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Intellectual Property Box Regimes: Effective Tax Rates and Tax Policy Considerations

Lisa Evers, Helen Miller, and Christoph Spengel

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Non-technical Summary

Intangible assets constitute a major input and value-driver for multinational firms. Often, the related intellectual property does not have a clear geographical location and firms use this flexibility to relocate IP and the associated income to low-tax countries in order to reduce their overall tax bill. Consequentially, tax legislators struggle with how to tax income from IP. In this regard, the most significant policy innovation in recent years has been the introduction of *Intellectual Property (IP) Box regimes* that offer a substantially reduced corporate tax rate for income derived from patents and other forms of IP. In Europe, 11 countries currently offer an IP Box with tax rates varying from 0% in Malta to 15.5% in France.

The contribution of this paper is threefold. First, we provide a comprehensive and systematic overview of the IP Box regimes in place in Europe. We address several aspects of the design of IP Boxes in detail which to date have received little attention, in particular the treatment of expenses related to qualifying income. Second, we incorporate IP Box regimes into effective tax rate measures for investment in a self-developed patent. In doing so, we are able to incorporate features of the tax base, including the treatment of R&D expenses. Third, we discuss IP Box policies' design features and the incentives they create.

Our survey of IP Box regimes in Europe shows that they broadly fall into two groups. One group (including Belgium, Luxembourg, the Netherlands, and the United Kingdom) has elements that are better targeted at incentivising R&D investment and innovation. Notably, they focus on patents and other trade intangibles and do not apply to acquired IP. The second group (including Cyprus, Hungary, Malta, and the Swiss Canton of Nidwalden) focuses on attracting mobile IP income, in particular by not requiring any original R&D activity on behalf of the taxpayer.

We show that IP Boxes produce substantial reductions in the effective tax burden of profitable investment projects, and in some cases the burden on investment projects that just break even (so called marginal investment). A key finding is that the treatment of expenses relating to IP income is generally more decisive for the effective tax burden than the nominal IP Box tax rate. The treatment of expenses can be sufficiently generous that IP Boxes provide negative effective tax rates, indicating that unprofitable investment projects are subsidised by the regime.

We discuss whether IP boxes are likely to affect real behaviours, specifically the amount and location of R&D investments. We conclude that, when taking into account the large degree of uncertainty associated with new R&D projects, IP Boxes are poorly-targeted at incentivising firms to undertake additional R&D investments. IP Boxes may work to attract mobile investments, and in theory could increase tax revenues. However, any positive effects might be eroded by the operation of similar policies by other countries.

Das Wichtigste in Kürze

Die Besteuerung der Erträge immaterieller Wirtschaftsgüter stellt eine der größten steuerpolitischen Herausforderungen der internationalen Unternehmensbesteuerung dar. Zum einen sind immaterielle Wirtschaftsgüter wie Patente, Marken, Urheberrechte und Prozessinnovationen ein zentraler Wertschöpfungsbeitrag. Zum anderen haben immaterielle Wirtschaftsgüter oftmals keinen eindeutigen geographischen Anknüpfungspunkt. Diese Flexibilität nutzen multinationale Unternehmen um mittels Steuerplanungsmodellen Gewinne in Niedrigsteuerländer zu verlagern.

Intellectual Property (IP) Box Regime stellen in diesem Kontext die bedeutsamste steuerpolitische Innovation der jüngeren Vergangenheit dar. Sie sehen einen reduzierten Steuersatz für Einkünfte aus der Verwertung von Patenten und ausgewählten anderen immateriellen Wirtschaftsgütern vor. Derzeit kommen in 11 Staaten in Europa IP Box Regime zur Anwendung, deren Steuersatz von 0% in Malta bis 15,5% in Frankreich variiert.

Dieses Papier leistet in dreifacher Hinsicht einen Beitrag zum Forschungsstand. Erstens geben wir einen umfassenden und systematischen Überblick über die IP Box Regime in Europa und thematisieren dabei eine Reihe von Eigenschaften, die bislang nicht umfassend diskutiert wurden. Zweitens integrieren wir IP Box Regime in effektive Steuerbelastungsmaße für Investitionen in ein selbst erstelltes Patent. Drittens, diskutieren wir die Ausgestaltung der IP Box Regime in Bezug auf mögliche Anreizwirkungen.

Unsere Untersuchung macht deutlich, dass sich die praktizierten IP Box Regime in zwei Gruppen unterteilen lassen. Während die eine Gruppe (Belgien, Großbritannien, Luxemburg und die Niederlande) in größerem Maße darauf ausgerichtet ist, Anreize für Forschungs- und Entwicklung (F&E) und Innovationstätigkeit zu geben, scheint die andere Gruppe (Malta, das Schweizer Kanton Nidwalden, Ungarn und Zypern) darauf fokussiert zu sein, vornehmlich Buchgewinne anzuziehen.

Wir zeigen, dass die Regime die effektive Steuerbelastung profitabler Investitionen in immaterielle Wirtschaftsgüter erheblich reduzieren und teilweise auch die Grenzbelastung senken. Zentrales Ergebnis ist dabei, dass die Behandlung von F&E Aufwendungen in der Regel von größerer Bedeutung ist als der nominelle Steuersatz. Einzelne Regime führen sogar zu negativen Effektivsteuersätzen. Dies impliziert, dass unprofitable Investitionsprojekte subventioniert werden.

Schließlich diskutieren wir, inwieweit IP Box Regime unternehmerische Entscheidungen tatsächlich beeinflussen können, insbesondere die Höhe und den Standort von Investitionen in F&E. Wir kommen zu dem Schluss, dass, unter Berücksichtigung des hohen Risikos von F&E Investitionen, IP Box Regime unzureichend darauf ausgerichtet sind, Unternehmen dazu anzuregen, zusätzliche F&E Investitionen im Inland zu tätigen. Zwar können sie mobile Investitionen und Buchgewinne anziehen und theoretisch das Steueraufkommen erhöhen. Sofern andere Staaten jedoch vergleichbare Regime einführen, könnten diese positiven Effekte jedoch sehr kurzfristiger Natur sein.

Intellectual Property Box Regimes: Effective Tax Rates and Tax Policy Considerations[a]

Lisa Evers[b]
(ZEW Mannheim and University of Mannheim)

Helen Miller[c]
(Institute for Fiscal Studies)

Christoph Spengel
(University of Mannheim and ZEW Mannheim)

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Abstract:

11 European countries now operate *IP Box regimes* that provide substantially reduced rates of corporate tax for income derived from important forms of intellectual property. We incorporate these policies into forward-looking measures of the cost of capital, effective marginal tax rates and effective average tax rates. We show that the treatment of expenses relating to IP income is particularly important in determining the effective tax burden. A key finding is that regimes that allow expenses to be deducted at the ordinary corporate income tax rate, as opposed to the IP Box tax rate, may result in negative effective average tax rates and can thereby provide a subsidy to unprofitable projects. We assess the specific design features of different regimes against the possible policy aim of improving the incentives to undertake R&D investment in a country. While some countries have tried to tie the policy to real activities, others have designed a policy targeted at the income streams associated with intellectual property. A key concern is the role that IP Boxes may play in increased, and possibly harmful, tax competition between European countries.

JEL: H25, H32, H87, K34, O38

Keywords: corporate taxation, effective tax rate, tax incentive, patent box, innovation box, preferential tax rate

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[b] Correspondence, Lisa Evers, Centre for European Economic Research (ZEW Mannheim), email: evers@zew.de, phone: +49 (0)621 1235 168.

[c] Correspondence: Helen Miller, Institute for Fiscal Studies, email: helen_m@ifs.org.uk.

1. Introduction

Intangible assets constitute a major input and value-driver for multinational companies. Often, the related intellectual property does not have a clear geographical location and firms use this flexibility to reduce tax payments. Patents, trademarks, brands, and copyrights can be located in low-tax jurisdictions with the goal of reducing tax liabilities (Darby and Lernaster (2007), Kang and Ngo (2012), Verlinden and Smits (2009)). This raises concerns that the tax treatment of the returns from exploiting intellectually property may distort the location and organisation of firms' real activities and lead to the erosion of government revenues. One policy response is to tighten anti-avoidance rules. For example, in 2008 Germany tightened its rules concerning the transfer of intangible assets (so called directive governing the transfer of functions). In contrast, a number of countries are responding by creating more competitive tax regimes for mobile income.

In this regard, the most significant policy innovation in recent years has been the introduction of *Intellectual Property (IP) Box* regimes that offer a substantially reduced rate of corporate tax on the income derived from patents and in some cases other forms of intellectual property.[4] Besides Ireland, France (in 2000) and then Hungary (in 2003) were the first countries to operate such policies. However, IP Boxes first received widespread attention when introduced by the Netherlands and Luxembourg in 2007. Since 2007, those policies have been made more generous, and 7 other European countries (Belgium, Cyprus, Liechtenstein, Malta, Spain, the Swiss Canton of Nidwalden and the United Kingdom) have implemented their own versions. Tax rates for eligible income vary from 0% (Malta) to 15.5% (France). IP Boxes increase the attractiveness of a country as a location for intellectual property. However, the design of IP Box regimes, and specifically the treatment of expenses (i.e. the tax base), differs significantly across countries.

The contribution of this paper is threefold. First, we provide a comprehensive and systematic overview of the IP Box regimes in place in Europe. We address several aspects of the design of IP Boxes in detail, including the treatment of expenses related to income qualifying for the IP Box, which to date have received little attention. Second, we incorporate IP Box regimes into forward-looking measures of the cost of capital and effective tax rates for an investment in a self-developed patent. We show that IP Boxes increase the after-tax return from investing in the

[4] These policies are often called Patent Box, Innovation Box or License Box regimes. For generality, we refer to them as IP Box regimes.

creation of a patent and therefore produce substantial reductions in effective average tax rates of profitable investment projects. As such, the treatment of expenses relating to IP income can be more decisive for the effective tax burden than the nominal IP Box tax rate. A key result of our analysis is that IP Box regimes that allow expenses to be deducted at the ordinary corporate income tax rate, as opposed to the IP Box tax rate, may result in negative tax rates and can thereby provide a subsidy to unprofitable projects. Third, we discuss the policies' design features and the incentives created by IP Boxes.

Our motivation in this work is to consider in detail one of the policy responses to the difficulties created by the mobility of corporate activities and income. Across Europe, and OECD member states, there has been a trend towards reducing headline corporate income tax rates so as to remain competitive locations for firms' activities (Devereux, Lockwood and Redoano (2008), OECD (2010c), Spengel et al. (2012)). One difficulty in using the headline tax rate as a means to boost a country's competitiveness is that the benefits of a lower rate in terms of reducing the distortions to mobile income must be traded off against the revenue loss on immobile activities. In addition, if large firms are already organising their mobile income streams to achieve substantially lower tax burdens, marginal reductions in the headline rate may be of a limited effect.

IP Boxes can be viewed as preferential tax rates on a mobile form of income. In principle, it may be more efficient to explicitly tax more mobile activities at a lower rate than less mobile activities (Mirrlees et. al. (2011), p. 440). This may allow a higher rate to be maintained on less mobile activities while reducing the distortions on activities that are highly responsive to tax. However, the theoretical effects of preferential rates on government revenues is unclear and depends on a number of factors, including how responsive the tax base is to tax changes and how other governments respond.[5] In a simulation exercise Griffith, Miller and O'Connell (2012) estimate that the introduction of IP Boxes in the Benelux countries and the UK will reduce revenue raised from IP because the policies will not attract sufficient additional income to offset the effect of the lower tax rate. The UK government also estimates a revenue loss, amounting to £1.1 billion a year (HMRC (2011), p. 29). The simulation exercise suggests that the revenue loss increases when other countries introduce IP Boxes. It is likely therefore that the IP Boxes initially introduced by Luxembourg and the Netherlands have been rendered less effective by the subsequent introduction of similar policies by other European countries.

[5] For a discussion of the different results in the theoretical literature see Wilson (2005).

One of the key concerns with preferential rates is that they lead to harmful tax competition. For this reason they have been discouraged by international agreements such as the OECD initiative against harmful tax competition and EU Code of Conduct for Business taxation (OECD (1998), Council of the European Union (1999); for an overview see Kiekebeld (2004), Pinto (2002)).

Of course, tax revenue is not the only consideration. IP Boxes have also been discussed as innovation policies aimed at making a country a more attractive location for research and development (R&D) activities. This is one reason that the policies have been linked to intellectual property. Governments often express a particular interest in ensuring that they remain attractive locations for innovative activities because they are associated with high skilled jobs and are deemed important for driving growth. Even if a country directly benefits from ideas that are created offshore, the ability to use and benefit from new technologies is likely to require a sufficiently advanced domestic research base (Griffith et al. (2006)). In addition, evidence suggests that geographically proximity facilitates knowledge spillovers between researchers (Jaffe et al. (1993), Keller (2002)).

The presence of spillovers from research that lead to under provision by the market is the rationale for reducing the marginal cost of investment in innovative activities and thereby incentivising such activity. However, and as we discuss in Section 5, despite the low cost of capital associated with some IP Box regimes, these policies are poorly targeted at incentivising new innovative activities (Griffith and Miller (2011)). Importantly, IP Boxes target the income from successful projects and not the underlying research. This greatly diminishes the incentive to undertake new risky research (which has a highly uncertain expected profit stream and a high probability of failure). It also means that the size of the tax break is not directly linked to the scale of the underlying innovative activities. Notably, a number of countries allow income from pre-existing patents to benefit from the tax break and thereby provide windfall gains to previous research efforts.

The effective average tax rate speaks to the incentives firms face when considering where to locate discrete projects. As tools for attracting firms' R&D projects to a country the efficacy of IP Boxes is less clear. We discuss how some of the specific design features of the policies are likely to affect this margin of behaviour. For example, some countries do not require any of the real innovative activity underlying an eligible form of intellectual property to have taken place in a country.

It is interesting to note that in November 2010, Ireland removed an exemption of royalty income (one element of IP Boxes) that had been in place since 1973, citing the conclusion (influenced by a recommendation of the European Commission) that "*the relief has not had the desired impact on innovation and R&D activity and that (…) it was not a particularly well-targeted measure providing good value for money*."[6]

IP Boxes stand in contrast to R&D tax incentivises (R&D tax credits, or super deductions) that are linked to R&D expenditures and currently operated by many governments (including 8 of the 11 European countries currently operating IP Box regimes) (OECD (2002), OECD (2011)). These policies target the cost-side of R&D investment and have been found to be effective in increasing R&D activities.

IP Box regimes compete for government funds with traditional R&D tax incentives and other policies such as spending on skills and directly funded research. Hence, the effectiveness and the efficiency of IP Boxes require careful consideration. This is particularly important in light of the current economic and fiscal challenges.

The remainder of this paper is structured as follows. Section 2 provides an overview of the most important features of IP Box regimes, including which types of IP and income qualify and how related expenses are treated. In Section 3 we adapt the measures developed in Devereux and Griffith (1999, 2003) to incorporate IP Box regimes into measures of effective tax rates. We lay out the results in Section 4. In Section 5 we discuss the design of the IP Box regimes, including the incentives created in relation to real activity.

2. The taxation of income from intellectual property in Europe

Income from the exploitation of intellectual property, whether by way of internal use, e.g. in the production of goods, or by licensing to third or related parties, is generally subject to the ordinary corporate income tax rate. IP Box regimes are an exception to this, as they provide a reduced tax rate for income from the exploitation of IP. Before addressing the taxation of IP income under the IP Box regimes in place in Europe in more detail, we will give a brief overview of the tax treatment of R&D expenses and self-developed intangible assets under the regular tax system.

[6] Houses of the Oireachtas, parliamentary debate 7, December 2010, written answers, download: http://debates.oireachtas.ie/dail/2010/12/07/unrevised2.pdf.

Current R&D expenses incurred for the creation of an intangible asset (i.e. materials, utilities, and wages) as well as on-going expenses for managing, improving and financing investment in intellectual property are generally immediately deductible as business expenses. In turn, capital expenditures such as the acquisition costs for machinery and buildings used for R&D activity as well as for the acquisition of an intangible asset are not immediately deductible but instead subject to capital allowances or tax depreciation, to put it differently.

It is rarely required to capitalise self-developed intangible assets for tax accounting purposes (among the 11 countries under consideration, none in general requires that self-developed intangible assets be capitalised[7]). Yet, many countries provide an option to do so upon meeting certain requirements (often similar to IAS 38: identifiably, probability of future economic benefits and the power to obtain these benefits, ability to measure the costs of the asset reliably; Spengel and Zöllkau (2012), p. 65). In some cases, this only applies to development expenses whereas research expenses may not be capitalised (Spengel and Zöllkau (2012), p. 58).

Capitalisation involves the initial deduction of R&D expenses being offset and then spread over the useful life of the intangible asset by way of periodical depreciation. Taking into account the time value of money, delaying the tax deduction of R&D expenses by way of capitalising self-developed intangible assets is favourable from the perspective of the treasury but unfavourable from the perspective of the taxpayer.

Many countries offer tax incentives for investment in R&D and innovation in the form of tax credits and extra deductions (i.e. super deduction, enhance deduction) for R&D expenses. As a consequence, the tax deductions exceed the amount which has actually been incurred. Besides this, some countries offer immediate or accelerated depreciation for assets used for R&D activity (Elschner et al. (2011), Ernst and Spengel (2011), OECD (2011)). Table 4 in Appendix I provides an overview of R&D tax incentives in place in the eleven countries which have implemented an IP Box. Among those eleven countries only Cyprus, Liechtenstein and the Swiss Canton of Nidwalden do not have R&D tax credits, super deductions or accelerated depreciation for R&D assets in place.

[7] However, this might be different under the IP Box regimes; this will be addressed in section 2.4.

2.1. Overview of the main features of IP Box regimes in Europe

Eleven European countries currently offer a reduced rate of corporation tax on the income derived from patents and, in many cases, income from other forms of intellectual property.[8] These are, in chronological order with the (financial) year in which they were first applied given in brackets, France (2000), Hungary (2003), the Netherlands (2007), Belgium (2007), Luxembourg (2008), Spain (2008)[9], Malta (2010), Liechtenstein (2011), the Swiss Canton of Nidwalden (2011), Cyprus (2012), and, most recently, the United Kingdom (2013)[10]. In contrast, Ireland removed the exemption of royalty income that had been in place since 1973 in November 2010. Whereas the role of the tax policy innovator in the field of IP Box regimes is generally attributed to the Netherlands, three other countries (Ireland, France, and Hungary), were already operating comparable regimes.

The most prominent feature of such IP Box regimes is the tax rate, which ranges from 0% in Malta, 2% in Cyprus and 2.5% in Liechtenstein to 10%, 12% in Spain[11] and 15.5% in France. Country practises differ with respect to how to derive this tax rate from the regular corporate income tax rate. Most countries either exempt part of the income or allow for a notional deduction of part of the IP income; these two approaches first and foremost differ in technical terms but are not substantially different. In contrast, France explicitly stipulates a separate tax rate for IP income. This approach differs significantly from the two former ones with respect to loss-situations. Whereas a separate statutory tax rate comes to nothing in loss-situations, a partial exemption and a notional deduction of IP income increase any loss carry-forward so that the effect of the IP Box be deferred unless this is explicitly precluded as under the Belgian IP Box regime.

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[8] The information on the IP Box regimes presented in this section mainly draws on the following sources as well as the respective tax legislation and is current as of August 31, 2013: IBFD Tax Research Platform, IBFD Global Corporate Tax Handbook (2013), Bellingwout et al. (2012), Dutler (2013), Eynatten (2008), Merrill et al. (2012); Belgium: Van Den Berghe and Kelley (2008), Eynatten and Brauns (2010), Felder (2013), Warson and Claes (2010), Warson and Foriers (2008), Willems (2012); Cyprus: Aristotelous and Neocleous (2012), Schaapman and Brekink (2012), KPMG (2012); Hungary: Koka (2012), Vosse and Harcos (2012); Liechtenstein: Felder (2013), Hosp and Langer (2012), Steuerverwaltung Fürstentum Liechtenstein (2012), Wanger (2012); Luxembourg: Eynatten and Brauns (2010), Felder (2013), Van Kuijk (2011), Van Kuijk (2013), Mundendam and Chiarella (2008), Circulaire L.I.R. n° 50bis/1; the Netherlands: Eynatten and Brauns (2010), Felder (2013), Nijhof and Kloes (2010), Sporken and Gommers (2007); Spain: Gonzales and Salcedo (2009), Ibañez and Velasco (2013); the Swiss Canton of Nidwalden: Felder (2013), Schäuble and Giger (2012), Hausmann and Roth (2012); the United Kingdom: Aquerreta et al. (2013), HMRC (2012), Gregory et al. (2013), Scott and Ross (2012).

[9] By way of Law 14/2013 which become effective September 29, 2013, Spain has substantially reformed its IP Box. We will indicate the changes where applicable. For an overview see Ibañez and Velasco (2013).

[10] The British Patent Box is phased in over a period of four years. In 2013, companies are only entitled to 60% of the full benefit, increasing to 70%, 80% and 90% in subsequent years. The Patent Box will fully be available in 2017.

[11] The amount of exempt IP income has recently been increased from 50% to 60% resulting in an IP Box tax rate of 12% instead of 15% (Ibañez and Velasco (2013)).

In some countries the benefit of the low IP Box tax rate are limited by a cap. Caps applied within the scope of IP Boxes may be designed in absolute terms or in relation to the R&D expenses or the overall profits, respectively. Namely, the notional deduction of 50% of qualifying IP income under the Hungarian IP Box regime is limited to 50% of the overall profits. Similarly, until the comprehensive reform of the regime in September 2013 the relief of the Spanish IP Box ceased to apply in the tax period which followed the one in which the qualifying IP income exceeded six times the costs of the IP.[12]. A comparable provision (four-times the R&D costs) was in place in the Netherlands until 2009.

The other key features that determine the generosity of the policies besides the IP Box tax rate are: (i) the types of IP that are eligible; (ii) the scope of qualifying income; and (iii) the treatment of expenses relating to qualifying IP income differentiating between the R&D investment expenses incurred in the past and on-going expenses. Table 1 summarises the policies.

[12] The costs of the IP comprise capitalised expenses as well as expenses which have not been capitalised.

Table 1: IP Box regimes in place in Europe (2013)

	IP Box rate (%)	CIT rate (%)	Qualifying IP			IP Box Tax Base	
			Types of eligible IP	Acquired IP	Existing IP	Treatment of current expenses	Treatment of R&D expenses incurred in the past
Belgium (2007)	6.8	33.99	Patents, SPC, certain know-how closely linked to patents or SPCs	N	N	Gross income	No recapture
Cyprus (2011)	2	10	Patents, secret formulas, designs, models, trademarks, service marks, client lists, internet domain names, copyrights (including software), know-how	Y	N	Net income	No recapture
France (2000)	15.5	34.43	Patents, SPC, patentable inventions, manufacturing processes associated with patents, improvements of patents	Y	Y	Net income	No recapture
Hungary (2003)	9.5	19	Patents, secret formulas and processes, industrial designs and models, trademarks, trade names, copyrights (including software), know-how, business secrets	Y	Y	Gross income	No recapture
Liechtenstein (2011)	2.5	12.5	Patents, designs, models, utility models, trademarks, copyrights (including software)	Y	N	Net income	Recapture
Luxembourg (2008)	5.84	29.22	Patents, SPC, designs, models, utility models, trademarks, brands, domain names copyrights on software	Y*	N†	Net income	Recapture (Capitalisation of development costs)
Malta (2010)	0	35	Patents, trademarks, copyrights (including software)	Y	N	Not applicable	Income not eligible if R&D costs previously deducted
Netherlands (2007)	5	25	Patents, IP for which R&D certificate has been obtained (inventions, processes, technical scientific research, designs, models, certain software)	N	N	Net income	Recapture
Spain (2008)	12	30	Patents, secret formulas and procedures, plans, models	N	Y	Net income	No recapture
Nidwalden, Switzerland (2011)	8.8	12.66	Patents, secret formulas and processes, trademarks, copyrights (including software), know-how	Y	Y	Net income	No recapture
United Kingdom (2013)	10	23	Patents, SPC, certain other rights similar to patents	Y*	Y	Net income before interest	R&D expenses are allocated to patent income on an overall basis

Abbreviations: CIT: corporate income tax rate, including surcharges; Y: Yes; N: No; SPC: Supplementary Protection Certificate. *Notes*: *Luxembourg and the UK allow acquired IP only under certain conditions. In the first column the data refers to the year in which an IP Box was first introduced. †In Luxembourg, IP created before the introduction of the regime qualifies if it has been acquired after the date of the implementation. For France the corporate tax rate includes the social surcharge, but not the exceptional tax surcharge that is levied if company turnover exceeds EUR 250 Million. The UK regime is being phased in over four years. In 2013, companies are only entitled to 60% of the full benefit, increasing to 70%, 80% and 90% in subsequent years and becoming fully available in 2017.

2.2. Eligible intangible assets

Types of qualifying intangible assets

When addressing the types of intangible assets eligible for the IP Box regimes, it is helpful to differentiate between trade intangibles, such as patents, which are characterised by being the result of R&D activity, and marketing intangibles like trademarks and brands which aid in the commercial exploitation of products or services (OECD (2010a)). Know-how, business secrets and processes may constitute either trade or marketing intangibles. Because they are related to R&D activities, trade intangibles are more likely to give rise to positive spillovers (which are the justification of a role for government in incentivising R&D investment). In contrast, firms tend to reap the returns to commercialisation activities.

All European IP Box regimes apply to patents. In Belgium, France, and the United Kingdom, the scope is limited to patents and so called Supplementary Protection Certificates (SPC).[13] In the Netherlands, the IP Box is granted for intangible assets for which a patent or an R&D certificate has been granted.[14] This opens the scope for intangibles which the taxpayer does not want to patent as well as other kinds of intangibles which are not patentable such as software and production processes.

Several countries also include trademarks and other kinds of marketing assets (Swiss canton of Nidwalden, Cyprus, Hungary, Liechtenstein, Luxemburg and Malta). Other types of IP which may qualify for the IP Box regimes comprise software (Cyprus, Hungary, Liechtenstein, Luxembourg, the Netherlands, the Swiss canton of Nidwalden), designs and models (Cyprus, Hungary, Liechtenstein, Luxembourg, Spain), and secret formulas (the Swiss canton of Nidwalden, Spain). Some countries even include know-how (Belgium[15], Cyprus, Hungary, the Swiss canton of Nidwalden), and business secrets (Hungary) and secret formulas and processes (Cyprus, Hungary, Spain, the Swiss canton of Nidwalden), which are difficult to value accurately, in the scope of the IP Box.

It is usually not required that the IP right has been registered in the country of residence of the taxpayer. Instead, patents granted by the European Patent Office or another EU/ EEA member

[13] SPC are intellectual property rights that come into force after the patent upon which they are based has expired. They are available for pharmaceuticals and plant protection products. The aim of SPCs is to compensate for the long time lag between the issuance of a patent and the regulatory approval to market the respective product. See Warson and Foriers (2008), p. 72, Van Den Berghe and Kelley (2008), p. 375.

[14] The R&D certificate is granted for development project, technical-scientific research, analysis of the technical feasibility of own R&D projects, and process-oriented technical research (NL Agency (2013), pp. 11 et seq.).

[15] This, however, requires that the know-how is closely linked to patents or SPC (Eynatten and Schaffers (2013), p. 11).

state's patent office generally also qualify. In some cases (e.g. in France, Malta, and the United Kingdom) it is nevertheless required that the patentability and examination criteria applied by the foreign national patent office are comparable to those applied by the respective domestic patent office (HMRC (2012), p. 5). Similarly, in case of other IP rights such as trademarks and copyrights, it is also generally not necessary that they have been registered with a domestic authority.

Finally, it is interesting to note that a significant number of countries (France, Hungary, Luxembourg (concerning acquired IP), the Swiss Canton of Nidwalden, and the UK) apply the IP Box to IP which has been created and/ or registered before the regime was implemented (HMRC (2011), p. 27, Merrill et al. (2012), pp. 1667 et seq.). This provides windfall gains to investments carried out before the provision has been introduced.

Requirements relating to the development of qualifying IP

Countries vary in whether the taxpayer in receipt of the IP Box deduction needs to have developed the qualifying IP. In Spain, only self-developed IP qualifies without exceptions. Belgium and the Netherlands require that acquired IP has been further developed (Van Den Berghe and Kelley (2008), p. 379). In the United Kingdom, only patents acquired from group companies qualify under the condition that the respective group company has developed the patent itself and that the acquiring taxpayer actively manages the patent subsequently (HMRC (2012), p. 26). By excluding acquired IP from the scope of the IP Box regime these four countries are likely seeking to ensure that there is some real activity behind the tax break.

In contrast, the other countries (Cyprus, France, Hungary, Liechtenstein, Luxembourg[16], Malta, and the Swiss Canton of Nidwalden) explicitly extend the benefit of the IP box to acquired IP.[17] This makes these regimes attractive for IP holding companies which do not perform any own R&D and innovation activity but focus on the management and the exploitation of IP.

A way of working around the "self-development"-criterion is contracting out R&D to an intra-group or external R&D provider. IP generated by way of contract R&D qualifies for most IP Box regimes in case the R&D activity has been carried out on the risk and account of the taxpayer.[18]

[16] The Luxembourg IP Box does not apply to IP acquired from directly related companies (Van Kuijk (2013), p. 295).

[17] In France, there is a two-year waiting period until income resulting from the exploitation of acquired IP is subject to the reduced tax rate.

[18] Contract R&D arrangements involve that R&D activities are performed by one party (the contractor) on behalf, meaning on the risk and on account, of another party (the principal) (OECD 2010a: 244). In return for its services, the contract R&D performer receives a remuneration which is generally determined on a cost-plus basis as the contract R&D performer is in general considered to carry out a routine function (Russo (2007), pp. 172 and 174). This requires

This in particular requires that the principal effectively manages and controls the party carrying out the R&D activity.

In line with the fundamental freedoms codified in the Treaty on the Functioning of the European Union, none of the IP Box regimes under consideration require that the R&D and innovation activity be carried out domestically. Nevertheless, a certain degree of domestic activity (in quantitative and/ or qualitative terms) is required in some cases.[19] Only rarely do the countries exploit the possibility to limit the scope to R&D carried out in a member state of the EU or the EEA (France and previously Ireland).

2.3. Qualifying income

Types of qualifying income

All IP Box regimes apply to royalties and license income, which are straight forward to calculate. When the respective income has been received from related parties, transfer pricing rules have to be considered. The majority of countries also apply the IP Box to capital gains from the sale of qualifying IP.[20] In Hungary, capital gains from the sale of IP are even fully tax exempt. Only in Belgium and Malta are capital gains from the sale of IP excluded from the scope of the IP Box. This was also the case under the IP Box regime applied in Ireland. For sake of completeness, it should be pointed out that many of the IP Box regimes furthermore cover infringement income and compensations paid for damages, insurance receipts and other kinds of compensations.

In the Benelux countries, Liechtenstein, and the United Kingdom the internal use of qualifying IP may also benefit from the IP Box as the respective regimes cover so called notional royalty income (i.e. embedded royalty income). Notional royalty income for example arises when qualifying IP is used in order to produce products or to provide services.[21] The notional royalty from internal use is usually ascertained by drawing on the arm's length principle and determining the royalty the taxpayer would have received from an unrelated party had it

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that the principal manages and controls the party carrying out the R&D activity. In order to determine whether this is the case in practise the following activities are of importance: planning, budgeting, identifying areas of potentially commercially successful R&D (Sporken and Gommers (2006), p. 267). This requires that the principal has appropriate resources, including adequately educated staff, to be able to effectively manage and control the R&D work (Russo (2007), p. 175). As a result, the principal receives the legal and economic ownership of the intangible asset resulting from the R&D activity. For practical examples see OECD (2012), p. 47 et seq.

[19] A certain amount of domestic R&D activity In particular is required in order to obtain an R&D certificate, which is the second entry ticket to the Dutch Innovation Box. For further details see NL Agency (2013), pp. 9 & 20, Nijhof and Kloes (2010), p. 70, Schellekens (2013).

[20] In Spain, this excludes transactions with group companies (Ibañez and Velasco (2013)).

[21] In Luxembourg, only notional royalty income embedded in the sale price of goods incorporating a self-developed patent qualifies. Internal use of qualifying IP other than patents such as marketing IP or acquired patents does not qualify for the reduced IP Box tax rate.

licensed out the IP (for further details refer to Muntendam and Chiarella (2008), p. 226, Van Den Berghe and Kelley (2008), pp. 377 et seq., Van Stappen et al. (2007), pp. 293 et seq.). The UK policy stipulates that the taxpayer assumes the opposite perspective. Here, the notional royalty is the royalty the taxpayer would have been charged by an unrelated party had it licensed the IP (HMRC (2012), p. 39). From this it follows that the taxpayer has a much broader leeway to attribute income to the IP Box as arm's length prices are associated with a certain degree of uncertainty especially when it comes to intangible assets. Tracking down the use of qualifying IP in the company's whole business activity and its contribution to all sale proceeds based on the arm's length principle will, however, involve considerable administrative effort on behalf of the taxpayer.

Mixed licenses and global licenses further complicate determining which part of the taxpayer's income benefit from the IP Box. Such licenses are characterised by the fact that they relate to different intangibles; some of them may qualify for the IP Box whereas others may not. Such arrangements pose a problem to determining IP Box income if the underlying contracts do not specify how the payment is to be split up between the two assets.

A special provision of the Dutch policy provides remedy by fully including royalties which related to qualifying and non-qualifying IP alike as long as qualifying IP contributes at least 30% to the income (Merrill et al. (2012), Niejhof and Kloes (2010)). Similarly, under the British Patent Box royalties relating to rights over "non-patented items also qualify for the Patent Box if the purpose of granting those rights is the same as for the rights over the qualifying IP (HMRC (2012), p. 36)." This is so called "IP-derived income". According to an example presented in the technical notes (HMRC (2012), p. 36), this refers to cases where royalty income is paid in relation to patents as well as other IP rights which do not fall under the scope of the Patent Box, e.g. trademarks. In cases where these IP rights are licenced in order to exploit a patent which also has been licensed, the royalty fee paid for to the use of the non-qualifying IP constitutes IP-derived income and also qualifies for the Patent Box (HMRC (2012), p. 36).

In the case of the UK Patent Box "income from the sale of items incorporating a qualifying item" furthermore benefits from the reduced tax rate (HMRC (2012), p. 33 et seq.). To give an example, the whole sale proceeds of a car qualify for the Patent Box as long as one patented item is incorporated. This partially compensates for the comparably narrow scope of qualifying IP which is mainly restricted to patents and similar rights.

Yet, this broad notion of qualifying income is only the starting point for determining the Patent Box tax base; in a second and third step several deductions are required in order to obtain a figure which approximates the profits from the use of patents. This will be described in more detail in the following section 2.4.

2.4. Determination of the IP Box tax base - treatment of expenses relating to IP income

Treatment of on-going expenses

IP Boxes effectively take two approaches with respect to the treatment of on-going expenses relating to IP income (and therefore to determine the IP Box tax base) – a gross and a net approach. Under the gross approach adopted by Belgium and Hungary,[22] expenses relating to IP income are deductible from non-IP income which is taxed at the regular corporate tax rate (Warson and Foriers (2008), p. 73, Vosse and Harcos (2012), p. 3, Eynatten (2008), pp. 511). This is of importance as tax deductions act to shield income from taxation, with the value of the tax shield being determined by the tax rate at which the expenses are deductible.

While the gross-income approach makes for an administratively simple system, the asymmetric treatment of IP income and IP expenses (meaning that the income taxed at the reduced tax rate whereas expenses are deductible at the regular corporate income tax rate) represents a substantial tax advantage, as long as the taxpayer has sufficient ordinarily-taxed non-IP income from which to deduct the IP expenses. Notably, due to the tax-shield character of the expenses the effective tax rate associated with an investment in a self-developed intangible asset may be reduced to as low as zero or even below zero when IP expenses can be deducted from ordinarily taxed income. Consequentially, this provides an incentive to finance R&D investment with debt. For this reason Hungary, which applies a reduced tax rate for IP income by way of allowing a 50% notional deduction of IP income from the overall tax base, limits this deduction of IP income to 50% of the overall profit of the company.

In contrast to this, under the net income approach, which is applied by the majority of European IP Box regimes, on-going expenses (i.a. depreciation allowances incurred on the use of capitalised IP, administrative expenses, improvement expenses, and financing expenses) have to be allocated to IP income and are thereby deducted at the lower IP Box rate.[23] This ensures that

[22] Before the recent reform of the Spanish IP Box, Spain also applied a gross income approach (Ibañez and Velasco (2013)).

[23] Please note that in the UK financing expenses do not have to be allocated to the Patent Box but may be deducted from non-patent income which is taxed at the regular corporate tax rate (HMRC (2012), p. 10). All other on-going-expenses are apportioned to either patent or non-patent income in line with the net income approach. In Liechtenstein, it is also

income and expenses are treated symmetrically. Hence, the tax value of the tax shield associated with these deductions depends on the lower IP Box tax rate.

Determination of the tax base under the British Patent Box

Under the UK Patent Box, the taxpayer is not required to determine the actual profits associated with individual patents. Instead, the tax base of the Patent Box is calculated by way of a simplifying, three-step procedure. In this regard, the starting point (step one) is the share of the overall profit of the company which relates to the ratio of qualifying income to the overall gross income ("Relevant IP Profit"). Alternatively, the taxpayer may choose to determine the qualifying profit by allocating all expenditures incurred on a "just and reasonable" basis to either qualifying IP income or non-qualifying income (called streaming) (HMRC (2012), p. 10). The first approach is less exact than the second one as it assumes that activities resulting in qualifying income and other kinds of activities of the taxpayer, which result in non-patent income, are equally profitable; this may not be the case in practise. Yet, allocating every item of expenditures to either qualifying or non-qualifying income as required by the streaming approach is probably more complex. In both cases, financing income and expenses are disregarded and are taxed and deducted, respectively, at the regular tax rate (HMRC (2012), p. 10).

The Relevant IP Profit derived by this first step still comprises profits which do not relate to the use of patents. This can be illustrated by turning again to the example of the proceeds from the sale of a car, which constitute "income from the sale of items incorporating a qualifying item", namely a patent, and thereby qualify for the Patent Box. In this case, in addition to profits stemming from the use of patents the qualifying profits derived from step one comprise profits from routine functions (first and foremost the production of the car) and profits from the use of non-qualifying IP such as trademarks. Consequentially, two further steps are required to eliminate these profits from the Patent Box tax base. In the second step, the Relevant IP Profit is reduced by deducting a return to routine functions in order to derive the "Qualifying Residual Profit". This is the profit a business is expected to make if it does not have access to unique IP. The return to routine functions is set at 10% (HMRC (2012), pp. 11, 46 et seq.). Consequentially, returns to routine functions which exceed 10% automatically fall inside the Patent Box.

required to allocate part of the notional interest expenses to the IP Box (Felder (2013), p. 222). This is not the case under the Belgian IP Box (Felder (2013), p. 24 with further references).

Finally, the third step comprises deducting a notional marketing royalty for the use of marketing intangibles (e.g. trademarks) from the Qualifying Residual Profit as such intangible assets are explicitly excluded from the Patent Box. The determination of the return to marketing assets is at the discretion of the taxpayer but must reflect the actual facts and circumstances and must meet arm's length requirements (HMRC (2012), pp. 50 set seq.). It nevertheless constitutes a leeway for shifting profits into the Patent Box. For sake of completeness it should be pointed out that two safe harbours are available which can simplify step three.[24]

Treatment of R&D expenses incurred in the past

Aligning the R&D expenses associated with the creation of the IP with the IP income is more complex, since these expenses have been incurred in the past and will have been deducted before the IP Box applies. In order to match the treatment of R&D expenses to the treatment of IP income, two approaches are currently in place. One option, which is applied in Luxembourg, is to stipulate that self-developed intangible assets have to be capitalised when opting for the IP Box regime (Muntendam and Chiarella (2008), p. 225). Alternatively, the IP Box rate may only be applied to (net) income exceeding the initial (research and) development expenses thereby recapturing these expenses at the regular corporation tax rate. This is the case under the Dutch and the Liechtenstein IP Box.

From the taxpayer's perspective the latter approach is more beneficial. This is due to the fact that capitalisation of the intangible asset involves that a revenue in the amount of the intangible asset's production costs is added to the profit and loss statement thereby increasing the tax base. As a consequence, the initial deduction of expenses is offset. An adjustment for inflation is, however, not required. Hence, an interest effect stemming from the time value of money remains from the initial tax deduction of the R&D expenses.[25]

Both the recapture approach and capitalisation ensure that the treatment of R&D expenses and IP income is aligned ex-post when opting for the IP Box regime. In contrast, under the IP Box

[24] For small claims, the taxpayer may simply deduct 25% of the Qualifying Residual Profit as the marketing royalty. The small claims treatment is available if the Qualifying Residual Profit are below 1 Million GPB as well as if the qualifying residual profits are below 3 Million GPB and certain further requirements are met. For larger claims, a de minimis relief is available where the taxpayer is reasonably convinced that the marketing royalty is less than 10% of the Qualifying Residual Profit, which implies that the deduction of a marketing royalty is not required (HMRC (2012), pp. 48-51).

[25] The immediate deduction of the R&D expenses brings about immediate tax savings given that the expenses can effectively be offset against other taxable income. This immediate tax saving during the investment phase implies that, in economic terms, the taxpayer receives an interest-free loan from the government as the taxable profit falls short of the true economic profit, as economically the investment is of a capital nature. In case the intangible asset is eventually capitalised the initial deduction is offset which also implies that the implicit loan is paid back. Yet, the taxpayer retains the interest saved on this notional interest-free loan.

regimes in place in Malta and the UK the treatment of R&D expenses and IP income is aligned ex-ante. In Malta, the full exemption of royalty income is only available if R&D expenses associated with the royalty income have not been deducted in the past. Hence, the full exemption of royalty income is confronted with a full inclusion of R&D expenses in the tax base (East (2011)).

Under the UK Patent Box R&D expenses incurred before the Patent Box has first been applied do not have to be recaptured and therefore remain deductible at the higher corporate income tax rate. Those R&D expenses incurred once the Patent Box has been opted for as well as on-going expenses are generally not allocated to IP income on a per-item basis. Instead, they are indirectly attributed to the Patent Box when the overall profit is split-up in qualifying profit and non-qualifying profit based on the ratio between qualifying income and non-qualifying income (step one of the three-step-procedure sketched out above). As the Patent Box profits are generally not determined directly by allocating expenses on a per-item basis, it is unclear whether the tax value of these expenses is effectively based on the Patent Box tax rate or the regular corporate income tax rate.

To our best knowledge, several countries do not require that R&D expenses incurred in the past be recaptured at all (Belgium, Cyprus, France, Hungary, Ireland, Spain, and Switzerland).[26] Consequentially, the tax value of the expenses associated with IP income may very well exceed the tax burden levied on the IP income. To give an example, in Belgium expenses relating to IP income may be deducted at a rate of approximately 34% (corporation tax plus surcharge) whereas royalties are only taxed at 6.8%.

Spain is among the countries that do not stipulate the recapture of previous R&D expenses. However, in the case that self-developed intangibles are not capitalised, the IP Box tax base is assumed to constitute only 80% of qualifying income; this generalising approach means that current expenses do not have to be allocated to IP income.

[26] Whereas the Belgian and Spanish provisions explicitly provide that R&D expenses do not have to be recaptured (Warson and Foriers (2008), p. 73, Eynatten (2008), p. 516), we are not aware that the provisions governing the IP Boxes in the other countries explicitly address this issue.

Treatment of IP Box losses

In cases where the tax base is IP Box profits (net income approach) as under the British Patent Box, the question arises whether IP Box losses may be offset against non-IP Box profits or only against (future) IP Box profits. Under the British and the French IP Boxes, losses may only be offset against Patent Box profits of other group companies but not against other profits. Any excess Patent Box losses may be carried forward separately and offset against future Patent Box profits of the same company or other group companies (HMRC (2012), pp. 69 et seq.). Liechtenstein, Luxembourg, the Netherlands, and the Swiss Canton of Nidwalden allow for a deduction from other income but require that the losses be eventually recaptured at the regular tax rate if the respective intangible assets generate IP profits in subsequent years (Felder (2013), pp. 104, 240, 310 et seq.) or, as the case in Luxembourg, when the IP is disposed of ((Felder (2013), p. 70).

In the context of IP Boxes which follow the gross income approach IP losses in general do not arise. Nevertheless, in cases where the IP Box regime provides for a notional deduction (instead of a partial exemption), the question arises whether this notional deduction may be used to create an overall loss and whether any unused notional deduction maybe carried forward. To give an example, the Patent Income Deduction in place in Belgium may neither be used to create a loss nor may any unused amount be carry-forward (Merrill et al. (2012), p. 1666, Warson and Foriers (2008), p. 71).

2.5. Interaction between IP Box regimes and R&D tax incentives

Of the 11 European countries currently providing IP Box regimes, 8 also offer R&D tax incentives. In general, taxpayers who make use of the IP Box regimes are not excluded from the benefits of R&D tax incentives. Malta is the only exception to this as the royalty income exemption only applies if no R&D expenditures (including the 50% super deduction available) relating to the patent which give rise to the tax exempt income have been deducted in the past.

Even if the application of the IP Box regime and the R&D tax incentive are not mutually exclusive, possible interactions between the IP Box regimes and R&D tax incentives may arise in case of IP Box regimes which apply a net income approach requiring that expenses be allocated to IP income. In case this requirement extends to super deductions granted for R&D expenditures, the tax value of this kind of R&D tax incentive would be determined by the lower IP Box rate. This would render the super deduction less attractive for the taxpayer. This is, however, not required in any of the countries under consideration. When designing the IP Box

regimes, tax legislators seem to be aware of this issue and ensure that the effects of the super deductions are not impaired by the application of the IP Box regimes. Similarly, when calculating the basis for the deductions of the return from routine functions under the British Patent Box (the second step of the three-step procedure as sketched out in Section 2.4), R&D expenses are explicitly excluded (Aquerreta et al (2013)).

The application of the IP Box regimes may nevertheless indirectly affect the use of R&D tax incentives. As the application of the IP Box regimes results in a lower overall tax burden, R&D tax incentives may come to nothing if the taxpayer does not generate sufficient non-IP income. In such cases, R&D tax credits which are refundable are advantageous. This is for example the case in Belgium (after 5 years), France (after 3 years), and Ireland (over three years).[27]

2.6. Summary

In summary, Malta, Cyprus and Liechtenstein offer the most attractive IP Box tax rates (0%, 2% and 2.5%, respectively). In terms of the qualifying IP, the scope of the regime is widest in the Swiss canton of Nidwalden, Cyprus, Hungary, Liechtenstein, and Luxemburg, as they all also include marketing intangibles in addition to trade intangibles such as patents. Most countries do not require that the eligible intangibles have to be self-created by the taxpayer and are available for acquired IP.

In terms of the qualifying IP income, the Benelux countries, the United Kingdom, and Liechtenstein are attractive for companies which use IP internally because embedded income benefit in addition to license income. In contrast, in Cyprus, France, Hungary, Malta, Spain, and the Swiss Canton of Nidwalden, the reduced IP Box tax rate does not apply to notional license income.

Regarding the IP Box tax base it is interesting to note that the majority of countries require that on-going expenses such as administrative expenses or financing costs be allocated to IP income thereby applying a net income approach; only Belgium, and Hungary subject gross IP income to the IP Box rate. In contrast, only 3 countries stipulate that R&D expenses incurred in the past have to be recaptured and allocated to IP Box income (Liechtenstein, Luxembourg, and the Netherlands). How the treatment of expenses affects the effective tax burden associated with the IP Boxes will be analysed in more detail in Section 4.

[27] Belgium: Deloitte (2013), France: Deloitte (2013), p. 16, Mayot and Juan (2009). Ireland: Irish Revenue (2012), IBFD Tax Research Platform, Country Analysis Ireland, Corporate Taxation, 1 August 2013, section 1.9.3.2).

3. Effective tax rates methodology

According to neo-classical theory, firms invest in capital as long as the (decreasing) marginal returns cover the marginal costs. The required pre-tax rate of return is called the cost of capital (Jorgenson (1963), Hall and Jorgensen (1967)). This is the pre-tax rate of return on marginal investment (an investment which just breaks even), which exactly meets the investor's minimum after-tax return requirements. In other words, a firm invests up to the point where the investment just earns the investor's minimum after-tax return, the cost of capital.

Neoclassical approaches which investigate the effects of taxes on the scale of investment consider how taxes affect the cost of capital. The main intuition is that corporate taxation drives a wedge between the capital market interest rate, which is the investor's opportunity cost associated with corporate investment, and the required pre-tax rate of return, the cost of capital.[28] This tax wedge is influenced by the corporate income tax rate and the definition of the tax base. This will be discussed in more detail below.

Another way of expressing the distortion which taxation exerts on investment decisions at the margin is the effective marginal tax rate (EMTR). If we ignore personal taxes, the EMTR is just a simple monotonous transformation of the cost of capital: it represents the tax wedge between the cost of capital and the real market interest rate, divided by the cost of capital. Put differently, it is the share of the cost of capital which is taxed away.

In addition to the effects of taxes on marginal investment which just break even, we consider the effects of taxation on profitable investment projects. Assuming that investment funds are limited, investment projects are mutually exclusive. The choice of which country to carry out an investment in, for example, constitutes a discrete investment decision between two profitable investment projects. With respect to the tax effects on the choice between alternative investment projects that are profitable we are concerned with how much of the pre-tax profit of the respective project is taxed away. Taxation will affect the investment decision if it changes the ranking of the projects in the post-tax as opposed to the pre-tax case. This can be measured by way of the effective average tax rate (EATR). The EATR indicates the percentage reduction of the investment's net present value (NPV) that is caused by taxation.

[28] We disregard personal taxation at the level of the individual investor. Arguing from the perspective of a large multinational company which raises funds for investment at the international capital market it is reasonable to assume that due to the lack of information concerning the tax treatment of the marginal shareholder the taxation at the shareholder level is not taken into account for investment decisions.

Summing up, the cost of capital and the EMTR on the one hand and the EATR on the other are relevant in quite different settings. The former two measures demonstrate the incentives firms face with respect to the scale of investment, whereas the latter is decisive for discrete investment decisions such as the location (domestic or abroad) or the type of investment (investment in tangible or intangible assets).

3.1. The Devereux & Griffith Model for calculating effective tax rates

To measure the cost of capital, the EMTR, and the EATR we apply the established approach put forward by Devereux and Griffith (Devereux and Griffith (1999), (2003)) which, in turn, builds on the works of Jorgenson (1963), Hall and Jorgensen (1967) and King and Fullerton (1984). This approach assumes a forward-looking perspective in the sense that it models the cost of capital, the EMTR, and the EATR as perceived by investors facing hypothetical investment projects. In line with neoclassical investment theory it rests on the assumption of a perfect capital market under certainty.

The starting point for measuring the cost of capital, the EMTR, and the EATR is the after-tax NPV of an investment project (R), the economic rent, denoted by formula (1) below. Please note that formula (1) reflects the case of equity-financing of the investment by way of retained earnings.[29] For the case of debt-financed investment see Appendix II.

$$(1)\quad R = \underbrace{-(1-A)}_{Term\ 1} + \frac{1}{1+i}\left[\underbrace{(p+\delta)*(1+\pi)*(1-\tau)}_{Term\ 2} + \underbrace{(1-\delta)*(1+\pi)*(1-A)}_{Term\ 3}\right]$$

The underlying idea is to consider a temporary increase of the capital stock. The first term of formula (1) reflects the investment carried out in period 1. The investment generates returns in the second period (term 2), where p represents the real financial return of the investment and δ reflects the one-period cost of depreciation. In the second period, the capital stock is reduced to its initial level leaving the overall capital stock unchanged (for a more detailed discussion of the methodology see Devereux and Griffith (1999, 2003), Spengel and Lammersen (2001), and Schreiber et al. (2002)). This is reflected by the third term.[30] The variables i and π represent the nominal capital market interest rate and the inflation rate, respectively.

[29] Please note that in case shareholder taxation is disregarded, it is not necessary to differentiate between the case of equity financing by way of retained earnings and equity financing via the issuance of new equity.

[30] This temporary increase of the capital stock can be pictured as an antedated replacement investment. Keeping the temporary increase of the capital stock aside, replacement investment has to be undertaken in order to keep the capital stock constant. A temporary increase of the capital stock can therefore accomplished by antedating replacement investment by one period. From this also follows that the replacement investment carried out in the second period must be lower than originally planned. This is reflected by the third term in formula (1).

Profit taxes, such as the corporate income tax, affect the payoff to an investment in two ways. First, a profit tax levied at the rate τ reduces the NPV of the returns from the investment (second term). Second, tax allowances such as tax depreciation (A in what follows) lower the amount of funds which are required to carry out the investment (first term) and thereby the NPV of the costs of the investment.

From the post-tax economic rent R the cost of capital is derived by setting the post-tax economic rent equal to zero and rearranging formula (1) in order to isolate the rate of return p. The cost of capital for the case of equity-financed investment is depicted by formula (2). The cost of capital for the case of debt-financing is shown in Appendix III.

(2) $\tilde{p} = \frac{(1-A)(i+\delta(1+\pi)-\pi)}{(1+\pi)(1-\tau)} - \delta$

In turn, the cost of capital are the basis for calculating effective marginal tax rate (EMTR) and effective average tax rates (EATR). Focusing on the company level, the EMTR is defined as the difference in percentage terms between the cost of capital, denoted by $\tilde{p}$, and the real capital market interest rate, denoted by r. The real capital market interest rate is derived from the nominal capital market interest rate assuming the Fisher effect which implies the following equation: $(1+i) = (1+r) * (1+\pi)$. The EMTR is illustrated by formula (3).

(3) $EMTR = \frac{\tilde{p}-r}{\tilde{p}}$

Finally, we determine the EATR as the difference between the NPV of the investment in the absence (R^*) and in the presence of taxes (R) put in relation to the NPV of the pre-tax total income stream net of depreciation. This is depicted by formula (4).

(4) $EATR = (R^* - R)/(\frac{p}{(1+r)})$

The EATR can also be presented as a linear combination of the EMTR and the statutory tax rate. As illustrated by formula (5) the EATR equals the weighted average of the EMTR and the combined statutory corporate income tax rate, denoted by τ. The weights are determined by the share of the pre-tax return p just covering the cost of capital $\tilde{p}$ (for the EMTR), and the excess return beyond the cost of capital (Lammersen and Spengel, 2001, Schreiber et al. 2002).

(5) $EATR = \frac{\tilde{p}}{p} \cdot EMTR + \frac{p-\tilde{p}}{p} \cdot \tau$

3.2. Incorporating IP Box regimes

In order to determine effective tax measures which take into account IP Box regimes, we consider an investment in a self-developed intangible asset, more precisely a patent. We assume that the investment costs fully constitute current R&D expenses, e.g. wages for R&D staff or materials. In general, current expenses account for the largest share of R&D expenditures (Cameron (1996), Dougherty et al. (2007)). Explicitly modelling a self-developed patent allows us to keep the model simple. In Appendix IV we additionally report results for an investment in a mix of R&D assets that are employed to create a patent.[31]

We incorporate the most important features of IP Box regimes: the IP Box tax rate; specific provisions for the recapture of R&D expenses incurred in the past; the treatment of financing expenses in the case of debt-financed investment.

The reduced tax rate of IP Boxes works simply to increase the post-tax NPV of investment returns and can be easily incorporated. The NPV of tax allowances must be adjusted according to how IP Boxes treat R&D expenses. Usually, tax systems (before taking into account IP Boxes or R&D tax incentives) allow that expenses for the creation of self-developed intangible assets are immediately deductible at the regular corporation tax rate such that the NPV of tax allowances is:

(6) $A = \varphi_0 \tau$

where φ_0 is the share of immediately deductible R&D expenses, generally 100%, and τ is the standard corporate income tax rate. There are four different approaches to the treatment of R&D expenses under IP Box regimes that result in different NPV of tax allowances. We discuss them in order of the most to the least generous treatment of expenses. In all that follows, and in line with previous literature, we assume that the taxpayer generates sufficient other income in order to immediately benefit in full from any tax deductions (i.e. taxpayers are not tax exhausted). The assumption of no tax exhaustion is most appropriate in the case of large mature companies which generate income from other investment projects.[32]

[31] In Tables 7 and 8 in Appendix IV we additionally report results for an investment in a mix of R&D assets, namely machinery used for R&D, buildings used for R&D and current R&D expenses. This is the approach commonly taken when incorporating R&D tax incentives, such as R&D tax credits, into effective tax rates (Bloom et al. (2002), Hall and van Reenen (2000), McKenzie (2008), Warda (2001), (2006). These studies also attribute by far the largest weight (90%) to current R&D expenditures.

[32] If, in contrast to this, the taxpayer is tax exhausted, the tax benefits associated with tax allowances are delayed. As a consequence, the NPV of tax allowances is lower and thereby the effective tax rates are higher as under the case of no-tax exhaustion (Devereux et al. (2002)).

First, the original deduction of R&D expenses at the regular corporate tax rate is left unchanged. In this case (e.g. Belgium and Hungary) the NPV of tax allowances under the IP Box regime is equal to the NPV of tax allowances under the general tax system (equation (6)). According to our best knowledge, no recapture of R&D expenses deducted in the past at the regular tax rate is stipulated by the majority of IP Box regimes (see Table 1). That is, the majority follow this approach.

Second, the IP Box may involve that newly incurred R&D expenses are immediately deductible at the IP Box tax rate once the regime has been opted for. This is generally associated with applying the IP Box regime on an overall basis instead of on a per-asset basis. As a result, no recapture is required for old R&D investment undertaken before the IP Box is first opted for, such that the regular corporate tax rate is relevant for past expenses as reflected by formula (6). For R&D investment carried out after the IP Box has first been opted for the IP Box tax rate is decisive for the NPV of tax allowances instead of the regular corporation tax rate as depicted by formula (7).

(7) $$A = \varphi_0 \tau_{IP\ Box}$$

When determining effective tax rates for this type of IP Box, which is only in place in the UK, we assume the stance of a new R&D investment by a firm that has already opted into the IP Box in the past. Under this assumption, the treatment of R&D expenses is reflected best by formula (7).

Third, the IP Box may require that R&D expenses incurred in the past be allocated to IP income on a per-asset basis. In doing so, two approaches are currently in place. In Luxemburg, development expenses have to be capitalised when the IP Box is opted for. As a result, the initial deduction of R&D costs is offset as reflected by the second term of formula (8).[33]

(8) $$A = \underbrace{\varphi_0 \tau}_{Immediate\ deduction} - \underbrace{\varphi_0 \tau}_{Capitalisation} + \underbrace{\varphi \tau_{IP\ Box} \{\frac{1}{1+i}^{1} + \cdots + \frac{1}{1+i}^{n}\}}_{\text{Periodical depreciation}}$$

Capitalisation furthermore entails that the intangible asset be subject to periodical depreciation in the subsequent periods. The present value of tax depreciation is reflected by the third term of

[33] At first glance, it may seem striking that the immediate deduction is offset by way of capitalisation in the same period as in practise there will be a time-lag between the immediate deduction of R&D expenses and the capitalisation of an intangible asset. Yet, as we consider a perturbation of the capital stock in the sense of an antedated investment, the duration of the R&D investment phase does not play a role. Hence, timing effects resulting from the fact that R&D expenses remain deductible until a self-developed intangible asset is created which is exploited subsequently are not taken into account.

formula (8) assuming straight-line depreciation, where φ represents the depreciation rate, n the useful life and i the nominal capital market interest rate. Note that the IP Box tax rate $\tau_{IP\ Box}$ is decisive for the NPV of the depreciation allowances instead of the general corporate income tax rate.

In contrast, the recapture mechanism in place in the Netherlands and Liechtenstein involves that IP income up to the development expenses is taxed at the general tax rate, whereas the IP Box rate applies to income exceeding the development costs. Hence, the IP Box tax rate potentially does not apply immediately when income is generated from the patent but only in subsequent periods. From this follows, that the recapture mechanism in place in the Netherlands cannot be precisely modelled in our two-period framework.[34] We therefore model these two IP Box regimes by applying the second approach depicted by formula (7). We consider this to be a reasonable approximation to the recapture approach with respect to aligning the tax treatment of IP expenses and IP income; both approaches ensure a symmetric treatment of IP expenses and IP income. In contrast, the capitalisation approach as reflected by formula (8) does not constitute a sensible approximation as in this case tax depreciation additionally influences the cost of capital and the effective tax rates if tax allowances deviate from economic depreciation as the case in both Liechtenstein and the Netherlands.

Forth, the IP Box may fully exclude the deduction of R&D expenses (e.g. Malta) resulting in a NPV of tax allowances equal to zero as shown by formula (9). Put differently, the IP Box may only be applied if R&D expenses have not been deducted in the past.

(9) $A = 0$

We also consider the treatment of financing expenses (which constitute on-going IP expenses) under the IP Box regimes. In case of debt-financed investment, tax deductible interest constitutes a tax shield. For marginal investment, IP Boxes which apply to gross income involve that the value of this tax shield exceeds the tax burden of the returns to investment. In case of debt-financing, the deduction of interest expenses from the profit tax base gives rise to an interest tax shield in the amount of the product of the nominal interest rate and the profit tax rate.[35] If financing expenses have to be allocated to IP income (net income approach), the value of the interest tax shield depends on the IP Box tax rate ($i * \tau_{IP\ Box}$). If this is not the case (gross

[34] The rate of return of 20% underlying our model involves that the income only exceeds the investment expenditures in period seven.

[35] Formulas for the post-tax economic rent and the cost of capital in case of debt-financed investment are given in Appendix II.

income approach), the value of the interest tax shield is determined by the regular corporation tax rate ($i * \tau$) and is thereby higher than under the former case.

We offer two points of comparison to IP Boxes. As a benchmark case, we consider the tax treatment of an investment in a self-developed patent under the regular tax system. In doing so, we take into account the treatment of current R&D expenses resulting in a self-developed intangible assets (immediate expensing or capitalisation and subsequent depreciation) as well as more general tax incentives which are available for any kind of investment such as the notional interest deduction available in Belgium and Liechtenstein. Where relevant, we additionally compare IP Box regimes to R&D tax incentives (super deductions or tax credits) available for current R&D expenditures.[36] The effects of the R&D tax incentives come solely through the tax base – that is, through a reduction in the cost of investment. Appendix II provides details on how R&D tax incentives are incorporated in the model.

3.3. Cross-border considerations

We consider a domestic investment where both the R&D investment and the exploitation of the resulting intangible asset are located in one jurisdiction. Yet, in practise the R&D activity and the exploitation of intangible assets may be located in different jurisdictions. In doing so, companies may exploit generous R&D tax incentives in one country and an attractive regime for the taxation of IP income in another country. Another motive for locating these two functions in separate jurisdictions may be the fact that a country which is an attractive location for R&D activity for non-tax reasons (e.g. highly-skilled workforce, good infrastructure, access to funding) taxes income from the exploitation of intangible assets at comparably high rates (e.g. Germany and the United States).

A separation of functions may either be achieved by locating an intra-group R&D unit abroad; for tax purposes, this unit will in general characterised as a permanent establishment. Alternatively, the R&D activity can be outsourced to a separate entity which performs as an intra-group (or an external) R&D service provider under a contract R&D or a cost contribution agreement. As pointed out in chapter two, due to requirements of European Law the IP Box regimes generally apply irrespective of the location of the R&D activity which has given rise to the intangible asset qualifying for the IP Box. The same applies to R&D tax incentives. Hence, both kinds of tax incentives generally apply in case of the first scenario.

[36] When calculating effective tax measures for a set of R&D assets as robustness check we furthermore take into account immediate depreciation and accelerated depreciation available for R&D machinery and R&D buildings.

In addition, most IP Box regimes are also available for IP generated by way of contract R&D if the following conditions are met: The R&D activity must be carried out by the contract R&D provider on the risk and on account of the commissioning party and the principal must actively manage and control the R&D activity.[37] Yet, this concerns the legal and/ or economic owner of the IP to whom the returns accrue. The reimbursement received by the R&D provider generally does not qualify for the IP Box. In turn, R&D tax incentives are first of all available for R&D providers. Yet, the R&D tax incentives available in Hungary, Ireland, Malta, and Spain extent to the fees paid by the principal in relation to contract R&D carried out by private companies.[38]

These cases of cross-border tax planning will be associated with considerably lower effective tax rates than the purely domestic cases analysed in chapter four. It has, however, to be kept in mind that R&D tax incentives only become effective if the R&D company/ unit earns sufficient income to offset the incentives. Hence, the more generous the R&D tax incentive, the higher must the reimbursement be in order to fully benefit from the tax incentive. Optimally, the effective tax burden of the group company or group unit performing the R&D located in a high tax country would be zero. This may, however, be difficult to achieve in practise as transfer pricing limits the leeway for the pricing of intra-group services. A detailed analysis of the effects on cross-border investment is beyond the scope of this paper.

4. Effective tax rates on income from intellectual property

In this section we present effective tax rates for an investment in a self-developed patent. With respect to marginal investment projects which only earn the capital market interest rate, the cost of capital and the effective marginal tax rate are the relevant tax measures. These two measures constitute the relevant figures for assessing incentive effects with respect to the scale of investment. In turn, regarding profitable investment projects and discrete investment decisions such as whether to invest in R&D or financial investments or where to locate real investment, the effective average tax rate is the relevant tax measure. Hence, the effective average tax rate is an indicator for a jurisdictions' attractiveness as a location for R&D investment.

Our calculations of effective tax rates rest on the following economic assumptions. We take a capital market real interest rate (r) of 5% and an inflation rate (π) of 2% (such that the nominal interest rate (i) is 7.1%) as a basis for our calculations. We furthermore assume a uniform pre-

[37] See footnote 19.

[38] Yet, lower tax credit rates, caps and further restrictions apply in this case.

tax rate of return (*p*) of 20% for profitable investments but additionally carry out sensitivity analysis in order to point out the effects of a higher rate of return on the effective tax rates. Finally, we assume an economic depreciation rate 15.35% for the self-developed patent following studies which determine effective tax rates for acquired patents (Spengel et al. (2012)).

4.1. Marginal investment

Table 2 depicts the cost of capital for equity-financed investment in a self-developed patent. In addition to the effective tax rates under the IP Box regimes, we show effective tax rates under the regular tax system and effective tax rates for R&D tax incentives. We assume that the patent is licensed out and generates royalty income. Whereas all IP Box regimes apply to royalty income, notional royalty income from internal use only benefits from the IP Box treatment in a subset of countries, namely in Belgium, Liechtenstein, Luxembourg, the Netherlands, and the United Kingdom. For these countries the figures presented below also apply to the case of internal use of a patent.

For marginal investment, the capital market interest rate constitutes the benchmark for assessing whether taxes incentivise the investment in a developed patent as compared to the alternative capital market investment. In general, cost of capital below (above) the real interest rate of 5% imply that the respective investment is treated in a more (less) tax-beneficial manner than financial investment. Investment decisions are only unaffected by taxation if the cost of capital equals the market interest rate, resulting in an effective marginal tax rate of 0%.

In fact, the regular tax treatment of an investment in a self-developed patent, namely the immediate deduction of expenditures incurred for the self-developed patent which is available in all of the considered countries, results in cost of capital equal to the real capital market interest rate of 5%. This is due to the fact that the immediate deduction of the R&D expenses shields the marginal return from taxation. As a result, the marginal return is left untaxed as illustrated by an effective marginal tax rate of 0%.[39] In Belgium and Liechtenstein, the application of the Notional Interest Deduction,[40] which allows for a deduction for notional

[39] The immediate deduction of the R&D expenses brings about immediate tax savings given that the expenses can effectively be offset against other taxable income. This immediate tax saving during the investment phase implies that, in economic terms, the taxpayer receives an interest-free loan from the government as the taxable profit falls short of the true economic profit, as economically the investment is of a capital nature. In case the intangible asset is eventually capitalised the initial deduction is offset which also implies that the implicit loan is paid back. Yet, the taxpayer retains the interest saved on this notional interest-free loan.

[40] For the financial year 2013 (tax assessment year 2014) the rates of the notional interest deduction are 2.742% in Belgium and 4% in Liechtenstein.

interest incurred on equity capital and which serves as a tax shield, drives the cost of capital below the market interest rate and the EMTR below zero.

Table 2: Effective tax burden (in %) of a marginal investment in a self-developed patent, equity-financing

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		BE	CH NW	CY	ES	FR	HU	LIE	LUX	MT	NL	UK[41]
CIT rate		33.99	15.11	10	30	34.43	19	12.5	28.8	35	25	23
IP Box rate		6.8	8.8	2	12	15.5	9.5	2.5	5.8	0	5	10
IP Box treatment of R&D expenses		A	A	A	A	A	A	S	S	S	S	S
Internal Use		Y	N	N	N	N	N	Y	Y	N	Y	Y
CoC	Regular tax system	3.62	5.00	5.00	5.00	5.00	5.00	4.44	5.00	5.00	5.00	5.00
	IP Box	-1.92	4.15	3.34	1.53	0.44	2.86	4.90	5.23	5.00	5.00	5.00
	R&D tax incentive[42]	n.a.	n.a.	n.a.	-3.46	-1.11	0.23	n.a.	n.a.	-0.48	1.34	2.97
EMTR	Regular tax system	-38.28	0.00	0.00	0.00	0.00	0.00	-12.62	0.00	0.00	0.00	0.00
	IP Box	-	-20.57	-49.76	-227.23	-1036	-74.59	-2.05	4.40	0.00	0.00	0.00
	R&D tax incentive	n.a.	n.a.	n.a.	-	-	-2107	n.a.	n.a.	-	-273.97	-68.63

Abbr.: BE – Belgium, CH NW – Swiss Canton of Nidwalden, -CY – Cyprus, ES – Spain, FR – France, HU – Hungary, LIE – Liechtenstein, LUX – Luxembourg, MT – Malta, NL – the Netherlands, UK – United Kingdom.
CIT – corporate income tax plus surcharges, A – Asymmetrical, S- Symmetrical, Y – Yes, N – No, CoC - Cost of capital, EMTR - Effective marginal tax rate, n.a. - indicates that the same tax rates as under the regular tax system apply.

Notes: When the CoC is negative the EMTR may not be interpreted in a meaningful way. In this case, the cell is left blank.

The regular tax system constitutes the reference point for analysing the effects of the IP Box regimes. As shown in Table 2, IP Boxes regimes can substantially lower the cost of capital and the EMTR. In most cases, the IP Box regimes drive the cost of capital below the capital market interest rate and the EMTR below zero (i.e. provides a subsidy).

The effects of IP Boxes on marginal investments are driven by the treatment of the tax base. When R&D expenses are not recaptured and remain deductible at the ordinary corporate tax rate (as in Belgium, Cyprus, France, Hungary, Liechtenstein, the Swiss Canton of Nidwalden, and Spain), the cost of capital falls below the market interest rate implying that R&D investment is incentivised by the IP Box regime. The asymmetric tax treatment of expenses and income means that the value of the tax shield associated with the deduction of R&D expenses is much higher than the tax rate applicable to the corresponding income from intellectual property.

[41] For the UK we assume that the Patent Box is already fully available instead of being phased in over a period of 4 years. We furthermore assume that the Patent Box has been opted for before so R&D expenses for new R&D projects are deductible only at the Patent Box tax rate (symmetrical treatment).

[42] Only R&D incentives available for current R&D expenses are taken into account. These are available in France, Hungary, Malta, the Netherlands, Spain, and the United Kingdom.

As the tax rate determines the size of the tax shield, the cost of capital and the effective marginal tax rates actually decrease when the tax rate increases. This might be a counterintuitive result on the first sight. Under the Belgian IP Box, the mismatch of R&D expenses and IP income is so severe that the cost of capital turns negative. The reason for this is the comparably high corporate tax rate of approximately 34% whereas the IP Box tax rate is only 6.8%. Negative cost of capital imply that the tax incentive provides such a strong subsidy that the investment would still be undertaken if it earned a negative pre-tax rate of return. Please note that the effective marginal tax rate may not be interpreted in a meaningful way if the cost of capital is negative.[43]

The same holds if, in the case of debt-financing, financing expenses may be deducted from regularly-taxed income instead of being allocated to IP income as the value of the interest tax shield generally depends on the applicable tax rate. Already under the regular tax system, debt-financing results in even lower cost of capital.[44] If the IP Box regime requires that financing costs be deducted from IP income when determining the IP Box tax base, the cost of capital of debt-financed investment taking into account the IP Box is higher than in the case of the regular tax system; this is driven by the lower net present value of the tax deduction (Table 5 in Appendix III shows the cost of capital for debt-financed investments).[45]

As appears from Table 2, the Luxembourg IP Box is the only regime which is characterised by cost of capital above the capital market interest rate implying that the investment in the self-developed patent is disfavoured by taxation. This is due to two aspects. First, the Luxembourg IP Box regime requires that R&D expenses have to be capitalised when opting for the IP Box; the self-developed intangible asset is subsequently depreciated at the IP Box tax rate. Second, the tax depreciation available for patents falls short of the economic depreciation. This finally drives the cost of capital above the capital market interest rate.[46]

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[43] As illustrated in Section 3.1, the EMTR are calculated by dividing the difference between the cost of capital and the market interest rate by the cost of capital. Yet, this mode of calculating the effective tax rate is not applicable when the costs of capital are negative. Under this mode of calculation, negative cost of capital result in very large, positive effective marginal tax rates which does correctly reflect the effects of the IP Boxes on the effective tax burden.

[44] Please note that, analogous to disregarding shareholder taxation, we do not consider the corresponding taxation of the interest payments at the level of the lender.

[45] This is also the case for equity-financed investment under the Liechtenstein IP Box as the provision requires that notional interest expenses have to be allocated to qualifying IP income when determining the IP Box tax base. As a consequence, the tax value of the notional interest deduction depends on the IP Box tax rate. In contrast, in Belgium the notional interest deduction is applied after the patent income deduction.

[46] Tax depreciation rules which are more generous than the economic depreciation rate would result in cost of capital below the capital market interest rate.

It should be noted that the effects of the asymmetric treatment of income and expenses under some IP Box regimes rest on the assumption that the taxpayer earns sufficient non-IP income from which the R&D expenses may be deducted. If this is not the case, the possibility of deducting R&D expenses from ordinarily-taxed income comes to nothing and the tax value of the deduction is again determined by the lower IP Box rate. Yet, multinational companies face an incentive to accrue sufficient other income in the IP Box country to fully make us of the tax benefit associated with the asymmetric treatment of IP income and expenses. Hence, IP Box regimes characterised by such an asymmetric treatment provide incentives to co-locate the exploitation of IP and other kinds of activity which are taxed at the regular corporation tax rate.

Finally, we compare the IP Box regimes to R&D tax incentives. R&D tax incentives tend to reduce the cost of capital substantially implying an incentive to invest in R&D as opposed to the alternative capital market investment. Accordingly, the super deductions and tax credits available for expenditures incurred for the creation of self-developed intangible assets available in Hungary, Malta, Spain, the Netherlands, and the United Kingdom drive the cost of capital below the capital market interest rate. The French tax credit (30% on R&D expenses up to 100 Mio. € and 5% above) and the Spanish tax credit (25% on the overall R&D expenses and 42% on incremental expenses) and the super deduction (50%) available in Malta are even associated with negative costs of capital. R&D tax incentives, if available, may reduce the tax burden on marginal investment to a larger extent than the IP Box regimes. This is demonstrated by the figures presented in Table 2 for France, Hungary, Malta, the Netherlands, Spain, and the United Kingdom.

The effects of super deductions available for R&D expenditures and of IP Box regimes which do not require that R&D expenses, which have originally been deducted at the regular tax rate, have to be recaptured when applying the IP Box are comparable to a certain extent. If the IP Box tax rate only amounts to 20% of the regular corporation tax rate, this corresponds to a 500% super deduction of R&D expenses when considering the lower IP Box tax rate as a benchmark.

Whereas Table 2 depicts cost of capital and effective marginal tax rates for IP Box regimes and R&D tax incentives in isolation, most countries allow both kinds of incentives to be applied in combination (Malta is the only exemption to this) resulting in even lower effective tax rates. Our results therefore raise the question whether some of the countries' tax incentives which are too generous.

4.2. Profitable investment projects

When analysing incentive effects for profitable investment, which yield a pre-tax rate of return above the market interest rate, we draw on the effective average tax rate (EATR). The EATR indicates the percentage reduction of the investment's NPV that is caused by taxation. This measure is decisive for discrete investment decisions such as where to locate R&D investment or where to locate intellectual property. Hence, the EATR also serves as an indicator for a country's attractiveness for investment.

As depicted in Table 3, the application of the IP Box regimes results in a significant reduction of the EATR for equity-financed investment as opposed to the regular tax system and, in general, also with respect to the application of R&D tax incentives. For some countries, the EATR for the IP Box regime even turns negative which implies that unprofitable R&D investment projects are nevertheless undertaken if the IP Box regime is available. As pointed out with respect to the negative cost of capital, the negative EATRs result from the fact that the respective IP Box regimes imply that R&D expenses remain deductible at the ordinary corporate tax rate although IP income is subject to the lower IP Box tax rate. Again, these effects are even more pronounced for the case of debt-financing than for the case of equity-financing (see Table 6 in Appendix III).

Table 3: Effective tax burden (in %) of a profitable investment in a self-developed patent, equity-financing

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		BE	CH NW	CY	ES	FR	HU	LIE	LUX	MT	NL	UK[47]
CIT rate		33.99	15.11	10	30	34.43	19	12.5	28.8	35	25	23
IP Box rate		6.8	8.8	2	12	15.5	9.5	2.5	5.8	0	5	10
IP Box treatment of R&D expenses		A	A	A	A	A	A	S	S	S	S	S
Internal Use		Y	N	N	N	N	N	Y	Y	N	Y	Y
EATR	Regular tax system	20.92	9.50	7.50	22.50	25.82	14.25	6.92	21.92	26.25	18.75	17.25
	IP Box	-27.14	2.74	-6.64	-2.95	-7.65	-2.54	1.39	5.47	0.00	3.75	7.50
	R&D tax incentive[48]	n.a.	n.a.	n.a.	-7.09	5.81	-5.08	n.a.	n.a.	8.44	5.01	9.42

Abbr.: BE – Belgium, CH NW – Swiss Canton of Nidwalden, -CY – Cyprus, ES – Spain, FR – France, HU – Hungary, LIE – Liechtenstein, LUX – Luxembourg, MT – Malta, NL – the Netherlands, UK – United Kingdom.

CIT – corporate income tax plus surcharges, A – Asymmetrical, S- Symmetrical, Y – Yes, N – No, CoC - Cost of capital, EMTR - Effective marginal tax rate, n.a. - indicates that the same tax rates as under the regular tax system apply.

Notes: For Belgium, Liechtenstein, Luxembourg, the Netherlands, and the United Kingdom the figures presented above also apply to the case of internal use of a patent.

[47] For the UK we assume that the Patent Box is already fully available instead of being phased in over a period of 4 years. We furthermore assume that the Patent Box has been opted for before so R&D expenses for new R&D projects are deductible only at the Patent Box tax rate (symmetrical treatment).

[48] Only R&D incentives available for current R&D expenses are taken into account. These are available in France, Hungary, Malta, the Netherlands, Spain, and the United Kingdom.

As in the case of marginal investment, the treatment of expenses may be more decisive than the statutory IP Box tax rate. Belgium features the lowest effective average tax rate although Cyprus, which comes second, offers a significantly lower IP Box tax rate. The tax rates of the IP Boxes in place in France and Spain, which come third and fourth in the country ranking, are the highest among all 11 countries. All but one (the Swiss Canton of Nidwalden) of the countries characterised by an asymmetric treatment of IP expenses and income even feature negative effective tax rates. A negative EATR implies that R&D investment projects which are unprofitable are nevertheless undertaken due to the application of the IP Box regime.

Again, our results rest on the assumption that the taxpayer generates sufficient non-IP income from which the R&D expenses may be deducted. In case the underlying assumption that the taxpayer generates sufficient non-IP income from which the R&D expenses may be deducted is dropped, the IP Box tax rate becomes the decisive factor for the effective tax burden and Malta leads the country ranking as it fully exempts IP income, followed again by Cyprus (2%), the Netherlands (5%), and Luxembourg (5.76%).

In the case of the UK we have assumed the stance of a new investment by a firm that has already opted into the IP Box. Hence, the value of the tax deduction of R&D expenses is determined by the Patent Box tax rate. However, investment projects that have already occurred and have been expensed at the regular corporate tax rate will have a more generous treatment than that indicated.

The effects of the asymmetric treatment of R&D expenses and IP income on the effective average tax rate largely depends on the profitability of the investment. With increasing profitability the effective average tax rates eventually turn positive. To give an example, the effective average tax rates under the IP Box regimes in place in France, Hungary, and Spain turn positive when considering a rate of return of 50% instead of 20% (see Table 9 in Appendix V). Under the IP Box in place in Belgium, the EATR turns positive when the rate of return is 100% (see Table 10 in Appendix V).

Finally, we compare the effects of the IP Boxes to the effects of R&D tax incentives. In contrast to the case of marginal investment, for profitable investment the IP Boxes generally result in lower effective tax rates than the R&D tax incentives. Assuming a rate of return of 20%, the effects of the IP Boxes in place in France, Malta, the Netherlands, and the United Kingdom outweigh the effects of the R&D incentives available in these countries. The same holds true for

the IP Box regimes applied in Hungary and Spain when considering investment projects which generate a higher rate of return (e.g. 50% as shown in Table 9 in Appendix V).

5. Policy design and incentive effects

We consider the rationale for IP Boxes and the likely incentive effects associated with specific design choices. We focus on how IP boxes are likely to affect real behaviours, and specifically the amount and location of R&D investments. Where relevant, we draw out the important role of IP Box features that are not captured by the stylised effective tax rates presented above.

5.1. The amount of R&D

The EMTR is informative about firms' incentives to undertake an additional unit of investment. As shown in Section 4, when IP Boxes treat expenses and income symmetrically the cost of capital for a marginal investment is unaffected. Under asymmetric treatment (i.e. when expenses are tax deductible at a high rate than income is taxed at) the EMTR can be reduced substantially (and in the case of Belgium turned into a subsidy), suggesting that IP Boxes can incentivise investment in the generation of IP income.

The rationale for using the tax system to incentivise investment in innovative activities is the presence of spillovers that accrue from the creation of new knowledge and lead the private market to underinvest in such activities. However, because IP Boxes target the income from new ideas and not the underlying research, they are a policy instrument poorly targeted at incentivising firms to undertake additional R&D activities.

Importantly, in calculating the EMTR we assume an R&D investment is successful in creating an intangible asset and do not consider the uncertain time lag and risk involved in new research.[49] In reality there is a large degree of risk and uncertainty associated with new R&D investments and when (or if) they will produce commercially viable outputs. The fact that not all R&D investments will become profitable intangible assets (that benefit from the tax break) means that the tax benefits associated with the IP Box regimes are uncertain and this will reduce the incentives firms face to respond to the lower tax rate by investing in the creation of new ideas.[50] In modelling effective tax rates we also assume that firms have sufficient other sources of income to be able to take full advantage of the tax shield created by the asymmetric treatment

[49] We do not incorporate risk in the Devereux & Griffith model as this requires arbitrary assumptions on how the risk of the return is affected by taxation (Devereux (2003)).

[50] The recapture mechanisms prescribed by the IP Boxes in place in Liechtenstein, Luxembourg and the Netherlands further delay the application of the reduced IP Box tax rate.

of expenses and income. While this may be likely for large multinationals, it is of less help to smaller firms.

The fact that the policy is targeted at income, rather than at underlying research, also implies that the size of the tax break need not bear a close relation to the size of the R&D investment (or the degree of spillovers). Much of the tax break is likely to accrue to highly successful projects, many of which would have occurred in the absence of the policy. As such the policy will entail a large deadweight cost.

In contrast to IP Boxes, R&D tax incentives are directly tied to the size of the R&D investment and are more certain because they are given at the same time as the costs occur.[51] Consequentially, R&D tax credits are much better targeted at incentivising additional R&D investment. They have been shown to reduce the cost of capital and empirical evidence suggests that such policies have been effective in increasing R&D activity.[52]

IP Boxes may incentivise greater investment in the commercialisation of intangible assets. However, firms are able to capture the benefits of such activities in large part because they have the monopoly protection offered by intellectual property, and therefore have an incentive to undertake the correct amount of investment. As such, there is no clear justification for the government to incentivise such activity.

While IP Boxes as a policy tool are poorly targeted at incentivising additional R&D activities, there are some specific design features that make them more (or less) effective as innovation policies. Regimes that limit eligible intellectual property to trade intangibles (notably patents) – which have a stronger link to spillover generating R&D activities than marketing intangibles – are more in line with the aim to increase investment in R&D. The UK limits the relief to patents. However, the UK method of calculating eligible income means that an additional patent can have little effect on the amount of eligible income and this reduces the incentive to undertake new innovative activities.[53] Those regimes that allow acquired IP to qualify without requiring that it is further developed by the taxpayer (Cyprus, France, Hungary, Liechtenstein,

[51] R&D tax incentives may create a tax deduction that is larger than the current tax liability. When schemes offer cash refunds independent of previous taxes paid the tax benefits are certain. There may be less certainty when, as is the case in most countries, the R&D tax relief limited to the amount of previous tax paid. However, large companies with multiple income streams can generally overcome this by offsetting the tax relief of one project against the liability of other projects.

[52] The incentive effects of traditional R&D tax incentives have been widely analysed theoretically and empirically (Bloom et al. (2002), Elschner et al. (2009), Guellec and van Pottelsberghe de la Potterie (2001), Hall and van Reenen (2000), OECD (2010b), OECD (2011), Parson and Philips (2007)).

[53] For further discussion in the context of the UK IP Box see Griffith and Miller (2011).

Luxembourg, Malta, and the Swiss Canton of Nidwalden) provide the weakest incentives for firms to undertake additional R&D. Most of these countries also reduce the incentive to invest by precluding income from the internal use of qualifying IP (notional royalty income).

5.2. The location of real activities

All of the IP Boxes in place lead to a substantial reduction in the EATR. For an investment in a successful, self-developed intangible asset IP Boxes are more generous than R&D tax incentives.

A large part of the returns to successful innovations will be economic rents. In part they are likely to arise as a result of the legal protection of a monopoly provided by intellectual property. As such, there would be a rational for taxing these activities at a high rate.[54] However, a tax on economic rents that are mobile (as is the case for the returns from intellectual property) can distort firms' choices over where to locate real activity and where to earn income for tax purposes. One aim of IP Boxes therefore is to reduce the tax rate on the income from IP with a view to incentivising firms to keep real activities in a country and reducing incentives to shift income offshore.

Empirical evidence shows that the location of real investment is responsive to the EATR (de Mooij and Ederveen (2008), Hines (1999) and Devereux (2006) provide surveys of the empirical literature). This includes the location of firms' innovative activities (Hines and Jaffe (2001)). Griffith et al. (2012) and Karkinsky and Riedel (2012) find that where firms choose to hold patents is responsive to the corporate tax rate. Riedel (2013) report that lower tax countries attract patent applications that are of higher quality and can therefore be expected to have a higher revenue stream. It is therefore possible that IP Boxes will succeed in attracting (or preventing firms from relocating) real investment. This is an empirical question.

However, the mobility of IP income that motivates the policy may also work to undermine how effective it is. Research activities, commercialisation of IP, and resulting income flows need not be collocated. To a significant degree large multinationals can organise their activities in such a way that R&D may be located in one country while the IP and the associated profits are shifted to a lower tax jurisdiction.[55] This has two important implications. First, if large multinationals are

[54] In principle the normal rate of return should be exempt from taxation (to prevent the distortion of marginal decisions), while the (location specific) rents can be taxed at a high rate. For discussion of the design of neutral corporation taxes and the considerations relevant for different firm decisions see Auerbach, Devereux, and Simpson (2010).

[55] For example, a firm may commission a related company to conduct R&D in one country (possibly taking advantage of R&D tax incentives) but structure their activities such that IP is exploited in a lower tax country. In general, firms have an incentive to pursue such contract arrangements rather than simply transfer IP because the latter may trigger capital gains taxation or exit taxes.

already achieving low tax rates on the income from IP, an explicitly lower IP Box rate may not be sufficiently attractive relative to other opportunities to illicit a large behavioural response.[56]

Second, countries may attract income but not the associated real activities. Recall, IP Box regimes in general do not stipulate that R&D underlying an eligible patent was carried out in the country. The degree to which any IP Box relief is associated with real activity taking place in the same country in which the income accrues will depend in part on the specific design on the policies. The co-location of IP income ownership with complementary activities may be more likely when the tax break extends to notional royalty income from internal use. Similarly, IP Boxes requiring that qualifying IP has been self-developed may encourage the co-location of the creation and exploitation of IP. In contrast, countries that allow (or restrict the relief to) acquired IP make it more likely that firms will gain a tax break from innovation that has been wholly created and developed offshore.

When expenses can be deducted at the ordinary corporate income tax rate, the value of the associated tax shield is several times higher than the tax burden on the related IP income (e.g. five times higher if the IP Box tax rate amounts to 20% of the regular tax rate). This requires that a sufficient amount of other income – stemming from activities other than the exploitation of IP - to be declared in a country to be able to take full advantage of the tax break. Whether the policy affects how much other activity takes place in a country will depend on how mobile such income is.

The mobility of income may justify IP Boxes, but it does not provide an argument for subsidising investment in intangible assets. Recall that the asymmetric treatment of expenses and profits can create a negative EATR, implying that unprofitable investment projects may be undertaken as a result of IP Box regimes. As discussed above, to rationalise a subsidy it would need to be the case that IP boxes incentivised or attracted activities with large spillovers.

[56] Evidence suggests that mobile income is already taxed at a de facto lower rate as a result of profit shifting opportunities. Hong and Smart (2010) and Peralta, Wauthy and van Ypersele (2006) model this.

6. Conclusion

This paper incorporates IP Box policies introduced by 11 European countries into measures of effective tax rates. IP Boxes offer substantially reduced rates of corporate tax on the income derived from certain kinds of intellectual property. The lowest rates are available in Malta (0%), Cyprus (2%), Liechtenstein (2%), the Netherlands (5%) and Luxembourg (5.76%).

However, the treatment of R&D and financing expenses is important in determining the attractiveness of the policies. In particular, many countries do not require R&D expenses to be allocated to IP Box income. This asymmetric treatment of expenses and income has a number of (possibly unintended) consequences. First, and most notably, this treatment is sufficiently generous that EATRs are negative. That is, the IP Box can subsidise otherwise unprofitable projects. As a result it is Belgium, Cyprus, and France that provide the lowest EATRs.

Second, the deduction of expenses at a higher rate than IP income creates a reduction in the EMTR. Finally, the policy design implies that governments are continuing to share in the risk associated with new investments (by making expenditures tax deductible) but are substantially reducing the extent to which they share in any returns (by reducing the tax levied on profits). While the decision not to recapture previously deducted R&D expenses may have been driven by a desire to keep the administration of the policy simple, it may also mean that the policies are more generous than actually intended.

In some ways intellectual property may seem like a natural candidate for preferential tax treatment. The real activity underlying the creation of intangible assets is often associated with the types of knowledge spillovers and high value jobs that governments seek to attract. At the same time, the mobility of the income stemming from intellectual property means that corporate income tax can have a particularly distorting effect. The evaluation of IP Boxes will require empirical evidence. However, we have outlined a number of concerns with the principle of IP Boxes and some of their specific design features.

While IP Boxes can work to reduce the cost of capital and the EMTR (and therefore in principle to incentive marginal investments), they are a poorly designed policy instrument for incentivising additional R&D activity. This is because they target the income resulting from successful projects rather than the underlying innovative activity. At the point when an investment decision is made the likely outcome (i.e. how successful a new research project will be) and therefore the expected tax benefit are highly uncertainty. This will work to reduce the effect of IP Boxes on marginal investments. IP Boxes will create large deadweight costs if the tax

break accrues mainly to projects that would have occurred in a country irrespective of the policy.

An IP Box may be more justified as a means of reducing the tax rate on a highly mobile form of income that is related to valuable real activities. How effective the policy is in reducing the distortions to real activities will depend on how attractive IP Boxes are compared with the current tax planning strategies firms employ to reduce tax liabilities, and whether the policies work to attract real activities rather than just IP related income streams. IP Boxes must also be evaluated in comparison to other policies (such as investments in higher education, basic research, and infrastructure spending). We show that some IP Boxes can lead to lower effective tax rates than R&D tax incentives. However, in the presence of risk the later are better targeted at additional investment in R&D and innovation.

The majority of countries that have introduced IP Boxes so far are mainly (relatively) small open economies where multinational firms account for a significant share of investment and/ or tax revenues. This may account for a desire to be attractive locations for mobile multinational investments. Our consideration of specific policy designs suggests that the countries operating IP Boxes can effectively be split into two groups.

Most of the larger countries in terms of economic activity – the UK, Netherlands, Belgium and Spain – have IP Boxes that require IP to be self-developed (or at least further developed) by the taxpayer. They exclude acquired IP and allow embedded license income from internal use to qualify. These features make the policy more likely to be related to real activities taking place within the country.

In contrast, the countries with small domestic tax bases – Cyprus, Hungary, Malta, and the Swiss Canton of Nidwalden – have instituted policies that are more focused on attracting IP income without requiring any original R&D activity. These regimes include acquired IP and marketing intangibles, but exclude income from the internal use of IP. They are attractive regimes for companies that licence the use of IP. Notably, these are countries that are known to operate a range of other corporate tax policies that are attractive to mobile income, including corporation tax rates that are significantly lower than the EU and OECD averages (Spengel et al. (2012)).

These differences likely relate to the strategies underlying IP Box introductions. In the larger of the countries, that have significant innovation bases, it is more likely that IP boxes will lead to significant revenue losses. Empirical evidence that simulates the Benelux and UK IP Boxes finds

that the increase in IP income locating in the countries is insufficient to outweigh the lower tax rate (Griffith et al. 2012).The larger countries may therefore be aiming to attract real activities.

The smaller countries may be more focused on tax revenues. The theoretical literature on preferential tax rates suggests that small countries have a greater incentive to introduce such policies (Bucovetsky and Haufler (2007)) because own tax elasticities will be relatively high (Wilson (1999)). The effect of the reduced rate (which will be smaller because the tax base is smaller) can more easily be offset by increased revenues flowing into a country.

The sequential nature of IP Box introductions in Europe is suggestive that tax competition may be important. Any benefits of an individual country's policy will have been eroded by the response of other governments. And European governments may consider responding by adopting similar policies to maintain their own competitiveness. In fact, according to recently announced plans to reform the corporate tax system, Portugal looks set to become the twelfth European country to introduce an IP Box in 2014 (KPMG (2013)). There has also recently been legislation introduced in the United States that seeks to introduce a Patent Box.

In the context of recent G20 talks over how to prevent corporate profit shifting, the German Finance Minister, Wolfgang Schaeuble, called for a review of whether the EU should allow IP Box policies. Other critics suggest that the policies could be seen as sanctioning tax avoidance, and that they may have detrimental effects on other countries (Soong Johnston and Stewart (2013)). A key concern is that IP Boxes lead to a situation in which all countries are made worse off. A progress report submitted to the European Council in June 2013 revealed that the patent box regimes operating in the United Kingdom and Cyprus have been put on the agenda of the Code of Conduct Group for Business Taxation (Code of Conduct Group (2013), Nouwen (2013), Soong Johnston and Stewart (2013)). This will further spur the debate around the effects of IP Boxes.

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Appendix I: Summary of main parameters of R&D tax incentives

Table 4: Summary of R&D tax incentive in place in the countries with IP Box regimes (2013) (without consideration of payroll tax incentives)

	Type	Size	Qualifying assets	Qualifying Expenditure	Carry forward/ refund
Belgium[57]	One-shot super deduction	14.5%	Environment friendly tangible and intangible assets which aim to promote R&D of new products and advanced technologies Patents if capitalised	Capital expenditure	Carry forward without time limit but limited according to the amount
	Spread deduction (alternatively)	21.5%			
	Tax credit (alternatively)	33.99% of the super deduction			Carry forward without time limit but limited according to the amount. Refund after five consecutive years
	Accelerated depreciation	3 years straight-line	Equipment, plant and machinery used for scientific research		
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.
France[58]	Tax credit	30% up to 100 Mio. €/ 5% above	Assets used for scientific and technical research	Revenue expenditure (wage costs, depreciation of fixed R&D assets, other operating costs)	Refund after a carry forward of 3 years
	Accelerated depreciation	1.5 to 2.5-times straight-line rate (as opposed to 1.25 to 2.25-times straight-line rate)	Scientific and technical research equipment	Capital expenditure	
Hungary[59]	Super deduction	100%	Assets used for fundamental research, applied research or experimental development	Revenue expenditure (wage costs, materials, services) Depreciation for capitalised assets resulting from experimental development	Carry forward/ carry back within the scope of the loss carry forward/ carry back

[57] See IBFD Tax Research Platform, Belgium, Country Analysis, Corporate Taxation, 15 July, section 1.9.2, Cops and Lemaire (2009), Deloitte (2013), Van Stappen et al. (2007), Willems (2012).

[58] See IBFD Tax Research Platform, France, Country Analysis, Corporate Taxation, 15 July, section 1.9.3.2, Deloitte (2013), Katyia et al. (2007), Mayot and Juan (2009).

[59] See Deloitte (2013), László et al. (2007), Vosse and Harcos (2012).

Table 4 continued

	Type	Size	Qualifying assets	Qualifying Expenditure	Carry forward/ refund
Ireland[60]	Tax credit	25% Up to 200,000 € on a volume-basis Above this, on an incremental basis (baseline figure is set by reference to expenditures incurred in 2003	Plant, Machinery, Buildings, structure Excluded: patents	Revenue expenditure Capital expenditure Excluded: financing costs	Carry back one year, carry forward, refund on a staggered basis over 3 years, limited to the higher of the payroll tax of the two preceding accounting periods or the corporate income tax of the 10 preceding accounting periods.
	Accelerated depreciation	100%	I.a. machinery, equipment, buildings used for qualifying scientific research	Capital expenditure	
Liechten-stein	n.a.	n.a.	n.a.	n.a.	n.a.
Luxembourg[61]	Investment tax credit	6% on investment up to 150,000 EUR, 2% above Additionally 12% on R investment exceeding the 5-year average	New tangible assets excluding buildings	Capital expenditure	Carry forward 10 years
	Accelerated depreciation	4-times straight-line rate (as opposed to 3-times), maximum 40% (as opposed to 30%)	Machinery used for scientific or technical research,	Capital expenditure	
Malta[62]	Super deduction	50%	Instruments and equipment, buildings, patents	Revenue expenditure (materials and supplies, wage costs, overheads, payments for contract research and patents (capped)) Depreciation allowances for buildings	Carry forward, indexed

[60] See IBFD Tax Research Platform, Ireland, Country Analysis, Corporate Taxation, 1 June, section 1.9.3.2, Deloitte (2013), Hickson (2011), Irish Revenue (2012), Maguire (2007).

[61] See IBFD Tax Research Platform, Luxembourg, Country Analysis, Corporate Taxation, 15 July, sections 1.5.1 and 1.9.3.2, Thomas et al. (2007).

[62] See Elschner et al. (2009), p. 241.

Table 4 continued

	Type	Size	Qualifying assets	Qualifying Expenditure	Carry forward/ refund
The Netherlands[63]	Super deduction	54%	Capital assets	Revenue expenditure Capital expenditure Excluded: wage costs, capital allowances and payments for contract R&D	Expenses of more than EUR 1 million must be deducted in equal parts spread over the following 5 years.
Spain[64]	Tax credit	25% Additionally 42% on expenses exceeding the 2-year average	n.a. (only revenue expenditure)	Revenue expenditure	Carry forward 18 years
		17%		Wage costs (payroll)	
		8%	Equipment, machinery Excluded: land and buildings	Capital expenditure	
	Accelerated depreciation	100% (free depreciation)	Movable tangible and intangible assets	Capital expenditure	
Nidwalden (CH)	n.a.	n.a.	n.a.	n.a.	n.a.
The United Kingdom[65]	Super deduction	30%	Excluded: rights derived from R&D (e.g. patents)	Revenue expenditure excluded: depreciation allowances	Carry forward within the loss carry forward provisions
	Tax credit[66]	10% (7.7% after tax)	See above	See above	
	RDA (immediate deduction of capital expenditure)	100%	Plant, machinery, equipment, buildings Excluded: rights, land	Capital expenditure	

[63] See IBFD Tax Research Platform, the Netherlands, Country Analysis, Corporate Taxation, 15 July, section 1.9.8, Van Den Bergh and Vrolijk (2011), Deloitte (2013).

[64] See IBFD Tax Research Platform, Spain, Country Analysis, Corporate Taxation, 15 July, section 1.9.1.1.1, Bernales (2012), Deloitte (2013), Estrelles Domingo and Oraa (2007).

[65] See IBFD Tax Research Platform, United Kingdom, Country Analysis, Corporate Taxation, 20 June, section 1.9.2, Buck and Coe (2013), Deloitte (2013).

[66] The Finance Act 2013 introduced a tax credit was introduced as an alternative to the super deduction (articles 104A – 104Y; for the tax credit rate see art. 104M). Originally, the tax credit rate was supposed to be equal to 9.1% (before tax) (Deloitte (2013)). In 2016 the super deduction is supposed to be abolished and only the tax credit will remain.

Appendix II: Effective tax rates methodology

Effective tax measures for debt-financed investment

In section three we have introduced effective tax measures for equity-financed investment based on the Devereux & Griffith methodology. In the following, we additionally provide the formulas for debt-financed investment. Again, the starting point is the post-tax NPV of the investment, the post-tax economic rent (formula (10)).

$$(10)\ R = \underbrace{-(1-A)}_{Term\ 1} + \frac{1}{1+\rho}[\underbrace{(p+\delta)*(1+\pi)*(1-\tau)}_{Term\ 2} + \underbrace{(1-\delta)*(1+\pi)*(1-A)}_{Term\ 3}]$$

For debt-financed investment, a financing term, depicted by formula (11), must be added. The underlying idea is that, in the case of equity financing by way of retained earnings, the investment reduces the funds which may be distributed to the shareholders. If, in turn, the investment is financed with debt instead of with retained earnings, funds may be distributed in period one (first term). In turn, the distribution available in period is reduced in the amount of the repayment of the loan and the interest expenses (i being the nominal interest rate) taking into account the tax deductibility of the interest expenses from the tax base of the corporation tax ($1-\tau$).

$$(11)\ F = (1-\tau\varphi_0) - \frac{(1-\tau\varphi_0)(1+i(1-\tau))}{1+i} = \frac{(1-\tau\varphi_0)(i-i(1-\tau))}{1+i}$$

In case of debt-financing of investment, the marginal return is shielded from profit taxation as interest payments are generally tax-deductible. This effect is pointed out in the third term of formula (12) which depicts the cost of capital of debt-financed investment. Please note that the formula depicting the cost of capital for equity-finance investment presented in section 3 (formula (2)) and formula (12) below only differ with respect to the third term which is added.

$$(12)\ \tilde{p} = \frac{(1-A)(i+\delta(1+\pi)-\pi)}{(1+\pi)(1-\tau)} - \delta - \frac{(i-i(1-\tau))}{(1-\tau)}$$

Under IP Box regimes which require that financing expenses are allocated to IP income (net income approach), the regular corporate income tax rate denoted by τ is replaced by the IP Box tax rate $\tau_{IP\ Box}$. Consequentially, the value of the interest tax shield also depends on the IP Box tax rate ($i * \tau_{IP\ Box}$). This is reflected by formula (13)

$$(13)\ \tilde{p} = \frac{(1-A)(i+\delta(1+\pi)-\pi)}{(1+\pi)(1-\tau_{IP\ Box})} - \delta - \frac{(i-i(1-\tau_{IP\ Box}))}{(1-\tau_{IP\ Box})}$$

If, in contrast to this, financing expenses may be deducted from regularly taxed income, the value of the interest tax shield depends on the regular tax rate ($i * \tau$). This is depicted by formula (14). Please note that formulas (13) and (14) only differ with respect to the numerator of term three

(14) $\tilde{p} = \frac{(1-A)(i+\delta(1+\pi)-\pi)}{(1+\pi)(1-\tau_{IP\ Box})} - \delta - \frac{(i-i(1-\tau))}{(1-\tau_{IP\ Box})}$

Incorporating R&D tax incentives

In the following, we point out how we incorporate R&D tax incentives into the model. R&D tax incentives are incorporate by their effect on the NPV of tax allowances. Formula (15) gives the NPV of tax incentives taking into account immediate write-offs (first term), accelerated depreciation available capital expenditures (second term), super deductions (third term) as well as tax credits (fourth term). The variables a and b refer to the rate of the super deduction and the rate of the tax credit, respectively. The variable φ_0 reflects the share of capital expenditure which may be immediate written-off.

(15) $A_c = \underbrace{\varphi_0 \tau}_{Immediate\ write-off} + \underbrace{A_d}_{Accelerated\ depreciation} + \underbrace{a * \tau}_{Super\ deduction} + \underbrace{b}_{Tax\ credit}$

Appendix III: Effective tax measures for debt-financed investment

Table 5: Cost of capital and EMTR (in %) for debt-financed investment in a self-developed patent, licensing out

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		BE	CH NW	CY	ES	FR	HU	LIE	LUX	MT	NL	UK
CIT rate		33.99	15.11	10	30	34.43	19	12.5	28.8	35	25	23
IP Box rate		6.8	8.8	2	12	15.5	9.5	2.5	5.8	0	5	10
IP Box treatment of R&D expenses		A	A	A	A	A	A	S	S	S	S	A
Allocation of financing exp. to IP income		N	Y	Y	N*	Y	N	Y	Y	Y	Y	N
CoC	Regular tax system	2.63	4.12	4.30	2.91	2.60	3.68	4.13	2.97	2.56	3.26	3.40
	IP Box	-2.61	3.56	3.21	-0.20	-0.40	1.68	4.83	4.82	5.00	4.65	3.40
	R&D tax incentive	n.a.	n.a.	n.a.	-	-3.50	-1.10	n.a.	n.a.	-2.92	-0.40	1.36
EMTR	Regular tax system	-89.82	-21.40	-16.17	-71.72	-92.06	-35.96	-21.07	-68.57	-95.03	-53.38	-47.10
	IP Box	-	-40.56	-55.72	-499	-	-197.60	-3.61	-3.66	0.00	-7.48	-47.10
	R&D tax incentive	n.a.	n.a.	n.a.	-	-	-	n.a.	n.a.	-	-	-266.56

Abbr.: CIT – corporate income tax plus surcharges, A – Asymmetrical, S- Symmetrical, Y – Yes, N – No, CoC - Cost of capital, EMTR - Effective marginal tax rate, n.a. - indicates that no R&D tax incentives apply.

Notes: "Allocation of financing expenses to IP income" indicates whether financing expenses have to be allocated to IP Box income or whether such expenses may be deducted from income which is subject to the regular corporate income tax rate.

*The Spanish IP Box regime generally follows the net income approach. However, in case of intangible assets which are not capitalised (such as a self-developed patent), the IP Box tax base is assumed to constitute only 80% of qualifying income and expenses (including financing expenses) do not have to be allocated to IP income.

When the CoC is negative the EMTR may not be interpreted in a meaningful way. In this case, the cell is left blank.

Table 6: EATR (in %) for debt-financed investment in a self-developed patent, licensing out

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		BE	CH NW	CY	ES	FR	HU	LIE	LUX	MT	NL	UK
CIT rate		33.99	15.11	10	30	34.43	19	12.5	28.8	35	25	23
IP Box rate		6.8	8.8	2	12	15.5	9.5	2.5	5.8	0	5	10
IP Box treatment of R&D expenses		A	A	A	A	A	A	S	S	S	S	A
Allocation of financing exp. to IP income		N	Y	Y	N*	Y	N	Y	Y	Y	Y	N
EATR	Regular tax system	17.68	5.65	4.37	15.19	17.97	8.89	5.57	14.72	18.33	12.22	11.09
	IP Box	-30.38	0.06	-7.27	-10.26	-11.18	-7.90	1.03	3.55	0.00	2.10	0.30
	R&D tax incentive	n.a.	n.a.	n.a.	-14.40	-2.05	-10.44	n.a.	n.a.	0.53	-1.51	3.25

Abbr.: CIT – corporate income tax plus surcharges, A – Asymmetrical, S- Symmetrical, Y – Yes, N – No, EATR - Effective average tax rate, n.a. - indicates that no R&D tax incentives apply.

Notes: "Allocation of financing expenses to IP income" indicates whether financing expenses have to be allocated to IP Box income or whether such expenses may be deducted from income which is subject to the regular corporate income tax rate. *See above.

Appendix IV: Effective tax measures for investment in R&D assets

As a robustness check we determine effective tax rates for a mix of different R&D assets, namely current R&D expenses, machinery used for R&D and buildings used for R&D. In doing so, akin to Bloom et al. (2002) and other studies which follow this approach we assume economic depreciation rates of 3.6% for R&D buildings. 12.3% for machinery used for R&D and 30% for current R&D expenditures. In line with this literature, we use the following weights when calculating combined measures of the cost of capital, the EMTR, and the EATR: 90% for current R&D expenses, 3.6% for buildings, and 6.4% for machinery.

Considering a set of R&D assets instead of a self-developed patent does not considerably affect the effects of the IP Box regimes on the cost of capital and the effective tax rates. As in the case of the self-developed patent, IP Boxes which are characterised by an asymmetric treatment of R&D expenses and IP income reduce the cost of capital and the effective marginal tax rate. The country ranking is also largely unaffected when considering a mix of R&D assets.

Table 7: Cost of capital and EMTR (in %) for equity-financed investment in R&D assets, licensing out

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		BE	CH NW	CY	ES	FR	HU	LIE	LUX	MT	NL	UK
CIT rate		33.99	15.11	10	30	34.43	19	12.5	28.8	35	25	23
IP Box rate		6.8	8.8	2	12	15.5	9.5	2.5	5.8	0	5	10
IP Box treatment of R&D expenses		A	A	A	A	A	A	S	S	S	S	S
CoC	Regular tax system	3.78	5.05	5.06	5.17	5.18	5.08	4.49	5.15	5.26	5.16	5.19
	IP Box	-5.47	3.67	2.36	-0.48	-2.24	1.62	4.91	5.02	5.00	5.02	5.07
	R&D tax[67] incentive	3.64	n.a.	n.a.	-8.17	-4.28	-2.31	n.a.	5.07	-3.22	-0.77	1.85
EMTR	Regular tax system	-34.04	0.94	1.00	2.51	2.61	1.29	-11.40	2.24	3.25	2.35	2.67
	IP Box	-	-37.60	-121.54	-	-	-251.75	-1.86	0.42	0.00	0.47	1.21
	R&D tax incentive	-37.59	n.a.	n.a.	-	-	-	n.a.	0.96	-	-	-210.00

Abbr.: BE – Belgium, CH NW – Swiss Canton of Nidwalden, -CY – Cyprus, ES – Spain, FR – France, HU – Hungary, LIE – Liechtenstein, LUX – Luxembourg, MT – Malta, NL – the Netherlands, UK – United Kingdom.
CIT – corporate income tax plus surcharges, A – Asymmetrical, S- Symmetrical, Y – Yes, N – No, CoC - Cost of capital, EMTR - Effective marginal tax rate, n.a. - indicates that no R&D tax incentives apply.

Notes: When the CoC is negative the EMTR may not be interpreted in a meaningful way. In this case, the cell is left blank.
For the UK we assume that the Patent Box is already fully available instead of being phased in over a period of 4 years.

[67] R&D incentives available for current R&D expenses, buildings used for R&D and machinery used for R&D are taken into account. These are available in Belgium, France, Hungary, Luxembourg, Malta, the Netherlands, Spain, and the United Kingdom.

The figures do, however, differ in absolute terms. In the following we point out what drives these differences. Under the regular tax system, plant and machinery and buildings used for R&D are generally subject to tax depreciation whereas current R&D assets are generally immediately deductible. This gives rise to differences in the cost of capital and the effective tax rates calculated for an investment in a mix of R&D assets as opposed to an investment in a self-developed patent. Cost of capital above the capital market interest rate of 5% indicate that tax depreciation fall short of the economic depreciation. Hence, an investment in the respective asset is treated less favourable than the alternative capital market investment. This is the case in almost all of the countries. In Belgium and Liechtenstein, the notional interest deduction drive that the cost of capital below the capital market interest rate.

Table 8: EATR (in %) for equity-financed investment in R&D assets, licensing out

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		BE	CH NW	CY	ES	FR	HU	LIE	LUX	MT	NL	UK
CIT rate		33.99	15.11	10	30	34.43	19	12.5	28.8	35	25	23
IP Box rate		6.8	8.8	2	12	15.5	9.5	2.5	5.8	0	5	10
IP Box treatment of R&D expenses		A	A	A	A	A	A	S	S	S	S	S
EATR	Regular tax system	21.45	9.72	7.75	23.10	26.40	14.57	7.16	22.43	27.08	19.33	17.97
	IP Box	-43.70	0.57	-11.42	-11.41	-18.96	-8.19	1.43	4.49	0.00	3.87	7.81
	R&D tax[68] incentive	21.01	n.a.	n.a.	-23.61	-4.60	-15.36	n.a.	22.15	-0.48	-2.89	5.12

Abbr.: CIT – corporate income tax plus surcharges, A – Asymmetrical, S- Symmetrical, Y – Yes, N – No, EATR - Effective average tax rate, n.a. - indicates that no R&D tax incentives apply.

Notes: For the UK we assume that the Patent Box is already fully available instead of being phased in over a period of 4 years.

Under the IP Box regimes which are characterised by a symmetric treatment of R&D expenses and IP income (Liechtenstein, Luxembourg, Malta, the Netherlands, and the United Kingdom), any deviations of the cost of capital from the capital market interest under regular tax system are reduced due to the application of a lower tax rate; the lower the tax rate, the smaller are the effects of a more/ less favourable tax treatment of real investment associated with the IP Box regime as opposed to the alternative financial investment.

The IP Box regimes which do not require that R&D expenses incurred in the past are recaptured (asymmetric treatment of R&D expenses and IP income) reduce the cost of capital and the

[68] R&D incentives available for current R&D expenses, buildings used for R&D and machinery used for R&D are taken into account. These are available in Belgium, France, Hungary, Luxembourg, Malta, the Netherlands, Spain, and the United Kingdom.

effective tax rates to a larger extent when an investment in R&D assets is considered as opposed to an investment in a self-developed intangible asset. This can mainly be attributed to the different economic depreciation rates we assumed for these assets; the average economic depreciation rate of the mix of R&D assets amounts to approximately 28% in contrast to 15.35% for the patent. As depicted by equation (2) in Section 3.1, the cost of capital are decreasing in the economic depreciation rate on an asset.

Finally, R&D tax incentives available for current R&D expenses and capital expenditures may vary. For example, in Belgium and Luxembourg, R&D tax incentives are limited to capital expenditures; current R&D expenses do not qualify. This furthermore gives rise to differences in the cost of capital and effective tax rates presented for an investment in R&D assets and an investment in a self-developed patent.

Appendix V: Sensitivity Analysis – Variation of the rate of return

Table 9: EATR (in %) for equity-financed investment in a self-developed patent, rate of return 50%

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		BE	CH (NW)	CY	ES	FR	HU	LIE	LUX	MT	NL	UK
CIT rate		33.99	15.11	10	30	34.43	19	12.5	28.8	35	25	23
IP Box rate		6.8	8.8	2	12	15.5	9.5	2.5	5.8	0	5	10
IP Box treatment of R&D expenses		A	A	A	A	A	A	S	S	S	S	A
Internal Use		Y	N	N	N	N	N	Y	Y	N	Y	Y
EATR	Regular tax system	28.76	11.40	9.00	27.00	30.99	17.10	10.27	26.30	31.50	22.50	20.70
	IP Box	-6.78	6.40	-1.46	8.18	6.24	4.68	2.05	5.69	0.00	4.50	9.00
	R&D tax incentive	n.a.	n.a.	n.a.	15.16	22.98	9.37	n.a.	n.a.	24.38	17.01	17.57

Abbr.: BE – Belgium, CH NW – Swiss Canton of Nidwalden, -CY – Cyprus, ES – Spain, FR – France, HU – Hungary, LIE – Liechtenstein, LUX – Luxembourg, MT – Malta, NL – the Netherlands, UK – United Kingdom.

CIT – corporate income tax plus surcharges, A – Asymmetrical, S- Symmetrical, Y – Yes, N – No, EATR - Effective average tax rate, n.a. - indicates that the same tax rates as under the regular tax system apply.

Table 10: EATR (in %) for equity-financed investment in a self-developed patent, rate of return 100%

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		BE	CH (NW)	CY	ES	FR	HU	LIE	LUX	MT	NL	UK
CIT rate		33.99	15.11	10	30	34.43	19	12.5	28.8	35	25	23
IP Box rate		6.8	8.8	2	12	15.5	9.5	2.5	5.8	0	5	10
1IP Box treatment of R&D expenses		A	A	A	A	A	A	S	S	S	S	A
Internal Use		Y	N	N	N	N	N	Y	Y	N	Y	Y
EATR	Regular tax system	31.38	12.03	9.50	28.50	32.71	18.05	11.39	27.76	33.25	23.75	21.85
	IP Box	0.01	7.62	0.27	11.89	10.87	7.09	2.28	5.77	0.00	4.75	9.50
	R&D tax incentive	n.a.	n.a.	n.a.	22.58	28.71	14.18	n.a.	n.a.	29.69	21.00	20.28

Abbr.: CIT – corporate income tax plus surcharges, A – Asymmetrical, S- Symmetrical, Y – Yes, N – No, EATR - Effective average tax rate, n.a. - indicates that the same tax rates as under the regular tax system apply.