity of alternative fiscal incentives and their design.

- Tax policy is an increasingly important element of these incentives. The most widely used types of tax incentive include tax credits or favourable tax deductions for R&D expenditures, but other types are focused on income from certain R&D activities, on certain types of R&D financing, and are, in some cases, provided directly to R&D researchers.

- Most countries providing R&D tax incentives focus the incentives on reducing the cost and encouraging increased expenditures on R&D. This can take the form of credits against income and/or payroll taxes for expenditures on wages and/or capital investments for R&D. It can also take the form of accelerated depreciation, allowing recovery of the investment faster than the underlying economic depreciation of the long-lived asset; or enhanced depreciation, where taxpayers can recover more than 100% of the cost of the R&D expenditures.

- An increasing number of countries have adopted, or are considering adopting, income-based tax incentives, often in addition to their expenditure-based incentives. These provide for lower tax rates on the future income from investments in R&D and increase the after-tax rate of return to those investments. The assets are highly mobile, however, allowing both the assets and future income from them to be located away from the activity that generated the assets and income. This is often in low-tax jurisdictions to reduce their corporate tax liabilities, which erodes tax revenues in the other countries where the R&D investments were actually made.

- To avoid harmful tax practices preferential tax regimes for research and development should be consistent with a "nexus" approach. This uses expenditure as a proxy for real activity and allows a taxpayer to benefit from the preferential regime only to the extent that the taxpayer itself incurred the qualifying expenditures that gave rise to the income generated by the research and development investment.

Introduction

Innovation is key to economic growth and productivity increases and will also play a role in helping to find solutions to many global challenges from climate change to ageing populations. Although not all firms that innovate carry out R&D, investment in R&D plays a major role in facilitating technology-based innovations that bring new and significantly improved products and processes to the market. The slowdown of productivity growth is currently a focus of many countries, however, this slowdown has not been uniform across countries, industries or firms. Chapter 2 in this Outlook highlights the importance of R&D for productivity growth in listed companies. The research finds that while innovation is high among global frontier firms, productivity growth is highly concentrated among some firms and industries, because innovation is not being sufficiently diffused or taken up by many other firms and industries (OECD,

2015d). There is significant heterogeneity across and within sectors with respect to the development and take-up of innovation.

Public policy must recognise the heterogeneity of the markets and individual actors involved in developing and using innovations. It must also recognise the heterogeneity of alternative fiscal incentives and their design.

This chapter discusses the rationales for government R&D incentives, alternative innovation fiscal policies, different innovation-focused tax incentives and general tax issues, and policy design considerations for R&D in a heterogeneous and fragmented world.

Rationales for government incentives for business R&D

Government support for business R&D seeks to encourage firms to invest in knowledge that can result in innovations that transform markets and industries and result in benefits to society. All industries rely extensively on fundamental science and ideas largely originating from or developed within the government sector itself or publicly-funded institutions, but additional support of a financial nature is also provided to private sector firms for a number of reasons. Most often, support is provided to firms with the intention of correcting market failure (OECD, 2015e), including:

- **Difficulties by firms to fully appropriate the returns to their investment.** Returns on investments in R&D are difficult to appropriate by firms as some of the resulting knowledge – non-rival and partially non-excludable in nature – will leak out or "spill over" to other firms, to the benefit of society. This leads firms to underinvest in innovation relative to what would be the socially optimal level.

- **Difficulties in finding external finance, in particular for small or young firms.** Innovation is a highly uncertain activity with large differences between the information available to inventors and that available to investors. This may imply that external capital for innovation will only be available at too high a cost or will not be available at all. This is especially the case for small start-up firms without collateral

Public support for business R&D is typically justified as a means of overcoming these market failures. In addition, countries may use support measures to attract the R&D activities, investments and jobs of multinational enterprises (MNEs) which typically account for a substantial share of R&D expenditure. For example, in some small open economies, such as Ireland, Belgium and Israel, more than 60% of business R&D is accounted for by affiliates of foreign companies (OECD, 2015e).

Alternative R&D and innovation policies

Where human capital is relatively abundant and infrastructure relatively well supplied, the focus often first shifts to resolving market and institutional failures, as noted above. However, for R&D and innovation policies to have the intended impact, attention also needs to be paid to some of the disadvantages that new firms and technologies may have relative to incumbents and existing technologies and policies that help overcome these. While there are many barriers and obstacles to innovation, and there are many reasons governments may wish to take action to encourage R&D and innovation, policy makers will always need to consider carefully whether they have a sufficient understanding of innovation in their economy and an understanding of the appropriate policy tools to take effective and efficient government action. This involves consideration of alternative policy actions where governments can best add value, and consideration of how governments can engage with other actors and encourage them to take action.

OECD analysis suggests that innovation thrives in an environment characterised by the following features (OECD, 2015e):

- A skilled workforce that has the knowledge and skills to generate new ideas and technologies, to bring them to the market, and to adapt to technological changes across society;

- A sound business environment that encourages investment in technology and in knowledge based capital (KBC) including R&D, that also enables innovative firms to experiment with new ideas, technologies and business models, and that helps them to grow, increase their market share and reach scale;

- A strong and efficient system for knowledge creation and diffusion that engages in the systematic pursuit of fundamental knowledge, and that diffuses that knowledge through society; and

- Policies that encourage firms to engage in innovation and entrepreneurial activity.

The latter may include targeted innovation policies to tackle a range of barriers to innovation. The appropriate policy mix might include tax incentives for investments in R&D; direct public support through grants, subsidies and innovation competitions; and policies to facilitate co-operation and networking, but also indirect incentives through public procurement and other so-called demand-side policies. As noted above, fiscal incentives must be part of a broader innovation-friendly environment and policies that are shaped by intellectual property protection, sound bankruptcy rules, STEM (science, technology, engineering and mathematics) training, etc. There are many non-tax policy tools available to governments, including public R&D by government, not-for profit and research sectors as well as support for public sector R&D through government grants, loans, guarantees and legal protection of intellectual property (IP) rights.

As Table 3.1 highlights, the market for innovation and R&D within which fiscal incentives operate is very complex and comprises a range of heterogeneous players and activities. R&D is one innovation activity and firms can engage in many non-R&D activities that can be part of innovation. [1] R&D comprises three types of activity (OECD, 2015b): basic research, applied research and experimental development. Companies may carry out R&D in-house and/or procure R&D services from other parties. They may also acquire from third parties the rights to use intellectual property (IP) arising from R&D (R&D assets) or other activities carried out in the past by third parties on their own account. Some firms will have business models that internally engage in R&D and also produce and distribute the resulting goods and services with the embedded KBC. Other firms will specialise in R&D, but then sell the resulting KBC to acquiring firms that will commercialise the products. The financing of innovation can also occur in a number of different ways. Equity and debt both play a role, with capital being provided by founders, angel investors and venture capitalists, as well as being raised with initial public offerings.

Large enterprises are disproportionately represented in some areas, notably patents, as a large share of patents is held by a small number of large MNEs. In 2012, the 250 leading R&D global corporations and their affiliates accounted for 70% of patents filed by the 2000 largest R&D performers at the largest five intellectual property offices worldwide. They also accounted for almost 80% of information and communications technology (ICT) related patents (OECD, 2015e).

Table 3.1. Heterogeneity in fiscal incentives for innovation

Sources of heterogeneity in the market (potential eligibility for incentives):

- Types of innovation: R&D (basic research, applied research, experimental development), non R&D activities(e.g. acquisition of other external knowledge, acquisition of machinery, equipment and other capital goods, training).
- • Types of R&D expenses: in-house R&D; procurement of R&D services; acquisition of rights to use IP (R&D assets).
- Types of R&D business models: internally developed combined with commercialisation; develop and sell; acquire R&D and commercialise.
- Types of firms: start-ups, incumbents, small and medium-sized enterprises; multinational enterprises.
- Types of financing: equity, debt, founder, angel investor, venture capital, private vs. public.
- Other economic and policy conditions in a country: bankruptcy laws, patent protection, STEM education, immigration laws.

Sources of heterogeneity in fiscal incentives:

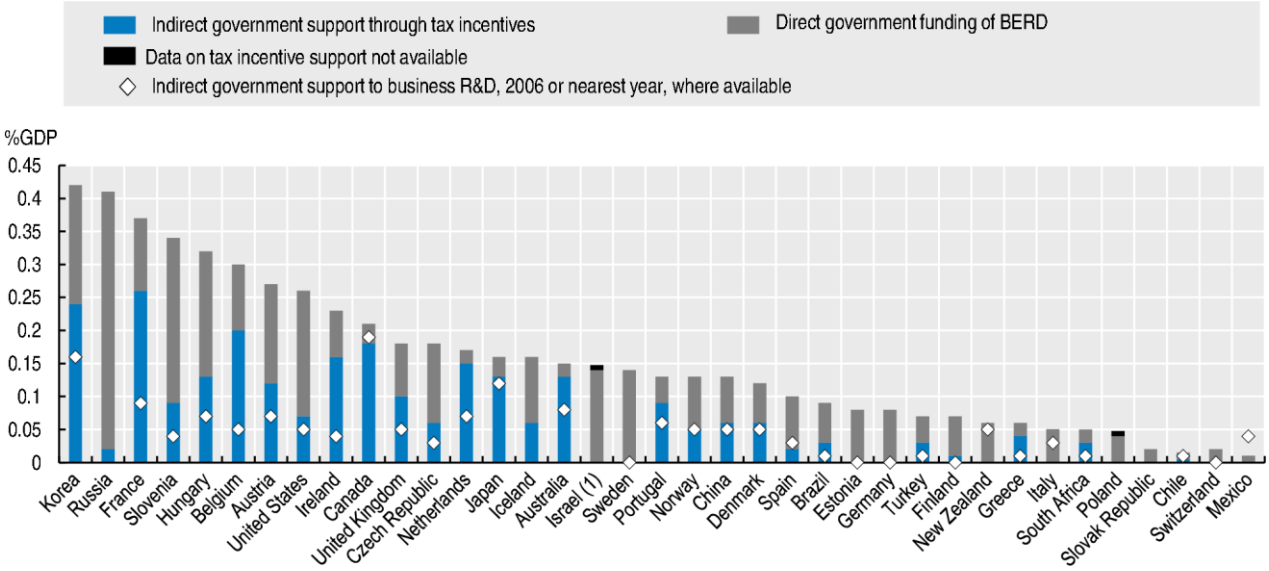
- Types of fiscal incentives: grants, loans, guarantees, tax.
- Types of tax incentives: general/targeted; input/output; volume-based/incremental, temporary/permanent.
- Targeted (complex, more subject to gaming) vs general (more likely to create windfalls).
- Type of tax: corporate income, personal income (including stock options), payroll, value added, property taxes.

Source: (OECD, 2015b).

There is also considerable heterogeneity within types of fiscal incentives. Fiscal incentives can include grants, public procurement, loans, guarantees as well as tax incentives (OECD, 2015e, Table 6.1). Tax incentives are provisions of the tax system that favour a particular type of activity relative to the general tax treatment of business activity. Within tax, multiple types of incentives are possible including up-front input incentives, such as tax credits and enhanced and accelerated tax depreciation allowances, as well as back-loaded output incentives, such as income-based IP or knowledge boxes and favourable capital gain tax rates. Incentives can be provided through relief to corporate income, personal income, payroll, consumption and property taxes. They can be targeted or general, temporary or permanent, volume-based or incremental. Various hybrids and combinations are possible.

As of 2013, approximately 6.9% of business R&D was directly funded (e.g. through R&D procurement and grants) by governments. R&D tax incentives accounted for the equivalent of an additional 5.2% of public funding of business R&D.[2] So tax incentives are at least 43% of fiscal support for business R&D. The level of tax incentives for business R&D increased in many countries between 2006 and 2013, although Mexico and New Zealand ended their tax incentives during that period (Figure 3.1). A number of countries such as Germany and Mexico do not provide dedicated R&D tax incentives. All OECD countries provide some form of direct financial support for R&D through grants or subsidised loans. For example, in Mexico, although there are no tax incentives for R&D, the National Council of Science and Technology (CONACYT) provides firms with grants and funding for these activities.

Figure 3.1. Direct government funding and tax incentives for business R&D, 2013



Note: All data are expressed in percent of GDP.

Source: OECD (2015d).

Overall, and leaving aside differences in design and implementation that can blur the dividing line between tax support and grants, there appears to be broad consensus that tax incentives are more suited in principle to encouraging R&D activities oriented towards the development of applications that have the potential to be brought to the market within a reasonable timeframe. In contrast, direct grant support is more suitable for supporting longer-term, high-risk research and for targeting specific areas that generate public goods (defence, environment, medical research, etc.) or that have particularly high potential for spillovers. Direct grant support may be designed to allow for an assessment of the quality of the underlying R&D activity being funded, whereas most tax incentives provide a general incentive for any activities falling within a defined category of eligible R&D activity.

How should R&D tax incentives be designed?

Fiscal incentives for business R&D are close substitutes for each other. Any direct government support or loan programme could be designed in principle as a tax incentive, or vice versa. Tax incentives are often chosen for particular design features which are characteristics of tax incentives but which generally are not characteristics of direct spending programmes. Two design features particularly favour tax incentives in many countries. First, tax incentives are often open-ended entitlements which do not typically require annual spending authorisation and are often unlimited in the amount of qualifying activity undertaken by the private company. Second, tax incentives reduce the scope for discretionary selection of individual firms or projects as they often do not have the pre-approval process or extensive reporting and audit requirements of most government funding programmes.[3] Qualified activity is defined in the statutory language and voluntary self-compliance with low levels of audit by tax authorities is generally the amount of oversight.

The term "tax expenditures" is used for government intervention programmes that are run through the tax system, but which could be administered through direct subsidies or loan programmes. Tax expenditures often include some disadvantages, in particular, limitations on the amount of the subsidies to the amount of pre-credit or pre-deduction tax liability of the company. Such tax liability limitations are

generally designed to prevent fraudulent claims for the subsidy, given the typical low level of programmatic audits, and to reduce the fiscal cost of the generally open-ended entitlement programmes. Limitations to income tax liability can significantly reduce or eliminate the value of a R&D incentive for start-up companies, and thus favours larger incumbent companies that may have other sources of taxable income which can be offset by the R&D tax subsidy.

Countries can make tax subsidies more like direct subsidies. In some countries, tax credits are immediately refundable or can offset non-income taxes. In some countries, audits of R&D tax credits claimed are extensive and done by specialised teams. An increasing number of countries have put caps on the amount of the R&D tax credit that can be claimed, so it is not an open-ended entitlement programme, but which then eliminates the incentive at the margin for additional R&D activity.

General vs. targeted tax incentives

As noted above, OECD analysis suggests that innovation thrives in a sound business environment that fosters investment, risk-taking and experimentation, a skilled labour force, and protection of property rights. A country's tax system is an important part of a sound business environment. Predictable low tax rates with broad tax bases to minimise inefficiencies across types of activities provide all companies with higher after-tax rates of return on their investments. OECD analysis suggests that in countries that have experienced a large number of R&D tax policy reversals, the impact of R&D tax credits on private R&D expenditures is greatly diminished (Westmore, 2013).

A country's general tax rules can be an important attraction or deterrent to risk-taking innovators and their companies. One study found that tax rates matter to the location of inventors and their patent registrations. The tax rates that mattered were personal income tax rates of the inventors, and those who were employed by MNEs were more likely to take advantage of personal income tax differentials (Akcigit and Stantcheva, 2015). Favourable tax treatment of employee stock options can make them more attractive to employers than paying cash salaries, as they help to reduce cash out-flows (OECD, 2006). Labour taxes, particularly employer payroll taxes, can significantly increase the cost of doing business in a particular country. Tax loss limitation rules and choice of business entity (e.g. corporation vs. partnership) can affect the general business tax climate as well as the value of particular targeted R&D tax incentives.

As noted in Table 3.1, considerable heterogeneity exists in the design of R&D tax incentive provisions. Table 3.2 shows the main features of current R&D tax incentives across OECD and selected other countries. Thirty of the 34 OECD countries offer some type of R&D tax incentive. Only four OECD countries did not offer R&D tax incentives (expenditure or income-based) in 2015: Estonia, Finland, Germany and Mexico. Most countries have increased the total value of tax incentives relative to GDP between 2006 and 2013, as shown in Figure 3.1.

Table 3.2. Main features of R&D tax incentives in selected OECD and other countries, 2015

Design of the R&D tax incentive scheme	
Expenditure-based R&D tax incentives • Volume-based R&D tax credit	Australia, Austria, Belgium, Canada, Chile, Denmark, France, Hungary, Iceland, Ireland, New Zealand, Norway, United Kingdom
• Incremental R&D tax credit	United States (credit on fixed, indexed base and incremental for simplified credit)
• Hybrid system of volume and incremental credits	Italy, Japan, Korea, Portugal, Spain
• R&D tax deduction beyond 100% recovery	Belgium, Brazil, People's Republic of China, Czech Republic, Greece, Hungary, Netherlands, Poland, Russian Federation, Slovenia, Slovak Republic, South Africa, Turkey, United Kingdom
Tax relief on wage taxes or related contributions	Belgium, France, Netherlands, Hungary, Russian Federation, Spain, Sweden, Turkey
More generous R&D tax incentives for SMEs, young firms or start-ups	Australia, Belgium, Canada, France, Italy, Japan, Korea, Netherlands, Norway, Portugal, Spain, United Kingdom
Ceilings on amounts that can be claimed for specific incentives	Australia, Canada, Chile, Denmark, France, Hungary, Iceland, Italy, Japan, Korea, New Zealand, Norway, Portugal, Slovak Republic, Spain, Sweden, Turkey, United Kingdom, United States
Income-based R&D tax incentives[1]	Belgium, People's Republic of China, Colombia, France, Hungary, Ireland, Israel, Italy, Luxembourg, Netherlands, Portugal, Spain, Switzerland (Canton of Nidwalden), Turkey, United Kingdom
No R&D tax incentives	Estonia, Finland, Germany, Mexico

1. OECD (2015c).

Source: OECD Directorate for Science, Technology and Innovation.

Twelve OECD countries offered more generous R&D tax incentives for SMEs. In the direct subsidy area, a notable trend among practitioners is a gradual move away from using firm size as a segmentation criterion, towards other differentiators, such as firm age or growth rate (OECD, 2015e, p. 147-148). Using firm age to determine subsidy eligibility could raise difficult issues to prevent aggressive tax planning, while using growth rates for subsidy eligibility would have similarities to incremental tax subsidies.

Several key features are whether the incentive is linked to the current expenditure on R&D or on the future income of the R&D; whether the incentive is volume-based or incremental; whether the incentive is capped on the amount claimed or more generous for SMEs; and whether the incentive is corporate income tax-based or provided through other taxes, such as personal income or payroll taxes.[4]

Expenditure (input) vs. income (output) incentives

Most countries providing R&D tax incentives focus the incentives on reducing the cost and encouraging increased expenditures on R&D. This can take the form of credits against income and/or payroll taxes for expenditures on wages and/or capital investments for R&D. An increasing number of countries have adopted or are considering adopting income-based R&D tax incentives, often in addition to their expenditure-based R&D tax incentives.

Expenditure-based incentives can also take the form of accelerated or enhanced tax depreciation. Accelerated depreciation is when the recovery of the R&D investment is faster than the underlying economic depreciation of the long-lived asset for tax purposes. Most countries allow companies immediate deductions of employee compensation and capital purchases for R&D, even though the underlying R&D investment is expected to generate income over a number of future years. Accelerated

tax depreciation is equivalent to an interest-free loan from the government to the taxpayer, which reduces the cost of the investment and the effective tax rate on the income generated from the investment. Ten OECD countries and several BRIICS countries provide enhanced depreciation, where taxpayers can recover more than 100% of the cost of the R&D expenditures. Enhanced tax depreciation is similar to an R&D tax credit. Enhanced depreciation of 200% of R&D investment (100% more than the actual cost) deducted immediately at a 25% tax rate is equivalent to a 25% expenditure-based tax credit.

The benefit of accelerated or enhanced depreciation can also vary by the heterogeneity of the economic depreciation of R&D investments. A recent study finds the pharmaceutical industry has the lowest R&D economic depreciation rate and longest useful life, which may reflect the fact that R&D resources in pharmaceuticals are more appropriable than in other industries due to effective patent protection and other entry barriers (Li, 2012). A similar accelerated tax depreciation rate provides greater benefit to longer-lived investments than shorter-lived investments.[5]

Income-based incentives via lower tax rates on the future income from R&D investments increases the after-tax rate of return to those investments, which can attempt to address the market failure from firms not fully appropriating the returns to their investment (spillovers). Just as tax and non-tax fiscal incentives are close substitutes, income-based and expenditure-based tax incentives can be designed to provide approximately the same level of tax incentive in present value terms. A 15% lower tax rate on future income for a firm earning a 30% pre-tax return on its R&D investment is the equivalent of a 31% expenditure-based tax credit (Modica and Neubig, 2016).

Income-based incentives, often referred to as patent, IP or knowledge boxes, have raised a number of questions about their effectiveness. Due to the highly mobile nature of IP assets, such as patents, copyrights, trademarks, and brands, the assets and future income from them can be located away from the activity that generated the assets and income. MNEs often locate their intangible assets in jurisdictions which offer relatively lower tax rates for the relevant income to reduce their corporate tax liabilities. The OECD study *Supporting Investment in Knowledge Capital, Growth and Innovation* (2013) shows that a 15% reduction in the corporate tax rate on R&D-created intangible assets transferred to an off-shoring holding company can result in -32% R&D tax wedge, compared to a +16% tax wedge if the R&D is used with a domestic license and production (OECD, 2013). A recent European Commission study found that a lower tax rate on patent income encouraged shifting of patent registrations and taxable income without a significant change in real economic activity (European Commission, 2015). However, patent box regimes that required a connection with local innovative activity found some positive impacts on real activity (number of resident inventors) within the country providing such qualified incentives.

An income-based incentive by its design gives an ex post reward only to successful innovators who already hold a monopoly right on their inventions. Experimentation is a risky activity, which naturally entails high rates of failure, so an income-based incentive may not benefit many firms undertaking R&D activity, and are more likely to benefit incumbent firms that have a diversified set of R&D activities to benefit from higher returns on their successful investments.

On the other hand, it is possible that an income-based incentive could increase the availability and terms of financing by investors given the higher after-tax returns of potentially successful R&D investments. The extent to which income-based incentives provide better financing of R&D that has not yet generated any income has not been analysed. Credit-constrained, innovative firms need funds to conduct their research as early as possible. Policies that provide funds with a lag, relative to research effort, might not be suitable for this group of firms and might make the playing field uneven (Andrews and Criscuolo, 2013). Income-based incentives are likely to have similar tax design issues as tax credits that are not immediately refundable.

An income-based incentive tied to a patent registration may push firms to focus on innovations that lead to outcomes susceptible to protection by patents, and may lead them to focus too much on applied research (Akcigit, Hanley and Serrano-Velarde, 2014) or products that are closer to market. In the long run this may have costs in terms of productivity enhancement. It also may push firms to seek patent protection for innovations for which they would not have sought patent protection in the absence of the tax incentive. Many innovation surveys report that several innovative firms choose not to seek any IP protection, but might if required to obtain a tax benefit.

Future empirical studies might find IP boxes have a positive effect on patent registrations, yet some of this increase could be due only to a re-labelling or reporting change, not a real increase in total R&D activity or the quality of the resulting R&D. Similarly, calculating the income eligible for R&D tax incentives is difficult, because identifying the stream of income generated by a single patent when multiple patents – often granted at different points in time – are used to produce a complex product (such as semiconductors). Measuring the income from a patent is already difficult because the income flows between related parties has to be imputed in the absence of an explicit price for the use of the IP with an unrelated third party. Measuring particular activity is also a problem with expenditure-based R&D incentive studies which may find higher R&D expenditures due to relabelling of activity or resulting from higher wages paid to R&D staff, not from an actual increase in the amount of R&D and innovation.

Volume-based vs. incremental incentives, ceilings and other limits

As countries have moved to strengthen their budget positions, they have aimed to improve the cost-effectiveness of their tax incentives. This has led to targeting tax incentives at firms and activities with the highest productivity-enhancing potential.

Countries vary in their use of volume-based R&D tax credits versus incremental-based tax credits. R&D tax incentives may apply to all qualified R&D expenditures (volume-based credits) or only to the additional amount of R&D expenditures above a certain base amount (incremental credits). The base amount usually takes the form of a rolling average of several prior year expenditures or a fixed base during a reference period which may be indexed to sales or inflation to stay relevant.

Using a volume-based approach has the advantage of being simple and predictable. Firms know they will get the credit on all eligible investments. From the government perspective, however, the volume-based approach is more costly as some of the support subsidises R&D that would have been performed without the incentive, and is likely to benefit mostly large firms in the absence of any ceilings.

An incremental R&D incentive seeks to minimise the amount of "subsidised" R&D that would have been undertaken even in the absence of support. However, the incremental approach also presents some undesirable features. Incremental incentives are more complex to design and use, as it increases transaction costs for firms and governments as well as uncertainty about the availability of future subsidies. Incremental incentives are possibly less effective in slow or no-growth economic environments when incremental incentives might be zero or negative. Heterogeneity across firms in their R&D investments year-over-year could exclude some firms from eligibility for an incremental incentive even though they would respond with more expenditure if the incentive were available. Finally, incremental incentives can elicit strategic behaviours to time R&D investment to maximise the tax benefits, thus distorting the temporal profile of the R&D investment.

Increasingly, countries are adopting hybrid systems that combine a volume and incremental tax credit. In order to manage the overall cost of R&D incentives and target the incentives to smaller firms, some countries apply upper ceilings or thresholds to eligible R&D expenditures or tax benefits. While they reduce the overall cost of the incentive, caps can eliminate the incentive effect of the incentive at the

intensive margin (e.g. an additional dollar of R&D expenditure) among firms with particularly high levels of R&D. Aggregation rules can play an important role in minimising tax arbitrage in the case of ceilings and targeting, as some groups may be able to break down their R&D tax credit claims across separate enterprises to meet size, growth, or "young firm" eligibility rules.

Cash refunds, carry back/forward, claw backs, transferability

The value of tax incentives can be significantly reduced if the benefits are delayed or potentially lost due to lack of taxable income or tax liability. Due to concerns about open-ended tax entitlements and low levels of tax audits, most countries limit tax benefits to firms with positive taxable income or income (or other) tax liability. Some countries give immediate refunds of R&D tax credits, while others allow taxpayers to either carry tax credits or losses back against prior tax liability (and thus provide immediate refunds) or carry them forward against future tax liability.

Table 3.3 shows the effect of the immediate refundability of tax losses compared to loss carry forwards without an interest adjustment for two types of KBC investments, which can include R&D: one where the KBC is developed and then sold to a third-party producer and another where the KBC is internally developed and used in the production of goods. In both cases, the lack of immediate refundability increases both the marginal effective tax rate (for investment levels at the intensive margin) and the average effective tax rate (for location decisions). Table 3.3 also shows that expensing of investment favours companies that can both develop KBC and produce goods resulting from the KBC themselves, compared to companies that specialise in developing KBC but then sell to other companies that may be more efficient at producing goods embedded with the purchased KBC.

Table 3.3: Average effective tax rates for different loss refundability treatment and different types of knowledge-based capital development

Development of knowledge-based capital (KBC) scenarios	Marginal effective tax rate	Average effective tax rate
Internal development followed by sale of rights to other users		
Expensing with immediate refundability	0.0%	25.0%
Non-refundable with loss carry forward	21.8%	29.1%
Internal development followed by internal use for production and sale of the output		
Expensing with immediate refundability	0.0%	22.5%
Non-refundable with loss carry forward	11.9%	23.4%

Source: Modica and Neubig (2016). Statutory corporate tax rate in example is 25%.

Given the importance of cash-flow for new firms undertaking R&D investments, the delay of tax benefits until they become profitable and tax paying reduces the effectiveness of the incentive. [6] Many R&D investments made by firms that are not successful will not receive any direct tax benefit. The ability to carry forward tax credits and tax losses is important, but delayed receipt of the credits or losses reduces their value compared to an immediate refund.

Some countries are evaluating whether tax incentives achieve the stated objectives of the programme. In the case of some discretionary tax incentives, including R&D incentives, if the company does not achieve the projected number of jobs or investment, the government may "claw back" or reclaim the tax incentives. There is an issue of the potential transferability of tax incentives to other companies if the R&D investing company is not able to benefit from the credit or deduction. In many incumbent firms, tax benefits can be transferred to related companies within a consolidated group who can benefit from the incentive. Tax policy design could allow companies to sell the tax incentive, typically at less than full value, to an unrelated company that can immediately use the benefit. This is not an efficient means of providing a government incentive, but has been one approach used to get around the tax incentive design

limitation of lack of immediate refundability due to the open-ended low-enforcement entitlement approach of many tax incentives.

Types of research activity or knowledge-based capital

OECD research finds that direct subsidies are more targeted towards long-term research, while R&D tax schemes are more likely to encourage short-term applied research and boost incremental innovation rather than contribute to radical breakthroughs (OECD, 2015e). Recent OECD analysis suggests that direct support measures – e.g. contracts, grants, awards for mission-oriented R&D or support for networks – may be more effective in stimulating R&D than previously thought for young firms that lack the upfront funds to start an innovation project (Westmore, 2013). Income-based tax incentives may push firms to focus ondevelopment to the detriment of research, since the incentive is only earned if the inventions earn immediate and attributable income, rather than reducing the cost of the investment (Akcigit, Hanley, and Serrano-Velarde, 2014).

The type of income and IP currently qualifying for tax relief through income-based incentives varies greatly. Royalties represent the most common category of income to qualify for tax relief, followed by capital gains and production income. Different categories of IP qualify. Patents feature as the most prominent, but a majority of countries allow for additional categories of IP, such as trademarks, designs and software copyrights. Countries also vary in the extent to which they allow for a preferential tax treatment of IP which is self-developed, existing or acquired.

Recent research finds that while innovation is high among frontier firms, productivity growth is highly concentrated among some firms and industries, because innovation is not being diffused or taken up by many other firms and industries (OECD, 2015d). There is significant heterogeneity across and within sectors with respect to both the development of innovation and the take-up of innovation, as described in Chapter 2 in this Outlook. General tax policies encouraging economic growth and labour mobility should be considered in addition to R&D incentives to ensure that innovations are diffused and taken up by non-innovative companies.

Other tax incentives for R&D

The tax incentives discussed above generally apply to business entities and income taxation. A number of countries have R&D tax incentives that provide tax benefits to other stakeholders and using other taxes (OECD, 2015c). Some examples include an exemption on payroll withholding taxes for qualified R&D workers; personal wage tax reduction for foreign researchers and key staff; wealth tax exemption for business angels; lower tax rates on capital gains for qualified R&D investments; and favourable tax treatment of employee stock options for R&D researchers and managers. Tax relief from consumption taxes, land and property taxes are also provided. Some of these incentives are a large part of the total R&D incentives in some countries, e.g. Belgium and the Netherlands. An advantage of these other tax incentives is they support R&D independent of whether the firm is profitable or loss-making.

Base erosion and profit shifting concerns (spillovers)

Fiscal incentives for R&D investments are intended to create positive spillovers which will diffuse the benefits widely, enhancing consumer welfare and productivity. However, by attracting jobs and investments of MNEs to the country offering incentives, these incentives may prove harmful to trading partners who face the loss of associated fiscal revenues. It is important that the design of these incentives avoids harmful tax practices.

Activities, such as financial and other service activities, including the provision of intangibles generated by R&D, are geographically lmobile and very easy to shift from one country to another.

Globalisation and technological innovation have further enhanced that mobility. The OECD has worked since 1998 in this area to secure the integrity of tax systems by addressing the issues raised by regimes that apply to mobile activities and that unfairly erode the tax bases of other countries, and potentially distort the location of capital and services. The work on harmful tax practices is not intended to promote harmonisation of tax structures or to dictate an appropriate level of tax rates. The work is about reducing the distortionary influence of taxation on the location of mobile activities, thereby encouraging an environment in which free and fair tax competition can tax place. This is essential in moving towards a "level playing field" and a continued expansion of global economic growth (OECD, 2015a).

The OECD/G20 Base Erosion and Profit Shifting (BEPS) Project addressed the issue of the separation of taxable profits with the substantial activities that generate them in the context of the Forum on Harmful Tax Practices. Countries in the Project agreed that a substantial activity requirement used to assess preferential tax regimes should be strengthened and a consensus was reached on a "nexus approach." This approach was developed in the context of IP regimes, and it allows a taxpayer to benefit from an IP regime only to the extent that the taxpayer itself incurred qualifying R&D expenditures that gave rise to the IP income (OECD, 2015a).

The nexus approach uses expenditure as a proxy for activity and builds on the principle that, because IP regimes are designed to encourage R&D activities and to foster growth and employment, a substantial activity requirement should ensure that taxpayers benefiting from these regimes did in fact engage in such activities and did incur actual expenditures on these activities. Future IP and Knowledge Boxes will be less susceptible to taxable income shifting and eroding the tax bases of other countries, but there are still many other important design features that countries need to consider before embracing them as the policy instrument of first choice.

In addition, the BEPS Project recognises that transparency is important and that tax rulings that could give rise to BEPS concerns should have compulsory spontaneous exchange of information.

Sixteen IP regimes were identified in 2015 as potentially harmful tax practices, in that all were considered inconsistent either in whole or in part, with the OECD/G20 BEPS Action 5 nexus approach. They and future such IP regimes will be subject to an ongoing monitoring and review mechanism. New entrants will not be permitted in any existing IP regime that is inconsistent with the nexus approach after 30 June 2016. If a new regime consistent with the nexus approach takes effect before 30 June 2016, no new entrants will be permitted in the existing IP regime after the new IP regime has taken effect. For purposes of the grandfathering, "new entrants" include both new taxpayers not previously benefiting from the regime and new IP assets owned by taxpayers already benefiting from the regime. Taxpayers benefiting from an existing regime may keep such entitlement until an abolition date, which can be no later than 30 June 2021. After that date, no more benefits stemming from old regimes not meeting the nexus requirement may be given to taxpayers.

Special IP regimes with nexus requirement can provide significantly reduced tax rates on income from R&D investments, but whether such income-based incentives are efficient and effective compared to alternative fiscal incentives requires further investigation. As noted above, income-based incentives only directly reward successful innovators, and thus are more likely to benefit incumbent firms rather than start-ups that need funds to conduct their research. Income-based incentives may push firms to focus on more applied research closer to commercialisation, and encourage firms to seek patent or other legal protection for their innovations. Income-based incentives are also more susceptible to tax avoidance than expenditure-based incentives, since measuring income attributable to a specific patent when the company has multiple patents and royalty payments with related parties is complex and requires significant tax administration enforcement.

Conclusions

Policy makers are increasingly recognising that, for efficient and effective incentives, the heterogeneity and fragmentation of not only different types of businesses, but different types of economic activity and alternative policies, need to be considered. What works for one country may be inappropriate for another country. What is a strong inducement for one type of business is detrimental for another. What achieves one objective may have unintended consequences or be difficult to administer.

Tax policy research is increasingly being done with firm-level data to reflect differences in types of firms and types of businesses. Tax rate reductions or tax credits that would appear to be a strong incentive for more R&D investment may not be beneficial to start-up companies that are credit-constrained. Accelerated tax depreciation may help profitable private companies with their cash-flow, but often are not viewed favourably by public companies since accelerated tax depreciation does not change public companies' reported profits or effective tax rates (Neubig, 2006, Edgerton (2010) and Zwick (2016). Tax incentives focused on businesses may be more beneficial to incumbents and multinational companies focused on R&D commercialisation, while grants and loans to individual inventors and small businesses may result in more innovative R&D breakthroughs.

Certainty and predictability of tax incentives may be more important than the reduction in tax liability for companies that are already taking significant risks in their R&D development and business. Thus, R&D fiscal incentives need to be considered as part of a country's total tax system, total innovation strategy, and overall economic and investment environment. More research is needed on the different fiscal incentives to identify the fiscal and economic conditions that will provide the biggest improvement in productivity and well-being from governments' significant investments in R&D given the significant heterogeneity of businesses and different type of R&D investments.

Given the heterogeneity of innovation across markets and firms, combined with the heterogeneity of countries' innovation policies, including innovation-specific tax incentives and general tax rules, further analysis at the firm level, across countries and across time can provide new and valuable insights. In order to address questions, such as which support design features contribute to higher levels of R&D performance and innovation-driven economic growth, the OECD has launched a new project that explores the variation in public support and business performance within and across countries, taking account of the wide heterogeneity in eligibility for support. The project is based on the analysis of micro-data through which the OECD collaborates with national experts with access to R&D and public support micro-data.[7] This entails undertaking a co-ordinated statistical analysis of the utilisation and impact of policy design features and their interaction with direct forms of public R&D funding.

Notes

1. The Oslo Manual distinguishes product, process, marketing and organisational innovations.

2. The amount of tax incentives only includes R&D tax credits and enhanced depreciation allowances. Other forms of tax incentives, such as accelerated depreciation, reduced tax rates on income derived from R&D activities, and personal income tax incentives for R&D investment, such as angel financing tax preferences, are not included in the total.

3. South Africa moved from a retrospective submission process to a pre-approval procedure for investments to qualify for enhanced (150%) depreciation. The Department of Science and Technology (DST) administers the programme, and companies must now apply to the DST for approval of qualifying R&D activities. Republic of South Africa DST (2014).

4 Some countries' tax incentives provide additional support to recipients that collaborate with universities or other publicly-funded research bodies.

5. Modica and Neubig (2016). It should be noted that the OECD B-Index does not measure the value of accelerated depreciation.

6. Caps on loss offsets could be restricted above a monetary threshold, thereby not limiting smaller firms.

7. For example, the measurement of R&D tax incentives: www.oecd.org/sti/rd-tax-stats.htm.

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