Annex 1

The effect of R&D tax incentives on location of R&D investment

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Introduction

Governments across developed and developing economies try to encourage firms to invest in Research and Development (R&D) using financial and fiscal incentives. The reason is that the returns to investment in knowledge and innovation cannot be fully appropriated by innovating firms as knowledge is a public good that can 'spill over' to others. Due to these externalities, the level of private R&D investment will be below what would be socially optimal.

Spillovers are generated from private firms' R&D and firms can therefore benefit from the presence of more innovative and more productive firms. There is now widespread evidence that multinationals are both more innovative and more productive than the average domestic firm. This is the rationale for policies to be aimed at attracting foreign firms.

In a world where multinational enterprises (MNEs) are increasingly internationalising their R&D activities, governments also compete in attracting R&D activities of multinational corporations which would have a high value added content and a strong knowledge spillover potential. The rationale is that generous incentives (e.g. a generous R&D tax incentive system) might make a country a relatively more attractive location for R&D investments than its competitors and that the forgone tax revenues would be compensated by the benefits accruing to the local and national economy from receiving the Foreign Direct Investment (FDI) both through increased employment, value added and localized knowledge flows.[1]

Understanding whether these policy measures have a significant impact on the location of multinationals' R&D investment is therefore becoming increasingly important since (national or local) governments' decisions on the introduction or modification of innovation support programs have the additional aim of attracting the increasingly mobile R&D investment projects by multinational corporations. Recently, several countries have made their R&D tax incentives more generous to be more attractive to foreign firms. For example, in Europe, France has recently changed

[1] The economic geography literature has stressed the importance of localized knowledge spillovers (LKS). Some researchers (e.g. Breschi and Lissoni, 2001) have stressed that more than pure externalities, local knowledge flows are actually mediated by economic mechanisms, .local markets, but do not dispute that knowledge flows are an important agglomeration force.

from an incremental tax credit system to a volume base scheme[2] ; Finland will likely introduce a tax credit scheme.[3]

Even though the impact of tax incentives on the international location of innovative activity of MNEs is an important policy question, very little quantitative analysis of this issue exists at present. More generally, evidence on the determinants of the location of R&D activities is mainly confined to evidence from survey of MNEs. The main reason for this paucity of evidence is due to a lack of suitable firm-level data on the location of innovative activities across countries.

This paper will provide evidence of the increased level of internationalization of R&D, review the literature on the determinants of R&D activity location focusing on the role of tax incentives and provide some policy conclusions and suggestions for further research on these issues.
The paper is organised as follows, in the next section we review the evidence on the increasing internationalisation of R&D activities by multinational corporations. In section 3 we are going to discuss the evidence on the determinants of the location of innovative activity. In section 4 we are going to review the studies on the importance of tax incentives and financial incentives for the location of R&D investments. Finally Section 5 concludes.

Internationalization of R&D: the evidence

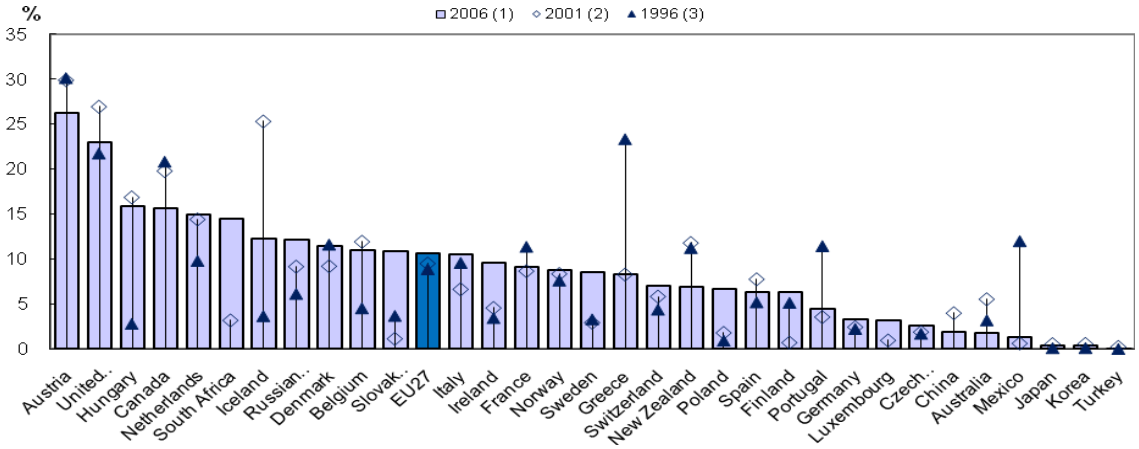
The internationalisation of R&D has been taking place at an increasingly faster pace in the last few years relative to previous decades. Moreover, new destinations such as China and India are playing an increasingly important role. We present below some evidence that confirms these trends.

A first measure to use to investigate R&D internationalization is the share of a country's business R&D sourced from abroad. Figure 1 shows that in 2006 in the EU 27 countries Business R&D sourced from abroad represents on average 11% of total business R&D. Within the EU the highest shares are found in Austria (26%) and the UK (23%) while the lowest in Luxembourg and Czech Republic with shares of less than 5%. The figure also shows that on average in the EU27 countries the share of R&D funds from abroad has increase between 1996 and 2006, even though a comparison across countries shows some heterogeneity in the trends.

[2] "This measure proves France's commitment to increasing innovation. Many companies – both French and foreign – will benefit from this important incentive, which will also help attract major research oriented businesses in France," says Philippe Favre, President of the Invest in France Agency (from http://www.investinfrance.org/uploads/files-en/07-12-17_145649_CP_CIR07_EN.pdf)

[3] In the Appendix we report a summary of tax incentives schemes in selected nations from http://www.investinamericasfuture.org/PDFs/newRDchartRev04-04-08doc1.pdf on October 12th 2009 and http://www.ibm.com/ibm/governmentalprograms/global-rd-incentives-2008.pdf .

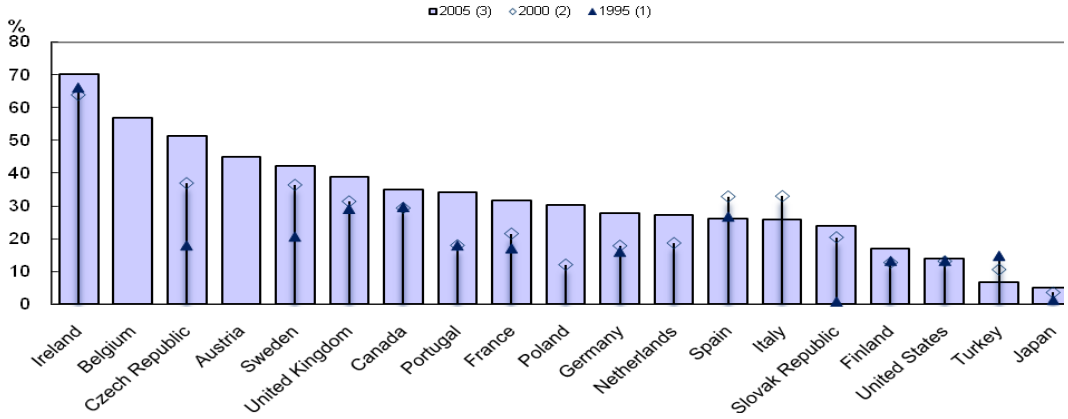
Figure 1: R&D funds from abroad, 1996, 2001 and 2006 (as a percentage of BERD)



Source: OECD STI Outlook 2008

A second way of capturing the increased internationalisation of R&D is to describe the increased importance of foreign affiliates in industry R&D. Within Europe the largest share of R&D expenditures by foreign affiliates are in smaller economies, such as Ireland, Belgium and Czech Republic with more than 50% of R&D expenditures by foreign affiliates, followed by larger open economies such as Sweden and the United Kingdom as shown in Figure 2.

Figure 2: R&D expenditure of foreign affiliates, 1995, 2000 and 2005



Source: OECD STI Outlook 2008

A third way to investigate internationalisation of R&D activity is to look at patenting activity of firms. Recent efforts by the academic community have lead to the availability of a dataset that matches firm level accounting information to the firm ownership structure and to the patents applied for at the European Patent Office (EPO) by these firms and their subsidiaries (see Abramovsky, Griffith, Macartney and Miller, 2008). These data gives a detailed picture of the increased internationalisation of R&D activities across fifteen EU countries. In particular, the data shows patterns very similar to the ones observed in the R&D expenditure statistics: the matched firm accounting - patent data show that an increasing number of patents owned by

European multinationals are associated with inventors based abroad. When looking at the innovative activity located in European countries, the data shows that amongst the firms associated with inventors located in a particular country the share of foreign multinationals is above 40% in some EU countries such as Belgium, Spain and the UK but remains well below 20% in others, such as Germany, Denmark and Finland.

Fourthly, a valuable source of information that has provided most of the existing evidence on the internationalization of R&D and the location of innovative activities by multinational firms across different countries comes from direct surveys to multinational corporations (see for example the work of Belderbos 2003, and Gastsby and Gatsby, 2006). We will discuss the evidence from these surveys regarding the determinants of the location of R&D below. Finally, very few countries have administrative microdata that contain information on the location of R&D activities of affiliates of domestic multinationals, for example Sweden, Japan and the US.[4] More recently, commercial microlevel data is available that identify the new location of multinational firms for different functions (production, headquarter and R&D) across EU countries since the late 1990s (see Defever, 2006). However, the exploitation of similar data remains still relatively unexplored. We will discuss some of the work that has exploited this information below.

Location of R&D: the determinants

Most studies on the determinants of the location of R&D activities are based on surveys to multinational corporations or on the analysis of "administrative" data of single countries. A survey of this evidence seems to suggest that the two main determinants of location are access and support to local markets, i.e proximity to other corporate activities, and proximity to local customers and access to local science and technology (e.g. Thursby and Thursby, 2006; von Zedtwitz and Gassman, 2002; Belderbos, 2006 and Kumar, 2001). In fact the international business literature generally distinguishes between home-base-augmenting and home-base-exploiting foreign R&D activities (Kuemmerle, 1997). *Home-base augmenting* laboratories aim at creating knowledge and transfer it back to the central R&D site; for these R&D labs access to frontier research, closeness to centres of excellence and the availability of a skilled workforce, engineers and scientists are particularly important. *Home-base exploiting* R&D labs on the other hand transfer knowledge from the multinational R&D centre – in the home country or in other home-base augmenting R&D lab - to the host country lab to commercialize that knowledge. For these laboratories closeness to other corporate activities (e.g. production) and to local customers is particularly important.

Similarly, in their survey of 1021 R&D sites owned by MNEs from different world regions, Von Zedtwitz and Gassman (2002) distinguish between the location determinants of Research and those of Development sites. Amongst the reasons to locate Research in a particular location (defined as science and technology drivers) access to local science and absorption of know-how

[4] We will discuss below the study of Foley et al. that use such US administrative data.

of global values are particularly important; amongst the reasons to locate Development closeness and cooperation with local customers and production are particularly important.

In their survey of over 200 American MNEs across 15 industries on the determinants of the location of R&D personnel Thursby and Thursby (2006) get to similar results. They find that location decisions are complex and affected by many factors. However, they suggest that four host country characteristics are extremely important: (1) output market potential, (2) quality of R&D personnel, (3) university collaboration and (4) intellectual property protection (IPR). Furthermore, they distinguish between determinants of location in developed and developing countries since they find that these are driven by different factors. Location in emerging economies is driven mainly by market growth potential; quality of R&D personnel; low costs of R&D and expertise of/collaboration with universities while it is hampered by weak IPR. Location at home and in other developed countries is spurred by the quality of R&D personnel, the strength of IPR protection and finally by the opportunity of collaboration with universities. Also, firms seem to be more likely to conduct potentially important R&D in developed economies while in developing countries - where IPR are weaker - firms tend to focus on improving existing technologies. Finally, an important result of this survey is that the majority (more than 70%) of new R&D sites abroad represent an expansion of existing R&D facilities (at home) rather than "relocation". Interestingly, tax incentives are not found to be an important determinant of multinationals' decision to locate R&D in a particular country. Thusby and Thursby find that amongst factors taken into account when selecting a site in an emerging economy tax breaks and/or direct government assistance[5] are not important in deliberations on the selection of the site and firms tend to disagree that the factor is important for emerging economies. They investigate the issue further and find that only 3 out of 80 multinational firms (3.8% of respondents) valued highly the importance of tax breaks and direct government assistance and agreed that they had been offered such incentives. Thursby and Thursby therefore conclude (p.24): *"Thus, one can reasonably reject the argument that tax breaks and/or direct government assistance are luring firms to establish R&D facilities in developing or emerging economies."*

Responses on the decision to locate sites in developed economies outside the home countries show again a low level of importance for tax breaks but here the answers are much more heterogeneous: about 24% of respondents both agreed that they had received incentives and that they were an important factor in the choice of the site. Thus, Thursby and Thursby conclude that tax breaks are more prevalent in developed economies.

One of the main worries when using results from surveys is that multinational firms would report strategically about the determinants of their investment location. In particular one might worry that when surveyed by government and tax officials they might report that tax incentives and government support in general are a strong determinant of their decision to invest in a particular region/country. On the other hand, when surveyed by other organisations they might downplay the importance of tax incentives and government support, in order not to look too opportunistic.

[5] A similar result also holds for the case in which the establishment of an R&D facility was a regulatory or legal prerequisite for access to the local market.

Therefore, we turn to econometric evidence to find additional support to the findings highlighted by the studies that use survey evidence.

How does the econometric evidence relate to the results of direct surveys to multinationals such as those presented above? The importance of universities as a driver of location found in the survey of Thursby and Thursby (2006) and that of von Zedwitz and Gassman (2001) is confirmed in more recent econometric studies (e.g e.g. Abramovsky, Harrison and Simpson, 2007 and Belderbos, Leten and Suzuki, 2009 and Alcacer and Chung, 2007). All of these studies show that the presence of universities – especially if they are centre of excellence - is strongly correlated with the location of MNEs' R&D laboratories in a region. Interestingly, they achieve this same conclusion using different data for different countries and different time periods and different econometric methodologies.

In a recent paper, Branstetter, Fisman and Foley (2006) confirm the important role of Intellectual Property Rights not only for the location of innovative activities of multinational corporations, measured both as R&D expenditures and foreign patent application, but also for the international technology transfer, measured as royalties payments, to affiliates of US multinational corporations. They find that legal reforms that strengthen IPR[6] in host countries over the period 1982-1999[7] lead to an increase in R&D expenditure and in technology transfer to multinational affiliates operating in reforming countries and that these effects are particularly strong for affiliates of US MNEs that use US patents extensively prior to reforms.

The study by Defever (2006) looks at the determinants of (co-)location of different functions of MNE firms and complementarities across functions. When regressing the entry of a new R&D lab in the EU on country characteristics he finds – we believe in line with survey evidence and with the study of Branstetter et al. – that judicial quality and market potential are significant explanatory variables. However, the most interesting result is the importance of both "functional agglomeration economies"[8] and of co-location of production activities by the same firm as determinants of R&D location. The latter result is in line with the New Economic Geography idea that multinational firms are likely to co-locate functions in the same country to exploit vertical linkages between different stages of the value chain and save on coordination costs (Krugman and Venables, 2005).

The evidence from both the surveys to multinationals and econometric studies therefore seems to suggest that the knowledge base, in particular that of universities, human capital and intellectual

[6] The authors classify reforms that expand and/or strengthen IPR along five dimensions: expansion in the range of goods eligible for patent protection; expansion in the effective scope of patent protection; increase in the length of patent protection; improvement in the enforcement of patent rights and improvement in the administration of the patent system.

[7] The authors conduct their main analysis on a sample of 16 host countries: Argentina, Brazil, Chile, China, Colombia, Indonesia, Japan, Mexico, Philippines, Portugal, South Korea, Spain, Taiwan, Thailand, Turkey and Venezuela; i.e., mainly developing countries.

[8] This result is in line with the Duranton and Puga (2005) result that activities belonging to the same function but not to the same sector are agglomerating together. While in the manufacturing/production sector the same is true for activities in the same sector.

property protection are important factors in the decision to locate investment in Research in a particular country. Development projects are also affected by access to local markets and by co-location with production activities. Tax breaks do not seem to affect the decision to locate R&D in a developing country while there is some variability in the importance of tax breaks and direct support to innovation for the location of R&D in developed countries.

Tax incentives and location of R&D

We discussed some survey evidence on the relevance of tax incentives and direct support to innovation for the location of R&D (Thursby and Thursby, 2006). However, the econometric evidence on the role of tax incentives on the location of R&D is still scarce. Most of the research on the effects of fiscal incentives has focused on taxes and corporate taxes in general rather than specific incentives for R&D activities. We will therefore first discuss the theoretical predictions and the evidence from this literature. We will then focus on the results on R&D tax incentives and R&D location, discussing both the descriptive evidence from qualitative data and econometric results from analysis of quantitative data.

Tax incentives and the location of multinational activities: the theoretical predictions

In standard models of tax competition (see survey by Wilson, 1999) mobile investment would be attracted in regions with lower corporate taxes. The rationale behind these models is that firms will, *ceteris paribus*, move to the country with the lowest tax rate. This in turn would give rise to a race to the bottom in corporate tax rates. On the other hand, the "New economic geography" literature predicts that a race to the bottom would not necessarily take place in the presence of agglomeration externalities (e.g. Ludema & Wooton, 2000; Baldwin & Krugman, 2004).[9] The reason is that these agglomeration economies will lead firms to locate or remain in locations even if they could be mobile and benefit from lower tax rates in other regions. Therefore differentials in tax rates can persist in the presence of agglomeration externalities. In fact Baldwin and Krugman show that the existence of agglomeration rents allows similarly sized nations to have different equilibrium tax-rates, contrary to the standard theoretical propositions in international tax competition. In fact they find that, with sufficiently free trade, industry can agglomerate in one country which can raise his capital taxes without losing capital because of agglomeration economies. This might lead to a 'race to the top' rather than a 'race to the bottom'.[10] In fact, Baldwin and Krugman challenge the idea that failure to align (capital) taxation would result in a

[9] The literature often refers to "first nature" and "second-nature" agglomeration externalities. "First nature" agglomeration externalities are due to exogenously given characteristics of different sites; while "second nature" agglomeration derives from the actions of human beings.

[10] The Baldwin and Krugman (2004) model finds also that other predictions of the basic tax competition models are reversed. For example they find that trade costs matter as well as the mobility of capital. Their model also predicts that if agglomeration forces are strong enough and capital is internationally mobile there will be a positive (rather than a negative) correlation between capital –labour ratios and tax rates: more industrialised region will have higher tax rates, *ceteris paribus.* Finally the paper confirms the findings from the economic geography literature that the agglomeration effects are much stronger for intermediate trade costs leading to a bell shaped relationship between taxes (agglomeration) and trade integration.

'race to the bottom' amongst countries in order to attract producers by competing in offering the lowest taxes. The inclusion of agglomeration forces in the analysis leads to conclusions far subtler than a simple 'race to the bottom': countries with generous welfare states paid for by high tax rates tend to be richer countries ("core countries") that relative to the poorer ("periphery") countries offer capital advantages (e.g. good infrastructure, established customer and supplier bases, skilled workforce) which allow them to attract and hold on to mobile factors of production even if they levy higher tax rates than poorer countries (up to a certain upper limit in the gap beyond which irreversible delocation takes place) leading to a race to the top in taxes before leading to a race to the bottom.[11]

Tax incentives and the location of multinational activities: the empirical framework

The empirical analysis of the effects of tax incentives on the location of multinational activities has been constrained by the availability of suitable microdata that contained information on both the cross-country location of multinational corporations and details about tax regimes across different countries.

The evidence from the literature on tax incentives[12] has analysed both the effects of taxation on the location of capital by multinationals and on the location of the income from that capital. This distinction is also important when we think about location of R&D activities: firms need to decide where to locate R&D investment and where to locate the income (e.g. patents; royalties) from those investments. The latter is likely to be affected by differences in statutory tax rates. Concerning the former location decision on investment, an important further distinction is between the decision of multinational on whether to invest in one country (extensive margin) and the decision on the scale of the investment, conditional on being located there (intensive margin). The literature on tax incentives suggests that these two margins are affected by taxes differently: the extensive margin is a discrete choice which is affected by the proportion of pre-tax income that is taken in tax, i.e. the effective average tax rate[13] (see Devereux and Griffith, 1998 for an example); while the intensive margin is a marginal decision and is affected by taxes through the cost of capital and therefore by the effective marginal tax rate. We believe that this distinction has important implications for the discussion of the effect of R&D tax incentives on the location of R&D investment and the design of R&D tax incentives.

An indication that distinguishing between location of capital and location of income from capital is important especially when looking at R&D activities can be found in the study of Stoewhase (2002). The study investigates the impact of statutory tax rate and effective average tax rate on the number of German multinational affiliates across eight countries. The author finds that while location of affiliates in production sectors is affected by the effective average tax rate;[14] the location of affiliates in the service, finance and R&D sectors are affected more by the statutory

[11] Moreover, since agglomeration is a bell-shaped function of the level of trade integration, the tax gap is also related to trade integration in a bell-shaped curve.
[12] For a comprehensive review of this literature we refer the interested reader to Devereux and Maffini (2007).
[13] One common measure of average tax rate at the firm level is the ratio of tax charges in the financial accounts on profits.
[14] The effective tax rate measures the tax burden of investment by dividing taxes paid by pre-tax profits.

tax rate, and suggests that this might be due to the fact that income from these activities may be more easily shifted to low-tax countries. These results are confirmed in other papers (e.g. Grubert and Slemrod, 1998 and Desai et al, 2006) that show that R&D intensive multinationals are more likely to be affected by the possibility of profit shifting and by the presence of tax havens (e.g. Puerto Rico in the late 80s).

To summarise, existing surveys of the literature (De Mooij and Ederveen, 2003 and Devereux and Maffini, 2007) suggest that taxation affects multinational decisions to locate their activities in a country, the intensity of this investment and the location of the income derived from this investment. However, the impact of taxes is heterogeneous, not only across different tax margins, but also across different sectors, activities and firms' and investments' characteristics. For this reason, it is important to have access to detailed micro-level panel data and it is also important to find good econometric strategies to identify the causal impact of taxation on location decisions by multinationals rather than just uncovering correlations. However, there are still very few papers that have been successful in this second endeavour and this is where the literature on the impact of taxation and location of multinational activities is still evolving.

Tax incentives are not the only tool that governments can use to attract foreign direct investment. A frequently used tool is grants/subsidies to set up greenfield plants in the host country. Examples of such grants/subsidies can be found across many countries. Case studies and econometric analysis of the successfulness of these policy tools are however not pervasive. An example of such a study is the work of Devereux, Griffith and Simpson (2007) who analyse the effectiveness of government grants in attracting foreign direct investment in disadvantaged regions of the UK. The authors find that incentives are more effective in attracting greenfield investments in regions with high agglomeration economies than to peripheral disadvantaged locations. Other papers have looked at the impact of European policies, rather than single governments' policies. For example, a recent paper by Basile, Castellani and Zanfei (2008) using data on more than 5000 foreign subsidiaries established in 50 regions of 8 EU countries over the nineties find that eligibility to European Structural funds (Objective 1 funds) does not make EU regions more attractive for multinational investment. However both the amount of EU Social funds and the eligibility of regions within countries to Cohesion Funds are strongly related to location of MNEs investment in the region. Therefore, in line with the evidence of the impact of taxes, the impact of grants and subsidies is also heterogeneous, across different programmes, different firms and regions' characteristics. Studies on the impact of programmes and subsidies are also still scarce and few use identification strategies that help them identify the causal impact of the subsidies on the location decision.

Cross-country studies on tax incentives and location of R&D activities

Few studies have analysed this issue across countries (Hines, 1995 and Hines and Jaffe, 2000; Bloom and Griffith, 2001) while others have looked at the impact of differences in R&D fiscal incentives across US states (Wilson, 2008).

Hines (1995) analyses aggregated data on R&D activities of US and foreign multinationals to show that the innovative activities in the host country are substitute for the innovative activity conducted in the home country

Billings (2003) uses macroeconomic data and analysis of variance to show that the growth rate of R&D of US foreign affiliates was higher in countries with tax-based R&D incentives than in countries that did not offer any tax-based R&D incentives. This is particularly the case for Japan, Mexico, Ireland and Brazil. These results are robust to exclusion of outliers and changes in US industry classification. One limitation of Billings' study is the use of aggregate data on US foreign affiliates, rather than company level data.

Jaffe and Hines (2000) use Compustat information on company R&D expenditure and match it with information on their patenting activity from the NBER patent database. Jaffe and Hines look at the interaction of taxation on three types of R&D and on foreign royalties on the innovative output of the firm. In particular they focus on the changes in US fiscal legislation in 1986 on the treatment of R&D conducted domestically for overseas sales; R&D conducted abroad and R&D conducted at home for domestic sales; and finally tax treatment of royalties on the innovation outcome abroad and in the US. The key tool for identification in the paper is that there will be a heterogeneous response to such changes by firms depending on their tax position relative to excess or deficit of foreign tax credits. The authors conduct an OLS regression of the difference in number of foreign patents in 1988-1991 relative to 1983-1986 on the change in number of domestic patents in the same period; the fraction of R&D expenses that the firm can deduct against their domestic tax liabilities in 1991; the percent of foreign sales and the change in the required cost of capital for a $1 dollar investment in domestic R&D intended to enhance foreign profitability. In robustness checks they also include the interaction of these two latter variables with the number of foreign patents in the initial period 1983-1986. The results show that those firms, for which the after-tax cost of doing domestic R&D for foreign sales grew most quickly after the 1986 change, also show the slowest growth of foreign patenting in 1988-1991 with an estimated cross-price elasticity of foreign patenting relative to costs of domestic R&D for foreign sales between 0.2 and 0.5. The authors highlight that these results suggest the existence of a complementarity between domestic and foreign innovative activity at the (multinational) firm level, but that they are not in contrast with evidence suggesting substitutability between domestic and foreign innovative activities at a more aggregated macro level, such as the ones presented in Hines, 1995 and in Bloom and Griffith, 2001 as described below.

Bloom and Griffith (2001) study aims at answering the question on whether the increased use of tax incentives is leading to an increase in R&D conducted worldwide (since the user cost of R&D is decreasing "globally"), or rather whether R&D tax incentives represent a form of tax competition between countries for 'footloose' R&D leading just to relocation of R&D activities. To answer this question they test whether the volume of R&D conducted in one country responds to changes in the R&D price in competitor countries using panel data for eight countries over the period 1979-1997 drawn from the OECD ANBERD database. The R&D price in competitor countries is measured as the weighted average of the user cost of R&D with weights depending

on the amount of FDI investment going to each country during 1982-92.[15] Bloom and Griffith are also concerned about possible omitted variable that could affect both the user cost of capital and R&D. Therefore, they use the tax component of the user cost of R&D as instrumental variable. The results suggest that domestic R&D is a decreasing function of the domestic user cost of R&D and an increasing function of the foreign user cost of R&D.[16] They interpret this result as suggestive that domestic R&D and foreign R&D are substitutes and of relocation in response to R&D tax incentives.

The studies presented in this section show that still little is known about the importance of tax incentives for the location of R&D; especially there is only limited evidence on the impact of R&D tax incentive on cross-country location of R&D activities. Therefore, questions on whether (the introduction of) R&D tax incentives can *cause* the location of R&D investment in a country/ region or which design of the tax incentives is better for achieving such a policy goal cannot be answered. As we repeatedly mentioned, in order to answer such question one would need both detailed microdata and a credible identification strategy (based for example on exogenous eligibility criteria and their changes or randomizations) for the causal effects of the policy.

Within country studies on tax incentives and location of R&D activities

Within the US, Wilson (2008) using firm level data for the US show that availability of R&D fiscal incentives in US states is associated with relocation of firms towards States with more generous R&D fiscal incentive schemes. Using panel data over 1981-2004 Wilson estimates an augment R&D factor demand model and finds that the in-state elasticity of R&D spending relative to in-state user cost of R&D is -2.5 and relative to the out-of-state user cost of R&D in neighbouring states is +2.7, and therefore he derives a net effect at the national level that is near zero.

Neither the Bloom and Griffith (2001) study nor the Wilson (2008) study analyse whether firms are shifting existing R&D activities towards more favourable areas in terms of fiscal incentives, i.e. the policy has an effect on their "intensive margins" (how much R&D to do in each area) or whether they are locating new R&D activities in one area and shutting down existing labs in the areas with the least advantageous fiscal regime; i.e. whether the policy has an effect on the "extensive margin" (i.e. whether to do R&D or not).

In fact, neither Bloom and Griffith nor Wilson studies have the necessary microlevel (establishment/firm) data to look at the difference between the impact of tax incentives on intensive and extensive margins.

Microlevel data would provide the additional advantage of describing the heterogeneity of the effects of R&D tax incentives on different types of firms (high vs low R&D spenders; start-up vs mature businesses). Additional evidence on the design and the eligibility rules of the policy and

[15] The main advantage of using weights based on FDI is that in most countries firms can benefits from R&D tax credits if they have taxable profits in that country.
[16] This result is stronger when using a static model relative to a dynamic one.

on how it changed over time would provide the possible source of identification of the causal impact of the policy. Finally, if data were available not only on tax incentives but also on other innovation policies (e.g. strength of IPR, policies for public research and universities) then one could investigate whether these policies are complementary to each other or whether they are substitute.

Policy Conclusions

Tax incentives might affect investment location of MNEs; however, there are other factors that affect the investment decisions of firms. In particular survey based and econometric evidence suggests that the presence of a market and of other (multinational) firms; universities; a skilled workforce and strong intellectual property rights seem to be important determinants of location of R&D activities.

Governments with a tight budget constraint therefore might face a trade off: should they allocate their limited resources to provide fiscal incentives for firms to locate their R&D activities and lose tax revenues or should they try to maintain the level of tax revenues that would allow funding of universities; skills and infrastructure that would make the region/country attractive to foreign investors?

Also, will countries race to the top or race to the bottom? The new economic geography literature seems to suggest that a race to the top is possible especially within the European Union. At the same time, the few empirical studies Bloom and Griffith, 2001 and Wilson, 2008) that estimate the elasticity of R&D to R&D costs at home and abroad – at the national and regional level - seem to suggest that while a decrease in the costs of R&D at home is associated with an increase in the level of R&D, a decrease in the cost of R&D abroad (e.g the introduction of an R&D tax credit) is associated with a decrease of R&D activity at home. In fact Wilson estimates suggest that - within the US - setting of R&D tax credits by states is nearly a zero sum game. How transferable to the European policy context this result is remains debatable. It is likely that the cross-country effect might be smaller in the EU where the cross-(member) states mobility is lower than in the United States. However, this might change as the degree of geographic mobility in R&D activity increases within the EU.

Finally, there are other features of the tax system that might lower the fiscal burden on firms. In particular, countries should make sure that the compliance costs are low; the fiscal system is clear and stable. These are factors that seem to be taken into account by firms when evaluating different fiscal systems.

The question, however, remains on how government can evaluate the successfulness of their R&D tax incentive policies in affecting the location of R&D. The key ingredients of such evaluations are (1) availability and access to rich longitudinal microlevel firm and establishment data both across countries and within countries (2) the use of robust identification strategies. Both of these elements are essential for the understanding the causal impact of R&D tax incentives on

both the decision to invest in R&D in a particular country and the amount of that investment. In an ideal world, one would want to be able to observe choices of multinationals when deciding where to locate their R&D labs; know the ranking of the locations (i.e. which country/region was the runner up?) and the whole functional structure of the multinational. In addition one would want to know other time-varying country characteristics and observe exogenous changes in the availability of R&D tax incentives. An alternative approach would be to randomize the availability of some incentives to some multinationals rather than others. Obviously this latter approach – although very appealing from the point of view of the econometrician to evaluate the policy – is very hard to implement in practice because of political reasons.

In this review, we have discussed the impact of tax incentives for R&D activities on the location of R&D investment. We have, however, not explicitly discussed a related question on whether the introduction of new (or the increased generosity of existing) R&D tax incentives in the home country affects the decision of existing R&D investment of whether to relocate abroad. This is a very interesting question which remains yet to be explored and it might be an interesting question for future research.

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