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POLICY WATCH

Intellectual property box regimes: effective tax rates and tax policy considerations

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Abstract In 2014, 12 European countries are operating Intellectual Property (IP) Box regimes that provide substantially reduced rates of corporate tax for income derived from important forms of intellectual property. We describe the key features of the policies and incorporate them into forward-looking measures of the cost of capital and the effective average tax rate. 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 lower IP Box tax rate, may result in negative effective average tax rates and can thereby provide a subsidy to unprofitable projects. We discuss the ways in which IP Boxes are likely to affect firms' decisions and relate this to possible policy aims. While some regimes attempt to link the tax benefit 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 tax competition between European countries.

Keywords Corporate taxation · Effective tax rate · Intellectual property · Patent box · Innovation box · Preferential tax rate

JEL Classification H25 · H32 · H87 · K34 · O38

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1 Introduction

Intangible assets constitute a major input and value driver for multinational companies.[1] Often, the related intellectual property, including patents, trademarks, brands and copyrights, does not have a clear geographical location (Lipsey (2010)). Firms can use this flexibility to reduce tax payments.[2] Grubert (2003) formalises how intangible assets can be used to shift income to lower tax countries and provides empirical evidence that about half of the income shifted from high-tax to low-tax countries by US manufacturing firms can be accounted for by income from intangibles linked to research & development (R&D). Recent empirical results show that European firms' intangible assets are more likely to be held in low-tax subsidiaries than tangible assets (Dischinger and Riedel (2011)) and that the location of patents is responsive to corporate income tax (Griffith et al. (2014)). Huizinga and Laeven (2008) estimate that profit shifting leads to significant revenue losses for high-tax countries. There are 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.[3]

In recent years, a number of countries have responded to such concerns by introducing *Intellectual Property (IP) Box* regimes that explicitly reduce the rate of corporate tax levied on the income derived from patents and in some cases from other forms of intellectual property.[4] France and Hungary were the first countries to operate such policies since 2000 and 2003, respectively. However, IP Boxes first received widespread attention when introduced by the Netherlands and Luxembourg in 2007. Since 2007, these policies have been made more generous and eight other European countries, including, most recently, Portugal, have implemented their own versions. China operates a similar policy, and legislation for a United States (US) version has been submitted to the US Congress.[5]

The contribution of this paper is to incorporate the main features of European IP Box regimes into forward-looking measures of the cost of capital and the effective average tax rate. To our knowledge, we are the first to do this.[6] We build on the methodology

[1] There is a growing body of work seeking to measure the growth and contribution of intangible assets. See, inter alia, Hulten (2013), Corrado et al., (2005, 2006) and OECD (2013b, section 1).

[2] Various approaches have been used to detect (at least indirect) evidence of the use of intangible assets in profit shifting. Grubert and Mutti (2009) show that the share of royalty payments associated with low-tax countries is higher than expected. Grubert (2003) and Harris (1993) emphasise the difficulty in assessing the transfer price of intellectual property in facilitating profit shifting. Desai et al. (2006) find that parent firms with high intangible assets are most likely to invest in tax havens. Verlinden and Smits (2009) discuss the management of IP rights for tax purposes.

[3] Hines (1999) reviews research on the effect of tax on the location of real innovative activities. Barrios et al. (2012) provides recent evidence for European firms.

[4] These policies are also often referred to as Patent Box or Innovation Box regimes.

[5] See *Manufacturing Innovation in America Act of 2013*, Rep. Allyson Schwartz, June 28 2013, http://www.gpo.gov/fdsys/pkg/BILLS-113hr2605ih/pdf/BILLS-113hr2605ih.pdf.

[6] We extend previous work by the authors to incorporate IP Box regimes into effective tax rates for some countries. See Bellingwout et al. (2012). OECD (2013b, pp. 135 et seq.) also presents a model for determining effective tax rates that incorporates the statutory IP Box tax rate but not the specific design of the tax base.

of Devereux and Griffith (2003), and consider the tax treatment of an investment in a self-developed patent, an important form of intellectual property. We describe the key differences between the IP Box regimes in place in Europe and draw on the measures of effective tax rates to discuss the design and incentive effects of the policies.

IP Box regimes vary in the tax rate they offer (from 0% in Malta to 15.5% in France), and in their design. The definition of the tax base, and specifically the treatment of expenses, differs significantly across countries and can be more decisive for the effective tax burden than the IP Box tax rate. We show 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. Such regimes produce large tax shields that can be used to offset tax liabilities for other forms of income.

There are (at least) three reasons that a government may introduce an IP Box: (i) to incentivise firms to increase investment in innovative activities; (ii) to attract (or retain) mobile investments that may be associated with high-skilled jobs and knowledge creation; (iii) to raise revenue more efficiently by differentiating tax rates on more mobile income streams. The success of the policies on any of these terms will depend largely on how effective IP Boxes are in changing firms' real behaviours. We discuss how the policies' design features are likely to affect the incentives created by IP Boxes.

The OECD and European Union (EU) have long discouraged the use of preferential tax rates because of concerns that they might be associated with 'harmful' tax competition (as described in Kiekebeld (2004)). The recent OECD Action Plan on Base Erosion and Profit Shifting (BEPS) identifies preferential tax regimes such as IP Box regimes as a 'key pressure area' in tax policy and calls for measures to counter harmful tax practices more effectively (OECD (2013a), action no. 5). The EU's Code of Conduct for business taxation (the 'Code' in what follows) identifies five criteria for assessing whether provisions that allow for substantially lower effective rates of tax than the regular tax system are in fact 'harmful'. The focus is on identifying regimes that are characterised by one or more of the following features: targeted at non-residents; ring-fencing; benefits given where there is a lack of substantive real economic activity; profit determination rules that depart from internationally accepted principles; lack of transparency (European Commission (1997)). Although the Code is only a political instrument as it is not binding, it has been successful in the sense that the EU Member States have withdrawn almost all tax regimes considered as harmful in the past 15 years (Fuest et al (2013)).

With the exception of France, IP Boxes have not been challenged under the OECD's or the EU Code of Conduct group's definition of harmful tax competition.[7] With regard to the Dutch regime (Council of the European Union (2007), margin no. 14) as well as the Belgian, Luxembourg and Spanish regimes, the Code of Conduct group agreed that there was no need to assess these tax measures against the Code's criteria (Council of the European Union (2008), margin no. 14-16). However, following a referral from the

[7] The EU's Code of Conduct group can assess tax practices at the behest of EU member states. To date, only the regimes in France and Hungary have been formally assessed. The Hungarian regime was found not to meet the criteria for a harmful tax practice. The French regime was deemed a harmful tax measure because the reduced tax rate was considered not to be applying to French source royalties (Council of the European Union (1999), pp. 46 and 300), and has been since modified (Mors 2007, p. 70).

European Commission upon the request from Germany, the Code of Conduct group is now discussing the recently introduced regimes in place in the United Kingdom (UK) and Cyprus (Council of the European Union (2013a), margin no. 11) and has put the Belgian regime back on its agenda (Council of the European Union (2013b), margin no. 8). The EU Commission has already taken a stance against the British regime concluding that the Patent Box meets two of the criteria used to identify harmful tax measures (European Commission (2013); Stewart (2013)). Most notably, the EU Commission argued that 'real economic activities and a substantial economic presence in the UK' are not necessarily required for the Patent Box to apply.

Following invitation by the Council of the European Union, the Code of Conduct group is also now reviewing all regimes in place in the EU Member States, including those already assessed or considered, in order to ensure a consistent treatment of the regimes (Council of the European Union (2013c)).The Group's review is expected to be completed by the end of 2014.

The growing debate around IP Boxes serves to demonstrate the importance of the exact design of regimes; relatively small details of the provisions may be sufficient to breach the de facto economic substance requirements. We contribute to this debate by discussing the design differences between policies and conclude that many of the policies in place in Europe have similar features to those being challenged in the UK.

The remainder of this paper is structured as follows. Section 2 discusses the key features of IP Box regimes. In Section 3, we adapt the measures developed in Devereux and Griffith (2003) to incorporate IP Box regimes into effective tax rates. We present our 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 IP Box regimes in Europe

Twelve 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. The most prominent feature of such IP Box regimes is the tax rate, which ranges from 0% in Malta to 15.5% in France. The other key features that determine the generosity of the policies 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. The policies are summarised in Tables 1 and 2 and the remainder of this section. [8] Additional details on the specific workings of IP Box regimes can be found in Evers et al. (2013).

2.1 Eligible intellectual property

All European IP Box regimes apply to patents. In Belgium, France and the UK, the scope is limited to patents, Supplementary Protection Certificates (SPC) that come into force after the patent upon which they are based has expired, and closely related rights.

[8] Information on IP Boxes was collected from a number of sources and is current as of April, 2014 (see Evers et al. (2013) for detailed references).

Table 1 IP Box regimes in place in Europe (2014)

	Date of implementation	IP Box rate (%)	Main rate* (%)	Qualifying IP		IP Box Tax Base	
				Acquired IP	Existing IP	Treatment of current expenses	Treatment of R&D expenses incurred in the past
Belgium	2007	6.8	33.99	N	N	Gross income	No recapture
Cyprus	2012	2.5	12.5	Y	Y	Net income	Capitalisation of development costs (regular tax system)
France	2000	16.76	35.41	Y	Y	Net income	No recapture
Hungary	2003	9.5	19	Y	Y	Gross income	No recapture
Liechtenstein	2011	2.5	12.5	Y	N	Net income	Recapture
Luxembourg	2008	5.84	29.22	Y[a]	Y/N[b]	Net income	Capitalisation of development costs
Malta	2010	0	35	Y	N	Not deductible	Income not eligible if R&D costs have been deducted previously
Netherlands	2007	5	25	N	N	Net income	Recapture
Portugal	2014	15	30	N	N	Gross income	Capitalisation of development costs (regular tax system)
Spain	2008	12	30	N	Y	Net income	No recapture
Nidwalden, Switzerland	2011	8.8	12.66	Y	Y	Net income	No recapture
United Kingdom	2013	10	21	Y[a]	Y	Net income before interest	Allocated to patent income on an overall basis

Abbreviations: Y: Yes; N: No. *Notes*: *The main rate presented includes the corporate income tax rate and, if applicable, surcharges (Belgium, France, Luxembourg and Portugal), local income taxes (Luxembourg and the Swiss Canton Nidwalden) and other income taxes (France (Contribution on the added value of enterprises)). We generally apply the maximum rate. With respect to France, we take into account the 3.3% social surcharge and the contribution on the added value of enterprises (CAVE) but disregard the 10.7% exceptional tax surcharge levied on the corporate income tax liability which applies in case the turnover exceeds EUR 250 Mio. [a] Luxembourg and the UK allow acquired IP only under certain conditions. [b] In Luxembourg, IP created before the introduction of the regime qualifies if it has been acquired after the date of implementation. The UK regime is being phased in over five years. In 2013, companies were only entitled to 60% of the full benefit, increasing to 70%, 80% and 90% in subsequent years, becoming fully available in 2017

As shown in Table 2, other IP Box regimes also apply to a wider set of intellectual property, commonly including trademarks and copyrights. Some countries include know-how, business secrets and secret formulas or processes in the scope of the IP Box. The scope of the regime is the widest in the Swiss canton of Nidwalden, Cyprus, Hungary, Liechtenstein and Luxembourg, which include designs, models, trademarks and copyrights (including software) in addition to patents.

Most regimes allow acquired, in addition to self-developed, IP to be deemed eligible. However, some operate rules around the types of acquired IP that are allowed or the conditions under which they can be included. Belgium and the Netherlands to some extent open the scope of their regimes to acquired IP under the condition that it is further developed. Yet, de facto, only the value added by the taxpayer qualifies whereas the value of the acquired IP is excluded from the benefit. In line with the fundamental freedoms codified in the Treaty on the Functioning of the European Union, none of the IP Box regimes require that the innovative activity underlying the intellectual property be carried out domestically.

2.2 Qualifying income

Regimes differ in the types of income that qualify for IP Box treatment as depicted by Table 2. All countries allow royalty income. With the exception of Belgium and Malta, all other countries allow capital gains from the disposal of qualifying IP (and/or the underlying intangible asset) in at least some circumstances. Five countries (Belgium, Lichtenstein, Luxembourg, Netherlands and the UK) allow IP income embedded in the sale price of patented products and notional royalty income from the internal use of qualifying IP. With the exception of the UK, the IP Box regimes apply on a per-asset basis and require the calculation of embedded IP income and notional royalty income from internal use based on arm's length transfer pricing principles.

Under the UK policy, all sales income relating to a good or service that embeds a qualifying patent may be attributable to the IP Box as qualifying income. The actual tax base of the UK IP Box is determined in the following three-step procedure, set out in HMRC (2012). First, qualifying profit is calculated by either (i) allocating total profits to the IP Box using the share of qualifying income to total gross income, or (ii) allocating all expenditures incurred to either qualifying or non-qualifying income (streaming approach). Financing income and expenses are disregarded and are taxed and deducted, respectively, at the regular tax rate. The relatively broad definition of qualifying profit can include profits that do not relate directly to the use of patents and could include profits from routine functions and the use of non-qualifying IP. The second and third steps therefore make two deductions that attempt to remove some of these profits. A deduction is made to allow for the return to routine functions; this is set at 10% for routine expenses, which excludes financing expenses and R&D (such that firms are able to benefit fully from any R&D tax credits they are eligible for). A deduction is also made to account for the use of marketing intangibles (e.g. trademarks) that are explicitly excluded from the regime. The value of the deduction should be set as the arm's length notional marketing royalty. The UK regime can be substantially broader in the scope of eligible income than those that use a per-asset

Table 2 Scope of qualifying IP and qualifying income (2014)

	Belgium	Cyprus	France	Hungary	Liechtenstein	Luxembourg	Malta	Netherland	Portugal	Spain	Nidwalden, Switzerland	United Kingdom
Kinds of income												
Royalties	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Capital gains		✓	✓[a]	✓[b]	✓	✓		✓	✓	✓[a]	✓	✓
Sales income	✓				✓	✓[c]		✓				✓
Notional royalties	✓				✓	✓[c]		✓				✓
Kinds of IP												
Patents	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SPC	✓		✓			✓						✓
Software		✓		✓	✓	✓	✓	✓[d]			✓	
Other Copyrights		✓		✓	✓		✓				✓	
Trademarks		✓		✓	✓	✓	✓				✓	
Designs & Models		✓		✓[f]	✓	✓		✓[d]	✓[f]	✓[e]	✓	
Utility models					✓	✓						
Secret formulas and processes		✓[g]		✓						✓	✓	
Know-how		✓		✓							✓	

Abbreviation: SPC: Supplementary protection certificates. *Notes:* [a]Capital gains from the disposal of qualifying IP rights benefit from the IP Box regime in case they are transferred to an unrelated party. [b]In Hungary, capital gains from the sale of IP are even fully tax exempt. [c]In Luxembourg, sales income and notional royalties from internal use only qualifies with respect to self-developed patents. [d]Provided an R&D certificate has been obtained.[e]Only models. [f] Industrial IP. [g]Only formulas

deduction in cases where the deductions for routine functions and marketing assets do not fully capture the returns to non-patent-related activities.

2.3 Determination of the IP Box tax base and the treatment of expenses

The generosity of the IP Box regimes is significantly influenced by the way expenses relating to qualifying income are treated. There are differing treatments with respect to current expenses and previous expenses incurred in the creation of IP. In both cases, a key factor is whether expenses are deductible against IP Box income, or can be used to create a tax shield against regularly taxed income.

With respect to the treatment of current expenses (e.g. expenses relating to current administration, improvement or financing of IP), IP Boxes effectively take either a *gross* or *net* approach. Under the gross approach, current expenses are deductible from non-IP income, which is taxed at the regular corporate tax rate. This creates an asymmetric treatment of IP income and IP expenses. As long as the taxpayer has sufficient ordinarily taxed non-IP income from which to deduct the IP expenses, this can produce a substantial tax advantage. Belgium and Hungary adopt this approach.

Most countries operate the net income approach under which current expenses are allocated to IP income and are thereby deducted at the lower IP Box rate. The UK operates a net approach for most expenses but allows financing expenses to be deducted from non-patent income. Malta fully exempts IP income from tax but only on the condition that all associated expenses (current and past) are not deducted. Hence, the full exemption of royalty income implies a full inclusion of R&D expenses that are incurred in Malta in the tax base.

With respect to the treatment of past R&D expenses, there are also broadly two approaches. In order for the treatment of R&D expenses incurred in the past to be aligned with the treatment of IP income, previously claimed deductions must be recaptured in some way. To the best of our knowledge, several countries do not require any recapture of previously deducted R&D expenses (Belgium, France, Hungary, Spain and the Swiss Canton of Nidwalden).[9] As a result, the original deduction of R&D expenses at the higher corporate income tax rate is not offset. This can result in a particularly generous tax treatment for an R&D project. 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.

Liechtenstein, Luxembourg and the Netherlands recapture previous expenses using different mechanisms. Luxembourg requires self-developed intangible assets to be capitalised when opting for the IP Box regime. The Netherlands and Liechtenstein only apply the IP Box rate to (net) income exceeding the initial R&D expenses. The latter approach is generally more beneficial from the taxpayer's perspective. This is because capitalisation implies adding the production cost of the intangible asset to

[9] In Cyprus and Portugal, taxable profits are determined based on financial statements prepared in accordance with international financial reporting standards (IFRS), subject to certain adjustments (see Spengel and Zöllkau (2012), p. 19).

the tax base, and subsequently allowing tax depreciation. Cyprus and Portugal are the only IP Box countries where the regular tax system stipulates the capitalisation of costs incurred for development of intangibles upon qualifying as an intangible asset.

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. In the UK, R&D expenses incurred and deducted, before the IP Box has first been applied, do not have to be recaptured. Once a firm has opted into the regime, R&D expenses are indirectly allocated to IP income in line with the ratio of qualifying income to total income, or allocated according to the streaming approach.

3 Incorporating IP Box regimes into a model of effective tax rates

In modelling the impact of IP Boxes on firms' effective tax burden, we follow the methodology put forward by Devereux and Griffith (2003), which builds on the work of Jorgenson (1963), Hall and Jorgensen (1967) and King and Fullerton (1984). This is a neoclassical approach that assumes that firms invest in capital as long as the (decreasing) marginal returns cover the marginal costs. Investment takes place until the return is equal to the cost of capital – the minimum pre-tax real rate of return required by an investor given a post-tax real rate of return on an alternative investment (financial investment). In line with neoclassical investment theory, this approach rests on the assumption of a perfect capital market under certainty.

The cost of capital is used to consider the effect of tax on marginal investment decisions, and therefore on the scale of investment. We also calculate effective average tax rates (EATR), which demonstrate the effects of tax on a profitable project. The EATR is calculated as the percentage difference in the net present value (NPV) of an investment in the absence and presence of tax. This measure is relevant for considering how tax affects firms' choices over discrete investment opportunities, such as whether or not to invest in an R&D project. Discreteness of investment decisions can arise when, for example, investment funds are limited, such that not all profitable investments will take place. Our interest here is in considering the effect of tax on firms' choice of which country to carry out an investment in. We present the methodology for calculating the cost of capital and the EATR in the appendix.

A corporate income tax affects the overall returns to a project in two ways. First, it reduces the NPV of after-tax income. Second, tax allowances, such as those for tax depreciation, serve as a tax shield and thereby reduce the NPV of investment expenditures.

We incorporate the key features of IP Box regimes in the context of a hypothetical investment in a self-developed patent.[10] We assume that all investment costs are current

[10] For simplicity, we capture the main features of IP Box regimes using a single intangible asset. Most applications of the Devereux and Griffith model assume a set of five assets, including an acquired (instead of self-developed) patent. In Evers et al. (2013) we also present results using a mix of R&D assets. We summarise these below.

(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)).

We incorporate the tax rates and tax allowances that define IP Box regimes. The IP Box tax rate replaces the regular corporate tax rate in relation to the tax treatment of income from the patent. The treatment of investment expenses associated with IP Box income is reflected in the NPV of tax allowances. We adjust the NPV of tax allowances to account for any recapture of previous R&D expenses. In addition, we adjust the interest tax shield for the treatment of financing expenses in the case of a debt-financed investment. We abstract from expenses incurred in the on-going management of IP.

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 that generate income from other investment projects.

All countries considered here except Cyprus and Portugal allow current expenses incurred in the creation of a self-developed intangible asset to be immediately expensed. Under the regular tax system, this implies that the NPV of tax allowances (denoted by A) is given by the regular tax rate ($A = \tau$). This will also be the relevant value of tax allowances in countries that require no recapture of R&D expenses (Belgium, France, Hungary, Spain and Switzerland). This is the most generous treatment of expenses. For other countries, we model the treatment of R&D expenses in one of three ways.

For the UK, we assume the stance of an investment that is undertaken after the IP Box regime has been opted for. The NPV of allowances is therefore based on the IP Box tax rate and is best reflected by: $A = \tau_{IPBox}$.[11] The tax treatment would be more generous if we alternatively assumed that R&D investment was undertaken before the IP Box is opted for and the costs deducted at the regular corporate tax rate.

Liechtenstein, Luxembourg and the Netherlands require R&D expenses to be allocated to IP income on a per-asset basis. There are two methods currently in place. In Luxembourg, development expenses have to be capitalised when the IP Box is opted for. The intangible asset is then subject to periodical depreciation in the subsequent periods. Since we model the perturbation of the capital stock, we do not consider the length of an R&D investment. We make the simplifying assumption that the immediate deduction and subsequent capitalisation occur in the same period.[12] The value of the allowances is modelled as follows:

[11] The UK regime has a number of complicated features. We abstract from these by assuming that the return to the self-developed patents fully constitutes eligible income. We do not deduct a return to routine functions, as R&D expenses are explicitly excluded from the routine deductions. We do not consider the deduction of a return to marketing assets and instead assume that the return of investment reflects a return net of expenses for marketing intangibles.

[12] As a consequence, there are no timing effects resulting from the fact that R&D expenses remain deductible until a self-developed intangible asset is created. Within this two-period framework, the alternative is to assume that capitalisation and exploitation happen in the second period. However, this would not lead to significantly different results.

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

where ϕ represents the depreciation rate (equal to 1 for immediate deduction), n is the useful life of the asset and i is the nominal capital market interest rate. Under this treatment, the IP Box tax rate is decisive for the NPV of allowances. In Portugal, capitalisation of the development costs of intangible assets is generally mandatory – under the regular tax system and when applying the IP Box regime. In contrast to Luxembourg, the depreciation allowances are deductible at the regular tax rate. Hence, the net present value of tax allowances denoted by equation (1) fully depends on the regular tax rate.

In Netherlands and Liechtenstein, the recapture mechanism requires IP income up to the R&D expenses to be taxed at the general tax rate, and only income exceeding this to benefit from the lower IP Box rate. Hence, the IP Box tax rate does not necessarily apply immediately when income is generated from the patent. This recapture mechanism cannot be precisely modelled in our two-period framework.[13] We therefore model these in the same way as Luxembourg's approach (equation (1)), but apply the economic depreciation rates instead of tax depreciation to make sure that the results are not distorted by the fact that tax depreciation is more or less favourable than economic depreciation. We consider this to be the most reasonable approximation to the recapture approach with respect to aligning the tax treatment of IP expenses and IP income.

Malta does not allow any deductions of expenses relating to IP income, such that there are no associated tax allowances ($A = 0$).

We also consider the treatment of financing expenses (which constitute current IP expenses) under the IP Box regimes. Tax deductible interest payments constitute a tax shield equal to the product of the nominal interest rate and the profit tax rate. When an IP Box regime requires financing expenses to be allocated to IP income (net income approach), the value of the tax shield depends on the IP Box tax rate ($i * \tau_{IP\,Box}$). If this is not the case (gross income approach), the value is determined by the regular corporation tax rate ($i * \tau$) and is thereby more generous.

4 Effective tax rates on income from intellectual property

4.1 Main results

In Table 3, we present the cost of capital and the EATR for an equity-financed investment in a self-developed patent under both the regular tax system and the IP Box system. We assume that the patent is licensed out and generates royalty income. We discuss the generality of our result below.

We make the following assumptions: the capital market real interest rate (r) is 5%; the inflation rate (π) is 2% (such that the nominal interest rate (i) is 7.1%);

[13] Assuming a rate of return of 20%, income will not exceed the investment expenditures until period seven.

Table 3 Effective tax burden of an equity-financed investment in a self-developed patent (2014)

	Belgium	Nidwalden, Switzerland	Spain	France	Hungary	Cyprus	Portugal	Liechtenstein	Luxembourg	Malta	Netherland	United Kingdom
IP Box treatment of R&D expenses	A	A	A	A	A	S	S	S	S	S	S	S
Internal Use	Y	N	N	N	N	N	N	Y	Y	N	Y	Y
Tax rates (%)												
Main rate	33.99	12.66	30	35.41	19	12.5	30	12.5	29.22	35	25	21
IP Box rate	6.8	8.8	12	16.76	9.5	2.5	15	2.5	5.84	0	5	10
Cost of capital (%)												
Regular tax system	3.67	5.50	5.00	5.00	5.00	5.53	7.62	4.44	5.00	5.00	5.00	5.00
IP Box	-1.88	4.15	1.53	0.44	2.86	5.10	3.57	4.90	5.23	5.00	5.00	5.00
R&D tax incentives	n.a.	n.a.	-3.46	-4.45	0.23	n.a.	-3.24	n.a.	n.a.	-0.48	0.93	2.97
Effective average tax rate (%)												
Regular tax system	21.11	9.50	22.50	26.56	14.25	11.69	31.68	6.92	21.92	26.25	18.75	15.75
IP Box	-26.95	2.74	-2.95	-6.41	-2.54	2.34	5.17	1.39	5.47	0.00	3.75	7.50
R&D tax incentives	n.a.	n.a.	-7.09	3.97	-5.08	n.a.	-6.33	n.a.	n.a.	8.44	3.49	7.71

Abbreviations: A – Asymmetrical, S – Symmetrical, Y – Yes, N – No. *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. 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). In Belgium and Lichtenstein, a notional interest deduction is available at a rate of 2.763% and 4%, respectively (financial year 2014). In case of self-developed intangibles that are not capitalised, the Spanish Patent Box does not require associated R&D expenses to be recaptured but assumes that only 80% of the income constitutes net IP income

profitable investments command a uniform pre-tax rate of return (p) of 20%; the economic depreciation rate for a self-developed patent is 15.35% (following Spengel et al. (2012)). We consider a domestic investment where both the R&D investment and the exploitation of the resulting intangible asset is located in one jurisdiction. We discuss the possible implications of cross-border investments below.

4.1.1 Marginal investments

The cost of capital demonstrates the effect of tax on a marginal investment (one that just breaks even). When the after-tax cost of capital is 5% (the assumed real market rate of interest), taxation does not affect the investment decision. An effective marginal tax rate (EMTR) can be straightforwardly computed as the difference between the cost of capital and the real market rate of interest, divided by the cost of capital. We do not report the EMTRs as they cannot be interpreted when the cost of capital is negative.

Assuming that the costs incurred in creating a patent are current in nature and that patents need not be capitalised (as is the case in the countries we consider with the exception of Cyprus and Portugal),[14] the immediate deduction of expenses under the regular tax system means that there is no effect of tax on marginal investments. In Belgium and Liechtenstein, the application of a Notional Interest Deduction for equity capital reduces the cost of capital below the market interest rate.[15] In contrast to this, the requirement to capitalise self-developed intangible assets drives the cost of capital above the capital market interest rate in Cyprus and Portugal.

IP Box regimes can substantially lower the cost of capital. This effect comes entirely from the IP Box tax base. When R&D expenses are not recaptured and thereby remain deductible at the ordinary corporate tax rate, the value of the tax shield associated with the deduction of R&D expenses is higher than the tax levied on the corresponding income. This drives the cost of capital below the market interest rate. In this case, the cost of capital is decreasing in the regular tax rate, which determines the size of the tax shield. A cost of capital below the capital market interest rate indicates that the respective investment is treated in a more tax-beneficial manner than financial investment. Under the Belgian IP Box, the mismatch of R&D expenses and IP income is sufficient to produce a negative cost of capital.

The examples of Liechtenstein and Luxembourg show that the IP Box may also be associated with higher cost of capital than under the regular tax system, implying that an investment in a self-developed patent is disfavoured by the IP Box. In the case of Liechtenstein, this is because the notional interest deduction has to be partially attributed to IP income and is therefore only deducted at the lower IP Box tax rate.

[14] We assume that the taxpayer does not make use of the option to capitalise the investment expenses of the self-developed patent. This minimises the effective tax burden.

[15] Please note that when considering the taxation of dividends, capital gains, or interest in the hands of individual investors in addition to taxation at the company level, the notional interest deduction may simply work to fully or partially compensate for the unfavourable treatment of equity financing as opposed to debt-financing. In this case, the notional interest deduction might simply align the cost of capital with the interest rate. As we do not consider personal taxation on the level of the investor but focus on the tax consequences on the company level, the notional interest deduction drives the cost of capital below the capital market interest rate.

In the case of Luxembourg, this is because the regime requires that R&D expenses are capitalised and then provides a rate of depreciation allowance that is lower than (assumed) economic depreciation.

In the case of the UK, we assume that the investment is undertaken by a firm that has already opted into the IP Box, such that the value of the tax deduction of R&D expenses is determined by the IP Box tax rate. For investment projects that have already occurred and have been expensed at the regular corporate tax rate, the regime will provide a more generous treatment than indicated. In this case, the cost of capital would be 2.06%.

4.1.2 Profitable investment projects

The EATR serves as an indicator for a country's attractiveness for investment. Recall, we consider a project that produces a rate of return of 20%. As shown in Table 3, all IP Box regimes result in a significant reduction of the EATR when compared to the regular tax system and for five of the countries the asymmetric treatment of R&D expenses results in a negative EATR. This effectively implies that the tax treatment provides a subsidy. As the profitability of the project increases, the EATR becomes positive for all countries, and approaches the IP Box rate.[16] Similarly, if firms do not generate sufficient non-IP income against which the R&D expenses can be deducted, the IP Box tax rate becomes the decisive factor for the effective tax burden, and the EATR will be higher than depicted in Table 3. One effect of the asymmetric treatment of expenses is to provide multinational firms an incentive to accrue sufficient other income in an IP Box country to fully make use of the tax shield.

Table 4 shows how the EATRs associated with IP Boxes have changed since the implementation of the first regime in 2000. In general, the regimes have been fairly stable with quantitatively significant changes only in France and the Netherlands. In 2005, the French IP Box tax rate was reduced from 19% to 15% resulting in a reduction of the EATR from -0.32% to -7.74%. In 2010, the Dutch IP Box tax rate was reduced from 10% to 5%. As a result, the EATR decreased considerably from 7.5% to 3.75%. The Spanish regime underwent a fundamental reform in 2013. This included a reduction of the IP Box tax rate from 15% to 12%. As the reform furthermore involved that the IP Box tax base for self-developed intangible assets not recognized on the balance sheet is irrefutable assumed to equal 80% of the IP income, the EATR overall increases slightly from -4.01% to -2.95%.

To put our results in a wider perspective, Figure 1 compares EATRs for a self-developed patent to the remaining EU-27 Member States. IP Box countries lead the country ranking. This is mainly because IP Box regimes offer lower tax rates than the regular tax rates in the other countries. Though, this is not always the case. For example, the IP Box rates in France (16.76%), Portugal (12.3%) and Spain (12%) are higher than the regular rate in Bulgaria (10%). However, in these cases, the ability to deduct R&D investment expenses at the higher regular tax rate ensures that the EATR of the IP Box countries is lower than for non-IP Box countries.

[16] See Appendix V in Evers et al. (2013) for effective tax rates assuming a profitability of 50% and 100%.

Table 4 EATRs over time (equity-financed investment in a self-developed patent)

	Belgium	Nidwalden, Switzerland	Cyprus	Spain	France	Hungary	Portugal	Liechtenstein	Luxembourg	Malta	Netherland	United Kingdom
2000	-	-	-	-	−0.38	-	-	-	-	-	-	-
2001	-	-	-	-	−0.36	-	-	-	-	-	-	-
2002	-	-	-	-	−0.35	-	-	-	-	-	-	-
2003	-	-	-	-	−0.35	−2.41	-	-	-	-	-	-
2004	-	-	-	-	−0.35	−2.14	-	-	-	-	-	-
2005	-	-	-	-	−7.76	−2.14	-	-	-	-	-	-
2006	-	-	-	-	−7.65	−2.14	-	-	-	-	-	-
2007	−28.87	-	-	-	−7.65	−2.14	-	-	-	-	7.50	-
2008	−29.75	-	-	−4.01	−7.65	−2.14	-	-	5.54	-	7.50	-
2009	−30.02	-	-	−4.01	−7.65	−2.14	-	-	5.35	-	7.50	-
2010	−28.90	-	-	−4.01	−6.41	−2.54	-	-	5.35	0.00	3.75	-
2011	−28.28	2.74	-	-4.01	−6.41	−2.54	-	1.39	5.39	0.00	3.75	-
2012	−27.57	2.74	1.87	−4.01	−6.41	−2.54	-	1.39	5.39	0.00	3.75	-
2013	−27.14	2.74	2.34	−2.95	−6.41	−2.54	-	1.39	5.47	0.00	3.75	7.50
2014	−26.95	2.74	2.34	−2.95	−6.41	−2.54	5.17	1.39	5.47	0.00	3.75	7.50

See notes to Table 3. The changes in Cyprus, Hungary and Luxembourg are due to adjustments of the main rate, which also affects the IP Box tax rate. The variation in the Belgian EATR is due to regular adjustments of the interest rate underlying the notional interest deduction. Changes for France in the years 2000 to 2004, 2006 and 2010 are due to changes in the rate of surcharges and additional taxes levied on top of the corporate income tax rate

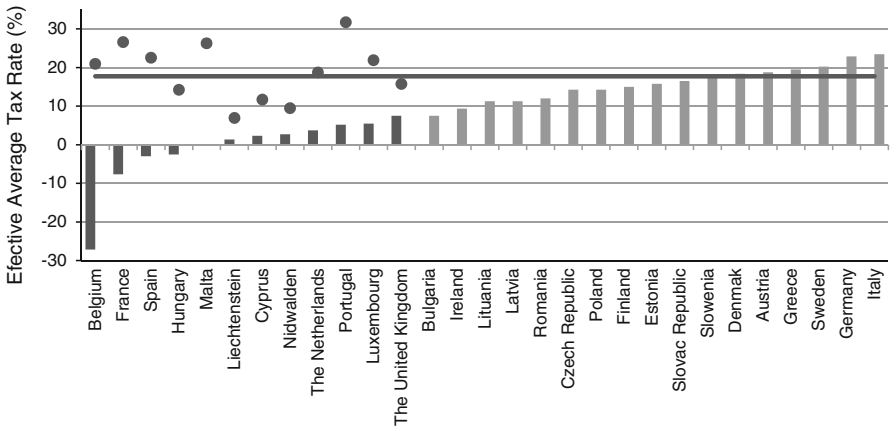

Fig. 1 Ranking of EATRs for the EU-27 Member States, Switzerland (Nidwalden) and Lichtenstein (equity-financed investment in a self-developed patent), 2014. Notes: See notes to Table 3. With the exception of Estonia, Slovenia and Sweden, none of the non-IP Box countries under consideration requires that self-developed patents are capitalised for tax purposes. Hence, the R&D expenses are subject to immediate expensing. For Estonia, which levies a distribution tax, we have assumed that the investment is financed with retained earnings

For IP Box countries, the dots in Figure 1 show the EATR under the regular tax system. The implementation of IP Box regimes significantly improves their country rankings. In Belgium, Portugal, France, Spain, Malta and Luxembourg, the IP Box regimes reduce the EATR below the EU-27 average EATR (depicted by the horizontal line).

In summary, our results show that IP Boxes substantially reduce effective tax rates and demonstrate that the treatment of expenses may be more decisive than the statutory IP Box tax rate in determining the effective tax burden. Malta, Cyprus and Liechtenstein offer by far the lowest rates. However, it is the regimes in Belgium and France followed by Spain and Hungary that can provide the most generous treatment for marginal investments. Belgium and France offer the most generous treatment of profitable projects. The combination of a relatively high regular rate and no requirement to recapture R&D expenses can provide for large tax benefits.

Our results apply strictly to the case of licensing income from the exploitation of patents. Section 2 (Tables 1 and 2) described that the scope of most IP Box regimes is much wider than this, and includes additional types of IP and kinds of income. To a large degree, our results will apply equally to these other cases, since other types of IP are treated in a similar manner to patents in the tax code. In calculating the precise tax rates, there would only be small differences, arising, for example, from different assumed economic depreciation rates.

4.2 Comparison to R&D tax incentives

Belgium, France, Hungary, Spain, the Netherlands, Malta, Portugal and the United Kingdom offer R&D tax incentives for current R&D expenditures.[17] These vary in

[17] Luxembourg offers a tax credit for capital expenditures, but not for current expenditures.

their generosity. As shown in previous work, R&D tax incentives can substantially reduce the cost of capital and the effective tax burden.[18] We consider how IP Boxes compare to R&D tax incentives (see Table 3). R&D tax incentives tend to reduce the tax burden on marginal investment to a larger extent than the IP Box regimes. This is unsurprising since R&D tax incentives are explicitly designed to reduce the tax base. However, IP Boxes that do not require R&D expenses to be recaptured can be equally generous. For example, if the IP Box tax rate is 20% of the regular tax rate (as the case in Belgium and the Swiss Canton of Nidwalden), this corresponds to a 500% super deduction of R&D expenses when considering the lower IP Box tax rate as a benchmark. For profitable investments, the IP Boxes uniformly result in lower effective average tax rates than the R&D tax incentives. As profit increases (and therefore as the rate become more important than the tax base for determining the tax burden), IP Boxes reduce EATR by more than R&D tax incentives.

With the exception of Malta, countries allow both R&D tax incentives and IP Boxes to be applied in combination. This can result in even lower effective tax rates than those presented in Table 3.

4.3 Variations in effective tax rate calculations

In addition to the main results, we consider effective tax rates for an investment financed by debt and an investment in multiple R&D assets. A summary is provided here. Details (including figures and formulas) are available in Evers et al. (2013). We also discuss how the results would likely differ in the case of a cross-border investment.

For a debt-financed investment, the deduction of interest payments from taxable income creates a tax shield, the size of which is increasing in the tax rate.[19] If financing expenses are deductible at the regular tax rate, the cost of capital decreases in the tax rate. As a consequence, the cost of capital and the EATR are lower compared to equity-financed investment. If financing expenses have to be allocated to IP income (net income approach), the cost of capital associated with the IP Box is higher than under the regular tax system because the value of the tax shield is lower.

In line with the approach commonly taken when considering R&D investments, we calculate effective tax rates for the following mix of R&D assets: current R&D expenses, machinery used for R&D and buildings used for R&D.[20] The key difference with this approach is that we consider the effect of IP Boxes on the treatment of capital assets. Whereas current R&D expenses are immediately tax deductible, machinery and

[18] See, for example, Hall and van Reenen (2000), Lester et al. (2007), McKenzie (2008), Warda (2001, 2006).

[19] Analogous to disregarding shareholder taxation, we do not consider the taxation of the interest in the hands of the lender.

[20] Our approach is equivalent to that taken in Bloom et al. (2002). 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 calculating overall effective tax measures for an investment that combines these assets we use the following weights: 90% for current R&D expenses, 3.6% for R&D buildings, and 6.4% for R&D machinery.

buildings are generally subject to tax depreciation. If tax depreciation falls short of economic depreciation, this raises the cost of capital above the capital market interest rate. Under IP Box regimes that stipulate that depreciation allowances are deducted at the lower IP Box tax rate, this effect is mitigated. In turn, comparably generous depreciation allowances are of less importance under such IP Box regimes. Besides this, the main difference in the results in absolute terms when considering a set of R&D assets, as opposed to a self-developed patent, stems from differing economic depreciation rates (28% on average for the mix of R&D assets in contrast to 15.35% for the patent). This is due to the fact that the cost of capital is decreasing in the economic depreciation rate on an asset (see equation (3) in the Appendix). However, this approach does not alter any conclusions. Assuming that current R&D expenses account for the majority of assets in a new project, we find that IP Box regimes have very similar effects to those reported above.

In the main results, we consider a domestic investment where both the R&D investment and the exploitation of the resulting intangible asset are located in one jurisdiction. In practice, research activities, commercialisation of intangible assets and the resulting income flows may be located in different jurisdictions. 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.

By way of contract R&D arrangements, multinationals may separate the location of R&D activity and from the location where the resulting income is earned without having to transfer intangible assets and thereby trigger exit taxation.[21] Whereas only 8 countries offer the IP Box treatment for acquired IP, all IP Box regimes are applicable to IP generated via contract R&D provided certain substance requirements are met (Huibregtse et al. (2011); Jacobs et al. (2011); Russo (2007)). Hence, in case of cross-border R&D investment where the IP is created via contract R&D meeting the respective substance requirements, multinationals may achieve effective tax rates as low as the ones presented for domestic investment. By exploiting generous R&D tax incentives in one country while earning IP income in an IP Box country, contract R&D arrangements may also allow multinational companies to achieve even lower effective tax burdens then the ones reported in Table 3.

An even wider perspective can be assumed by additionally considering a foreign parent company and assuming that the IP profits are eventually distributed. Also in this case, the results presented in Section 4.1 generally hold true. This is due to the following: as foreign dividend income is exempt from corporate income tax in all EU Member States. Ireland is the only exception to this as foreign dividends are subject

[21] 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 (2010), p. 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 that the principal manages and controls the party carrying out the R&D activity (Sporken and Gommers (2006), p. 267). In order to do so, the principal must have the 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.

to tax and a tax credit is granted for foreign profit taxes; hence, the larger tax rate (IP Box tax rate or Irish corporate tax rate amounting to 12.5%) is eventually decisive. In addition, the Parent & Subsidiary Directive ensures that such dividends are not subject to withholding taxes. Finally, due to ECJ case law controlled foreign company rules de facto do not apply either.

5 Discussion

Whether the IP Box is an appropriate tax instrument depends on the goal of the policy and how IP Boxes (including their revenue cost and the distortions they affect) compare with other tax instruments. There are three reasons that a government may introduce an IP Box: (i) to incentivise firms to increase investment in innovative activities; (ii) to attract (or retain) mobile investments that may be associated with high-skilled jobs and knowledge creation; (iii) to raise (or retain) revenue, or to raise revenue more efficiently by differentiating tax rates on more mobile income streams. We discuss these in turn with reference to policies' specific design features.

5.1 Incentives to increase innovative investments

The calculations presented above show that IP Boxes work to increase the incentive to invest in innovative activities relative to a financial investment, which serves as a benchmark in our analysis. Much of the effect of IP Boxes is seen through a (often substantial) reduction in the EATR. This incentivises investment in projects that rely on intellectual property and encourages the location of investments in a country with an IP Box. IP Boxes can also have a positive effect on the level of investment in innovative activities by reducing the cost of capital (recall this occurs when there is an asymmetric treatment of expenses and firms have other income against which to offset the tax shield associated with a deduction of R&D expenses at the regular tax rate).

The precise design of different policies will affect the magnitude of the incentives to undertake new investments and the ways in which firms are likely to respond. For example, the UK approach to calculating income that is eligible for the IP Box – which, in many cases, is likely to extend beyond the notional royalty that would be associated with a specific patent (see section 2) – means that an additional patent can have little effect on the amount of qualifying income. This reduces the incentive to invest in new patentable technologies, but may encourage complementary investments that increase eligible income (such as investment in marketing assets). In some countries, the incentive to invest in new ideas is reduced because firms can benefit from the policy by acquiring pre-existing intellectual property.

An important question is why governments should seek to incentivise certain types of investments. The traditional policy 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 under-invest in such activities relative to the socially optimal level of investment. This is the basis for R&D tax incentives, which directly reduce the cost of doing R&D. Empirical evidence suggests

that such policies can be effective in increasing R&D activity.[22] Governments may also seek to affect the location of innovative activities because evidence suggests that geographical proximity facilitates knowledge spillovers between researchers (Jaffe et al. (1993); Keller (2002)).

In considering whether an IP Box is the most appropriate policy tool to incentivise investment in spillover-generating activities, a concern is that the policy is not well targeted at research activities.[23] Spillovers are likely to be largest at the point of research, especially research that is attempting to advance scientific knowledge, and including research that increases knowledge but fails commercially.[24] IP boxes are targeted at the income from successful projects and not the underlying research. The correlation between the extent of any spillovers and the resulting income stream could be positive (because both are driven by the quality of an idea) or negative (because returns are higher when firms are able to maintain the exclusivity of an idea) and is likely to vary across projects.

Spillovers can also arise from the development and commercialisation of innovations, and under IP Boxes firms have a greater incentive to invest in these activities in order to increase the commercial value of intellectual property. Specifically, spillovers can plausibly arise from knowledge gained in incorporating innovations into commercial products (OECD (2013b), p. 132), or from network externalities that arise when the value of a new idea or product is dependent on the development of related technologies. However, such spillovers are less likely for marketing intangibles (such as brands), for which firms are more likely to capture all of the benefits of commercialisation activities. In all cases, the returns from exploiting intangible assets will also reflect any market power associated with intellectual property, such that the size of the tax break is not directly linked to the scale of spillovers from the underlying innovative activities. In addition, and as can be the case with R&D tax credits, there will be eligible projects that would happen without a tax break, such that an IP Box entails a potentially large deadweight cost, especially where income from pre-existing IP is eligible (as the case in France, Hungary, Spain, the Swiss Canton of Nidwalden, and the UK).

A second possible reason for seeking to incentivise certain types of investments using the tax system is if they have characteristics (other than spillovers) that the government values more highly than alternative investments. If investment projects are associated with different types of jobs, assets and tax revenues, and if not all profitable projects will take place (because of credit constraints, for example), governments may wish to affect which ones are undertaken, and ensure that they are retained in or attracted to a specific country. Governments often express a particular interest in innovative activities because they are associated with high-skilled jobs and are deemed important for driving growth (OECD (2013b)). An advanced domestic research base

[22] The incentive effects of traditional R&D tax incentives have been analysed theoretically and empirically. See, for example, Bloom et al. (2002), Elschner et al. (2009), Guellec (2001), Hall and van Reenen (2000), Parson and Phillips (2007).

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

[24] Unlike R&D tax incentives, IP Boxes do not support firms facing credit constraints at the research stage.

also helps to ensure that a country can create new technologies as well as use and benefit from those that are created offshore (Griffith et al. (2006)).

5.2 Incentives over the location of investment

Multinational firms now conduct a large part of their R&D activities outside of their home countries (OECD (2008)). One of the stated aims of IP Boxes has been to create a tax system that is attractive to innovative activities with a view that such activities are retained in or attracted to a country.[25]

The large reductions in EATRs resulting from IP Boxes show that the policies do make countries more attractive locations in which to earn the income from intellectual property. Whether the policies succeed in attracting real activities is likely to depend largely on the extent to which firms will choose to co-locate real activities alongside income streams.

If the tax liability associated with innovative activities accrues in the same location as those real activities then IP Boxes make a location much more attractive relative to countries without such a policy. Ernst et al. (2013) consider cases where firms co-locate patents alongside the underlying inventors that created the technology. They provide evidence that lower rates of tax on patent income can attract particularly innovative projects with high earning potential.

However, it is well known that multinational firms commonly use intellectual property in tax planning strategies. One of the attractions of using IP is that the ownership can be separated from the innovative activity and located with a view to reducing tax liabilities. For example, locating the beneficial ownership of a patent in a tax haven allows royalty payments to be used to shift income out of higher tax jurisdictions. Evidence suggests that the location of firms' intangible assets is negatively affected by corporate taxes (Dischinger and Riedel (2011); Karkinsky and Riedel (2012)). In a simulation exercise, Griffith et al. (2014) find that IP Boxes work to attract patents, and that those with a high expected value are particularly responsive to tax.

The success of IP Boxes in attracting real investments may therefore be limited by tax planning activities for two reasons. First, firms may already be achieving low rates – e.g. by shifting income to lower tax jurisdictions – such that IP Boxes are not as attractive as they may appear. The de facto lower rates achieved through income shifting may also mean that taxes in relatively high-tax countries are having a less detrimental effect on the location of innovative activities than if income and real activities were co-located (Hong and Smart (2010)). Second, firms may respond to an IP Box by moving paper profits but not the underlying real activity. With respect to the second point, recall that domestic R&D activity is generally not required for the IP Box regimes to apply, such that intangible assets that were created abroad mostly benefit as well. For example, in most cases IP Box treatment would still be available if intellectual property was created via a contract R&D arrangement with a related company in another country. Of course, firms' behaviour may be changed by

[25] For example, the stated aim of the UK policy was to 'to strengthen the incentives to invest in innovative industries and ensure the UK remains an attractive location for innovation' (see Griffith and Miller (2010)).

IP Boxes. For example, by allowing low-tax rates to be achieved without the need to shift income, IP Boxes may increase the extent to which income is co-located with real activities.

The design features of IP Boxes will have a bearing on how firms respond to a lower EATR. Acquired IP is eligible under the majority of IP Box regimes (except Belgium, Netherlands, Portugal and Spain). This is one way in which firms may be able to separate the income stream from real innovative activities.[26] The regimes in place in Belgium and the Netherlands are available for the value added to acquired IP by way of further development by the taxpayer. This attempts to ensure that some real activity is associated with the IP Box tax relief. Cyprus, France, Hungary, Malta and the Swiss Canton of Nidwalden neither require acquired IP to be further developed in order to qualify nor do they allow internal use of IP to benefit from the relief. These regimes are therefore particularly attractive for IP holding companies that licence-out IP and are less well targeted at attracting real innovative activities. Notably, Cyprus, Malta and Switzerland 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 EU and OECD averages (Spengel et al. (2012)). Theoretical literature suggests that smaller countries have a greater incentive to introduce generous treatments of mobile income streams because those streams are larger relative to the domestic tax base (Bucovetsky and Haufler (2007)). That is, own tax elasticities will be relatively high for small countries (Wilson (1999)).

As highlighted in the introduction, one of the reasons that the design of the UK regime has been challenged by the European Commission is that it may grant tax advantages without requiring any real economic activity or economic presence in the UK. If this is the case, the UK regime would breach one of the criteria for harmful tax measures set out in the Code of Conduct for business taxation. The preceding discussion suggests that the same concerns are raised by most IP Boxes, and may be more acute for those regimes that restrict relief to acquired IP and do not require substantive (if any) domestic economic innovative activity.

Overall, whether IP Boxes will be effective in attracting real innovative activities is unclear and will require empirical evidence. The effectiveness may also be evolving over time. For example, as more countries have introduced IP Boxes, the benefits to others of providing an attractive regime for mobile investments are likely to have diminished.

5.3 Differentiating tax rates on mobile income streams

The final possible reason to operate a preferential rate for income from intellectual property is as a means to reduce distortions that are currently present in the tax system, and possibly to raise additional revenue. Corporate income taxes distort both the level

[26] The transfer of IP out of a country can trigger capital gains taxation or exit taxes. The IP would need to be transferred at an arm's length price lower than the expected value of the asset for there to be a tax advantage. This may occur if, for example, the firm has superior knowledge on the IP's value compared to tax authorities. It can be particularly difficult to assess the market value of intangible assets because they are often firm specific, such that there is no comparable market transaction.

and the location of investment, such that any reduction in tax can be expected to reduce distortions in at least some dimensions. However, distortions are likely to be higher in relation to activities that are internationally mobile.

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 could alleviate some distortions with respect to the location of real activity and reduce the incentives for firms to shift income using highly contrived structures. IP Boxes also work to make preferential treatment available to all firms and thereby reduce the distortions to the ownership of intangible assets that arise when firms differ in their access to tax avoidance strategies.

However, this relies on the income from intellectual property being a good proxy for mobile income and measurable independent of other forms of income. By favouring certain kinds of investments, IP Boxes also introduce distortions into the tax system that must be weighed against any benefits. They create another boundary in the tax system between types of income that are taxed differently. As well as distorting firms' decisions, this requires policing to prevent avoidance behaviours, which in turn involve administrative costs (Klemm 2010). Further, while the mobility of income may justify a reduced tax burden, it does not provide an argument for subsidising investment in intangible assets, as occurs when the EATR is negative. To rationalise a subsidy, it would need to be the case that IP boxes incentivise or attract activities with large spillovers.

A key concern with preferential rates, and one that is raised by the 'harmful tax' initiatives, is their effect on government revenues from corporate income taxes. Raising revenue need not be the primary goal of the corporate tax system (it is a goal of the overall tax system). However, if governments are choosing between different policies, then the revenue consequences are important.

The theoretical literature highlights that preferential rates can actually increase overall revenue by effectively isolating tax competition with respect to a mobile tax base (Keen (2001)). However, it can also been shown that in many cases revenues are reduced for all countries, including those without preferential regimes (Janeba and Peters (1999)).[27]

Griffith et al. (2014) estimate that the introduction of IP Boxes in the Benelux countries and the UK will reduce revenue raised from IP; the policies do not attract sufficient additional income to offset the effect of the lower tax rate. The revenue loss for all countries increases when additional IP Boxes are introduced. This result is in line with the UK government's estimate that the IP Box will lead to a revenue loss of £1.1 billion a year in steady state (HMRC (2011), p. 29). This is roughly equivalent to a third of the annual science budget or the annual cost of a 1.5 percentage point cut in the headline rate of corporate income tax.[28]

[27] Wilson (2006) provides a discussion of theoretical results. Janeba and Smart (2003) present conditions under which restricting the use of preferential rates may be desirable.

[28] In 2013-14 the UK's Science Budget is £2.8 billion and the cost of a 1 percentage point cut to the main rate of corporation tax is around £800 million (see http://www.rcuk.ac.uk/about/Aboutrcs/Pages/Governmentfunding.aspx and UK Budget 2013, policy costing (https://www.gov.uk/government/publications/budget-2013-documents) respectively).

IP Boxes may produce offsetting beneficial effects in other parts of the tax system (e.g. personal taxes) if there is an increase in real activities, or if setting a preferential rate on a more mobile form of income allows a higher rate of corporate income tax to be maintained on less mobile activities. However, an overall revenue gain would likely require a substantial increase in other sources of tax revenue. Those countries with relatively small domestic tax bases and operating policies that are attractive to income flows may be the most likely to see a positive overall revenue effect.

6 Conclusion

In this paper, we demonstrate that IP Box regimes can result in large reductions in effective average tax rates. This effect stems not only from the low IP Box rates but also from the treatment of related expenses. Policies that do not require the recapture of previous R&D expenses are particularly generous. Such regimes result in a reduction in the tax liability of a marginal project. They may even be associated with negative effective average tax rates. There is not a clear justification for this effective subsidy, which may arise as an accident of the policy design rather than from an active design decision.

IP Boxes work to incentivise investment in innovative activities and make countries more attractive locations for the financial returns to intellectual property. The designs of the policies vary in many ways and are likely to be important for the precise effects of the policy. Overall, the likely effect on real activities is uncertain because firms have substantial scope to separate income from underlying activities. In contrast to the increasing popularity of IP Box regimes, in November 2010, Ireland removed an exemption for royalty income that had been in place since 1973, due to the finding of a government 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*."[29]

The sequential nature of IP Boxes in Europe suggests that governments are taking steps to preserve their relative attractiveness for internationally mobile activities. As more countries adopt IP Boxes, the benefits to any one country are likely to be reduced and the costs to those countries not operating such regimes increased. In the context of 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. He was cited as suggesting that the policies could be seen as sanctioning tax avoidance, and that they may have detrimental effects on other countries.[30] There may be value in European countries coordinating to prevent preferential rates.

The European Commission has challenged the specific design of the UK regime based on their assessment that it meets two of the criteria used to identify a harmful tax practice as set out in the code of conduct for business taxation. Our discussion of policies' designs suggests that other countries' policies may also be challenged on the

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

[30] The comments on the German minister were reported by Reuters in reference to a meeting on 9 July 2013 (http://uk.reuters.com/article/2013/07/09/uk-europe-taxes-idUKBRE9680KY20130709). For further details see Soong Johnston and Stewart (2013).

grounds of not requiring domestic real economic activity. At the time of writing, it is unclear whether the EU Commission and the Code of Conduct group as well as the OECD project on BEPS will challenge any of the IP Box regimes.

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Appendix I: Effective tax rates methodology

The investment project is modelled as follows. In period 1, there is a temporary increase of the capital stock by one unit. The cost of the investment 1, is subject to depreciation allowances, the net present value (NPV) of which we call A. In period 2, the investment generates a real financial return of p and a one-period cost of depreciation, δ. Inflation between periods 1 and 2 is a rate of π and income is subject to corporate income tax at rate τ. The capital stock is reduced (by $-(1-\delta)(1+\pi)$) to return to its initial level. In calculating the NPV of a net income stream, firms are assumed to discount income in period 2 in line with the nominal capital market interest rate, i.[31] We disregard personal taxation at the level of the individual investor.[32] The post-tax NPV of the investment project (R) can be denoted as:

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

where the first term corresponds to the investment carried out in period 1, the second term to the real (inflation adjusted) return that is generated in period 2 and the third term to the reduction in the capital stock. Corporate income taxes affect the payoff to an investment in two ways: (i) a tax reduces the NPV of the returns; (ii) tax allowances for depreciation (A) determine the tax base.

[31] For a more detailed discussion of the methodology see Devereux and Griffith (1999, 2003) and Schreiber et al. (2002). It is assumed, as is standard, that the real and nominal interest rates are related as follows: $(1+i) = (1+r)(1+\pi)$.

[32] Arguing from the perspective of a large multinational company, which raises funds 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.

From equation (1), the cost of capital is calculated by setting the post-tax return (R) equal to zero (to represent an investment that just breaks even) and rearranging to isolate the rate of return, p. For an equity-financed investment the cost of capital is given by equation (3). An effective marginal tax rate (EMTR) is straightforwardly computed as the difference between the cost of capital and the real market rate of interest, divided by the cost of capital.

$$\tilde{p} = \frac{(1 - A)(i + \delta(1 + \pi) - \pi)}{(1 + \pi)(1 - \tau)} - \delta \tag{3}$$

The EATR is calculated as the difference between the NPV of the investment in the absence and presence of taxes, scaled the NPV of the pre-tax total income stream, net of depreciation. In the absence of tax the return reduces to $R^* = p - r/1 + r$. The EATR is therefore given by:

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

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