TAXATION OF KNOWLEDGE-BASED CAPITAL: SOME ADDITIONAL ISSUES FOR POLICYMAKERS' CONSIDERATION[1]

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Introduction and background

Tax policy affects after-tax returns and influences business decisions on the level and types of investments in knowledge-based capital (KBC). Prior analyses of the taxation of KBC have focused on research and development (R&D) investments in terms of their positive externalities (spillovers) and their marginal effective tax rates. Most OECD countries subsidise business investments on R&D through tax credits for R&D expenditures, favourable allowances for R&D expenditures, and/or lower tax rates on R&D-generated income. This tax relief is often central to governments' efforts to foster private sector innovation and growth.

Prior analyses illustrated that significant tax relief on KBC is available to multinational enterprises (MNEs) using cross-border tax planning strategies (OECD, 2013a). International tax planning needs to be more fully integrated into consideration of whether targeted government support should be provided, how much should be provided, and the form and design of any public support.

While investment in R&D is important, it is not the only type of KBC contributing to labour-productivity growth. In the major countries studied, non-R&D KBC accounts for over 70% of total KBC investment and contributes more than half of the total contribution of KBC intangibles to productivity growth (Corrado et al. 2012). Non-R&D KBC generally does not have specific tax incentives, but investment in non-R&D KBC is affected by tax policy.

The tax treatment of KBC investment is affected by whether KBC investment is expensed (deducted 100% in the year of investment) or capitalised and then amortised over the life of the KBC investment. Effective tax rates can also be affected by the differences in the tax treatment of internally developed KBC investment versus acquired KBC. Effective tax rates are affected by whether expenditures are deducted immediately or at a later stage due to tax loss limitations.

These tax effects have an impact on whether KBC investment is made, how much KBC investment is made, where the KBC investment is made, who conducts the KBC investment and the form of the KBC investments made. Algebraic models of effective tax rates are important tools in analysing tax policy design, particularly forward-looking marginal effective tax rate (METR) models of investment. They are important in determining how much investment is made in competitive

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markets and they show differences in tax incentives or disincentives across different types of investments.

Increasingly, forward-looking METRs are supplemented with average effective tax rates (AETRs), which are important tax indicators in evaluating the effect on the choice between alternative investment projects or alternative geographical locations.[1] AETRs are also helpful in analysing finite KBC investments, investments with above-normal rates of return, and investments with multiple owners or less than full tax loss/credit offsets.

Some policy implications of the analysis are:

- Tax policy toward scientific R&D KBC uses a number of different tax instruments to encourage R&D with its expected domestic spillovers, including enhancing labour-productivity growth. But the design of tax incentives must be carefully designed to ensure the benefit all companies undertaking innovation investments, including SME's and start-up companies.

- While R&D KBC investments benefit from tax subsidies in many countries, other types of KBC investment generally do not have specific tax incentives. Non-R&D KBC may have potential positive spillovers, similar to the spillovers of R&D KBC, which might merit government incentives. The potential spillovers and potential incentives and their effectiveness require further investigation.

- Even in the absence of tax credits or other specific KBC incentives, KBC investments can be affected by a country's general tax rules with respect to depreciation and limitations on losses.

- Under certain circumstances, expensing (immediate write-off and relief) of capital investments can effectively eliminate income tax on such investments. However, this may not be the case for many intangible investments given their finite or lumpy nature, the above-normal returns from many of these investments, and the potential sale of KBC assets by innovators to producers. The statutory tax rates can be very important to innovators, more so than accelerated deductions or credits, in cases where the project's internal rate of return is above the investors' discount rates.

- In most countries, internally-developed KBC expenditures are generally deducted when incurred, but some internal development costs, such as capital investments may be capitalised.

- Lack of immediate refundability of tax incentives can reduce the value of those incentives for companies in a tax loss position, which is particularly problematic for start-up companies and some small firms.

- Externally acquired KBC is capitalised and depreciated over time. The different tax treatment of internally-developed KBC compared to externally-acquired KBC generally favours larger firms that have the ability to both innovate and commercialise through vertical integration. This disadvantages many firms, particularly small and medium-sized enterprises (SMEs) and start-up companies that don't have the capability to both innovate and manufacture the projects, but rather specialise just in innovation.

- Tax incentives lowering the tax rate on the income from KBC investments, such as intellectual property or patent boxes, can provide significant tax benefits to high-return KBC, equivalent to very high R&D tax credit rate, and potential opportunities for geographic income shifting without carefully designed rules to prevent harmful tax competition.

- Additional tax policy analysis and research is needed in this important area for both domestic and international investments of R&D and non-R&D KBC. If government encouragement of KBC is warranted, the design of tax policy and its incentives should maximise the effectiveness and reduce unintended consequences.

Non-R&D knowledge-based capital

R&D is often deemed to be one of the main sources of innovation and economic growth. Many governments provide favourable tax treatment to such investments. However, estimates of the total amount of intangible capital show that R&D capital represents only 30 per cent of the total intangible capital stock in many advanced economies.

Corrado et al. (2012), by using a cost-based approach, provide recent estimates of the intangible capital stock divided into three major categories: computer software, innovative property (which includes scientific R&D), and economic competencies. In 2010, innovative property accounted for slightly more than half of the total intangible capital stock, based on the unweighted average of countries in the analysis, as shown in Table 1, but non-innovative KBC accounted for over 45 percent of the total KBC capital stock.

Table 1: Major types of KBC capital as a percentage of total KBC capital stock for selected countries, 2010

	Computer software	Innovative Property	Economic Competencies
Austria	10.5%	58.4%	31.2%
Belgium	11.6%	47.1%	41.3%
Czech Republic	9.7%	56.7%	33.5%
Denmark	23.6%	52.2%	24.3%
Finland	14.2%	63.4%	22.4%
France	16.8%	51.9%	31.3%
Germany	9.0%	63.5%	27.5%
Ireland	8.6%	45.9%	45.5%
Italy	12.8%	53.3%	33.9%
Netherlands	15.1%	44.4%	40.6%
Slovenia	9.9%	59.8%	30.3%
Spain	19.5%	53.7%	26.9%
Sweden	17.4%	59.9%	22.8%
United Kingdom	17.6%	43.3%	39.1%
United States	9.4%	65.3%	25.4%
Average	**13.7%**	**54.6%**	**31.7%**

Source: Corrado et. al. (2012).

Corrado et al. (2012) also estimate the contribution to labour-productivity growth of intangible assets by the three major categories over the period 1995-2007 for a subset of countries. They find that intangible capital contributes between one-third and one-fifth of labour-productivity growth. Innovative property (which includes scientific R&D) contributes the largest fraction of productivity growth from KBC intangibles in Finland and the United States. Economic competencies (which include market research, advertising, training and organisational capital) contribute the largest fraction of productivity growth from KBC intangibles in the United Kingdom (see Table 2).

Table 2: Contribution of intangible and tangible assets to labour productivity growth for selected countries, 1995-2007

	Computer software	Innovative Property	Economic Competencies	Total Intangible	Total Tangible	Labour Composition	Multifactor Productivity	Labour Productivity Growth
Finland	0.2	0.4	0.2	0.7	0.2	0.2	2.6	3.8
France	0.2	0.2	0.2	0.6	0.4	0.4	0.4	1.9
Germany	0.1	0.1	0.1	0.3	0.7	0.0	0.7	1.7
Italy	0.1	0.1	0.1	0.2	0.5	0.2	-0.4	0.6
Netherlands	0.2	0.1	0.2	0.5	0.4	0.4	1.0	2.3
United Kingdom	0.2	0.1	0.3	0.7	0.8	0.4	1.1	2.9
United States	0.2	0.4	0.3	0.9	0.8	0.2	0.8	2.7

Source: Corrado et. al. (2012).

Other studies find that R&D is an important source of growth but suggest the role of other types of KBC is also relevant and should not be overlooked. For example, Cummins (2005), estimating the role of intangible capital on firms' rate of return, provides empirical evidence that organisational capital generates higher rates of return than R&D capital.

The major category of "innovative property" has been divided into four subcategories: scientific R&D, new architectural and engineering designs, new product development costs in the financial industry, and entertainment, artistic and literary originals plus mineral explorations. Table 3 shows that scientific R&D accounted on average for about 29% of the total intangible capital stock in 2010, ranging from 20% to 45%. Architectural and engineering designs are 17% of total intangible capital, while entertainment, artistic and literary originals are 6%, and new product development costs in the financial industry are 2%.

Table 3: Composition of innovation property as a percentage of the total KBC capital stock for selected countries, 2010

	Innovative Property KBC			
	Scientific R&D	New architectural and engineering designs	New product development costs in the financial industry	Entertainment, Artistic and Literary Originals + Mineral Explorations
Austria	40.9%	13.7%	1.3%	2.5%
Belgium	27.2%	15.8%	1.6%	2.5%
Czech Republic	20.0%	28.4%	1.3%	7.0%
Denmark	32.4%	14.9%	1.4%	3.5%
Finland	44.8%	13.5%	1.2%	3.9%
France	27.7%	18.3%	2.1%	3.8%
Germany	42.5%	15.0%	1.5%	4.6%
Ireland	21.4%	10.9%	4.8%	8.8%
Italy	23.1%	23.1%	2.1%	5.0%
Netherlands	21.2%	15.9%	2.8%	4.4%
Slovenia	22.8%	27.7%	1.9%	7.4%
Spain	21.8%	22.3%	3.4%	6.2%
Sweden	41.5%	15.8%	0.9%	1.6%
United Kingdom	19.7%	15.8%	2.3%	5.4%
United States	29.6%	9.1%	2.7%	23.9%
Average	**29.1%**	**17.4%**	**2.1%**	**6.0%**

Source: Corrado et. al. (2012).

Table 4 shows the composition of "economic competencies" KBC intangible assets. The largest is organisational capital accounting on average for 17% of total KBC assets. Training accounts for 8% of total KBC assets, followed by 5% for advertising expenditures and 2.5% for market research.

Table 4: Composition of economic competencies as a percentage of the total KBC capital stock for selected countries, 2010

	Economic Competencies			
	Market research	Advertising expenditure	Training	Organisational Capital
Austria	0.7%	5.3%	8.6%	16.6%
Belgium	8.5%	3.9%	5.2%	23.7%
Czech Republic	4.2%	7.7%	6.3%	15.2%
Denmark	1.3%	3.5%	11.9%	7.6%
Finland	0.8%	3.9%	4.8%	13.0%
France	1.8%	2.9%	8.7%	18.0%
Germany	1.2%	3.6%	9.4%	13.2%
Ireland	3.0%	10.7%	10.4%	21.4%
Italy	4.5%	4.3%	9.1%	16.0%
Netherlands	4.0%	3.3%	9.3%	24.0%
Slovenia	1.3%	7.8%	4.1%	17.2%
Spain	2.6%	7.1%	6.2%	11.0%
Sweden	0.8%	2.5%	5.2%	14.2%
United Kingdom	1.7%	3.2%	8.8%	25.4%
United States	0.8%	4.3%	6.7%	13.6%
Average	**2.5%**	**4.9%**	**7.7%**	**16.7%**

Source: Corrado et. al. (2012).

Rationales for tax incentives for KBC

The goals of a tax system are to raise the needed revenue in an equitable, economically neutral, growth enhancing, administrable, and certain manner. These goals often involve trade-offs. Tax incentives to offset potential underinvestment from market failures in one area may be growth enhancing and move toward greater economic neutrality, but may be difficult to administer and create greater uncertainty. Different tax treatments of types of investments or types of companies to enhance economic growth may result in unfairness or economic distortions.

R&D investments, as well as other KBC investments, enable productivity and process innovation, and can be key drivers of labour-productivity growth, as shown above in Table 2. While most businesses naturally innovate as part of their profit-maximising strategy, many governments are keen to promote additional growth by attempting to accelerate the innovation process by providing incentives for private R&D. Part of the productivity enhancement of R&D and other KBC investments are the spillover benefits or positive externalities that arise from KBC investment. The social return from many KBC investments exceeds the private return to the initial private sector innovator because not all of the benefits are captured by the innovator.

The positive spillovers from KBC often occur when employees leave one company and take their knowledge and experience to other companies, industries or countries. When employees or management who undertake R&D or other KBC investment move to other firms, they help their new firms innovate and achieve productivity gains. Similarly when employees who help embed R&D or other KBC into the production of goods and services move, the total social return from the initial investment in the employees is not fully captured by the initial innovator that made the investment. Their competitors or other industries receive some of the higher returns from increased productivity. Spillover benefits can also occur when KBC, much of which is not patented or protected by other intellectual property rights, is copied by other firms.

Positive spillovers also arise from the fact that some KBC can be used simultaneously by multiple users without significantly diminishing the productivity of the KBC. The "non-rival" nature of intangible assets in production can generate economies of scale, further reinforced by positive network externalities created when the benefit from a network rises with the number of users. Over time, KBC depreciates in economic value as new innovations supersede old innovations.

The same arguments that motivate favourable tax treatment of R&D could apply to the other types of KBC. Indeed, the aforementioned characteristics of R&D are actually common to many other types of intangible assets. For example, software can be used simultaneously by more than one user. Human capital and employee training are not solely firm-specific and the skills learned can be transferred to other firms.

While several studies have found positive externalities from scientific R&D,[2] the extent to which social returns exceed private returns for other types of KBC is not clear. If private returns are significantly lower than their social returns, then firms may under-invest (relative to a socially optimal level) because some of the benefits accrue to other participants in the economy. To the extent that tax incentives benefit consumers or employees rather than the investors in KBC, then these incentives may not result in additional KBC investment. To the extent that a government's tax incentives benefit the initial investors, but do not provide an incentive for additional investment in that same country, then it is questionable whether the incentive is achieving its intended purpose (OECD, 2013a).

If the returns to KBC investment are almost fully captured by the private sector investors, a government incentive may not be a worthwhile investment given the alternative opportunities for the government to enhance innovation and growth. Some have questioned whether certain types of KBC, such as advertising and brand development, have social returns greater than the private returns (Atkinson, 2013).

Tax incentives for KBC which aim at internalising the external effects will not necessarily result in businesses undertaking investments that have the highest social returns. Incentives in some cases can result in investments which are not profitable without the support of tax expenditures. While these may lead to positive spillovers, it does not guarantee that those projects yield the highest social returns.[3]

Additional research is needed to better understand and measure potential spillover benefits from KBC, their source, size and value, and how they are affected by tax policy.

The tax treatment of knowledge-based capital

The tax treatment of KBC investments varies by the type of investment, whether it is internally-developed or externally-acquired, and across countries. The tax rules are very complex and more detailed analysis of the tax rules for specific intangible investments across countries is needed.

Tax credits for R&D investments are available in most OECD countries,[4] but are not provided for other types of KBC. Favourable income tax rates on income from certain types of intellectual property (i.e., so-called "patent boxes") are available in some countries, but are not provided for other types of KBC. It should be noted that differential tax rates can encourage misreporting of income and expenses to benefit from a lower tax rate or tax credit, and the international tax rules associated with intangible assets, including both R&D and non-R&D KBC can provide significant tax relief to income earned by MNEs engaging in certain tax planning that separates taxable income from the location of its value creation.[5]

For most non-R&D KBC investments, the biggest tax issue is the treatment of capital cost recovery. For many intangible assets that are internally-developed or self-constructed, the investment is often available to be written off fully in the year of the investment (i.e., expensed) for tax purposes, however, there are many exceptions. For example, several countries require research costs to be capitalised, and several additional countries require development costs to be capitalised and depreciated over time.[6] Other internally-developed KBC investments may be expensed or capitalised and depreciated depending on the country, and depending on the particular intangible asset.

Several recent studies have calculated economic depreciation patterns for KBC investments (Corrado, 2012, OECD 2013b; BEA 2013). KBC investments are multi-year assets which decline in value over time, so are not equivalent to immediate expenses nor non-depreciable goodwill or land. In its 2013 comprehensive revision of its National Accounts, the US Bureau of Economic Analysis capitalised investment spending on research and development plus entertainment, literary, artistic originals, in addition to the previously capitalized investments in computer software. Custom and own-account software is assigned a 33% rate of depreciation, compared to around 10% for movies and books. R&D rates of depreciation range from 10% for pharmaceutical and medicine manufacturing to 40% for computer and peripheral equipment manufacturing (BEA, 2013).[7]

Acquired intangible assets are generally considered to be fixed assets subject to individual tax depreciation, similar to the treatment of fixed tangible assets. The depreciation period is typically the useful life for which the intangible asset enjoys legal protection or for which the right to the intangible was granted. Most countries use straight-line depreciation over the useful life or a statutory fixed period, either for all acquired intangibles or for specific acquired intangible assets. Some countries have the same rules for internally-developed and acquired intangibles.[8]

Where intangible assets cannot be separately identified as part of an acquisition, they may be included in the value of goodwill. Acquired goodwill is capitalised in all countries, but in some countries does not qualify for tax depreciation. In those cases, the value of acquired goodwill reduces taxable income only upon disposition or when the goodwill has been impaired. In some countries, acquired goodwill is depreciated the same way as specific acquired intangibles, but often has a longer recovery period than other intangible assets.[9] In 1993, the United States required the same 15 year recovery period for acquired intangibles and goodwill to reduce tax controversy and simplify tax administration, compared to identifying and valuing specific types of acquired intangibles.

As part of business tax reforms to lower the corporate tax rate through base broadening, some countries are considering requiring capitalisation and depreciation of internally-developed intangibles. For instance, the Chairman of the House Ways and Means Committee in the United States recently proposed that R&D expenditures be capitalised and depreciated straight-line over five years, and certain advertising expenditures be capitalised and depreciated by 50% in the first year with the remaining 50% amortised straight-line over 10 years. The proposals recognise that intangible assets provide a value to a business over more than a single year, and that the costs of assets should be recovered over their useful life,[10] unless accelerated depreciation is intended to provide a tax benefit to offset a market failure.

One of the reasons why expenditures incurred in producing internally-developed intangibles are expensed in many countries is for administrative simplicity. Expensing avoids the necessity of defining specific separate intangible expenses and determining a realistic depreciable life and recovery pattern.

Although a large proportion of R&D expenditures are for wages and salaries, some depreciable tangible capital is used as well as purchases from outside vendors in the development of R&D and

other KBC investments and in the production of the goods or services within which the KBC is ultimately embedded. While wages and salaries are expensed in the process of developing internally-generated KBC in most countries, the equipment and buildings used as part of the KBC production are generally subject to general tax depreciation rules. In addition, some countries provide an enhanced allowance for R&D wage expenses or a credit against payroll tax, withholding tax or social security contributions of the employers for KBC workers.[11] The analysis below does not factor in the depreciable capital used in the KBC development process or payroll based tax incentives.

Effective tax rates on knowledge-based capital

Tax policy analysis of capital taxation typically focuses on the impact of taxation on a marginal investment, earning a competitive rate of return and zero economic rent. These studies assume that firms invest up to the point where the discounted present value of the investment's cash flow equals the discounted present value of the investment's costs, taking into account grants and allowances, given to the project. In the case of project involving zero economic rent, investors earn their minimum required rate of return which equals the cost of financing.

This assumption is realistic for many types of investments, particularly physical capital investments and some types of KBC. Investment in advertising would appear to be incremental (with positive and decreasing marginal productivity) where a firm chooses the scale of its advertising investment such that the marginal return of the last unit of capital invested equals the marginal cost of financing.

To measure the tax wedge on R&D used in production at the margin, OECD (2013) investigated the case where R&D spending increases the probability of "success" in developing a technology that can be used in production. Under the methodology used in that study, if the initial R&D investment was "successful", the technology resulting from the R&D investment was treated as having been embedded in the physical capital used for the production of the ultimate product or service, and therefore the intangible asset was not considered an independent capital good. Thus, the effective tax rates did not just relate to the R&D investment, but related to a combination of both the intangible and tangible capital used in the production process.

Marginal effective tax rate (METR) analysis is appropriate when the aim is to investigate the effects of tax distortions on the level of KBC investment. However, investments in intangible assets often do not occur in marginal or competitive settings. Some KBC investments are lumpy and finite; the initial R&D, design, training or brand may be undertaken on an "all-or-nothing" basis rather than incrementally determined. Many KBC investments produce unique products, which may place those making the KBC investment in a privileged position within the market, either by entitling them to the monopoly rents that arise from holding a patent or, at least, the temporary benefits of first-mover advantage. Moreover, small or medium-sized enterprises (SME) might only be able to manage and finance one investment project rather than a portfolio of research ideas. In that case, KBC is often developed by one company and sold to a third-party for further development and production. The rate of return of the last unit of capital invested could in these cases be higher than the competitive "normal" return assumed by standard analysis and higher than the next best alternative investment in which to invest the returns from the KBC. To evaluate the tax burden of investment in these types of finite, above-normal return, and transactional investments, an algebraic METR calculation can miss important dimensions.

Average effective tax rates on knowledge-based capital

To more fully capture the specific features of KBC investments and important details of the tax rules, this analysis uses a discrete project model to calculate average effective tax rates (AETRs). Two alternative AETRs are calculated to reflect differences in the types of KBC and their economic settings. The Annex provides a more detailed description of the AETR modelling.[12]

The first alternative, AETR(IRR), takes the ratio of the pre-tax internal rate of return (IRR) less the after-tax IRR divided by the pre-tax IRR. The AETR(IRR) is similar to the conventional marginal effective tax rate analysis, which assumes zero economic profit, so the return on the after-tax return on the investment equals the investors' minimum required discount rate.[13] In the discrete project modelling, AETR(IRR) assumes the project's after-tax rate of return equals the investors' minimum required rate of return, which implicitly assumes that the reinvested earnings from the investment can generate the same return as the initial investment. The AETR(IRR) produces the result that immediate deductibility of an investment with full tax refundability results in a zero effective tax rate, irrespective of whether the investment earns a "normal" rate of return or an above-normal rate of return.

The second, AETR(PV), takes the ratio of the present value of taxes to the present value of pre-tax income. The AETR(PV) is similar to the Devereux-Griffith EATR which calculates the average tax rate on economic rent.[14] The present values are calculated at a 5% discount rate rather than at the higher IRR earned on the KBC. The AETR(PV) should be considered to be more appropriate for the analysis of the tax burden in cases of lumpy, non-diversified KBC investments, where the innovators are deciding to undertake one investment rather than an alternative investment. The innovators are likely to expect to earn high-rates of return on their investment, but are unlikely to be able to reinvest the earnings at the same high rate of return due to investment or financing constraints.

AETRs and investors' investment opportunities

The two alternative AETRs capture different investment opportunities. The AETR that is most appropriate for tax analysis will depend on the type of KBC, the types of investors, the type of investment decision, and the scope of the market.

The AETR(IRR) is more likely to be an accurate representation of the expected tax burden when companies are investing in a single competitive market or when they have a portfolio of many different risky investments. In the case of most tangible property investments, the markets are competitive and investors will continue to invest until the last (marginal) investment earns their minimum required rate of return. If a company is investing in a unique KBC investment, but has the resources to have a large portfolio of risky investments, it will likely continue to invest until the marginal investment earns the minimum required rate of return.

The AETR(PV) is more likely to be an accurate representation of the expected tax burden when companies are investing in unique capital investments or investments that are expected to earn rates of return significantly higher, such as from some potential monopoly power from patents or other market advantage, than the next available investments. Many innovators and start-up companies face investment or financing constraints: they have one unique idea, or due to a lack of scale or financing are unable to invest in more than one capital investment at a time. These investments are made with the expectation of earning an above-average rate of return. Their next best alternative investment is likely to be a financial investment or another business opportunity earning a competitive rate of return.

The difference between the two situations can be expressed in terms of the investors' discount rate, used to value the future cash-flow stream. In the AETR(IRR), the investor's discount rate is the same as the rate of return on the capital investment. In the AETR(PV), the investor's discount rate is more likely to be a weighted average cost of capital, or simply the market borrowing rate, which could be significantly below the project's expected rate of return. Differences in discounting of the after-tax cash flows can affect the AETR.

The AETR(PV) tends to show higher tax rates, closer to the statutory tax rate, when evaluating accelerated timing provisions, compared with AETR(IRR). This result occurs because the AETR(PV) does not discount future income as much as the AETR(IRR), particularly for assets with above-normal returns. This is consistent with an approach where accelerated tax deductions are treated in a similar way to an interest-free loan.

Both AETRs can incorporate the tax relief associated with the provision of tax credits, accelerated tax deductibility of the KBC investment, and lower tax rates on the future income, not just for the initial innovator but also for subsequent owners of the KBC. The analysis can incorporate the potential delay in the timing of tax credits and deductions, which is important for many start-up businesses.

There are many different types of effective tax rates. Many AETRs are based on historical data comparing taxes paid with profits earned from public companies' financial statements. These "backward-looking" AETRs are different than the "forward-looking" project-based AETRs presented below. These forward-looking project AETRs show the same results as a METR when using the same parameters, but have more flexibility when undertaking sensitivity analysis of different economic and tax policy scenarios.

AETRs on different types of knowledge-based capital

This analysis only focuses on the effective tax rate on the development and resulting income of alternative intangible assets.[15] The investment in KBC, when successful, produces an independent intangible asset that can be used in the production of goods and services by the innovator or sold to a third-party for commercialisation. Considering a purely domestic setting, Table 5 shows the two average effective tax rates for three types of KBC: scientific R&D, computerised information, and organisational capital. The AETR for R&D is shown with and without a 5% R&D tax credit. In all cases, the KBC is internally-developed, rather than externally-acquired.

Table 5: Average effective tax rates on R&D with and without tax credit and other selected internally-developed KBC

Knowledge-based capital investment	AETR (IRR)	AETR (PV)
R&D with 100% expensing and no tax credit	0.0%	20.8%
R&D with 100% expensing and 5% tax credit	-7.0%	18.0%
Computerised information KBC with 100% expensing	0.0%	20.8%
Organisational capital KBC with 100% expensing	0.0%	20.8%

Note: The AETR calculations assume a statutory tax rate of 25%, a pre-tax return (net of depreciation) of 30%, economic depreciation rates are presented in Table 6, a discount rate of 5%, and immediate refundability of tax credits and tax losses.

Table 5 shows the significant difference between the AETR(IRR) and the AETR(PV). Expensing with full refundability can be characterised as the government sharing in the losses and income of private investors, reducing both the after-tax investment and the future income by the statutory tax rate. Thus, the after-tax IRR is the same as the pre-tax IRR, resulting in a zero effective tax rate. However, if the discount rate used by the investor is different than the rate of return earned on the investment, then investors can feel burdened by the taxes collected on future income since the net present value of the taxes on future income is greater than the net present value of the benefit of the accelerated tax deductions.

The AETR(PV) is below the statutory tax rate in these examples (20.8% without a tax credit), since the pre-tax return on the KBC is relatively high at 30%. In the case of the AETR(IRR) and expensing, the statutory tax rate of a country does not matter. It could be 10% or 90% and the AETR(IRR) remains at 0%. The statutory tax rate, however, is very significant for the AETR(PV) on high return investments even with expensing. A high statutory tax rate will discourage companies from developing KBC in a country even if it offers immediate expensing if taxpayers are evaluating the cash flow streams with discount rates below the project's pre-tax rate of return (i.e., earning above-normal returns or economic profits).

Additional research is needed to better understand investors' evaluation of effective tax rates. It has been noted that many investors do not place a high value on accelerated tax deductions since for corporate financial statement purposes, expensing or accelerated deductions do not reduce financial statement effective tax rates or after-tax reported profits. Expensing can be important for firms that are financially-constrained and need the cash-flow (if it is available through refundable credits or the firm has other taxable income and tax liabilities to be offset by losses and credits), but otherwise expensing only changes the composition of financial statement total tax expense from current to deferred tax expense.[16]

As noted in OECD (2013a), MNEs may be able to significantly reduce the METR on KBC, including R&D, through various types of international tax planning. Such international tax planning would have a similar effect on both of the AETRs presented. Particularly where taxable income can be separated from the geographic location of the real KBC investment, MNEs can gain a competitive advantage over other MNEs which are not aggressive in their international tax planning and over domestic competitors which do not have the same opportunities to reduce their tax rate through international tax schemes. The OECD Base Erosion and Profit Shifting (BEPS) project has an Action Plan (OECD, 2013c) to significantly curtail such international tax planning, so marginal and average effective tax rates for MNEs will be closer to those of domestic corporations.

Differences in AETRs on KBC with different tax depreciation treatment

Table 6 compares AETRs for three types of KBC investments with different tax depreciation rules. Although many countries allow internally-developed KBC to be immediately expensed (deducted 100% in the year of investment), some countries require KBC expenditures to be capitalised and depreciated over their useful life or over a statutory recovery period. As described above, externally-acquired KBC is capitalised and depreciated. The AETR will depend on the capitalisation and depreciation tax treatment of the KBC investment.

The table illustrates several important points:

- When tax depreciation rules are the same as economic depreciation, then the AETR is equal to the statutory tax rate, under both AETR calculations. When the year in which an investment is deducted for tax purposes aligns with the year when the cost of depreciation can be imputed, then taxable income equals the pre-tax profit over the life of the assets, everything else held the same.

- If companies benefit from an investment tax credit, then the AETR will be lower than the statutory tax rate. An upfront tax credit reduces the AETR(IRR) more than the AETR(PV) since the credit is a higher percentage of the discounted future income stream in the case of the AETR(IRR).

- When tax depreciation is accelerated compared to economic depreciation, then the AETR(PV) is higher than the AETR(IRR). This is particularly true in the case of expensing.

- When tax depreciation is slower than economic depreciation, then the AETR(PV) is slightly lower than the AETR(IRR).

Table 6: AETR on different types of KBC with different tax depreciation rules

Type of KBC	Economic Depreciation	Tax Depreciation	Tax credit	AETR (IRR)	AETR (PV)
Scientific R&D	7.7% SL - useful life 13 years	expensed	NO	0.0%	20.8%
		useful life	NO	25.0%	25.0%
		SL 10 years	NO	23.1%	24.3%
		expensed	5%	-7.0%	18.0%
		useful life	5%	20.4%	22.1%
		SL 10 years	5%	18.4%	21.4%
Computerised information	33% SL - useful life 3 years	expensed	NO	0.0%	20.8%
		useful life	NO	25.0%	25.0%
		SL 5 years	NO	31.0%	26.9%
Organisational Capital	10% SL - useful life 10 years	expensed	NO	0.0%	20.8%
		useful life	NO	25.0%	25.0%
		SL 15 years	NO	28.1%	26.5%

Note: The AETR calculations assume a statutory tax rate of 25%, a pre-tax return (net of depreciation) of 30%, economic depreciation described below, and a discount rate of 5%.

Recent estimates (OECD, 2013b) show the useful life of organisational capital is between 7 and 10 years. If organisational capital is depreciated for tax purposes over 15 years (as in the case of an acquisition of a business in the United States), then the AETR(PV) is 26.5%, which is higher than the statutory corporate tax rate.

Tax effect on choice of internally-developed or externally-acquired KBC

Companies have the choice of developing internally their own KBC or acquiring KBC from a third-party. Many companies benefit from the synergies of developing their own KBC in combination with their production, marketing and distribution. A vertically-integrated company may be able to earn significantly higher returns from their internal KBC investments as a result of the synergies across the company's different functions. For example, the marketing department may better focus the company's R&D on consumers' needs. The production department may better focus the company's R&D on innovative production efficiencies.

Other companies may choose to acquire KBC from a third-party that is not able to or prefers not to take the product or service to market. Many small bio-technology companies invest in new drug opportunities, and if successful sell the company or the KBC to a larger pharmaceutical company. Many small high-technology companies sell the company or their KBC to larger companies.

The tax treatment of internally-developed KBC can differ from the tax treatment of acquired KBC. In a number of countries, internally-developed KBC is expensed (written off in the year the investment is made) while acquired KBC must be capitalised and depreciated over future years.

In addition, the sale of KBC generally triggers a taxable gain for the seller, which often is not matched by an offsetting immediate deduction of the purchaser, so tax on the value of the KBC is accelerated. When a firm sells an intangible asset that has been expensed, it is subject to tax on the

entire selling price. If the intangible asset has been capitalised, there may be an undepreciated basis, which reduces the amount of the capital gain.

Table 7 shows the AETR in the case where a company develops KBC and then sells it to a third-party acquirer, who may be better positioned to produce, market and distribute the good or service with the embedded KBC.

The acquiring firm must capitalise and depreciate the acquired KBC. In this case, the acquirer faces an AETR equal to the statutory rate if the amortisation and the economic depreciation rates are equal. If the amortisation rate is higher than the economic depreciation rate, the AETR is below the statutory tax rate.

Tax rules should be neutral with respect to different business models, absent some significant market failure, since companies will be in the best position to determine whether internally-developed KBC or acquired KBC provides the highest market return. Tax rules may have some unintended incentives or detriments, due to tax administration issues, such as the difficulty of valuing businesses on an accrual rather than a realisation basis or the difficulty of determining the economic depreciation of different types of KBC assets.

Table 7 compares the two alternative business models: 1) a vertically-integrated firm uses internally developed KBC in its production, and 2) a company develops KBC, the company or KBC is sold to a third party, and the acquirer then uses the KBC in production. The table shows that the AETR in both cases is below the statutory tax rate, but the internally-developed KBC has a lower AETR than the externally-acquired KBC. The difference is quite large in the case of AETR(IRR), but not nearly as large in the case of AETR(PV).

Table 7: Effective tax rates on internally developed KBC vs acquired KBC

Internal vs. external KBC development	**AETR (IRR)**	**AETR (PV)**
Internally-developed KBC for production	0%	22.5%
Externally-acquired KBC for production	17.3%	25.0%

Note: The model assumes that the KBC is developed over a period of three years and used in production if internally developed, or is sold at the beginning of the fourth year and used by an acquirer in their production. Calculations assume immediate refundability of tax losses.

Thus, the tax rules often provide more benefits to larger companies that can support internally-developed KBC as part of a vertically-integrated firm. The tax rules provide an incentive for internal development of KBC when it might be more economically efficient to have a separate company develop the KBC and sell it to an acquirer.[17] Countries that have the same depreciation rules for internally-developed and externally-acquired KBC reduce this tax distortion, although the imposition of any capital gains tax on the sale of the KBC will also distort the business choice.

Effect of tax credit and loss carry forwards

Most countries while encouraging R&D do not allow companies to get tax refunds if they do not have a tax liability from their operations. This is often done to ensure that companies are operating legitimate for-profit businesses, but in some cases is done to reduce the cost of incentives and to target the incentive to successful firms. Countries generally allow corporations to carry forward unused tax credits and tax losses to use against future tax liabilities.

The deferral of the benefit of tax credits and deductions can significantly reduce their value to investors. In particular, accelerated depreciation is a timing issue which increases the present value of tax depreciation deductions. If the accelerated deductions cannot be used immediately, then the value of the acceleration is lost. Similarly, if a tax credit cannot be claimed until three years after the creditable expenditure has been made, then the present value of the tax credit as a percentage of the eligible expenditure is reduced by the time value of money. For firms that are not successful, tax credits and deductions may have little or no value. Haufler et al. (2011) find that limited loss offset provisions encourage entrepreneurs to undertake less risky projects. Some firms may not be able to recognise the financial statement benefit of tax credits or tax deductions if the tax benefits are not able to be carried forward and utilised in the foreseeable future.

Some countries are starting to recognise the adverse effect of non-refundable (wasteable) tax credits on their incentive value. In some countries, certain tax credits are refundable, or can be used as a credit against non-corporate income taxes, or can be converted to a government grant. Sometimes smaller companies may choose to remain in non-corporate form so the individual investors can take the deductions or credits against other taxable income or other income tax liability rather than having the tax benefits trapped in the corporate entity.

Table 8 shows the increase in the AETRs when tax losses from expensing are not immediately refundable. In the case of KBC that is developed then sold, the developing firm's AETR increases from 0% to 21.8% in the case of the AETR(IRR) and from 25.0% to 29.1% in the case of the AETR(PV). A similar effect occurs in the case of internally-developed KBC, which is used by a vertically integrated firm in its production. The increase without full refundability is smaller in the case of internally-developed KBC since the fact pattern has taxable income earned sooner to offset the losses. The effect of loss carryforwards is smaller in the case of AETR(PV) again since the upfront losses are less important relative to the future income when the discount rate is lower.

Table 8: Effective tax rates with full refundability of tax losses versus if tax losses have to be carried forward

Development of KBC scenarios	AETR (IRR)	AETR (PV)
Development of scientific R&D KBC then sale		
Expensing with immediate refundability	0.0%	25.0%
Non-refundable with loss carry forward	21.8%	29.1%
Internally-developed KBC plus production		
Expensing with immediate refundability	0.0%	22.5%
Non-refundable with loss carry forward	11.9%	23.4%

Note: See appendix for the underlying model of development and sale of KBC and internally-developed KBC plus production. Assumes no tax credit.

Larger companies are also more likely to be able to immediately benefit from accelerated deductions and tax credits, compared to smaller or start-up companies, since their larger mature operations are more likely to be generating positive tax liabilities. These tax issues are not unique to KBC investments, but apply to any type of government incentives provided through the income tax system.

Investment incentives vs. income incentives

With increased policy focus on mobile high-return KBC intangible assets, a number of countries are providing tax benefits not only through tax credits and accelerated or additional deductions of

KBC investment expenditures, but also lower tax rates on the future income from those investments. As the return to investments increases, the value of accelerated deductions or tax credits tied to the investment expenditure decreases in relative value in the case of the AETR(PV). A 5% tax credit based on R&D investment expenditures reduces the project's AETR(PV) much more when the project is expecting a 10% return on investment versus when the project is expecting a 30% return on investment.

15 OECD countries plus 2 partner countries have enacted so-called intellectual property or patent boxes which provide lower corporate income tax rates from investments in certain types of intangible assets.[18] The income tax rate reduction only benefits firms that are profitable and certain types of income from certain intangible assets. Appelt et. al. (2016) show some of the detail of the IP box designs. Several feature affecting the effective tax rates include whether there is recapture of prior IP development expenses and the treatment of IP losses, whether taken at ordinary or IP box tax rates. If expenses can be deducted at the higher ordinary tax rate while income is taxed at the lower rate, the asymmetric treatment will cause the average effective tax rates to be negative.

Table 9 shows the investment tax credit equivalent of an IP box with a 5% tax rate (compared to a general corporate tax rate of 12.5%, 20% and 35%), when the investment is earning a 30% pre-tax return.[19] The greater the difference between the IP box rate and the ordinary corporate tax rate, and the greater the pre-tax rate of return, the larger the tax incentive is, expressed as an equivalent tax credit on the investment.

In this example, the investment tax credit equivalent rate increases from 11% at an ordinary 12.5% corporate tax rate, to 22% at a 20% tax rate, and to 44% at a 35% tax rate, when income and expenses are taxed at the same rate, treated symmetrically. If income is taxed at the lower rate, but expenses or losses are able to offset other income at the higher ordinary tax rate, the tax credit equivalent increases to 19%, 38% and 75%, respectively[4]. The investment tax credit equivalents are smaller in the case of AETR(IRR), since the IRR has a higher discount rate on the future lower taxed income than the AETR(PV). The tax credit equivalent is zero for a symmetric lower tax rate on IP income using the IRR approach, since expensing reduces the AETR(IRR) to zero irrespective of the tax rate on the income. The present value approach where the discount rate is lower than the above-average return shows the expected positive benefit of the patent box provision.

[4] Another way to treat IP losses is to allow deduction of IP losses at the ordinary rate, but once the IP related income becomes positive, such income will not be taxed at the reduced rate up to the amount of IP losses used to offset ordinary income. This approach is less beneficial to companies, both in terms of AETRs and tax credit equivalent, than the asymmetric treatment of expenses approach but more beneficial than the case of symmetric treatment of expenses.

Table 9: Average Effective Tax Rate and Tax Credit Equivalent of Lower Tax Rate on Scientific R&D

Tax Depreciation	IP Box status	AETR (IRR)	AETR (PV)	Tax credit equivalent (IRR)	Tax credit equivalent (PV)
Ordinary rate: 12.5%, IP Box rate 5%					
Expensed	No IP Box	0.0%	10.4%	0.0%	0.0%
Expensed	Yes with **symmetric** treatment of expenses	0.0%	4.2%	0.0%	10.9%
Expensed	Yes with **asymmetric** treatment of expenses	-11.3%	-0.3%	9.2%	18.7%
Econ deprec.	No IP Box	12.5%	12.5%	0.0%	0.0%
Econ deprec.	Yes with **symmetric** treatment of expenses	5.0%	5.0%	7.5%	13.0%
Ordinary rate: 20%, IP Box rate 5%					
Expensed	No IP Box	0.0%	16.7%	0.0%	0.0%
Expensed	Yes with **symmetric** treatment of expenses	0.0%	4.2%	0.0%	21.8%
Expensed	Yes with **asymmetric** treatment of expenses	-24.7%	-4.9%	17.4%	37.7%
Econ deprec.	No IP Box	20.0%	20.0%	0.0%	0.0%
Econ deprec.	Yes with **symmetric** treatment of expenses	5.0%	5.0%	15.0%	26.2%
Ordinary rate: 35%, IP Box rate 5%					
Expensed	No IP Box	0.0%	29.2%	0.0%	0.0%
Expensed	Yes with **symmetric** treatment of expenses	0.0%	4.2%	0.0%	43.6%
Expensed	Yes with **asymmetric** treatment of expenses	-60.2%	-13.9%	30.4%	75.2%
Econ deprec.	No IP Box	35.0%	35.0%	0.0%	0.0%
Econ deprec.	Yes with **symmetric** treatment of expenses	5.0%	5.0%	30.0%	52.4%

Note: Assumes 30% pre-tax return net of economic depreciation; economic depreciation of 7.7% SL - useful life 13 years; and 5% discount rate

Income tax rate reductions can provide significant tax benefits for profitable firms undertaking KBC.[20] As the prior OECD (2013a) tax analysis of R&D noted, international tax planning could reduce the effective tax rates on such R&D investments further into negative territory and the host country may not benefit from as much of the potential positive spillovers if the tax benefits are not closely linked to the real economic activity underlying the KBC returns. Preferential tax regimes, which provide lower tax rates on particular types of income, but previously without an economic nexus to the country providing the tax incentives, are addressed in the G20/OECD Base Erosion and Profit Shifting Project Action 5 (Countering harmful tax practices) (OECD, 2015a).

Further research and analysis required

This analysis, plus the prior OECD analysis (2013a) on cross-border tax planning strategies of MNEs on R&D investment, extends the tax analysis of KBC beyond simply looking at R&D incentives and immediate expensing of internally-developed intangible assets.

With the increasing importance of KBC investment and its returns, tax policy can play an important role in encouraging KBC where it has clear and significant positive spillover benefits to the

economy and society. Research on the spillover effects of non-R&D KBC investments is an important area for future research. Identification of potential market failures in the areas of non-R&D KBC should be a necessary condition for government intervention.

The tax rules for KBC include some specific incentives for R&D investments, including tax credits, enhanced deductions and lower tax rates on income. Definitions of eligible expenditures and income vary across the countries, as do the tax incentive designs. Non-R&D KBC investments do not have specific tax incentives, but the tax rules involving capitalisation and depreciation vary significantly by the type of KBC and by country.

Additional analysis is needed of the economic depreciation of different types of KBC investments, since recent analysis suggests significant differences in the rate of economic depreciation not only across different KBC but also across industries.

Some countries require capitalisation and depreciation of internally-developed KBC, while most allow immediate expensing. When considering tax reforms that lower the tax rate financed by base broadening, the accelerated depreciation of long-lived KBC investments will be under consideration. Requiring capitalisation of internally-developed KBC raises important issues of the effect on KBC investment, the appropriate depreciation lives and pattern, and the definitional issues for tax administration.

The design of tax policy affecting KBC investments is also in need of additional research. As shown in the prior OECD analysis (2013a), cross-border tax planning can significantly affect the tax benefits provided to KBC investment and have unintended consequences, including upon the competitiveness of MNEs with aggressive tax planning versus other MNEs and domestic competitors. Similarly, the current domestic tax rules affecting KBC investments can disadvantage smaller and start-up companies due to wasteable tax credits and the rules around the carrying forward of losses and deductions. In combination with the current favourable treatment of internally-developed KBC, the extent to which the tax system is distorting the efficient production of KBC investment should be subject to future research.

Annex A

OVERVIEW OF AVERAGE EFFECTIVE TAX RATE MODELLING OF KBC

AETRs are helpful in policy analyses when looking at the total tax burden on alternative investment projects and locations, especially when the project earns more than a "normal" return due to a unique, discrete or non-competitive economic situation. The AETR calculations, similar to the METR calculations, depend on the specific parameters underlying the calculations.

This annex shows the AETRs calculations of three fact patterns:

- A KBC investment in organisational capital with a 10 year straight-line annual economic depreciation rate to illustrate the AETR(IRR) and the AETR(PV) calculation where tax depreciation is the same as economic depreciation.

- A similar KBC investment to the first case to illustrate the tax effect of expensing with immediate refundability on the AETRs, and the effect of limitations on tax losses with carry forwards.

- A KBC investment with a three-year development period to compare AETRs of internally developed and externally acquired KBC.

Example of AETR calculation with tax and economic depreciation the same

Table A1 shows in the first column the pre-tax cash flow of a firm which invests 100 in organisational capital in the first year. The investment over the next ten years earns a declining stream of revenue due to its 10 year straight-line annual economic depreciation rate. The intangible investment earns a pre-tax internal rate of return of 30%, net of depreciation. Annual depreciation is 10 and the statutory corporate tax rate is 25%. The after-tax cash-flow is shown in the far right column.

The AETR (IRR) is computed as the difference between the pre-tax rate of return (30%) and the after-tax rate of return (22.5%) divided by pre-tax rate of return, resulting in a 25% AETR, equal to the statutory tax rate, since economic and tax depreciation are assumed to be the same.

The AETR (PV) is the ratio of the net present value of taxes (34.2) and the net present value of profits (136.7), assuming a 5% discount factor. Again, the AETR is equal to the statutory corporate income tax rate of 25%, since economic and tax depreciation are the same.

Table A1: Average Effective Tax Rates on KBC Investment with Tax Depreciation Equal to Economic Depreciation

Year	Pre-tax cash flow	Tax Depreciation	Taxable Income	Tax	After-tax cash flow
0	-100		0	0	-100
1	40	10	30	8	32
2	37	10	27	7	30
3	34	10	24	6	28
4	31	10	21	5	26
5	28	10	18	5	23
6	25	10	15	4	21
7	22	10	12	3	19
8	19	10	9	2	17
9	16	10	6	2	14
10	13	10	3	1	12
IRR	30.0%				22.5%
AETR IRR				25.0%	
PV(5%) taxes				34	
PV(5%)profits				137	
AETR PV				25.0%	

Example of expensing with refundability versus carryforward of tax losses

Table A2 compares the same investment in organisation capital as in Table A1, but illustrates the effect of expensing (immediate write-off) with refundability of losses and expensing but with tax limitations and carryforward of unused tax losses until there is tax liability. With expensing the tax deduction for the capital investment occurs in year 0 rather than over the life of the asset.

With immediate expensing and refundability (as shown in the left section of Table A2), the after-tax cash-flow is 75% of the pre-tax cash flow, since the corporate tax rate of 25% reduces both the cost of the investment and the net income received. In this case the pre-tax IRR is 30% and the after-tax IRR is 30%, so the AETR(IRR) is 0% [(30%-30%)/30%]. This is consistent with the argument that in the case of expensing with immediate refundability, the government is a partner in the investment sharing both the cost and the revenue.

However, if the firm cannot immediately receive the tax refund, but must wait until it has taxable income against which to use the initial investment's deduction (as shown in the right section of Table A2), then after-tax cash flow is not proportional to the pre-tax cash flow. The after-tax IRR is 25.6% compared to the pre-tax IRR of 30%, so tax has lowered the investor's IRR by 4.4 percentage points for an AETR(IRR) of 14.5% [(30%-25.6%)/30%].

The present value of the tax payments in this example is 28 with expensing and immediate refundability, but it increases to 31 if the tax losses must be carried forward. The AETR (PV) under full refundability is 20.8% and it increases up to 22.4% if the loss has to be carried forward.

Table A2: Average Effective Tax Rates on KBC Investment from Expensing Comparing with Immediate Refundability and Loss Carry-forwards

	Immediate refundability					Loss carry-forward			
Year	Pre-tax cash flow	Tax Depreciation	Taxable Income	Tax	After-tax cash flow	Tax Depreciation	Taxable Income	Tax	After-tax cash flow
0	-100	100	-100	-25	-75	100	-100	0	-100
1	40	0	40	10	30	0	0	0	40
2	37	0	37	9	28	0	0	0	37
3	34	0	34	9	26	0	11	3	31
4	31	0	31	8	23	0	31	8	23
5	28	0	28	7	21	0	28	7	21
6	25	0	25	6	19	0	25	6	19
7	22	0	22	6	17	0	22	6	17
8	19	0	19	5	14	0	19	5	14
9	16	0	16	4	12	0	16	4	12
10	13	0	13	3	10	0	13	3	10
IRR	30.0%				30.0%				25.6%
AETR IRR				0.0%				14.5%	
PV(5%) taxes				28				31	
PV(5%)profits				137				137	
AETR PV				20.8%				22.4%	

Example of internally-developed versus externally-acquired KBC

Table A3 illustrates the difference between internally-developed and externally-acquired KBC. The internally-developed example (on the left side of table) is a vertically-integrated company that invests 300 in each of the first three years. The company uses the KBC in production which increases its revenue by 366 for the next 15 years, thereby providing a 30% pre-tax IRR.

The externally-acquired KBC case (on the right side of the table) has a company investing the same 300 in the first three years for the development of the KBC, which it then sells the KBC to a third-party producer for 1556. The sale provides a 30% IRR to the innovator. The third-party producer sells the produced goods or services for the same price as the internally-developed case in years 4-18.

Assuming expensing and full refundability of the KBC investment, the AETR(IRR) of the internally-developed is zero, similar to the expensing case shown in Table A2. The AETR(PV) is 22.5%, slightly higher than the expensing example in Table A2 because of the different fact pattern.

The externally-developed and acquired KBC case has a different after-tax cash flow due to two factors. First, the innovating firm has to pay tax on the capital gain from the sale of the KBC in year 4. The additional taxable income is the full sales price since the initial investments had already been deducted. Second, the acquiring firm has to capitalise and depreciate the acquired KBC (straight-line over 15 years) so the tax liability in years 4-18 is lower that the internally-developed case.

The upfront tax liability due to capitalisation reduces the after-tax IRR to 24.8%, for an AETR(IRR) of 17.3% in the case of externally-acquired KBC, compared to 0% for internally-developed KBC.

The AETR(PV) on the acquired KBC is 25%, the statutory tax rate, given the assumption that the tax depreciation is the same as economic depreciation in this case. The AETR(PV) also shows the favoured status of internally-generated KBC (22.5%) relative to acquired KBC (25%), but the tax differential is smaller than with the AETR(IRR).

Table A3: Average Effective Tax Rates Comparing Internally-Developed With Externally-Acquired KBC Investment

		Internally developed				Externally Acquired			
Year	Pre-tax cash flow	Tax Depreciation	Taxable Income	Tax	After-tax cash flow	Tax Depreciation	Taxable Income	Tax	After-tax cash flow
1	-300	300	-300	-75	-225	300	-300	-75	-225
2	-300	300	-300	-75	-225	300	-300	-75	-225
3	-300	300	-300	-75	-225	300	-300	-75	-225
4	366	0	366	92	275	104	1,819	455	-88
5	366	0	366	92	275	104	263	66	301
6	366	0	366	92	275	104	263	66	301
7	366	0	366	92	275	104	263	66	301
8	366	0	366	92	275	104	263	66	301
9	366	0	366	92	275	104	263	66	301
10	366	0	366	92	275	104	263	66	301
11	366	0	366	92	275	104	263	66	301
12	366	0	366	92	275	104	263	66	301
13	366	0	366	92	275	104	263	66	301
14	366	0	366	92	275	104	263	66	301
15	366	0	366	92	275	104	263	66	301
16	366	0	366	92	275	104	263	66	301
17	366	0	366	92	275	104	263	66	301
18	366	0	366	92	275	104	263	66	301
IRR	30.0%				30.0%				24.8%
AETR IRR				0.0%				17.3%	
PV(5%) taxes				648.1				740.0	
PV(5%)profits				2885.4				2960.0	
AETR PV				22.5%				25.0%	

In the case of externally acquired, in year 4 the taxable income is given by the sum of the price of the asset earned by the developer plus the revenue net of tax amortisation earned by the producer. The tax amortisation rate for the producer is assumed to equal the economic depreciation rate.

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Notes

1 Devereux and Griffith (1998a and 1998b) conclude the average effective tax rate is a more appropriate tax measure, than marginal effective tax rate, to evaluate the effect of taxation on the choice between alternative investment projects. Once the investor has chosen one project, having evaluated the associated total amount of after-tax economic rent, the scale of the investment depends on the marginal effective tax rate.

2 Wolff (2011).

3 If KBC investments provide high expected rates of return to innovators, then tax incentives may not be needed to stimulate additional investments. However, the expected return before undertaking an investment project might be considerably smaller than the ex-post return of a successful investment. Therefore, tax incentives may play an important role in encouraging risky KBC investments.

4 OECD (2013b).

5 OECD (2013a). Chapter 2 "Taxation and knowledge-based capital."

6 Spengel and Zollkau (2012), p. 58-59.

7 Economic depreciation of an intangible asset depends on the intellectual property rights regime, if applicable. If the rights granted by a patent (or by other type of IP) are extensive, economic depreciation could occur over a longer time period. Economic depreciation may be endogenously determined by firms or governments, such as firms requiring employees leaving the firm to pay back training and education costs.

8 Ibid, p. 65-67.

9 Ibid, p. 68.

10 U.S. House Ways and Means Committee Chairman David Camp's tax reform proposal: http://waysandmeans.house.gov/uploadedfiles/ways_and_means_section_by_section_summary_final_022614.pdf

11 Palazzi (2011).

12 The analysis assumes equity financed investment and no equity relief at the corporate level.

[13] The AETR(IRR) provides similar results to the King-Fullerton METR by assuming no economic rent, but provides more flexibility to evaluate loss carryforwards and sales of the investment over the economic life of the investment.

[14] Devereux and Griffith (1998a). The AETR(PV) calculation is similar to the Devereux-Griffith EATR, which calculates the difference between the present value of the pre- and post-tax economic rents divided by the present value of the pre-tax income stream. The AETR(PV) takes the difference between the present value of the pre- and post-tax income streams divided by the present value of the pre-tax income stream. The difference is the tax on the so-called "normal" or required rate of return. The two are highly correlated especially when the "normal" return is low. The AETR(PV) does not require an assumption about the "normal" rate of return in addition to the discount rate.

[15] The OECD (2013a) analysis examined the case where KBC investment was embedded into tangible production property, and thus the effective tax rates were an average of the intangible and tangible investments.

[16] Neubig (2006).

[17] Companies undertaking internally-developed KBC face the risk of unsuccessful investments compared to companies that are acquiring proven successful KBC.

[18] Appelt et. al. (2016).

[19] The investment tax credit equivalent is calculated by adjusting the tax credit rate until the AETR with the credit and 25% corporate tax rate is the same as the AETR with no credit and a 10% corporate tax rate, everything else the same. The project is a single investment in year 1 which produces the different pre-tax returns over the following 24 years. Tax depreciation is set equal to economic depreciation to avoid issues of tax loss carryovers. The discount rate for the AETR(PV) is 5%.

[20] Ernst et al. (2014) assess the effect of R&D tax incentives on the quality of the resulting innovation (i.e. their innovativeness and earning potential) rather than on quantity. They provide empirical evidence that reduced tax rates on patent income improves the quality of the innovation; tax credits and tax allowances seem instead to exert a negative effect on investment quality.