Chapter 2.

Taxation and knowledge-based capital

Effective tax rate measures of the tax burden on investment in R&D typically focus on the tax treatment of R&D expenditure, including the availability of R&D tax credits or allowances. This chapter reports work on identifying common cross-border tax planning strategies used by MNEs to avoid tax on returns from R&D, and incorporating these strategies in a new effective tax rate (QETR) model analysing effects of domestic and international tax policies on the tax burden on R&D, firm behaviour and tax revenues.

Tax policy affects after-tax returns and may influence business decisions on investment in research and development (R&D) to create knowledge-based capital (KBC) and on the use of KBC in production. Through R&D tax credits or allowances, many OECD countries subsidise business expenditure on R&D. Indeed, tax relief of this kind is often central to efforts to foster innovation and growth. As emphasised in this chapter, significant tax relief on returns on KBC is available to multinational enterprises (MNEs) using cross-border tax planning strategies. A key message is that international tax policies and cross-border tax planning should be taken into account when measuring the tax burden on R&D by MNEs, and in assessing the design and behavioural effects of R&D tax incentives.

In spite of tax rules designed to protect the tax base, MNEs can often largely avoid domestic tax on income earned from the use of KBC, for example by assigning economic ownership of KBC to offshore holding companies. MNEs typically operate as integrated global businesses and are able (within the limits of the law) to exploit differences in tax systems and rates across countries and significantly reduce their overall tax bill. Because such tax planning is widespread in industries such as information and communications technology (ICT) and pharmaceuticals, for which KBC is crucial and MNEs are major players, this aspect must be addressed.

Owing in part to pressures to provide internationally competitive tax treatment, countries are generally reluctant to impose "controlled foreign company" (CFC) rules that tax on a current basis (rather than a deferred or exempt basis) royalty income received by offshore holding companies of resident MNEs. Moreover, it is difficult for tax authorities to establish an appropriate arm's-length price for transfers of KBC within a multinational group, as the characteristics of KBC often mean that there are neither similar transactions nor observable prices between unrelated parties. There are obvious risks that the managers of MNEs, possibly better aware of the value of KBC to the profitability of their businesses, may under-report its value in order to minimise their corporate tax burden.

It is difficult to make robust estimates of the global scale of profit shifting to no-/low-tax countries through MNE tax planning strategies that involve KBC, but the magnitudes appear to be significant. For example, research suggests that the corporate tax revenue cost to the US, in 2004, due to income shifting by US-based MNEs may be as high as USD 60 billion (approximately 35 per cent of corporate tax revenues), with possibly half of it due to aggressive transfer pricing of KBC-related transactions (Clausing, 2009).

Estimates of the tax burden (effective tax rate) on R&D tend to focus on the "pure domestic" case where KBC from domestic R&D is used in domestic production. While such estimates factor in R&D tax incentives, they largely ignore the international dimension of tax policy and overlook the effects of MNEs' tax planning behaviour. A main objective of the work on taxation undertaken in the New Sources of Growth project has been to identify common cross-border tax planning strategies of MNEs that use KBC in production and to incorporate these in a model analysing the effects of domestic and international tax policies on the tax burden on R&D, firm behaviour and tax revenues.

The OECD Centre for Tax Policy and Administration (CTPA) has developed a new effective tax rate (QETR) model for assessing tax burdens and examining the influence of domestic and international tax policy on business decisions to undertake R&D, where to hold KBC (e.g. patents) resulting from R&D, and where to locate production using it. The model captures effects of R&D tax credits and allowances, domestic "patent box" regimes that lower tax rates on income from KBC (to discourage the migration of KBC offshore), and common cross-border tax planning strategies, including tax avoidance on royalty income. These are important considerations, given the evidence that such tax planning is now widespread among MNEs (in some sectors more than others).

The overall objective of the project, with main findings presented here, is to assist countries in their efforts to assess how tax policy can most cost-effectively encourage investment in knowledge based capital. While the work presented here offers a new perspective, it needs to be more fully integrated into analyses of the broader questions of whether targeted government support should be provided, and if so, how much support should be given, to what types of KBC, and how public support is best provided (what policy instruments). The answers to these questions require other evidence and analyses to be brought together with more empirically based analyses, including further applications of the new QETR model.

Policy context and project objectives

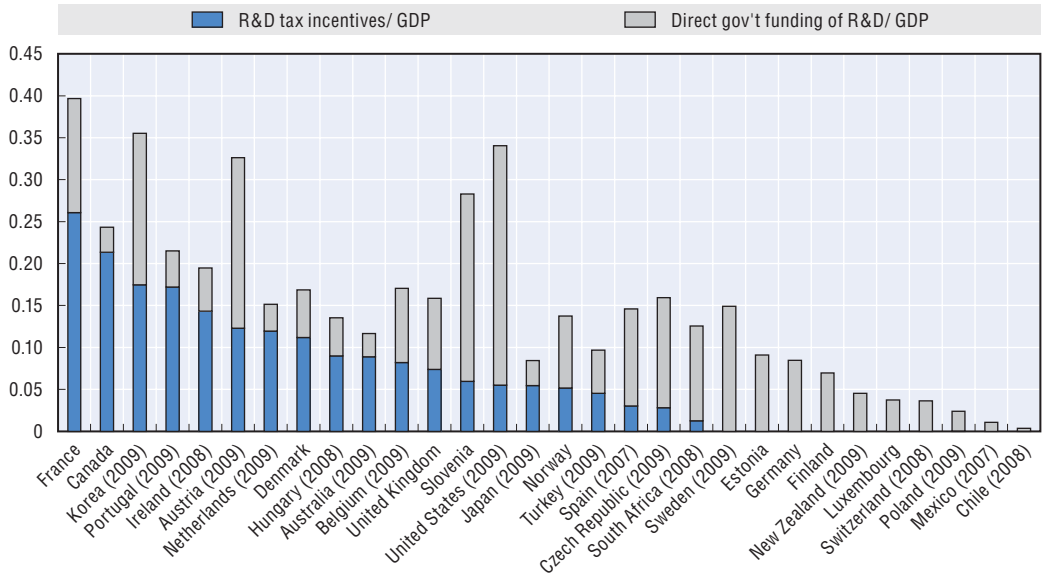
With numerous studies pointing to spillover benefits of R&D for the economy and the importance to growth of KBC, many countries offer up-front tax incentives that subsidise R&D expenditure.[1] As Figure 2.1 indicates, 24 OECD countries provided R&D tax credits or allowances in 2010 (double the number in 1995). Some countries also have "patent box" regimes that lower tax rates on income of resident taxpayers derived from KBC, including royalty income from patents. Today, governments face severe budget constraints and need to be sure that subsidies for R&D are worthwhile. This calls for systematic evaluation of tax relief measures in order to assess the continuing validity of their rationale and objectives and whether their targeting and design remain appropriate and intended outcomes are being achieved.

Assessment of the full scale of tax relief provided to R&D and predictions of behavioural responses require consideration not only of the tax treatment of R&D expenditure but also of the income earned on KBC created by R&D. Multi-national enterprises (MNEs), for example, use cross-border tax planning strategies – in particular, profit-shifting opportunities – to avoid corporate tax and obtain very high levels of overall tax relief on investment in R&D. The effects of such strategies are not captured by conventional effective tax rate measures. Incorporating these effects is an important complication, as there is considerable evidence that such tax planning is now widespread in industries such as pharmaceuticals and computer and electronic equipment manufacturing, where KBC is crucial and MNEs have a major market presence or even dominance.

International tax policies may result in the migration of economic ownership of KBC and intellectual property management activity to offshore holding companies, and encourage the use of KBC in foreign rather than domestic production. Resulting losses in domestic tax revenues and smaller domestic benefits from R&D weaken the case for special subsidies for R&D expenditure, including R&D tax credits and allowances. At the same time, relative to MNEs, stand-alone R&D performers (firms that are not part of a MNE group and thus without foreign affiliates to engage in cross-border tax-planning) may be placed at a competitive disadvantage relative to MNEs for undertaking R&D. In some cases this may inhibit the creation of KBC.

Figure 2.1. Direct government funding of business R&D (BERD) and tax incentives for R&D

Budget impact as a percentage of GDP; 2010 or latest available year



Notes: Countries ranked from highest to lowest R&D tax incentives/GDP. R&D tax incentives do not include sub-national incentives. Direct government funding includes grants and public procurement of R&D and excludes repayable loans. Figures are not shown for Greece, Israel, Italy, the Slovak Republic, China and the Russian Federation, which provide R&D tax incentives, but cost estimates are not available. For the United States, direct government funding of R&D includes defence spending on R&D by the government in the form of procurement contracts or the subcontracting by government agencies of non-classified projects to private firms. That is, it includes only R&D spending not directly performed by national or publicly funded institutions (e.g. military laboratories etc). If a project is conducted by the private firm in direct collaboration with the government, publicly funded institutions or universities, only the part that is done by the private firm and paid to her would be included. This figure is also included in Chapter 1 as Figure 1.17.

Source: OECD, Main Science and Technology Indicators (MSTI) Database, June 2012; OECD R&D tax incentive questionnaires of January 2010 and July 2011; OECD (2011), *OECD Science, Technology and Industry Scoreboard 2011*, OECD Publishing, doi: http://dx.doi.org/10.1787/sti_scoreboard-2011-en; and national sources.

It is particularly difficult for tax authorities to establish an appropriate arm's-length price for transfers of KBC within an MNE, as the characteristics of KBC often mean that there are no similar transactions or observable prices between unrelated parties. There are obvious risks that managers of a MNE, possibly better aware of the value of KBC to the profitability of their business, may under-report its value in order to minimise corporate income tax. Also, owing in part to pressures to provide internationally competitive tax treatment, countries are often reluctant to impose controlled foreign company (CFC) rules that tax on a current basis (rather than a deferred or exempt basis) royalty income received by offshore holding company affiliates of resident MNEs.

Some countries have introduced "patent/innovation box" rules which partly exempt from domestic corporate tax income derived from the use of KBC, including royalty income on licences. Such rules may discourage MNEs from locating economic ownership of KBC offshore. Of concern is that they may be used by MNEs for base erosion and profit-shifting (BEPS) purposes and result in significant foregone corporate tax revenues. The behavioural effects are unclear and depend on a number of factors. For example, MNEs may continue to have incentives to use offshore holding and finance companies to avoid tax on royalties (depending on patent/innovation box exemption rates) and interest income.

Designing cost-effective policies to promote innovation in a globalised economy in which KBC and MNEs play a major role is an enormous challenge. The intrinsic characteristics of KBC themselves create particular challenges for tax policy. For one, because of their intangible nature, intellectual assets may be developed in one country, held in another and used for production in a third. As noted, they are also hard to value when they are shifted between affiliates of an MNE, resident in different locations (owing to the absence of a market to gauge an arm's-length price). Transfer pricing challenges also concern other intangibles, such as brand names. All of this has made it easier for MNEs to shift profits between tax jurisdictions and harder for tax authorities to establish where profits have been earned and to tax them accordingly.

The liberalisation of trade and capital flows, technological and telecommunications developments and the increasing integration of emerging and developing economies in the global economy have heightened these concerns. These developments have had important effects on the structure and management of MNEs, which have shifted from country-specific operating models to global models. In today's MNEs the different companies of the MNE operate within a framework of group policies and strategies. These policies and strategies are likely to include managing the tax liabilities of the group as a whole, including by shifting profits between tax jurisdictions.

Against the backdrop of these developments and growing concerns over aggressive tax planning by MNEs (BEPS), international tax systems are being re-examined. A particular issue is the limited taxation of profits generated by KBC, given the relatively low cost and ease of moving intangible assets, including intellectual property, between the tax jurisdictions in which MNEs operate and the difficulties involved in pricing such assets.

These developments have led to a substantial gap in the analytical tools ("metrics") for assessing tax effects on R&D. To address this gap, standard theory on effective tax rates (ETRs) on investment projects (widely recognised in the public finance literature and used in ministries of finance in member countries) has been extended in the new QETR model to capture the impact not only of R&D tax credits and allowances but also of domestic "patent box" regimes for taxing returns to R&D. Common MNE cross-border tax planning strategies that involve KBC have also been identified and incorporated. The model is used to understand how domestic and international tax rules influence the tax burden on R&D, and to assess how taxation may influence decisions about how much R&D to undertake, where to locate economic ownership of KBC, and where to undertake production that exploits it.

A better understanding of MNEs' tax planning opportunities and implications for corporate decisions on where to locate economic ownership of KBC and where to use it in production, as well as implications for tax collections, has become a pressing issue. So far, the analysis has focused on illustrative examples under plausible parameter settings. Future work will incorporate OECD country-specific domestic and international tax policies and parameters and will examine effective tax rates on intangible and tangible capital, identify tax distortions, and explore the scope for efficiency and revenue-enhancing reforms.

Overall, the findings to date strongly suggest that the effects of international tax rules and tax avoidance strategies should be factored into tax burden assessment, despite the complexities involved. If substantial tax revenues, domestic productivity gains, and knowledge spillovers from R&D do not accrue to the country providing tax subsidies for R&D, some redesign of R&D tax incentives and tax allowances and, indeed, of the wider tax regime may need to be considered.

Market failure and productivity arguments for tax relief for R&D

In general, a neutral corporate income tax system is desirable, one that does not distort choice among investment projects. Under a neutral system, capital tends to be invested in line with pre-tax returns, with all projects meeting the same pre-tax "hurdle rate of return" at the margin. However, many OECD countries offer corporate tax incentives that lower the after-tax cost of R&D and thereby lower the hurdle rate of return, tending to stimulate R&D expenditure. Depending on their scale, R&D tax incentives may significantly offset the discouraging effects of corporate income tax (CIT) on investment. Indeed, if R&D incentive rates are set high enough, they may encourage R&D expenditure beyond levels that would be observed in the absence of tax.

As shown in Figure 2.1, many OECD countries offer up-front R&D tax incentives to spur R&D. A main reason is that KBC resulting from R&D enables productivity and process innovation, driving growth. While firms normally innovate as part of their profit-maximising strategy, governments keen to promote growth may wish to accelerate the innovation process. An additional rationale rests on the positive externality (spillover benefit) argument that, in the absence of subsidies for R&D, firms would tend to under-invest (relative to a socially optimal level) because they generally do not include in their R&D investment decisions the various benefits from their R&D that spill over into the economy.

Two properties of R&D and KBC have particularly positive implications for growth. First, benefits from investment in many forms of KBC flow not only to R&D investors in the form of returns on investment but also to others. For example, the staff who undertake R&D gain knowledge and experience which generates spillover benefits when they move to other firms, innovate and help achieve productivity gains. While the core spillover benefits from R&D may be those derived from R&D activity, secondary benefits may come from incorporating KBC into production. Such spillover benefits include the knowledge and experience gained by employees involved in embedding KBC into production. Such skills are also transportable.

Second, the cost incurred in developing KBC through R&D is not incurred again when KBC is used repeatedly in production. Software and product designs, for example, may be used simultaneously by many users without diminishing their productivity ("non-rivalry"). This can create economies of scale, with the effects on productivity reinforced by the positive network externalities created when the benefit from the network rises with the number of users. Such externalities are particularly prevalent in industries intensive in KBC, such as ICT.

Thus governments are generally keen to encourage R&D to realise domestic spillover benefits and drive growth. However, spillover benefits from R&D are increasingly global. Skilled R&D staff may be highly mobile and decide to relocate away from the jurisdiction where they performed tax-assisted R&D. Also, production activities of MNEs are becoming more global, with fewer and fewer restrictions on trade and investment and reduced transport, telecommunications and other trans-border business costs. With foreign production, there may be corresponding losses of domestic spillover benefits from R&D in the form of less knowledge and experience gained by workers from process innovation (involving the incorporation of new KBC in production). MNEs may in fact be encouraged to exploit KBC in low-tax foreign production and locate economic ownership of KBC in tax-favoured (offshore) holding company locations. Both effects could imply a tax-induced loss of potential spillover benefits and tax revenue. In some cases, such losses would tend to weaken the case for R&D tax credits for MNEs.

Evidence and elements of cross-border tax planning

A main objective of the study has been to identify common elements of cross-border tax planning strategies involving the use of KBC in production and to incorporate these in the QETR model.

Systematic and publicly available evidence on tax planning by MNEs is very limited, although tax authorities potentially have much more information available from taxpayer data. Much of the available evidence is for the United States, which makes such data publicly available, and suggests large amounts of offshore profits in sectors that use KBC intensively in production.

In particular, a 2011 report by the US Senate Subcommittee on Investigations gives a detailed account of the response to a tax provision introduced in the 2004 America Jobs Creation Act that provided a one-time reduction in US corporate tax on the repatriation of offshore profits.[2] This provision prompted the repatriation of USD 362 billion of dividends qualifying for tax relief. In the absence of this provision, significant amounts of US tax would have been payable on low-taxed foreign earnings, if repatriated, under the US worldwide tax system (with relatively low foreign taxes on foreign earnings achieved partly through complex tax planning strategies). The provision was aimed at encouraging US MNEs to repatriate such earnings, rather than invest them offshore, to promote domestic investment and employment.

Figure 2.2 shows cash dividends received by US-based MNEs, disaggregated by country of residence of the distributing controlled foreign company, while Figure 2.3 disaggregates the data by industry of the parent and by industry of the distributing CFC. The US study reports, as shown in Figure 2.3, that USD 289 billion (or roughly 80% of the USD 362 billion of dividends repatriated) were received by US manufacturing MNEs. Of this, USD 168 billion was paid directly by foreign manufacturing CFCs to their US parents, and USD 121 billion through other channels, including offshore holding companies.

Figure 2.2. Cash dividends of US MNEs on outbound FDI, repatriated under the one-time dividend received/corporate tax deduction provision, 2004-06

(millions USD)

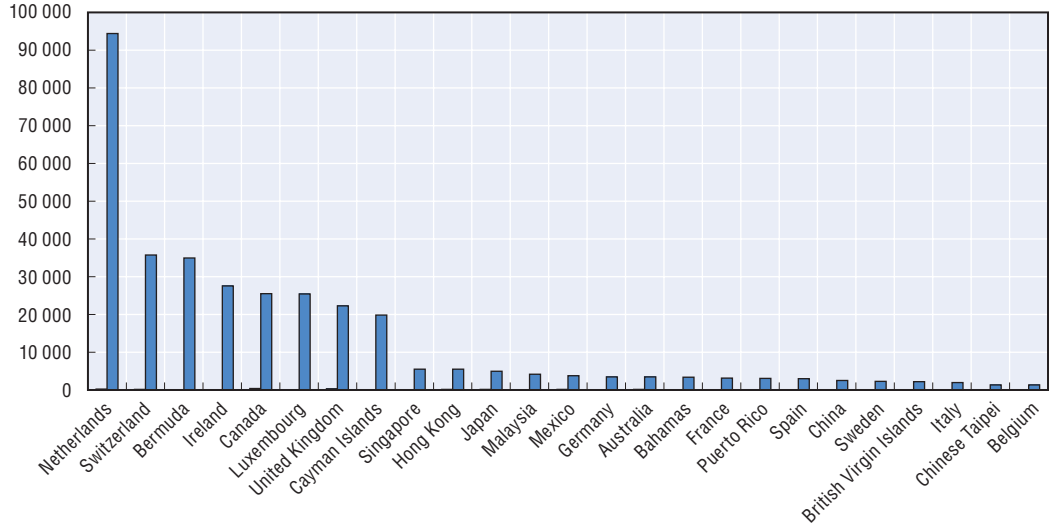


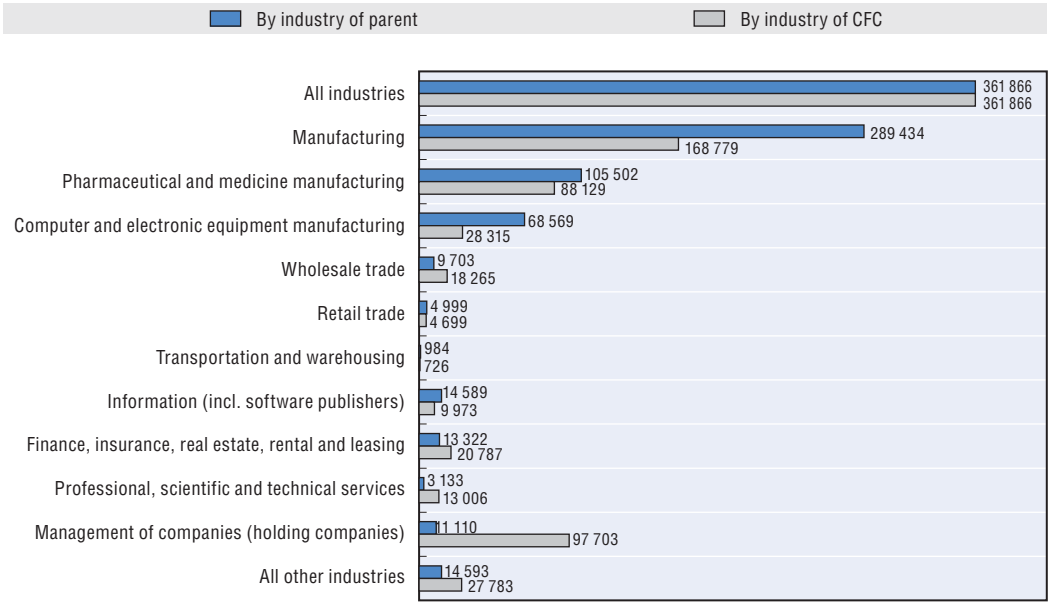
Chart shows data for the top 25 countries (where aggregate cash dividends exceeded USD 1.3 billion).

Source: US Internal Revenue Service (IRS), Statistics of Income Division.

Over USD 174 billion was received by MNEs in the pharmaceutical and technology manufacturing industries, where KBC is a key income-producing asset. In particular, USD 106 billion was received by MNEs in pharmaceutical and medicine manufacturing industries, and USD 69 billion by MNEs in computer and electronic equipment manufacturing industries. Of the 15 MNEs with the largest dividend repatriations, ten were in these manufacturing industries, and five (Pfizer, Merck, Hewlett-Packard, Johnson & Johnson, and IBM) accounted for 28% of total repatriations.

Figure 2.3. Cash dividends of US MNEs by industry of parent and by industry of CFC repatriated under the 2004-06 dividend received deduction

(millions USD)



Source: US Internal Revenue Service, Statistics of Income Division.

The US Senate Subcommittee investigation also reported that these repatriations came largely from jurisdictions with no corporate tax or otherwise attractive CIT regimes that enabled tax avoidance. Of the 19 companies accounting for the bulk of repatriations, seven repatriated between 90% and 100% of their offshore profits from jurisdictions with such regimes, another six repatriated between 63% and 89% of offshore profits, and another two between 30% and 39%.

To the extent that the available evidence (mostly from the United States) is representative, it points to the need for more systematic collection by other countries of data on cross-border related-party (inter-affiliate) royalty and interest flows. It also points to the need for more analytical and modelling work to assess rates of tax on investment in innovation more comprehensively, to inform strategies to counteract profit shifting and to promote innovation.

Based on reports of tax planning strategies and discussions with experts, the following common elements of cross-border tax planning involving the use of KBC in production were identified:

- Locating production in foreign host countries with an attractive (i.e. relatively low) statutory corporate income tax rate and possibilities to reduce or eliminate non-resident withholding tax at source on royalties, dividends and interest remitted abroad to another company in an MNE group (e.g. through the use of conduit entities).
- Reducing foreign (host country) corporate tax by increasing deductions against the host country corporate tax base (e.g. using tax-deductible royalty and interest payments), and through methods to reduce gross profit (e.g. risk stripping).
- Reducing domestic corporate income tax on the ultimate parent company – through the use of offshore holding and finance companies, conduits/intermediaries, preferential regimes, hybrid entities and hybrid instruments – on royalty income, interest income and profit.
- Using transfer pricing practices involving related-party transactions in knowledge capital (i.e. transfers of economic ownership, licences).
- Reducing domestic corporate tax using deductions for interest on funds borrowed to finance FDI that generates exempt or deferred foreign income.[3]

Metrics and main findings from the QETR model

The new QETR model measures tax wedges and corresponding effective tax rates (ETRs) as summary indicators of the tax burden on investment in R&D and the use of KBC in production. As described in Annex 2.A1, a "tax wedge" measures the difference between pre- and post-tax returns on investment at the margin. A positive (negative) tax wedge implies that taxation discourages (encourages) investment.

A main objective of the development of the QETR model is to provide summary tax burden indicators that account for the tax treatment of expenditures on R&D and income derived from the use of KBC in production.[4] In particular, the QETR metrics (tax wedges and ETRs) factor in R&D tax credits and allowances on R&D expenditure, as well as statutory tax relief from "patent box" regimes and reductions in domestic (home country) and foreign (host country) tax achieved by MNEs from various cross-border tax planning strategies.

The indicators are formula-based and thus provide a transparent means of examining how the details of international and domestic tax rules factor into tax burden assessment. One use of the indicators is to examine features of tax law that create differences in the tax burden for different taxpayer groups (e.g. the tax burden on R&D investment by MNEs versus that of stand-alone firms not part of an MNE group). Another is to assess the change in tax burden resulting from tax policy reform (e.g. reducing the R&D tax credit rate), or the tax policy required to achieve a given tax burden (e.g. the R&D tax credit rate that neutralizes the impediment to R&D resulting from corporate taxation of returns on investment).

A related application is the use of QETR metrics to assess how domestic and international tax policies may influence investment location and scale decisions. To varying degrees, R&D, intellectual property (IP) management and certain production activities employing KBC are geographically mobile, and MNEs' decisions about their location and the amount of capital to invest may be sensitive to tax policies affecting net returns on investment.

In general, IP management may be the most mobile and thus most sensitive to tax, to the extent that pre-tax profit determinants (e.g. management costs) are largely similar in alternative locations. Decisions on the location of R&D may also be sensitive to tax, particularly if R&D skills and facilities are supplied at similar pre-tax costs in alternative locations. As regards production, for certain outputs, key variables relevant to decisions on the location of production (e.g. transport and distribution costs) may vary significantly across locations so that tax considerations are not decisive in location choice. However, for other outputs (e.g. pharmaceuticals, electronic products), pre-tax returns may be similar and tax considerations may play a more decisive role.

The QETR metrics may be applied to assess possible tax distortions related to the location and scale of investment activity. By themselves, average effective tax rates indicate tax distortions that favour one location over another (with mobile investment attracted to relatively low-tax locations). For scale effects, tax wedges and corresponding marginal effective tax rates indicate the direction of bias. When combined with elasticity estimates of the sensitivity of investment to tax (derived from statistical analysis of investment data), they may be used to assess the percentage change in levels of investment when tax policy changes.

While R&D may be undertaken in the home country of the parent of a MNE, or in the country of a foreign affiliate or in more than one location, the QETR model assumes that R&D is carried out in the home country and assesses QETR metrics (tax wedges, ETRs) relevant to assessing tax effects on MNE decisions with respect to:

- the level of R&D
- the location of economic ownership of KBC
- the location of KBC used in production, i.e. home country vs. a foreign (low-tax) country
- the level of investment in physical capital used in production.[5]

As noted above, by itself the model indicates the direction of bias (e.g. whether tax encourages or discourages R&D relative to the no-tax case and under different uses of KBC), without measuring the level or percentage amounts by which investment is affected by tax.

An R&D tax wedge – measuring the (minimum) pre-tax net return on R&D that is just sufficient to pay corporate tax (see Box 2.A1.1 in Annex 2.A1) – is used to assess the tax burden on R&D, and tax effects (bias) on the level of R&D undertaken, relative to the no-tax case. The larger the tax wedge, the larger the tax burden on R&D and the larger the predicted negative effect of tax on the level of R&D. Taxation is predicted to be neutral and not distort R&D decisions when the average effective tax rate on economic profit derived from the use of knowledge in production ($AETR^*$) matches the effective rate at which R&D costs are offset by tax relief, in which case the R&D tax wedge is zero.[6]

The effective tax burden on production and possible tax distortions to the choice of where to locate KBC in production are assessed using an average effective tax rate on economic profit ($AETR^*$), calculated for different locations (home vs. foreign country). The $AETR^*$ is calculated as the present value of tax on royalties and profit (earnings in excess of royalties), divided by the present value of pre-tax economic profit. Tax policy is predicted to encourage investment in production in a location with relatively low $AETR^*$, and thus higher after-tax return, under the assumption of a fixed pre-tax rate of return. For

each location, a marginal effective tax rate (METR) is derived to assess tax distortions to the profit-maximising level (scale) of investment in physical capital in that location.

Based on illustrative results from the QETR model, the main findings are:

- In many countries, overall tax relief for R&D (particularly that of MNEs) may be greater than governments intended when they designed support of R&D expenditure. Analysis based on the QETR model suggests that when tax planning strategies to avoid tax on returns are taken into account, MNEs may obtain a much larger than intended tax subsidy for their investment in R&D, and the post-tax return on R&D spending may exceed the pre-tax return.
- Compared to MNEs, stand-alone R&D performers (firms that are not part of a MNE group, and thus without foreign affiliates to engage in cross-border tax planning) may be placed at a competitive disadvantage. This disadvantage in terms of scope for tax planning may be more pronounced for business start-ups that are not part of a MNE group and have not yet generated taxable income to make immediate use of R&D tax credits (if they are non-refundable). The absence of a level playing field may make it more difficult for such firms to compete with MNEs. This may inhibit knowledge creation, as such firms may have particular strengths as R&D performers (e.g. in creating radical innovations). The analysis strengthens the case for targeting R&D tax credits to SMEs, in particular those that are not part of a multinational group. This approach is supported by OECD analysis performed under the New Sources of Growth project which shows that the productivity impacts of fiscal incentives are unclear, possibly because they may favour incumbents at the expense of more dynamic young firms.

  If countries do not choose to target R&D tax credits, they may decide instead to consider scope for curtailing profit shifting by MNEs to level the playing field without significant negative impacts on innovation activity. OECD work on base erosion and profit shifting (BEPS) will provide a collaborative framework for developing appropriate reforms to international tax systems (OECD, 2013).
- No-/low-tax rates and favourable tax regimes encourage MNEs to locate economic ownership of KBC (and receipt of income in the form of royalties) in offshore holding companies. In addition, limited taxation of foreign royalty income tends to encourage the use of KBC in foreign production and particularly in host countries with relatively low corporate tax rates. It follows that:
  - Because MNEs are typically well placed to exploit cross-border tax planning strategies, countries that provide tax incentives for R&D expenditure may collect little tax on the commercialisation of the subsidised R&D. The host country will, however, benefit from the spillover of knowledge that results from the R&D performed.
  - If KBC is held offshore and used in foreign production, there may be an important loss of domestic spillovers from R&D (e.g. knowledge gained from embedding KBC in production technology). There may thus be leakages of the wider benefits of R&D as well as of tax revenues.
  - Domestic employment may be negatively affected by tax policies that encourage the use of KBC in foreign production. Over time, the economy is likely to adjust and other jobs may be created. While overall employment may thus change little the composition of employment may be altered and the wages paid by these jobs may be lower.

  - Global output may be lower than otherwise if capital is attracted away from locations where pre-tax rates of return are higher. That is, investments may be made in KBC not where they are most productive but where the tax arrangements afford the highest post-tax profitability.

  These effects tend to weaken the benefits from R&D commercialisation, insofar as they diminish benefits of R&D to the domestic economy, and underline the need to re-examine international tax policies that facilitate tax planning and profit shifting. These findings have important implications for the design of R&D tax incentives. In particular, policymakers should not assume that downstream activities such as production will take place in the same country, and any cost benefit analysis should consider this.

- The academic literature suggests that while R&D tax incentives generally increase the amounts of R&D undertaken, their cost-effectiveness is less certain (dependent in part on design features). There is a risk that international competition to raise levels of tax support for R&D, to attract R&D-intensive FDI, could lower tax revenue without commensurate increases in taxable income from R&D commercialisation. Scope for international co-operation could be usefully explored to limit unintended tax relief for R&D (and its use in production) from cross-border tax-planning, and possible inefficiencies arising from R&D support through tax credits and patent boxes. Additional research is needed to better understand spillover benefits stemming from R&D, their source (i.e. what parts of the R&D and production process generate them), their size and value and how they are affected by tax policy and how R&D responds to tax relief.

The main analytical findings are discussed below. Illustrative QETR model results are summarised in Table 2.1. All of the results assume equity finance (debt finance is ignored) in order to highlight the effects of avoidance of tax on royalty income.

Competitive disadvantage for stand-alone R&D performers

The QETR analysis finds that "stand-alone" R&D performing firms (not part of a MNE group, and thus without foreign affiliates to engage in cross-border tax planning) may be placed at a competitive disadvantage, relative to MNEs. This disadvantage in terms of scope for tax planning may be more pronounced for early-stage firms that are not part of a MNE group and have not yet generated taxable income to make immediate use of R&D tax credits (if they are non-refundable). The absence of a level playing field may make it more difficult for such firms to compete with MNEs. This may inhibit knowledge creation as such firms may have particular strengths as R&D performers (e.g. in creating radical innovations).

More specifically, the R&D tax wedge is much lower for MNEs than for stand-alone firms that only have domestic production and pay corporate income tax at domestic rates on income from KBC. In analysing the tax treatment of (taxable) domestic producers, both the "own-use" case and the domestic licence case are considered. In both, the taxation of returns to investment (royalties and profit) at the standard CIT rate results in relatively high average effective tax rates on income from production and a correspondingly high R&D tax wedge.

In the "own-use" case, a parent company undertakes R&D and uses newly created KBC in domestic production. If domestic income is subject to CIT at a 40% rate, with a tax deduction for R&D costs but no additional CIT relief, the R&D tax wedge is positive, at 16.2%. The wedge is positive, as the tax rate on total income (normal return plus

economic profit) assessed as a percentage of economic profit exceeds 40%. The positive wedge indicates that on balance taxation discourages R&D relative to a no-tax case.[7] A 5% R&D tax credit lowers the tax wedge to 6.1%.[8] These results are shown in Table 2.1, line 1.

Rather than undertake production itself, a parent may establish a domestic manufacturing subsidiary and license KBC to it in return for royalty payments. The R&D tax wedge results are unchanged from the own-use case. The reason is that with a domestic licence, royalty income is taxed at 40%, while distributed earnings in excess of royalties are also taxed (at source) at the 40% CIT rate. As in the own-use case, the tax rate on total income (normal return plus economic profit) assessed as a percentage of economic profit exceeds 40%. Introducing a 5% R&D tax credit lowers the R&D tax wedge from 16.2% to 6.1%.

These illustrative results strengthen the case for targeting R&D tax credits to SMEs, in particular those that are not part of a multinational group. This approach is supported by OECD analysis performed under the New Sources of Growth project which shows that the productivity impacts of fiscal incentives are unclear, possibly because they may favour incumbents at the expense of more dynamic young firms.

An alternative, and arguably better, approach to levelling the playing field may be to curtail the ability of MNEs to avoid tax on intra-group royalty (and interest) income. This is an issue that OECD countries are encouraged to analyse as part of a strategy for addressing base erosion and profit shifting (OECD, 2013).

Table 2.1. Summary R&D tax wedge and AETR* results

		R&D tax wedge No R&D tax credit (percentage points)	R&D tax wedge 5% R&D tax credit (percentage points)	AETR* (percentage)
1.	Own-use / Domestic licence and production	16.2	6.1	48.0
2.	Foreign licence and production (territorial system)	11.7	2.0	46.0
3.	Transfer of KBC to offshore holding company, foreign production, 80% domestic inclusion	-3.0	-11.5	38.2
4.	Transfer of KBC to offshore holding company, foreign production, 20% domestic inclusion	-32.4	-38.4	13.3
5.	R&D cost-sharing agreement with offshore holding company, foreign contract manufacturing, level I domestic tax base shifting	-14.5	-17.3	7.2
6.	R&D cost-sharing agreement with offshore holding company, foreign contract manufacturing, level II domestic tax base shifting	-20.7	-25.9	0.4
7.	Patent box, domestic production, 20% inclusion	-31.1	-37.3	14.7
8.	Patent box, foreign production, 20% inclusion	-32.8	-38.8	12.8

Note: The table reports results discussed in the text. R&D tax wedge=difference between pre-tax required "hurdle" rate of return on R&D at the margin, and the after-tax required rate of return of investors; AETR*=average effective tax rate on economic profit (return in excess of normal return) from KBC used in production. In case 5, level I domestic tax base shifting involves charging the parent company 200% of production costs for goods sold to it for domestic sales; in case 6, the charge is 280%. Tax rate assumptions: 40% statutory CIT rate in home country; 25% statutory CIT rate and 5% withholding tax rates on dividends and royalties in foreign host country B (no withholding tax on royalties in KBC transfer case and cost-sharing agreement case). Income derived from KBC at source equals 65% of pre-tax earnings. Equity finance is assumed in all cases.

Tax considerations tend to encourage offshore economic ownership and use of KBC

Illustrative results from the QETR model predict that no-/low-tax rates and favourable tax regimes encourage MNEs to locate economic ownership of KBC (and receipt of income in the form of royalties) in offshore holding companies. In addition, limited taxation of foreign royalty income tends to encourage the use of KBC in foreign production and particularly in host countries with relatively low corporate tax rates.

In particular, the results find a relatively low average effective tax rate ($AETR^*$) on economic profit from production and a correspondingly low R&D tax wedge, when economic ownership of KBC is assigned to an offshore holding company and KBC is used in foreign production. When factoring in cross-border tax planning, the tax burden on R&D is well below estimates derived from conventional ETR measures that assume taxation of returns on investment at the domestic CIT rate. This implies that corrective R&D tax incentive rates – if chosen on the basis of conventional ETR measures, and provided to gain spillover benefits from R&D and incorporating KBC in domestic production – may be too high.[9] Where this is the case, the findings strengthen calls for reassessment of the efficiency of R&D tax incentives.

Furthermore, relatively low $AETR^*$s on economic profit from investment in foreign production signal a tax distortion that favours the use of KBC in foreign rather than domestic production (for mobile production activities). In general, a low $AETR^*$ results from the avoidance of tax on foreign royalty income. $AETR^*$s on foreign production are lower still where the foreign corporate tax rate is low relative to the home country CIT rate (implying taxation at source of income in excess of royalties at a relatively low host country CIT rate).

Scope for tax avoidance is generally greater when economic ownership of KBC is assigned to an offshore IP holding company and KBC is licensed from there. As IP management/holding company activity tends to be highly mobile, location decisions for this activity can be expected to be highly sensitive to tax considerations. Evidence that MNEs locate ownership of KBC offshore tends to aggravate the production location distortions and attendant costs noted above, while also heightening concerns over foregone tax revenues (which have to be replaced through higher tax rates elsewhere).[10]

In general, tax relief from exploiting KBC in production in locations where host and home country tax on royalty income can be avoided encourages MNEs to consider such locations for mobile production, other factors being equal. Where domestic production and foreign production are substitutes, this distortion may reduce domestic employment and output. From an international perspective, production efficiency may be reduced to the extent that location-dependent production costs are higher in low-tax foreign countries chosen as production locations for tax reasons. Potential R&D spillover benefits tied to the incorporation of KBC in production may also be lost to the domestic economy. In addition, foregone home country tax revenues mean that other taxes have to be higher than otherwise.

Foreign licence and production (no offshore holding company)

The $AETR^*$ on economic profit derived from production is lower when an R&D performer (parent) licenses KBC directly (no intermediation) to a foreign operating subsidiary in a low-tax country, rather than to a domestic subsidiary, even if foreign and domestic royalty income are taxed at the home country CIT rate. This result (which is

sensitive to the percentage of production income paid out as royalties) arises with foreign income in excess of royalty payments, paid out as foreign dividends, subject to a relatively low host country CIT rate.[11]

Results from the QETR model consider, for illustrative purposes, production in a host country with a statutory CIT rate of 25% (compared to 40% in the home country). If 65% of gross earnings from production is paid out as royalties, the average effective tax rate on economic profit (AETR*) is 46%. This compares with 48% in the pure domestic case. The corresponding R&D tax wedge is 11.7% and falls to 2% with a 5% R&D tax credit.[12] These results are shown in Table 2.1, line 2.

Offshore holding company and foreign production

In the direct (non-intermediated) foreign licence case considered above, where economic ownership of KBC is held by a parent company (or domestic affiliate), foreign royalty income would normally be taxed at the basic domestic (home country) CIT rate.[13] Given the mobility of KBC, the parent company of an MNE may avoid home country tax on royalty income by transferring economic ownership of KBC to an offshore holding company located in a country that does not levy CIT on royalty income.

Consideration of transfer pricing and controlled foreign company rules

In general, tax relief due to the use of an offshore holding company would normally be limited by transfer pricing/anti-avoidance rules that trigger home country corporate tax. In particular, upon a transfer of economic ownership of KBC to a holding company, a parent company would normally be required under transfer pricing rules to include, in calculating its taxable income, an income amount established on an arm's-length basis that reflects the value of KBC surrendered to the holding company.

However, it is difficult for tax administrators to identify an appropriate arm's-length amount to include in the domestic tax base, particularly if KBC is unique and there are no identifiable markets or means to establish its value. Therefore, MNEs, possibly better aware of the value of KBC, may attempt to under-report values in order to minimise their home country tax burden.

Given the difficulty of establishing an appropriate taxable amount to accompany a transfer of economic ownership of KBC, a number of OECD countries have introduced so-called controlled foreign company (CFC) rules as an additional anti-avoidance measure. In general, such rules, if enforced, would have the effect (in the preceding example and others like it) of taxing resident corporations on a current basis on certain forms of passive income (as opposed to active business income) received through offshore affiliates. This would include, in the example, taxing a parent company on a current basis on royalty income received passively by its controlled foreign holding company. This home country taxation would tend to offset the advantages of the holding company as a tax avoidance vehicle.

Effective CFC provisions may take the pressure off transfer pricing rules by alleviating the need to value KBC when it is transferred offshore and its contribution to future profit may be still be highly uncertain for tax authorities (and possibly business).

Taxing a parent company, under CFC rules, on a yearly basis on royalty income received by its holding company may achieve a more appropriate allocation of the tax base to the home country that better reflects the costs and risks assumed by the parent in creating the KBC.

Circumvention of host country withholding tax and home country CFC rules

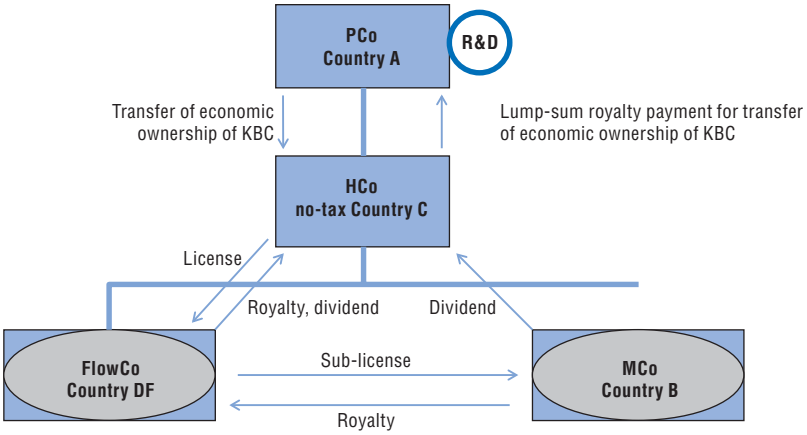
In countries with CFC rules that could, in principle, counter tax-planning opportunities presented by offshore IP holding companies, the CFC provisions may not be broad enough in scope to apply. In countries with broadly applicable CFC rules, there may be mechanisms for avoiding the application of those rules. Such mechanisms may be new or revised tax-planning strategies. In some cases, countries may tacitly accept schemes that avoid CFC provisions, given the absence in other countries of robust CFC rules and pressures from business for an internationally competitive tax system.

Figure 2.4 depicts a tax-planning structure designed to circumvent CFC rules in the United States and also avoid royalty withholding tax that would apply on royalties paid by a manufacturing affiliate (MCo) directly to an offshore holding company (HCo). Under the indirect licensing structure, a parent (PCo) transfers economic ownership of KBC to HCo in no-tax country C. HCo then licenses rights to KBC to FlowCo, a wholly owned controlled foreign company (CFC) resident in high-tax country D with an extensive tax treaty network. FlowCo then sub-licenses rights to the KBC to a manufacturing subsidiary MCo. The use of the conduit entity FlowCo ensures that no withholding tax is paid on royalties paid by MCo to FlowCo, or on royalties paid by FlowCo to HCo.[14]

Moreover, the possible application of CFC rules in home country A may be avoided where PCo elects, for home country tax purposes, to treat FlowCo and MCo as branches (disregarded entities) of HCo. With this election, royalty payments from MCo to FlowCo, dividend payments from MCo to HCo, and royalty and dividend payments from FlowCo to HCo are treated as payments within a single corporation, and thus are disregarded (not recognised) for home country tax purposes.

Tax relief under the preceding tax-planning structure may be illustrated with the QETR model, where the ETR and R&D tax wedge results depend on the amount of income taxed in the home country on the transfer of KBC to HCo.[15] In the limiting case in which home country tax rules do not impose any tax on PCo on income accruing to HCo (no home country tax base inclusion), the average effective tax rate on economic profit ($AETR^*$) is only 5% and the R&D tax wedge is highly negative (-38.7%, not shown in Table 2.1). Where PCo is taxed on this income, and the home country tax base inclusion is equal to 80% of royalty payments by MCo, the $AETR^*$ is 38.2%, and the corresponding R&D tax wedge is -3.0% or -11.5% if a 5% R&D tax credit is available. [16] This result is shown in Table 2.1, line 3. If the home country tax base inclusion is only 20% of royalty payments (e.g. owing to limited base protection rules), the $AETR^*$ is only 13.3%, and the corresponding R&D tax wedge is -32.4% (-38.4% if a 5% R&D tax credit applies). This result is shown in Table 2.1, line 4.

Figure 2.4. Foreign production: Transfer of KBC to offshore IP holding company, licence to conduit, sub-licence to manufacturing subsidiary



R&D cost-sharing agreement with offshore holding company and foreign contract manufacturing

Another tax planning structure analysed involves a cost-sharing agreement (CSA) between a parent company (R&D performer) and an offshore IP holding company, and contract manufacturing. Under the CSA, the parent is responsible for domestic sales, while the holding company is responsible for foreign sales.[17] The contribution of the holding company to the parent for its R&D costs is proportionate to the share of foreign sales in total worldwide sales of the MNE group. Withholding tax on royalties is avoided and host country corporate tax in the place of production is minimised, with a low-risk manufacturing subsidiary only paid a fee (with limited mark-up) for provision of manufacturing services. Taxable profits of the parent are reduced via transactions with a foreign base company that arranges production for the group and transfers profits to the IP holding company using deductible royalty payments.

It is not possible to compare directly R&D tax wedge results under the CSA structure and other tax-planning strategies, owing to the different methods by which host and home country tax are avoided. Under one scenario examined in the analysis, the AETR* on economic profit from foreign production is calculated at 7.2%, and the R&D tax wedge is -14.5% (-17.3% with a 5% R&D tax credit). With more aggressive shifting of the domestic tax base offshore, the AETR* on foreign production is only 0.4%, resulting in an even more negative R&D tax wedge of -20.7% (-25.9% with a 5% R&D tax credit) (Table 1, lines 5 and 6).[18]

The preceding findings raise the following considerations:

- Because MNEs are typically well placed to exploit cross-border tax planning strategies, countries that provide tax incentives for R&D expenditure may collect little tax on the commercialisation of the subsidised R&D. The host country will, however, benefit from the spillover of knowledge that results from the R&D performed.
- If KBC is held offshore and used in foreign production, there may be an important loss of domestic spillovers from R&D (e.g. knowledge gained from embedding KBC in production technology). There may thus be leakages of the wider benefits of R&D as well as of tax revenues.

- Domestic employment may be negatively affected by tax policies that encourage the use of KBC in foreign production. Over time, the economy is likely to adjust and other jobs may be created. While overall employment may thus change little the composition of employment may be altered and the wages paid by these jobs may be lower.
- Global output may be lower than otherwise if capital is attracted away from locations where pre-tax rates of return are higher. That is, investments may be made in KBC not where they are most productive but where the tax arrangements afford the highest post-tax profitability.

These effects tend to weaken the benefits from R&D commercialisation, insofar as they diminish benefits of R&D to the domestic economy, and underline the need to re-examine international tax policies that facilitate tax planning and profit shifting. These findings have important implications for the design of R&D tax incentives. In particular, policymakers should not assume that downstream activities such as production will take place in the same country, and any cost benefit analysis should consider this.

Overall levels and targeting of tax relief for R&D may not be aligned with policy intentions

The QETR analysis finds that overall tax relief for R&D (particularly that of MNEs) may be greater than governments intended when they designed support of R&D expenditure. Analysis based on the QETR model suggests that when tax planning strategies to avoid tax on returns are taken into account, MNEs may obtain a much larger than intended tax subsidy for their investment in R&D, and the post-tax return on R&D spending may exceed the pre-tax return.

As considered above, when cross-border tax planning relief involving the use of an offshore holding company does not apply, the R&D tax wedge is 16.2% in the domestic production case (6.1% with a 5% R&D tax credit), and 11.7% in the foreign production case (2% with a 5% credit). In contrast, if economic ownership of KBC is transferred to an offshore IP holding company, and 80% of income derived from KBC and received offshore is subject to domestic tax, the R&D tax wedge is -3% without any special tax relief for R&D expenditure (-11.5% with a 5% R&D tax credit). If an offshore transfer of economic ownership of KBC triggers a domestic income inclusion that is less than 80% of the income derived from KBC (a likely outcome in certain cases), the R&D tax wedge is more negative. Similarly, the analysis of cost-sharing agreements and contract manufacturing arrangements finds strongly negative R&D tax wedges (with and without R&D tax credits).

Moreover, the balance of tax relief for R&D by MNEs, compared with R&D by stand-alone firms, may be significantly different from what was originally intended. Again, this may result in cases where tax relief available to MNEs from cross-border tax planning strategies has been ignored.[19]

Results reported in Table 2.1 also show average effective tax rates calculated for the domestic licence and foreign licence cases, where economic ownership of KBC remains in the home country and patent/innovation box rules are in effect that tax 20% (exempt 80%) of royalty income. The AETR* for such cases, at 14.7% and 12.8% (Table 2.1, lines 7 and 8) are comparable to values calculated for the offshore IP holding company case (13.3%) in the case where the transfer of KBC to a holding company triggers a taxable income inclusion of only 20% of income from KBC (Table 2.1, line 4).[20]

These results demonstrate the need, when considering the design and pros and cons of a patent/innovation box regime, to address tax relief provided by cross-border tax-planning opportunities. This presupposes that a central objective in introducing and selecting taxable income inclusion rates for such a regime is to provide similar tax relief to that realised when holding KBC offshore, and thereby discourage offshore migration of economic ownership of KBC.[21]

The preceding considerations encourage reviewing R&D tax policies, even before recognising the possible need for reassessing spillover benefits. If further study finds that tax policies are encouraging offshore migration of ownership and use in foreign production of KBC, domestic spillover benefits may be considerably smaller than previously thought (when domestic production and employment are displaced, domestic productivity gains are diminished and domestic tax revenues are lost). If this is the case, the overall rates and targeting of tax incentives for R&D may be further in doubt.

Further research and analysis is required

The academic literature suggests that while R&D tax incentives generally increase the amounts of R&D undertaken, their cost-effectiveness is less certain (dependent in part on design features). There is a risk that international competition to raise levels of tax support for R&D, to attract R&D-intensive FDI, could lower tax revenue without commensurate increases in taxable income from R&D commercialisation. Scope for international co-operation could be usefully explored to limit unintended tax relief for R&D (and its use in production) from cross-border tax-planning, and possible inefficiencies arising from R&D support through tax credits and patent boxes.

Additional research is needed to better understand spillover benefits stemming from R&D, their source (i.e. what parts of the R&D and production process generate them), their size and value and how they are affected by tax policy. This would help assessments of the loss of domestic spillover benefits when economic ownership of KBC is transferred to an offshore holding company (possibly before its commercial value is widely recognised to minimise home country tax on KBC transfers) and KBC is used in foreign production.

Further empirical analysis would also help to gauge more accurately the responsiveness of R&D activity to R&D tax incentives. This would involve extending the application of the QETR model to incorporate country-specific information on domestic and international tax policies and profit margin data to calibrate the model, and using QETR metrics in regression analyses of R&D and production data. As biased measures of the effective tax rate on R&D have been used in the past, in particular measures that do not factor in tax relief from cross-border tax planning, new empirical work based on revised effective tax rate measures would help identify elasticity (sensitivity) estimates to guide policy making.

The illustrative QETR model results presented here have shown that international tax policies may create a competitive disadvantage for stand-alone R&D-performing firms not part of an MNE group. Assessments of whether on balance a country's tax system distorts the playing field of stand-alone firms and MNEs would need to take account of tax policies not captured in the QETR model, such as the treatment of small business losses and capital gains/losses on small business shares, as well as other targeted (non-tax) policies and programmes in support of innovation and entrepreneurship.

The implications of a co-ordinated policy response on the provision of cost-effective support for R&D might also be examined in order to address concerns over international competition. A full assessment of policy options could also include examining the implications of a co-ordinated tightening of defensive tax measures (e.g. CFC rules), to reduce concerns over loss of international competitiveness that may be holding back unilateral action.[22]

A central insight from the QETR model results reviewed so far is that, while the importance of KBC to economic growth has provided arguments for favourable taxation, globalisation makes designing and implementing a tax regime that provides cost-effective support increasingly difficult. In particular, profit-shifting by MNEs may mean that a substantial part of the return to R&D undertaken in a given home country may be lost to that country (through lost CIT revenues and spillovers) if an MNE shifts the ownership and exploitation of KBC to other jurisdictions.

While the work presented here offers a new perspective, it needs to be more fully integrated into analyses of the broader questions of whether targeted government support should be provided, and if so, how much support should be given, to what types of KBC, and how public support is best provided (what policy instruments). The answers to these questions require other evidence and analyses to be brought together with more empirically based analyses, including further applications of the new QETR model.

The analytical framework presented in this paper is the first of its kind and draws attention to the need for policy makers to use effective tax rate measures for investment in R&D that take account of tax relief from cross-border tax planning strategies when assessing tax burdens and implications of possible tax policy reforms. Further work and additional research are needed to:

- Better understand the types, sources and size (value) of the spillover benefits derived from R&D, and how closely they are linked to undertaking R&D and to embedding KBC in production.
- Extend application of the QETR model by incorporating country-specific information (including domestic and international tax policies, and profit-margin data used to calibrate the model).
- Improve elasticity estimates of the responsiveness of R&D to changes to tax policy (using revised effective tax rate measures for MNEs that factor in cross-border tax planning).
- Examine implications of a co-ordinated policy response on the provision of tax relief for R&D, to address concerns over international competition and enhance scope for cost-effective support for R&D.
- Examine implications of co-ordination in tightening defensive tax measures (e.g. controlled foreign company rules), to reduce concerns over loss of international competitiveness that may be holding back unilateral action.

Annex 2.A1

Overview of the QETR model

Standard indicators of the tax burden on R&D (e.g. B-index) do not separately treat KBC as an output of R&D, and focus on tax relief tied to R&D expenditure.[23] Such approaches only partly capture the tax relief available for R&D. Some governments provide special partial exemptions for returns to R&D (e.g. a patent/innovation box system). Moreover, virtually all allow MNEs to obtain significant tax relief when locating economic ownership of KBC offshore, or locating production using KBC in a no-/low-tax country. As tax regimes of host countries for production and international tax policies in the MNE's home country affect how much tax the MNE pays and where, such policies should be accounted for when assessing total amounts of tax relief provided (and the behavioural effects of R&D tax policies).

The QETR model developed to address these issues considers a two-stage process that involves R&D expenditure in a first stage to create KBC, and, in a second stage, the exploitation of KBC in the production of output requiring investment in physical capital.

Profit-maximising production involves a location decision (where to locate production) and a scale decision (how much physical capital to invest in a given location). In making a location decision, a parent of an MNE is assumed to compare after-tax rates of return on investment in production in the home country and in a (low-tax) foreign host country.[24] In each case, relevant corporate taxes on royalties and profit (earnings in excess of royalties) are modelled, which involves modelling host and home tax liabilities (withholding tax and corporate taxes) in the case of FDI.

Location choice is assumed to depend on a comparison of average effective tax rates ($AETR^*$), with tax policy tending to encourage investment in a location with relatively low $AETR^*$, and thus higher after-tax return, under the assumption of a fixed pre-tax rate of return. The $AETR^*$ is calculated as the present value of tax on royalties and profit (earnings in excess of royalties), divided by the present value of pre-tax economic profit at the optimal capital stock.[25] For each location, a marginal effective tax rate (METR) is derived to assess tax distortions to the profit-maximising level (scale) of physical capital in that location.

In the analysis of the effects of tax on the level of R&D, a parent company is assumed to invest in R&D as long as it is profitable to do so (i.e. up to the point where the marginal after-tax benefit of an additional unit of R&D expenditure just equals its marginal after-tax cost). The marginal after-tax cost depends on tax deductions for R&D costs, including tax credits. In the model all costs are assumed to be current costs (e.g. wages of scientists and engineers). The marginal benefit of additional R&D is the value of an increase in the probability of creating knowledge and enabling after-tax earnings in the production stage.[26] This equilibrium condition determines the pre-tax (minimum) "hurdle" rate of return to R&D (r^R_g) and the tax wedge (i.e. the difference between the pre-tax hurdle rate of return to R&D, and the fixed after-tax rate of return required by investors) which measures the degree of tax distortion – the larger the tax wedge, the larger the predicted negative effect of tax on the level of R&D (offset by tax relief).[27] See Box 2.A1.1.

Box 2.A1.1 The hurdle rate of return and R&D tax wedge

The "hurdle rate of return" (r^R_g) is the marginal (minimum) pre-tax net return on an additional dollar of R&D required by the parent to pay shareholders their required rate of return (ρ), and pay corporate tax on that return. The R&D tax wedge (RDTW) – derived from the hurdle rate of return, and calculated as (r^R_g-ρ) – which measures the marginal pre-tax net return on R&D that is just sufficient to pay corporate tax, provides a measure of tax distortion at the margin. As the tax burden and hurdle rate of return may be negative with large tax subsidies for R&D, interpreting a marginal effective tax rate for R&D is not obvious (if rRg<0 then METR=(rRg-ρ)/rRg is positive despite a negative tax burden). The R&D tax wedge is arguably a preferable, more easily interpreted tax burden indicator. When the R&D tax wedge is positive, tax is predicted to discourage R&D relative to the no-tax case (conversely, if RDTW<0, tax encourages R&D relative to the no-tax case).

As the hurdle rate of return (rRg) is a return at the margin, it cannot be measured directly and so is derived from profit-maximising conditions. Under the QETR model, profits are maximised where R&D is increased just up to the point where the marginal after-tax gross return from an additional dollar of R&D just equals its marginal cost:

$$\frac{\Delta q(RD)}{\Delta RD}\frac{PV\Pi(1-AETR^*)}{(1-d_A)}=(1+\rho) \quad (1)$$

The marginal after-tax gross return (left-hand-side of (1)) is the value of an increased probability of earning future after-tax economic profit from production using KBC, expected to result from an additional dollar of R&D. In equation (1) q(RD), measuring the probability that R&D is successful, is assumed to increase with the level of R&D but at a decreasing rate. PVπ measures the present value of future economic profit from production using KBC. The average effective tax rate on economic profit from production ($AETR^*$) is assessed as the present value of tax on future earnings from production, divided by PVπ. The term ($1-d_A$) factors in tax relief per unit of R&D expenditure (in particular, d_A factors in deductibility from the CIT base of current R&D expense (wages paid to staff performing R&D) and relief (if any) from R&D tax credits at rate ξ_A on current expenditure ($d_A=u_A+\xi_A$)).

Using (1), the **hurdle rate of return** (r^R_g) can be inferred as follows:

$$r_g^R=\frac{\Delta q(RD)}{\Delta RD}PV\Pi-1=\frac{(1+\rho)(1-d_A)}{(1-AETR^*)}-1 \quad (2)$$

Using (2), the **R&D tax wedge** is measured by:

$$RDTW=r_g^R-\rho=\frac{(1+\rho)(1-d_A)}{(1-AETR^*)}-(1+\rho)=\frac{(1+\rho)(AETR^*-d_A)}{(1-AETR^*)} \quad (3)$$

The R&D tax wedge is zero when the rate of tax relief for R&D expenditure equals the average effective tax rate on economic profit derived from KBC – that is, where $d_A=AETR^*$.

Taxation is predicted to be neutral and not affect the level of R&D when there is tax symmetry – that is, where the average effective tax rate on economic profit derived from the use of knowledge in production ($AETR^*$) matches the tax rate at which R&D costs are relieved (d_A), in which case the R&D tax wedge is zero.

Importantly, in the QETR model, the effects of taxation on the level of R&D depend on the treatment of R&D expenditure and the treatment of returns on the use of KBC in production. The present value of tax on income derived from the use of (intangible) KBC and tangible capital in production, captured by the $AETR^*$, depends on where production occurs and whether rights to the use of KBC in production are licensed directly or indirectly through an offshore IP holding company.

Including cross-border tax planning in tax burden measurement of ETR (i.e. AETR* on production, and R&D tax wedge) is potentially useful for policy analysis in several respects. First, in considering levels of support being provided to R&D, in addition to R&D tax incentives, policy makers need to consider (using the same ETR metric) how much tax relief MNEs may in effect be achieving for themselves ("self-help"). This might suggest greater targeting of R&D tax incentives to (small) stand-alone companies that are not in a position to exploit cross-border tax planning opportunities.

Second, the analysis illustrates how domestic and international tax policies may interact to influence MNEs' decisions about the location of economic ownership of KBC and the locations of its use in production. Such behavioural responses may significantly erode the tax base and the domestic spillover benefits of R&D, negatively affect domestic employment, and reduce global output if capital is attracted away from locations earning higher pre-tax rates of return.

Third, on the empirical side, if more representative ETR measures are generated when factoring in tax avoidance on returns to investment, they could be used in statistical work to estimate the sensitivity of FDI to taxation and the sensitivity of R&D to taxation. To date, empirical work has been based on theories of investment (used to specify investment equations used in statistical analysis) that overlook cross-border tax planning. Preliminary results from the QETR model suggest that this may be a serious oversight when attempting to explain MNEs' investment in KBC.

Notes

1. KBC comprises a range of assets: intellectual property (patents, copyrights, designs, trademarks); computerised information (software and databases); and economic competencies (firm-specific human capital, networks joining people and institutions, organisational know-how, and aspects of advertising and marketing). These assets create value (current and future income) but, unlike machines, equipment, vehicles and structures, they do not have a physical embodiment. This non-tangible form of capital is, increasingly, the largest form of business investment and a key contributor to growth in advanced economies. See Overview/ Chapter 1.

2. See Majority Staff Report, *Repatriating Offshore Funds: 2004 Tax Windfall for Select Multinationals*, prepared by the Permanent Subcommittee on Investigations, Committee on Homeland Security and Government Affairs, United States Senate, 11 October 2011. The 2004 AJCA repatriation provision allowed MNEs to deduct from their taxable income 85% of qualifying dividends received from controlled foreign corporations during 2004, 2005 or 2006. This provision reduced the statutory tax rate on dividends from 35% to 5.25%.

3. This element of tax planning is not incorporated in the version of the QETR model developed for the study.

4. In the QETR model, Q denotes knowledge-based capital (KBC) and ETR denotes effective tax rate. The analysis of tax effects on the level of R&D focuses on the R&D tax wedge as a preferred indicator. The R&D tax wedge is easy to interpret compared to a marginal effective tax rate for R&D – calculated as the R&D tax wedge, divided by the required pre-tax hurdle rate of return on R&D – given that the pre-tax hurdle rate of return may be negative in the presence of significant tax relief for R&D.

5. While not measuring the amount by which levels of R&D and production in a given location may be affected by tax, results of the model illustrate directions of bias to scale decisions – that is, whether home and host country tax policies can be expected on balance to encourage or discourage investment compared with alternative tax policy settings.

6. "Economic profit" refers to an above-normal return (i.e. a return in excess of the normal return to shareholders), with manufacturing income assumed to consist of a normal return plus an above-normal return. The average effective tax rate on economic profit (AETR*) is calculated as the present value of tax, divided by the present value of pre-tax economic profit. The R&D tax wedge is positive (negative) if the AETR* is greater (less) than the rate of tax relief for (deductible) R&D labour costs. A related tax burden indicator is the average effective tax rate (AETR) on manufacturing income, calculated as the present value of tax, divided by the present value of pre-tax income. As income exceeds economic profit, this tax burden indicator (AETR) is in each case lower than the AETR* assessed on economic profit.

7. See footnote 7. Also note that the R&D tax wedge is measured in *percentage points* (in particular, the percentage point difference between the pre-tax hurdle rate of return on R&D and the required after-corporate tax rate of return). The AETR* measures the

present value of tax as a *percentage* of present value of pre-tax economic income from production.

8. This result assumes taxation of manufacturing income at 40%. Under this treatment, the average effective tax rate on economic profit (AETR*), at 48%, exceeds the 40% rate of tax relief for (deductible) R&D labour costs, so the R&D tax wedge is positive. In contrast, under an allowance for corporate equity (ACE) system that provides a tax deduction for the normal return on equity, the AETR* is 40% and the R&D tax wedge is zero.

9. A "corrective" R&D tax incentive rate means a rate chosen to partly, fully or more than offset an assessed tax distortion to R&D.

10. In general, holding company activity involves relatively limited amounts of labour, physical capital and other productive assets. Therefore production efficiency concerns tied directly to this misallocation would not be significant. However, the knock-on effects – a deepening of the tendency to shift production to a low-tax location – may raise significant employment and production efficiency concerns.

11. Most OECD countries operate "territorial" tax systems which exempt foreign dividend income from home country tax. Some operate "worldwide" systems that tax foreign dividend income, but provide a tax credit to offset foreign tax on that income (to avoid double taxation), while also allowing taxpayers to defer home country tax by deferring the receipt of foreign dividends. Under both systems, the overall (host and home country) tax burden on income from production that exploits KBC is typically lower when locating production in a country with a relatively low CIT rate.

12. The AETR on foreign manufacturing income is 38.4%, while the AETR* is 46.0%. The calculations assume a 25% CIT rate in the foreign host country, withholding tax on dividends and royalties at 5%, and royalty payments equal to 65% of gross production earnings. With foreign royalty income subject to home country tax at 40%, host country withholding tax on royalty payments at 5% is assumed to be fully offset by foreign tax credits provided by the home country. Withholding tax on dividends, also at 5%, is final (no foreign tax credit, under the assumption of no home country taxation of dividend income, as under a territorial system).

13. This assumes that "patent box" rules that would exempt some percentage of royalty income do not apply. Also, some tax systems (e.g. the US system) allow excess foreign tax credits on high-tax dividend income to shelter foreign royalty income from home country tax.

14. Royalties paid by MCo to FlowCo are deductible against the CIT base of MCo in country B which does not levy withholding tax on royalty payments to country D. FlowCo pays relatively little CIT in country D on a small profit margin determined by royalty receipts from MCo, less royalty payments to HCo. Country D does not impose withholding tax on royalty payments to HCo, where they are received free of corporate tax. After-tax profits of FlowCo are distributed as a tax-free dividend to HCo (no withholding tax and no CIT in country C).

15. In the model, the home country tax base inclusion triggered by a transfer of KBC offshore is modelled as a percentage of the present value of royalties paid out by the manufacturing subsidiary. The lower the percentage taxed in the home country, the larger the tax subsidy. The results reported here assume that the statutory CIT rate in host country B (where KBC is used in production) is 25%; and all royalty and dividend payments are free of withholding tax, except dividends paid by the manufacturing subsidiary to the holding company, taxed at 5%.

16. The R&D tax wedge is -15.1% if the home country tax base inclusion is 60% of royalty income paid out by MCo.

17. Where PCo earns an R&D tax credit, a key policy design choice is whether the R&D cost contribution from the holding company reduces (or not) the base of the R&D tax credit. The R&D tax wedge of -11.5% assumes that the base of the R&D tax credit is not reduced by the R&D cost contribution. If the home country tax base inclusion is 60% (rather than 80%) of royalty payments by MCo, the AETR* falls to 29.9%, and the R&D tax wedge is -15.1% (-22.6% with a 5% R&D tax credit).

18. The results in lines 5 and 6 of Table 2.1 assume that a parent company is assigned domestic sales (50% of total sales), a holding company is assigned foreign sales (50% of total sales), and a manufacturing service affiliate is paid a 5% mark-up over production costs equal to replacement investment. In line 5 results, the transfer price charged by a foreign base company to the parent to cover 50% of the cost of goods produced equals 50% of manufacturing costs; in line 6 results, the transfer price charged is 100% of manufacturing costs (200% of manufacturing costs corresponding to domestic sales). In each case, profits of the foreign base company are paid to the holding company through royalty payments.

19. The AETR* results for the offshore holding company case do not incorporate tax planning relief (reductions in host country tax) that would result if the manufacturing affiliate is capitalised in part by related-party debt. Instead, the QETR results for the offshore holding company case assume 100% equity finance of the manufacturing affiliate. Introducing intra-group debt finance provided by a dual purpose offshore IP holding company (holding economic ownership of KBC, while also providing debt finance) would find lower average effective tax rates under the IP holding company structure.

20. The AETR* calculated for the offshore holding company case assumes that CFC rules are not in place. Instead, the transfer of knowledge capital to a holding company is subject to transfer pricing rules that require the parent company to include, in calculating its taxable income in country A, an income amount established on an arm's-length basis reflecting the value of knowledge capital surrendered to the holding company.

21. Patent/innovation box regimes may also be intended to stimulate R&D. However, effects on R&D would need to be considered alongside R&D tax wedge measures under alternative holding structures (that is, such a regime may have a limited stimulus effect on R&D if greater tax relief is possible by transferring KBC offshore).

22. In assessing the ramifications of a tightening of CFC rules that would tax on a current basis related-party royalty income received by an offshore holding company (and possibly interest income on related-party loans provided by an offshore finance subsidiary), it is difficult to gauge the tendency of MNEs to change the location of headquarters activities (i.e. corporate inversion), taking into account the attractions of a given home country as a place for headquarter activities.

23. Standard indicators include the B-index, and the more sophisticated "user cost of capital" model developed to analyse the effects of tax on investment in tangible capital, used to assess effects on investment in intangible capital. Such applications do not treat KBC as a distinct output of R&D, which makes the interpretation of results difficult. Treating KBC as an output of R&D better captures R&D and production processes, while also allowing the modelling of the tax implications of tax planning,

where R&D is undertaken in one country, economic ownership of KBC is assigned to second, and KBC is used in production in a third.

24. In practice, a parent may consider several foreign countries as host locations for production. The QETR results presented in this chapter consider a comparison between the home country and a low-tax foreign country. In this case FDI is either a) direct, with the parent company holding economic ownership of KBC, investing directly in a foreign manufacturing affiliate and licensing (directly) KBC to it, and receiving foreign dividends and royalty income, or b) intermediated, with economic ownership of KBC assigned to a dual purpose (IP and equity) offshore holding company, the parent investing in a foreign manufacturing affiliate indirectly through the holding company, and foreign dividend and royalty income received and retained indefinitely offshore).

25. The present value of tax on income derived from the use of intangible and tangible capital in production depends on where production occurs and whether rights to the use of KBC in production are licensed directly or indirectly through an offshore intellectual property holding company.

26. The probability that R&D is successful is assumed to increase with the level of R&D expenditure, but at a decreasing rate, implying diminishing marginal returns to R&D.

27. Tax distortions to the level of investment are normally assessed using a marginal effective tax rate calculated as the tax wedge divided by the pre-tax "hurdle" rate of return. However, with significant tax subsidies to R&D, the pre-tax hurdle rate of return may be negative. In such cases, a negative tax wedge divided by a negative pre-tax hurdle rate of return yields a positive METR, which is difficult to interpret (as a positive METR normally signals a tax distortion that discourages investment). To avoid confusion, the assessment of tax effects on the level of R&D focuses on the numerator of the METR, that is, on the R&D tax wedge.

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