The Unknown Side of Income-Shifting Micro-Estimates: The Role of Trademarks

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Abstract

Based on affiliate level data, estimates for the extent of income shifting by multinational corporations have been rather modest. This is in stark contrast to the high estimates based on aggregate data and to the high level of concern about income shifting in many countries and multilateral organizations. One potential explanation is the incomplete coverage of granular financial information. This paper provides evidence in support of this view by empirically analyzing strategic location decisions of intangible assets at the affiliate level without depending on the availability of financial information. We find that location choice is very sensitive to tax differentials. By directly comparing decisions about patent and trademark location, we show that the issue is particularly aggravated for trademarks. Trademarks tend to be more mobile than patents which can be sticky when forming agglomerations.

Keywords: intangible assets; patent; trademark; tax planning; corporate taxation

JEL-Classification: H25, F23, H26, H3

I. INTRODUCTION

Profit shifting by multinational corporations (MNCs) is very prominent on the public agenda.[1] It is not surprising that given their importance in public policy, multilateral organizations such as the International Monetary Fund (IMF), the Organization for Economic Co-operation and Development (OECD), the United Nations (UN) and the World Bank Group (WBG) have raised concerned about these relocation activities and put into place co-operative actions to support countries dealing with such practices.[2]

This is in stark contrast with a string of empirical academic studies employing detailed firm-level data, which implies that the profit allocation of MNCs is rather insensitive to international tax differentials.[3] Not surprisingly, empirical estimates based on national accounts (Tørsløv, Wier and Zucman, 2018) appear to imply a greater extent of profit shifting. One argument brought forward in the latter approach is that there are blind spots in the firm-level data studies which structurally attenuate the profit-shifting estimates.[4]

In this paper, we reconcile the two streams of the literature by addressing one of these blind spots. Anecdotal and empirical evidence points out the importance of intangibles assets for MNCs' tax planning (Dischinger and Riedel, 2011; De Simone, Mills and Stomberg, 2014) showing that corporate tax rates and tax incentives are important factors in determining where

[1] See OECD/G20 BEPS Project: http://www.oecd.org/tax/beps/beps-actions/

[2] See Platform for Collaboration on Tax: PCT Progress Report 2019-2019: https://www.oecd.org/ctp/tax-global/platform-for-collaboration-on-tax-progress-report-2018-2019.pdf

[3] Even estimates vary across papers, Heckemeyer and Overesch (2017) show a semi-elasticity of 0.8 as a consensus estimate using a meta-analysis. This indicates that after increases in corporate tax rate differentials, for every 100 euros earned in high tax rate affiliates, eight will be shifted to low tax rate affiliates.

[4] For instance, although Orbis provides accurate information for consolidated profits of a MNC, there is little available data for profits booked by the subsidiaries of MNCs in low tax rate countries or tax havens (Dharmapala 2014; Tørsløv et al., 2018). Further, as Orbis relies on public business registries to record financial data, in countries with no public information available, subsidiaries remain invisible which precludes having an accurate map of the MNC. Another limitation is that using OLS models and controlling for outliers, adds further difficulties to this task. Thus, the global strategic map of MNCs is incomplete and micro-level income-shifting estimates are downward biased.

firms decide to locate their patents (Griffith et al., 2014).[5] While Griffith et al. (2014) is a first step to reconcile earlier micro and macro studies, we take a step further bylooking at differences in the strategic location of patents and trademarks as a function of tax rates. There is limited empirical evidence for trademarks and it stands to reason that the location of trademarks is more sensitive to taxes than the location of patents. For example, one of the world's largest spirits producers, Diageo PLC, was accused of relocating some of its famous trademarks (including *Johnnie Walker Scotch, J&B Rare* and *Gilbey's Gin)* for profit-shifting purposes. While this anecdote suggests the importance of trademarks for profit-shifting schemes, there is no empirical evidence to draw broader conclusions about the tax sensitivity of trademarks to corporate taxes. One exception is the study by Overesch, Heckemeyer and Olligs (2018) in which the authors use the S&P 500 firms to analyze whether trademarks are responsive to tax incentives. Their results suggest that the location of trademarks is not driven by tax incentives, but rather is motivated by foreign activities. This result appears to be counterintuitive and might be due to the specific setting they use.[6]

We start by considering some theoretical differences between the tax elasticities of patents and trademarks worldwide. This enables us to draw inferences about the characteristics of these different assets and how they affect MNCs' profit-shifting opportunities. The development of a patent typically involves large amounts of physical and human capital such as R&D expenditure pre and post the patent's granted date. There is also the risk that the R&D phase will not be successful. Trademarks, however, involve marketing expenses that are usually of a smaller scale than patents' investment, with no particular need of R&D resources (e.g.

[5] Anecdotal evidence includes the Apple case (see Charles Duhigg and David Kocieniewski, 'How Apple Sidesteps Billions in Taxes', New York Times, April 28, 2012).

[6] S&P 500 firms are subject to a higher scrutiny. In fact, recent accounting studies show that reputational costs are a mitigating factor for aggressive tax planning (Dyreng, Hoopes and Wilde, 2016; Austin and Wilson, 2017) and thus, firms could be more cautious while deciding where to locate their intagible assets under high scrutiny situations. Furthermore, even though patents and trademarks are both intellectual property for MNCs, costs and expected benefits differ between them and this affects a firm's decision on where to locate their assets.

high-skilled workers) in the country where they are located offering a potentially high expected value. Also, given that patents depend on a country's endowment, they provide lower flexibility in terms of strategic location/relocation for tax planning, resulting in an agglomeration effect.[7] This reduced flexibility of mobile income results in lower tax savings (De Simone et al., 2014).[8] Furthermore, patents are granted during a limited period of time, whereas a trademark's protection is indefinite. Thus, for MNCs, patents are considerably more costly to develop than trademarks and less attractive for a firm's tax planning strategies. Based on the Scholes-Wolfson framework (Scholes and Wolfson, 1992) the key questions are (1) whether MNCs use trademarks more than patents for profit-shifting schemes given their lower cost and their higher expected benefits and (2) if they do use trademarks more, how large are the responses? These questions are particularly relevant given the ongoing debate about macro and micro profit-shifting estimates, the lack of studies using trademark data for international MNCs and the potential implications for the ongoing debate on tax policy.[9]

Using micro level data that contain the location of patents and trademarks in MNCs without setting specific requirements for subsidiary financial data, has the advantage of capturing a broader spectrum of the strategic map of multinational firms. This overcomes the limitations of previous studies. We rely on detailed panel data of MNCs' trademark and patent applications filed at the European Patent Office (EPO), the European Union Intellectual Property Office (EuIPO) and the United States Patent and Trademark Office (USPTO) by 15 countries from 1996 to 2012. This gives us 624,801 trademark applications and 1,696,332 patent applications filed by 162,640 MNCs. Methodologically, we follow Griffith et al. (2014) and we apply a mixed logit model in a fixed-effects framework. This enables us to control for

[7] MNCs tend to locate patents in existing patents' locations (Akcigit, Grigsby, Nicholas and Stantcheva, 2018).
[8] The ownership of intangible assets is transferable within a multinational group. An affiliate within the group may develop an intangible asset, another affiliate could become this asset's official owner through a sale or a cost-sharing agreement.
[9] See Action 8 from the OECD BEPS project.

observed and unobserved heterogeneity in the intangibles assets' location choices. This identification strategy allows for the possibility that the unobserved information relevant to a decision-making process may indeed be rich enough to induce correlation across the alternatives in each choice situation and across choice situations. This results in more realistic substitution patterns between the different choices.

Our empirical analysis starts by computing the own and cross-country tax elasticities of patents' and trademarks' locations. Our baseline results show that trademarks' tax semi-elasticity (-6.5) is significantly higher than patents' tax semi-elasticity (-2.8). This indicates that, holding other factors constant, increasing a country's tax rate by an average of 1%, is likely to decrease the number of trademarks more than the number of patents. We provide evidence which suggests that the type of intangible asset seems important for MNCs' tax planning schemes, since trademarks are considerably more sensitive to corporate tax rates than patents.

We also decompose the average effect to provide insight regarding the mechanism behind this difference. While this effect does not seem to be explained by the quality of the intangible asset, we find that the difference in patents' and trademarks' tax sensitivity might be explained by an agglomeration effect consistent with findings from Akcigit et al. (2018). Our results show that the agglomeration effect of patents considerably reduces their tax elasticity as compared to trademarks. This suggests that patents are more likely than trademarks to be located in already existing patents' locations within the group. In other words, patents offer less flexibility than trademarks for location/relocation choices and therefore are less attractive for tax planning strategies. Furthermore, since some countries allow for legal and economic ownership separation, we test its effect on our results. If MNCs have the option to separate legal and economic ownership, then they will be less tax sensitive in their location choices. Our

analysis confirms that the existence of economic and legal ownership separation reduces the tax sensitivity of trademarks and patents almost equally.

The basic result is robust and holds true despite different identification strategies. We use a conditional logit model in which the independence of irrelevant alternatives is not relaxed and use a nested logit model by including location fixed effects. Results are also robust to binomial logit and OLS models and the exclusion of all control variables. Then we show that the results hold after keeping firms owing at least one patent and trademark during the period of observation and also by taking the statutory tax rate and the parent-subsidiary tax differential as our independent variables. To gain additional support for our results we include American MNCs and our results remain unchanged.

We contribute to the current tax policy debate on the importance of intangible assets' location for income shifting started by the OECD as our results can be interpreted as showing that firms use trademarks more aggressively than patents for income-shifting schemes.[10] The Action Eight of the BEPS project strengthened the general principles that a firm should consider while structuring a trademark's ownership and license to ensure that the value creation principle is accomplished.[11] However, tax-policy initiatives consider still consider patents as the main intangible asset used my multinational groups for income-shifting purposes (OECD 2015). In contrast to that, we show that there are more opportunities for MNCs to strategically locate/relocate trademarks since they are not dependent on the country's endowment. Thus, it

[10] http://www.oecd.org/ctp/transfer-pricing/transferpricingaspectsofintangibles.htm

[11] Any global trademark structure and licensing should accomplish the following: 1) the company should have an intercompany trademark agreement structure, which should reflect economic substance, 2) intercompany trademark licences and transfers should comply with both trademark law and tax law, 3) the intercompany agreements should be explicit about ownership of the trademark, 4) the royalty or other payment amount should be based on or supported by sound transfer pricing economic analysis, 5) the structure should ensure the exercise of ongoing trademark management and control by the trademark company owner. Personnel, functions and risks should be consistently aligned with both the group's trademark and tax strategies. http://www.oecd.org/tax/transfer-pricing/guidance-for-tax-administrations-on-the-application-of-the-approach-to-hard-to-value-intangibles-BEPS-action-8.pdf

is easier for a multinational firm to engage in aggressive tax planning by exploiting this type of intangible. Even though Action Eight is a good way to start addressing profit shifting, we suggest that local tax administrations should devote relevant resources (e.g., tax auditors) to look for potential aggressive tax planning through the use of trademarks.

This paper contributes to the literature on tax-motivated profit shifting. First, in our methodological approach we use detailed data at the subsidiary level containing the location of patents and trademarks. However, unlike previous studies, we do not require specific financial data at the subsidiary level (Huizinga and Laeven, 2008), and we are therefore able to capture a broader spectrum of the multinational firms' structure. This allows us to reconcile the gap between micro and macro profit-shifting estimates found in previous studies (Dharmapala, 2014; Tørsløv, Wier and Zucman, 2018) by showing the importance of including firms owing trademarks in the income-shifting estimates. This allows us to draw conclusions about the relative importance of these two types of intangibles for a firm's tax planning. Additionally, we contribute to the literature on the effects of trademarks (e.g., Graham and Somaya, 2006; Von Graevenitz, 2007; Greenhalgh and Rogers, 2012; Crass, 2014; Crass and Peters, 2014) by showing that for MNCs, trademarks appear to play a more relevant role for tax planning strategies.

This paper is structured as follows. Section 2 presents the theoretical considerations for the development of our hypothesis and the identification strategy. Section 3 presents the data and sample selection. Section 4 presents the results and robustness tests and the conclusion is in Section 5.

II. PATENTS VS. TRADEMARKS' TAX ELASTICITY

In this section, we consider theoretical differences between patents and trademarks that potentially motivate a firm's location choices for these intangible assets. Intangible assets are more mobile than other kinds of labor or capital investments (Griffith et al., 2014). The value of intellectual property (IP) in a multinational firm, stems from its exclusive right to exploit a technology/brand/trademark in a particular geographic area. Thus, MNCs have a clear incentive to strategically locate or relocate their IP in low tax rate locations (e.g., Dischinger and Riedel, 2011; Karkinsky and Riedel, 2012; Böhm et al., 2015; Bradley et al., 2015). This profit-shifting opportunity scheme is emphasized by the difficult task of determining the adequate transfer price depending on the unique nature of the asset.

Conceptual Firms' Payoff Differences Between Patents and Trademarks

Although patents and trademarks are both intellectual property, there are important differences between them which might influence a firm's strategic decision on where to locate the assets to maximize the firm's payoff. According to the OECD, the definition of a patent is related to the right granted to an inventor for the exclusive usage of a certain invention during an agreed period.[12] In contrast, a trademark usually refers to exclusive right to use a word, symbol or logo that distinguishes a firm's products or services from those offered by others.[13]

The development of a patent typically involves greater risks and greater physical and human capital expenditure compared to trademarks. Developing a trademark involves merely selecting a word or designing a symbol of non-generic nature that is not identical or similar to already existing trademarks. Marketing expenses related to this procedure are usually of a

[12] "The term of trademark registration can vary, but is usually ten years. It can be renewed indefinitely on payment of additional fees". https://www.wipo.int/trademarks/en/
[13] See OECD (1993), p.83.

smaller scale than the development costs of a patent and are not country-specific. Greenhalgh and Rogers (2012) argue that granting a patent requires an item to be novel and non-obvious. This requires substantial R&D expenditure and human capital, which in certain industries are country-specific.[14] This results in an agglomeration effect for which patents that belong to a family of a number of different, but related inventions are usually located in the same country (Parchomovsky and Wagner, 2005; Akcigit et al., 2018). In contrast, trademarks are not dependent on a country's endowment and therefore are less likely to trigger subsequent trademark applications in the same country. The agglomeration effect of patents implies that firms are more restricted in choosing a patent's location/relocation than deciding on a trademark and that trademarks have a more negative tax elasticity than patents. This lower flexibility of mobile income results in lower tax-savings which in turn results in patents being more costly to develop than trademarks and less attractive for tax planning strategies.

Most of the expenditure connected with patent development is undertaken *before* the patent is registered, whereas most of marketing expenses for a trademark are incurred only *after* the trademark is granted (Sander and Block, 2011). In the case of a trademark, the firm usually faces the marketing costs (i.e., tax-deductible expenses) and the income from the trademark in the same accounting period. Thus, we suggest that this is an additional incentive for firms to register a trademark in a low tax rate country which will substantially increase a firm's trademark payoffs.[15]

[14] For instance, Germany has a long history and the necessary large stock of research work force and tangible assets needed for innovation in the automotive industry.

[15] Another difference between patents and trademarks lies in the documentation required during their development. Many countries have laws similar to the German Employee Invention Act that requires the precise identification of a patent's inventor. In the case of trademarks, there are usually no such regulations. Furthermore, in many states companies have to capitalize self-developed patents, whereas trademarks are often not allowed to be capitalized. Capitalization of patents requires once again a detailed documentation of the R&D process. Hence, if affiliates of a company group undertake a cost-sharing agreement or a contract R&D to develop a patent, they have to clearly document which party invented it and which party covered the costs. By contrast, trademark development does not usually involve such strict documentation requirements and thus gives companies a larger scope for a strategic relocation of trademark rights.

Thus, there are several reasons why one should expect different tax elasticities of patent and trademark location choices. From a tax perspective, it is less costly and more interesting for MNCs to locate or relocate trademarks rather than patents in low tax rate countries.[16] Therefore, within the Scholes-Wolfson framework, we expect that trademark location choices might be more elastic to taxation than patents.

Firms' Payoff Model

Following Griffith et al. (2014),[17] let us assume the latent variable payoff, which firm *f* obtains from choosing location *j* for the ownership of its intangible asset *p*, is described as follows:

$$\pi_{pifj} = \alpha_i Tax_{pj} + \beta \boldsymbol{X}_j + \vartheta_{rj} + \varepsilon_{pifj} \quad (1)$$

In equation (1), π_{pifj} stands for the payoff generated by the intangible asset *p* belonging to the idea *i* owned by firm *f* in country *j*. The idea *i* represents a patent or trademark family allowing the intangibles within this family to be correlated. The term Tax_{pj} denotes a statutory income tax rate that applies to the payoff generated by the intangible asset *p* in country *j*.[18]

[16] An additional difference is that a patent's application is usually more costly in terms of fees and time spent than is the registration of a trademark. Applying for the European protection of a trademark at the European Union Intellectual Property Office costs 900 euros, whereas filing a patent application at the European Patent Office incurs a fee of 1,405 euros. Beyond registrations costs, it usually takes longer to grant a patent. While the granting process for a trademark takes on average two to three years at the EuIPO, an equivalent procedure for a patent at the EPO requires, on average, four to five years (see World Intellectual Property Organization, 2016). Furthermore, patents are granted for a limited period, usually for up to 20 years. At the same time, the protection of a trademark can be extended over an unlimited period of time (see European Union Intellectual Property Office, 2017). This implies that if a company group decides to strategically relocate its intangible assets, trademarks are not only cheaper and faster, but also provide a longer lasting solution than patents. This once again points to trademarks having more negative tax elasticity than patents.

[17] In table 11 (appendix A) we replicate Griffith et al. (2014) analysis and we compare our results with theirs.

[18] Tax_{pj} is intangible-specific (as denoted by the subscript *p*) because some IP Boxes apply only to patents and the others include trademarks as well. This implies that in some countries income generated by a trademark is taxed at a regular corporate income tax rate and income generated by a patent is taxed at the reduced IP Box rate. See Evers et al. (2015), p.508 for further details.

Furthermore, in our baseline specification we follow Griffith et al. (2014) and randomize the coefficient on Tax_{pj}. As a result, α_i varies across ideas and is a function of observables and unobservable idea characteristics, defined as follows:

$$\alpha_i = \alpha_i' + \varphi_r \mu_i, \quad (2)$$

where the parameter α_i' captures the mean marginal effect of tax on the payoff, while φ_r shows the standard deviation of the tax effect on the payoff. μ_i is a random term in the tax parameter α_i. Equation (2) implies relaxing the independence of irrelevant alternatives (IIA) assumption in our estimation. In other words, by randomizing the coefficient on Tax_{pj} we allow the payoffs of different location choices to be correlated. According to Nevo (2001) and Train (2009), this step results in a more realistic model design capturing a greater degree of flexibility in the substitution patterns between different locations.

Firm *f* will choose the location *j* for the ownership of its intangible asset if

$$\pi_{pifj} > \pi_{pifh}, \quad \forall\, h \in (1, \ldots, H),\ h \neq j \quad (3)$$

In equation (3), *H* indicates the number of potential location choices *h*.

Therefore, we expect a negative value of α_i for both intangible assets. This would imply that affiliates of a company group that are located in high-tax countries are less likely to own intangible than affiliates in low-tax countries. Furthermore, we predict that the magnitude of coefficient α_i should be larger for trademarks than patents based on the theoretical considerations described above. This would imply that trademark location choices are more elastic with respect to taxation than patent location choices.

The model described above results in the probability of the choice given by,

$$P(\pi_{pifj} > \pi_{pifh}) = \frac{\exp(\alpha_i Tax_{pj} + \beta \boldsymbol{X}_j + \vartheta_{rj})}{\sum_{h=1}^{H} \exp(\alpha_i Tax_{ph} + \beta \boldsymbol{X}_h + \vartheta_{rh})} \quad (4)$$

In equation (4), the parameters α_i and β can be estimated by means of a mixed logit model.

Identification

Although the distribution of unobserved preferences should be non-parametrically identified in random utility multinomial models if enough micro data are available (Berry and Haile, 2010), we follow earlier studies and assume that firms' payoffs are linear with independent error terms and that the distribution of unobservable parameters follows a normal distribution (Griffith et al., 2014). Therefore, we require that the error term ε_{pifj} and the ideas specific error terms φ_r are independent of each other.

Tax_{pj} is substituted by the corporate income tax rate of the parent company if the controlled foreign company rules apply. The vector $\boldsymbol{X}_j$ and the error term ε_{pifj} represent all other observable and unobservable factors that might have an impact on the payoff π_{pifj}. For instance, $\boldsymbol{X}_j$ includes the quality of country *j*'s intellectual property rights protection, its market size, and its R&D expenditure. The baseline estimation also contains ϑ_{rj}, which denotes country fixed effects as well as fixed effects at the industry-firm-size level *r*.

III. DATA AND SAMPLE SELECTION

To test our hypothesis, we perform an empirical analysis in which patent and trademark location choices are the dependent variables. We follow previous literature and use data on

patent and trademark applications as a proxy for patent and trademark ownership choices (Ernst and Spengel, 2011).[19]

The data on patent and trademark applications were obtained from the Bureau van Dijk database and include patent and trademark applications filed at the European Patent Office, the European Union Intellectual Property Office, and the United States Patent and Trademark Office. Most of the previous studies of patent applications use only the EPO statistics. In total, our sample includes patent and trademark applications made by 162,640 unique firms located in fifteen countries.[20] Applications by firms contained in our sample amount to 1,696,332 patents and 624,801 trademarks in the period between 1996 and 2012.

To control for industry heterogeneity among firms, we divide all patents and trademarks of the final sample into three industry classes.[21] Following Griffith et al. (2014), the three sectors used in the baseline estimations are chemical, engineering and electrical. The chemical industry includes patents and trademarks connected to pharmaceutics, agriculture, the extraction and processing of raw materials, chemicals, metals and natural resources. The engineering category primarily comprises intangibles related to the engineering and manufacturing sectors. Finally, the electrical industry includes patents and trademarks in the area of technology and telecommunications, electronics, computers, research and similar fields. Table 1 presents country-specific statistics on patents (Panel A) and trademarks (Panel B) by country and each firm-size group.

[19] As Ernst and Spengel (2011) note, the intangible's applicant is its legal owner because only the asset's legal owner is entitled to apply for its registration at an international office.

[20] Countries included in our sample are: Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States. Following Griffith et al. (2014), we include only companies with parent firms in one of the following fourteen states: Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom. Appendix B shows the results after additionally including firms with parent companies located in the United States.

[21] For industry identification, we employ the intangible-level data. In cases where these data are missing, the industry classification of a firm is used.

To account for the firm-size differences across companies, we split each industry into two groups (Griffith et al., 2014). Large companies are those that have applied for a number of intangibles greater than the 80th percentile of the given industrial sector. The remaining firms are classified as non-large firms. According to Table 1, companies located in Germany own the greatest number of patents, while firms that reside in the US hold the largest portion of trademarks in our sample. As for industry classification, around 37% of all patents in our sample belong to the engineering sector and around 36% of all trademarks to the electrical industry.

Intangibles generated by the same company in the same industry are likely to be closely related to each other in terms of their underlying idea and innovation process. We allow for the correlation between such assets. Thus, intangibles belonging to the same firm and industry within a period of one quarter and sharing a network of common inventors are grouped into a single idea. Around 80% of the patents and trademarks contained in our sample represent just one intangible asset per idea.

Tax Data

Tax Rate is our independent variable. We gather information from the International Bureau of Fiscal Documentation (IBFD) *Global Corporate Tax Handbook* as well as the *IBFD Research Platform*.[22] We use the statutory corporate tax rates in the main specification, since these apply to the income generated by intangible assets and are therefore relevant for tax planning strategies. We modified the variable if the country has implemented an IP Box.[23]

The final tax rates used in our estimations take into consideration the effect of controlled foreign company (CFC) rules.[24] Table 2 provides an overview of the CFC rules that exist in the

[22] See International Bureau of Fiscal Documentation (1996-2012). Available at: http://www.ibfd.org/.
[23] Information on the IP Box regimes was taken from Evers et al. (2015) and extended through our own research.
[24] Data on CFC rules were obtained from Karkinsky and Riedel (2012) and extended through our own research. These rules aim to reduce profit shifting by firms that are tempted to place their assets in low-tax countries. According to CFC regulations, passive income of a subsidiary in a tax haven is subject to taxation at the rate of its

countries relevant to our analysis. In addition to the standard regulations, some countries have introduced a so-called "Black List", which usually contains countries considered as tax havens. By contrast, Sweden has developed a "White List" that includes states that are not considered to support profit-shifting activities. Since the *Cadbury Schweppes*[25] case at the European Court of Justice (ECJ) in 2006, the CFC rules are not applicable within the European Economic Area (EEA).[26]

The CFC rules apply to approximately 10% of the intangible assets in our sample. Incorporating these regulations into our analysis is of a great importance, since profits generated from patents and trademarks are typically classified as passive income and therefore have to be taxed according to controlled foreign company rules if they apply. Aside from this, accounting for the parent company's taxation in the calculation of tax rates provides another source of variation in the main independent variable of interest.

Other Control Variables

In addition to tax rates, the baseline model includes an independent vector of control variables. We control for the quality of patents and trademarks. A patent or trademark idea is considered high quality if the majority of its applications have been filed at the three main registration offices (i.e., European, US and Japanese). In addition, we control for the *Real Activity* of a firm in the case of patents.[27] This is a dummy variable that is equal to one if at least one of the inventors is from the same country as the patent is located.

We gather data from the Heritage Foundation to control for property rights protection. Property rights protection is measured with an index that ranges from zero to one hundred and

parent company. Passive income is defined differently in each country that implements the rules, but it typically refers to royalty payments and other income that is not associated with real economic activity.

[25] See C-196/04 (2006).

[26] Denmark is the only exception in this case. See Schmidt (2014) for more information on the Danish CFC rules.

[27] We are not able to include this variable in our analysis in the case of trademarks due to a lack of available data.

represents the level of intellectual property rights protection in a country.[28] Following Griffith et al. (2014), we define a country as having a high level of intellectual property rights protection if it scores above the median of countries in our sample. We include some additional variables to control for the market size and the total R&D expenditure in the country where an intangible asset is located (Dischinger and Riedel, 2011; Karkinsky and Riedel, 2012; Ernst et al., 2014; Griffith et al., 2014). We include gross domestic product (GDP) as a proxy for a country's market size. Data on GDP were collected from the World Bank's *Development Indicators.*[29] BERD captures country *j*'s business expenditure on research and development as a percentage of its GDP and represents its level of innovative activity. Statistics on BERD are from the OECD database *Main Science and Technology Indicators.*[30]

We include location, industry and firm-size fixed effects in our estimations to capture all the non-observed time-invariant heterogeneity across countries, industries and firm size. For instance, companies might prefer to register an intangible asset in a particular country because of its geographical or historical characteristics. Alternatively, firms in certain industries may face specific rules concerning the development and registration of intangible assets. Such regulatory and operational peculiarities of each country, industry and firm-size category could give rise to unobserved heterogeneity which is captured by the corresponding fixed effects.

IV. RESULTS

Descriptive Statistics

Table 3 presents descriptive statistics for our sample. Panel A summarizes data for patents and Panel B shows statistics for trademarks. We have 25,444,980 observations for patents and 9,372,015 observations for trademarks across the years 1996 to 2012. This represents 1,696,332

[28] Available at: http://www.heritage.org/index/
[29] See World Bank (2017).
[30] See OECD (2016).

individual patent applications and 624,801 individual trademark applications. Recall that our variable of interest, *Tax Rate*, is a country's final statutory tax rate by considering reductions from IP Boxes and also CFC Rules. The mean value of *Tax Rate* for patents is 28% while for trademarks it is 31%. This shows that, on average, trademarks are subject to a higher tax rate. The mean quality for sample patents is nearly 24% and for trademarks it is 6%. This indicates that patent applications are more often filed at multiple registration offices as compared to trademarks. The mean of High IP Right Protection (BERD) is about 1% (22.83) for both intangible assets while GDP for the countries in which patents are located is slightly higher than that for trademarks.

Baseline Results

Table 4 present the results for our main analysis. Panel A shows patents' tax elasticity while Panel B shows trademarks' tax elasticity. Recall that in all estimations, the intangible's location choice is our dependent variable. The results are presented by industry and firm size. All estimates include location, industry and firm-size fixed effects.[31]

According to Table 4, the mean marginal impact of a statutory tax rate on the intangible's location choice is negative and statistically significant across all industries and firm-size groups. In both cases (patents and trademarks) the impact is greater for non-large companies than large firms. In the case of patents the effect is more pronounced in the engineering industry and for trademarks the effect is more pronounced in the electrical industry.

Comparing results across panels, we show that tax rates have a considerably stronger effect for trademarks' location choices as compared to patents'. This result confirms our

[31] Detailed results on the fixed-effects' coefficients are available upon request.

hypothesis that firms are more sensitive to royalty income tax rates with respect to trademarks than with respect to patents.

Table 4 shows that patents and trademarks of a higher quality are more sensitive to taxation than low quality ones. This effect is more negative in the case of trademarks compared to patents across almost all industry and firm-size categories with the exception of large companies in the engineering sector. In addition, patents tend to be owned in countries where real R&D activity takes place. This is captured by the positive coefficient on *Real Activity* in Panel A. As for the effects of other control variables shown in Table 4, a higher quality of intellectual property rights protection seems to play an important positive role in deciding the asset's location across almost all industry groups and firm-size categories consistent with Karkinsky and Riedel (2012) and Griffith et al. (2014). A positive significant coefficient on GDP in most categories indicates that patents and trademarks are usually located in economies with larger markets. However, in some categories, the coefficient on GDP flips sign, which indicates that these companies tend to locate their intangibles in stagnating economies with shrinking markets.

Table 4 shows that the coefficient on BERD, which denotes a country's total business expenditure on R&D in relation to its GDP, is positive and significant across both panels for almost all industry-size groups. This highlights that a greater share of investment in R&D positively affects the number of intangibles in a given country.

In summary, our results provide new empirical evidence of a higher tax sensitivity for trademark locations choices as compared to patents.

Cross-Country Tax Elasticities of Patent and Trademark Location Choices

To determine the scale of the impact in more detail, we calculate the own and cross-country tax elasticities of patent and trademark location choices:

$$e_{pijh} = \frac{\Delta P_{pj}}{\Delta Tax_{ph}} \frac{Tax_{ph}}{P_{pj}} \quad (5)$$

In equation (5), e_{pijh} is the elasticity of the probability that an intangible asset *p* belonging to an idea *i* is located in country *j* with respect to a marginal change in the tax rate in location *h*. Tax_{ph} indicates the statutory tax rate in country *h* on the profits generated by intangible assets owned by firm f.[32] P_{pj} represents the predicted probability that an intangible asset *p* will be located in country j.[33] Equation (4) describes the formulation of P_{pj} in more detail. We aggregate the elasticities of the location choices that arise within the same country and report the corresponding findings in Table 5.

Panel A of Table 5 presents the elasticities of the patent location choices with respect to corporate income tax. The diagonal values depict their own tax elasticities, which are negative in all locations. In this case, the lowest (in absolute terms) own tax sensitivity of -0.1 is observed in Ireland and the highest, -1.4, is in the US. This means that, on average, a 1% increase in the tax rate in Ireland leads to a -0.1% fall in the number of patent applications in the country. A 1% rise in the tax rate of the US results, on average, in a -1.4% decrease in the number of patents. The cross-country tax elasticities are positive, which indicates that alternative locations experience a positive change in the number of patents once one country increases its tax rate on royalty income.

Panel B of Table 5 shows tax elasticities in the case of trademarks. These values, as expected, are more negative than patents' tax elasticities. For instance, a 1% tax rate increase in Ireland leads to a -1.4% decrease in the number of trademarks. If Danish tax rates go up by 1%, the number of trademarks will likely experience a drop of -2.3%. There are a few reasons

[32] ΔTax_{ph} equals the standard deviation of the residuals of Tax_{ph} divided by 1000. This implies that ΔTax_{ph} is close to the smallest possible change in the tax rate. Using a change of 1% instead does not alter the results.
[33] ΔP_{pj} is calculated through subtracting the predicted probabilities of the location choices before and after a tax change.

why some low-tax countries such as Ireland and Switzerland have rather low tax elasticities (in absolute terms) as compared to the other countries in our sample. First, CFC rules often apply in these countries because they could be considered as tax havens. Then a change in the tax rate of these countries does not have an impact on firms' location choices since income from intangible assets will be subject to the corporate tax rates in the country where the headquarters is located. Second, if the tax rate is initially low, then a 1% increase implies a smaller scale of change as compared to a location with an initially higher tax rate.[34]

Tax Semi-Elasticities

To link our results with those from previous literature, we calculate tax semi-elasticities. Tax semi-elasticities represent a percentage change in the share of intangibles' assets in a country caused by a 1% change in the country's tax rate. Table 6 present the results.

The average tax semi-elasticity of a patent location choice is -2.8, whereas the average tax semi-elasticity of a trademark location equals -6.5. These findings give us further confidence that trademarks are more sensitive to taxation than patents. The semi-elasticity of patents that we obtain is comparable to the ones found by previous studies for different countries and time periods.[35]

Robustness Checks

To check the robustness of our baseline results, we perform additional tests .We consider only non-large firms in the engineering sector as a representative sample for these tests.[36] The

[34] For example, if the tax rate is 10%, a 1% increase implies that it goes from 10% to 11%. If the tax rate is 30%, a 1% increase constitutes a change from 30% to 33%.
[35] For instance, Griffith et al. (2014) conclude that the tax semi-elasticity of a patent location choice lies between -0.5 and -3.9. Karkinsky and Riedel (2012) find this value to equal around -3.5.
[36] This industry-firm-size category was chosen as a representative sample because it contains the largest number of observations as compared to other industry-firm-size groups. Untabulated results for other industry-firm-size types are in line with the outcomes obtained using the representative sample.

results of all robustness checks are reported simultaneously for patents and trademarks to facilitate a direct comparison.

To check the robustness of our main findings, we first perform two alternative multinomial logit models. Columns I-IV of Table 7 show the results. Similar to the baseline model, the dependent variable in these estimations is the location choice for an intangible asset in one of 15 countries shown in Table 1. Additionally, these specifications include country-fixed effects. Columns I and II show the results of using a conditional logit model, in which the assumption of the independence of irrelevant alternatives is not relaxed. Hence, the alternative location choices are assumed to be uncorrelated here. However, this alteration does not change the results considerably. Columns III and IV present the results of a nested logit estimation. According to Hensher et al. (2005), this model relaxes the IIA assumption by clustering similar alternative location choices into nests. Thus, 15 locations in the baseline estimation are divided into five clusters according to their geographical region. For example, consider a firm that wants to place a patent in Sweden, but this country increases its statutory corporate tax rate. The company thus chooses an alternative location for the patent and we assume that it sees other Nordic countries as preferred alternatives to Sweden. All other locations become inferior options. Allowing for such a correlation between alternative locations leads to stronger negative results as compared with the baseline findings.

Earlier papers on patent location choices have used a different identification strategy than the one used by Griffith et al. (2014) and our study. For instance, Karkinsky and Riedel (2012) and Bornemann, Laplante and Osswald (2019) perform an analysis at the firm level rather than at the level of an intangible asset, by applying such estimators as the negative binominal and ordinary least squares (OLS) models. To tie our results with current literature, we perform an alternative identification strategy. Columns V-VIII in Table 7 show the results. Consistent with earlier studies, the dependent variable in these estimations is the number of

patents or trademarks held by a firm in the given year. Columns V-VI (VII-VIII) present the results of using a negative binominal estimator (OLS estimation). Firm-fixed and year-fixed effects are included in these regressions. Our findings are consistent with our main analysis results, showing a negative and statistically significant coefficient for both assets, with a larger effect for trademarks than patents. This further confirms that a country's tax rates are negatively associated with the number of intangible assets owned by a firm and that this association is stronger in the case of trademarks. Additionally, companies with patents and trademarks of a high quality seem to be more sensitive to changes in taxation than firms with low quality intangibles. The magnitude of the effect we find using an alternative identification strategy is in line with previous studies.[37]

Columns IX and X of Table 7 show the baseline results presented in Table 4 after the exclusion of all control variables. This exclusion has no relevant impact on the main results. Table 7, columns XI and XII show the results after including only the firms that held at least one patent and one trademark during our sample period. Although the coefficients seem to be weaker for this test, they still remain negative and significant, with the effect considerably larger for trademarks.

Table 7, columns XIII-XVI present results by using a different independent variable. We proxy a country's tax rates as the statutory corporate tax rate without considerations for IP Boxes and CFC rules. Although, the magnitude of the results appears to be smaller in absolute terms compared with the baseline model, the effect is still larger for trademarks. Table 7, columns XV-XVI show the results by using the tax differential between an affiliate and its parent firm as the independent variable. This alteration does not have a significant impact on the results. Once again, the effect is more negative in the case of trademarks than patents.

[37] See, for example, Karkinsky and Riedel (2012), Table 3 on p.183 (columns 1-2 for OLS and columns 12-13 for negative binominal).

Agglomeration of Patents vs. Trademarks

Regarding the conceptual firms' payoff differences between patents and trademarks, country endowments and an agglomeration effect could be the drivers for such a difference. We perform some additional tests to empirically address whether an agglomeration effect is one of the drivers for a lower mobility of patents within a company group compared to trademarks. As in the previous section, we use only non-large firms in the engineering sector as a representative sample.

Patents are more likely to be held together in a bundle, since multiple patents often belong to one family as compared with trademarks. Although in the baseline model, we allow for some degree of correlation between related patents by grouping them into ideas, several ideas might belong to one patent family and thus, those are more likely to be registered in the country where the first patent of the family is held. By contrast, trademarks are more often registered independently or belong to smaller families and are therefore expected to be less dependent on the location of previous trademarks.

Table 8 present the results of this test. The specifications include *New Location*, which is a binary variable that takes on the value of one if a firm has never applied for an intangible asset in the given country, otherwise it is zero. [38] The coefficient of *New Location* is negative and statistically significant for both patents and trademarks, but is larger for patents. This suggests that both IP assets are more likely to be registered in the countries where a company already holds some intangible assets and are less likely to be located in a completely new location.

The coefficient for the interaction term in columns II and IV is and significant, with the aggregated effect slightly stronger for patents as compared with trademarks. This indicates that

[38] Here, we consider previous patent and trademark applications in the same industry.

patent and trademark location choices are less responsive to changes in taxation in countries where firms do not hold any related IP assets. These results give us further comfort for the agglomeration effect mechanism driving the difference in tax elasticity between the two assets.

Legal vs. Economic Ownership

The empirical analysis of this study uses data on patent and trademark applications filed at several international application offices. These applications contain information about their legal owners. Although for the main analysis, we assumed that the legal owner of a patent or a trademark is the only possible owner, this is not necessarily the case in some countries. Markham (2005) shows that several OECD members provide different IP ownership options. The legal owner of an intangible asset is usually the owner by law based on the legal registration of patents, trademarks, copyright, designs and other intangibles. However, the economic owner is the one that bears the greatest share of the development expenses (and likewise the greatest risk).[39] In some countries, the economic owner is the one entitled to get the income derived from the intangible asset and therefore the one facing the tax burden of this income.[40]

Legal and economic ownership of an intangible asset is regulated in many countries at the national level. The OECD (2010) has addressed the separation of IP ownership in its transfer pricing guidelines arguing that the rightful owner of an IP is the economic owner, as it is the economic owner that bears the costs and risks associated with the development of the intangible asset. Similar conclusions have been made in the OECD/G20 Action Plan on base erosion and profit shifting (BEPS) (2015).[41] According to Actions 8-10, the functional or economic owner

[39] Please note that different ownership options exist not only for patents, but also for other types of intangibles, including trademarks.
[40] Van Gorp (2012) gives a thorough review of further IP ownership types such as contract-based ownership, control ownership, functional ownership, and beneficial ownership. These are similar to the concept of economic ownership.
[41] See OECD/G20 (2015).

of an intangible asset should be entitled to the returns remaining after the legal owner has been remunerated for their own functions, assets and risks related to the R&D process.

Table 9 gives a detailed overview of the treatment of economic and legal ownership concepts in the countries analyzed in this study. According to Table 9, most countries in our dataset distinguish between legal and economic ownership and the majority of them follow the transfer pricing guidelines and Actions 8-9 of the Action Plan on BEPS.

To assess the impact of the distinction between legal and economic ownership in our data, we include in our main analysis the binary variable *Separation*. This variable equals one if a country allows the distinction between legal and economic ownership, otherwise it is zero. We interact this variable with the tax rate.[42] Table 10 shows the results. Columns I and II show that the coefficient for the interaction term *Tax Rate*Separation* is positive and statistically significant for patents and trademarks. This indicates that the existence of economic ownership significantly reduces the tax sensitivity of legal ownership. This implies that the large effect that we observe in our data is concentrated in countries in which separation between legal and economic ownership does not exist. The marginal effect of taxation on patent location choice is -14.4 in the absence of a distinction between ownership and it amounts to -4.2 if a separation of legal and economic ownership exists. In the case of trademarks, these effects equal to -16.6 and -7.3 respectively. This further confirms that although economic and legal ownership separation reduces the tax elasticity of IP, this effect is stronger for patents as compared with trademarks.

In columns III and V of Table 10 we simultaneously control for the agglomeration effect and the distinction between ownership concepts. Results show that the impact of ownership

[42] In line with the robustness checks and extended analysis shown above, we only use non-large firms of the engineering sector as a representative sample.

separation remains almost unchanged once we control for these effects. In columns IV and VI, we add a triple interaction term between the tax rate, separation of legal and economic ownership and the agglomeration effect. Results point out that the separation of ownership has an even larger positive impact on the tax sensitivity of patents in new IP locations as compared with the baseline. At the same time, there is no statistically significant effect on the interaction between taxation, *Separation* and *New Location* in the case of trademarks.

V. CONCLUDING REMARKS AND FUTURE WORK

The conflicting findings and inferences in the prior literature regarding estimates of income shifting are especially relevant because they have different implications for policymaking. We reconcile both streams of the literature by first looking at one of the blind spots overlooked in previous studies and second by employing a rarely used econometric technique in tax research that overcomes the limitations of a pooled OLS model.

Specifically, we look at differences in the strategic location of patents and trademarks as a function of tax rates. Previous studies have not considered trademarks due to a lack of data. However, they have shown the importance of IP assets for MNCs tax planning (Bornemann et al., 2019; De Simone et al., 2014; Dischinger and Riedel, 2011; Klassen and Laplante, 2012). With respect to trademarks, there is limited empirical evidence and it stands to reason that the location of trademarks is more sensitive to taxes than the location of patents. Trademarks are less costly to develop, relocate and register than patents. Their development does not depend on the location of other intangibles in the same family, as can often be the case with patents not on a country's specific endowments. Therefore, based on the Scholes-Wolfson Framework (Scholes and Wolfson, 1992), we suggest that this kind of IP property is more attractive for MNCs' tax planning as compared with patents.

We test our hypothesis on a sample of patent and trademark applications filed by 162,640 firms during the period between 1996 and 2012. In total, our sample comprises 1,696,332 patents and 624,801 trademarks during the period of observation.

The main findings of our empirical analysis support our hypothesis. We find a negative relationship between tax rates and the location of patents and trademarks. This is consistent with earlier studies that focused on the location choices for patents (Ernst and Spengel, 2011; Karkinsky and Riedel, 2012; Griffith et al., 2014). However, we further show that location choices for trademarks are more sensitive to corporate tax rates than location choices for patents. According to our key findings, a 1% increase in the tax rate leads to a decrease of -0.1% to -1.4% in the number of patents located in a particular country and a -1.4% to -2.3% drop in the number of trademarks.

Furthermore, a 1% increase in the tax rate on royalty income leads to a -2.8% fall in the number of patents and a -6.5% decrease in the number of trademarks in this country, holding other factors constant. Moreover, we conduct additional tests in an attempt to show the mechanism behind the large differences between patents' and trademarks' tax elasticities. Our results suggest that this might be at least partially due to an agglomeration effect. In other words, patents may be less sensitive to taxation than trademarks because they are more likely to be registered in the country where the rest of the patent family is located and therefore are more dependent on a particular country's endowments. This paper contributes to the literature on tax-motivated profit shifting. First, in our methodological approach, we use detailed data at the subsidiary level containing the location of patents and trademarks. Earlier studies have tended to overlook trademarks. Unlike earlier studies in micro estimates or income shifting, we do not require specific financial data at the subsidiary level. This is an advantage enabling us to capture a broader spectrum of multinational firms' structure. In this way we reconcile the gap between micro and macro profit-shifting estimates found in previous studies (Dharmapala 2014;

Tørsløv, Wier and Zucman, 2018) by showing the importance of including firms that own trademarks (in the income-shifting estimates). Additionally, we contribute to the literature on the effects of trademarks (Graham and Somaya, 2006; Von Graevenitz, 2007; Greenhalgh and Rogers, 2012; Crass, 2014; Crass and Peters, 2014) by showing that for MNCs, trademarks appear to play a more relevant role for tax planning strategies.

We also contribute to the current tax policy debate started by the OECD on the importance of intangible assets' location for income-shifting. Our results point out that firms could be using trademarks more aggressively than patents for income-shifting opportunities as this kind of intangible asset can strategically locate/relocate more easily due to the lack of a country's endowment dependence.

Over the next few months, we plan to further test this result. In the spirit of reconciling macro and micro estimates of income shifting and the effect of Patents and Trademarks on it, we intend to compare micro and macro estimates to better explain the gap. To do so, we will be following Dharmapala and Riedel (2013) approach for micro estimates of income-shifting. We expect to find substantially smaller micro estimates, although still larger effects for trademarks than for patents.

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TABLE 1

Summary Statistics on the Number of Patents and Trademarks by Country

Panel A. Patents

	No. of Applications	% of Total, by Industry:			% of Total, by Firm Size:	
		Chemical	Engineering	Electrical	Large	Non-Large
Belgium	20,116	49.25	22.05	28.70	33.49	66.51
Denmark	21,460	44.76	26.03	29.22	32.80	67.20
Finland	46,729	26.90	21.13	51.98	49.33	50.67
France	146,420	29.39	36.05	34.56	34.29	65.71
Germany	844,890	28.73	39.73	31.54	31.31	68.69
Ireland	5,460	14.98	34.93	50.09	33.72	66.28
Italy	95,610	40.31	42.74	16.95	30.63	69.37
Luxembourg	2,549	29.27	34.68	36.05	35.90	64.10
Netherlands	84,471	22.36	25.87	51.77	40.85	59.15
Norway	12,661	43.57	29.65	26.78	30.87	69.13
Spain	29,665	34.12	37.72	28.16	31.01	68.99
Sweden	71,156	25.42	26.66	47.91	41.29	58.71
Switzerland	76,819	18.86	54.54	26.60	30.87	69.13
UK	91,903	27.17	30.74	42.09	30.36	69.64
US	146,423	30.85	33.88	35.27	30.98	69.02
Total	1,696,332	29.19	36.99	33.81	32.87	67.13

Panel B. Trademarks

	No. of Applications	% of Total, by Industry:			% of Total, by Firm Size:	
		Chemical	Engineering	Electrical	Large	Non-Large
Belgium	8,938	45.50	30.28	24.22	36.10	63.90
Denmark	10,833	40.28	36.20	23.52	32.35	67.65
Finland	5,956	33.63	38.13	28.24	35.76	64.24
France	41,856	42.35	27.92	29.73	32.39	67.61
Germany	134,341	35.08	33.65	31.27	30.90	69.10
Ireland	5,747	39.93	29.34	30.73	37.48	62.52
Italy	54,074	37.52	42.27	20.21	31.60	68.40
Luxembourg	4,122	23.68	30.49	45.83	39.06	60.94
Netherlands	26,784	31.61	33.21	35.19	32.96	67.04
Norway	2,409	35.16	33.17	31.67	35.70	64.30
Spain	39,420	35.77	37.05	27.18	31.91	68.09
Sweden	16,944	32.58	36.78	30.64	36.51	63.49
Switzerland	28,240	41.48	28.79	29.73	37.21	62.79
UK	57,819	26.52	26.53	46.95	31.56	68.44
US	187,318	22.92	30.61	46.47	32.50	67.50
Total	624,801	31.65	32.48	35.87	32.47	67.53

Notes: Large stands for companies with a total number of patent/trademark applications above the 80th percentile in their industry. Non-Large companies represent enterprises of other sizes (including medium and small firms).

TABLE 2

Countries with CFC Rules in Place

Country	Introduction	Conditions under which CFC Rules are Binding
Belgium	-	-
Denmark	1995	Always binding
Finland	1995	Effective tax rate is < 60% of Finnish tax or on the "Grey List"
France	1980	Effective tax rate is < 50% of French tax
Germany	1972	Effective tax rate is < 25%
Ireland	-	-
Italy	2000	Effective tax rate is < 50% of Italian tax or on the "Black List"
Luxembourg	-	-
Netherlands	-	-
Norway	1992	Effective tax rate is < 66% of Norwegian tax or on the "Black List"[1]
Spain	1995	Effective tax rate is < 75% of Spanish tax
Sweden	1990	Effective tax rate is < 55% of Swedish tax, except a country is on the "White List"
Switzerland	-	-
UK	1984	Effective tax rate is < 75% of British tax

Notes: [1]The rules do not apply if a tax treaty exists. Since the European Court of Justice *Cadbury Schweppes* case of 2006, CFC rules do not apply within the European Economic Area except for special cases. Sources: Karkinsky and Riedel (2012) and our own research.

TABLE 3

Descriptive Statistics

Panel A. Patents

Variable	Obs.	Mean	Std. Dev.	Min	Max
Tax Rate	25,444,980	0.28	0.11	0.00	0.45
Quality	25,444,980	0.24	0.43	0.00	1.00
Real Activity	25,444,980	0.06	0.23	0.00	1.00
High IP Rights Protection	25,444,980	0.01	0.12	0.00	1.00
GDP	25,444,980	1.76	3.21	0.02	14.41
BERD	25,444,980	22.83	1.47	19.55	26.42

Panel B. Trademarks

Variable	Obs.	Mean	Std. Dev.	Min	Max
Tax Rate	9,372,015	0.31	0.08	0.06	0.45
Quality	9,372,015	0.06	0.23	0.00	1.00
High IP Rights Protection	9,372,015	0.01	0.12	0.00	1.00
GDP	9,372,015	1.70	3.09	0.02	14.23
BERD	9,372,015	22.83	1.47	19.55	26.42

Notes: The samples include 1,696,332 patent applications and 624,801 trademark applications. Multiplying the number of patent and trademark applications by 15 (the number of country choices) gives the number of observations in each sample (the number of observations is 25,444,980 for patents and 9,372,015 for trademarks). *Tax Rate* stands for a host country's statutory tax rate levied on the income from intangible assets and accounts for IP Boxes and CFC rules. *Quality* is a dummy variable that indicates intangible assets of a high quality (applications that were filed at multiple offices). *Real Activity* is a binary variable, which equals one if at least one of the intangible's inventors resides in the given country and zero otherwise. *High IP Rights Protection* represents an indicator of a country's level of intellectual property rights protection. *GDP* stands for gross domestic product. *BERD* denotes a country's business expenditure on research and development in relation to its GDP.

TABLE 4

Patents and Trademarks Tax Elasticity

Panel A. Patents

Industry	Electrical		Engineering		Chemical	
Size	Large	Non-Large	Large	Non-Large	Large	Non-Large
Tax Rate	-2.122***	-2.779***	-4.362***	-4.969***	-3.657***	-3.197***
	(0.111)	(0.065)	(0.137)	(0.074)	(0.099)	(0.081)
*Tax Rate*Quality*	-1.739***	-2.488***	-2.918***	-2.804***	-0.280**	-2.493***
	(0.119)	(0.101)	(0.142)	(0.113)	(0.134)	(0.114)
Tax Rate (Std.Dev.)	5.851***	3.749***	4.018***	4.233***	4.604***	2.441***
	(0.108)	(0.092)	(0.173)	(0.102)	(0.142)	(0.168)
Real Activity	4.772***	6.427***	5.781***	8.362***	7.777***	8.872***
	(0.027)	(0.037)	(0.036)	(0.063)	(0.107)	(0.092)
Real Activity (Std.Dev.)	1.661***	2.911***	2.076***	4.273***	4.527***	4.373***
	(0.036)	(0.034)	(0.033)	(0.049)	(0.104)	(0.068)
High IP Rights Protection	0.190***	-0.151***	-0.424***	0.963***	-0.253***	-0.044
	(0.041)	(0.036)	(0.078)	(0.036)	(0.067)	(0.046)
GDP	-0.499***	0.465***	-0.564***	1.128***	1.108***	0.659***
	(0.019)	(0.017)	(0.028)	(0.019)	(0.029)	(0.019)
BERD	-0.934***	2.962***	1.243***	-0.517***	5.478***	0.970***
	(0.062)	(0.049)	(0.086)	(0.053)	(0.087)	(0.055)

Panel B. Trademarks

Industry	Electrical		Engineering		Chemical	
Size	Large	Non-Large	Large	Non-Large	Large	Non-Large
Tax Rate	-5.592***	-8.305***	-5.451***	-7.217***	-6.620***	-7.444***
	(0.163)	(0.111)	(0.159)	(0.114)	(0.152)	(0.111)
*Tax Rate*Quality*	-3.253***	-4.828***	-0.865***	-3.085***	-6.330***	-2.683***
	(0.287)	(0.216)	(0.310)	(0.262)	(0.231)	(0.261)
Tax Rate (Std.Dev.)	6.240***	6.247***	4.940***	6.235***	5.224***	7.055***
	(0.185)	(0.133)	(0.207)	(0.139)	(0.196)	(0.127)
High IP Rights Protection	0.347***	0.363***	0.321***	0.176***	0.212***	0.158***
	(0.070)	(0.044)	(0.058)	(0.041)	(0.056)	(0.043)
GDP	0.058***	-0.009*	0.010	0.001	-0.053***	-0.018***
	(0.008)	(0.005)	(0.008)	(0.006)	(0.009)	(0.006)
BERD	-0.236***	0.485***	0.413***	0.203***	0.041	0.174***
	(0.055)	(0.039)	(0.052)	(0.036)	(0.052)	(0.037)

Notes: *** p<0.01, ** p<0.05, * p<0.1 The samples include 1,696,332 patent applications and 624,801 trademark applications (the number of observations is 25,444,980 for patents and 9,372,015 for trademarks). Dependent variable is the intangible's location choice in one of 15 countries shown in Table 1. Location-industry-firm size fixed effects are included in all estimations. Large stands for companies with a total number of applications above the 80th percentile in each industry. Non-Large companies are enterprises of other sizes. *Tax Rate* stands for a host country's tax rate levied on the income from intangible assets and accounts for IP Boxes and CFC rules. *Quality* is a dummy variable that indicates intangible assets of a high quality (applications filed at multiple offices). *Real Activity* is a binary variable, which equals one if at least one of the intangible's inventors resides in the given country and zero otherwise. *High IP Rights Protection* represents an indicator of a country's level of intellectual property rights protection. *GDP* denotes a country's gross domestic product. *BERD* stands for a country's business expenditure on R&D in relation to its GDP.

TABLE 5

Own and Cross-Country Elasticities of Location Choices with Respect to Changes in the Tax Rate

Panel A. Patents

	Belgium	Denmark	Finland	France	Germany	Ireland	Italy	Luxem-bourg	Nether-lands	Norway	Spain	Sweden	Switzer-land	UK	US
Belgium	-0.88	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Denmark	0.01	-0.98	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Finland	0.03	0.03	-0.80	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.03
France	0.06	0.06	0.05	-0.66	0.06	0.05	0.06	0.06	0.06	0.05	0.06	0.05	0.05	0.06	0.06
Germany	0.69	0.69	0.54	0.69	-0.64	0.45	0.69	0.69	0.69	0.54	0.69	0.54	0.35	0.69	0.71
Ireland	0.00	0.00	0.00	0.00	0.00	-0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Italy	0.07	0.07	0.07	0.07	0.07	0.06	-1.11	0.07	0.07	0.07	0.07	0.07	0.05	0.07	0.07
Luxembourg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Netherlands	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.04	-0.77	0.03	0.04	0.03	0.03	0.04	0.04
Norway	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	-0.85	0.01	0.01	0.01	0.01	0.01
Spain	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02	-0.93	0.02	0.01	0.02	0.02
Sweden	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	-0.81	0.03	0.04	0.04
Switzerland	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	-0.44	0.04	0.04
UK	0.05	0.05	0.05	0.05	0.06	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.04	-0.96	0.06
US	0.08	0.07	0.07	0.08	0.09	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.07	-1.35

Notes: Elasticity represents a percentage change in the patent location relative to a percentage change in the tax rate. Each cell shows the elasticity of patent applications in the country in column 1 with respect to the tax change in country in row 1.

Panel B. Trademarks

	Belgium	Denmark	Finland	France	Germany	Ireland	Italy	Luxem-bourg	Nether-lands	Norway	Spain	Sweden	Switzer-land	UK	US
Belgium	-2.14	0.04	0.04	0.03	0.03	0.04	0.03	0.04	0.04	0.04	0.03	0.04	0.03	0.04	0.02
Denmark	0.04	-2.31	0.05	0.04	0.04	0.06	0.04	0.06	0.05	0.05	0.04	0.05	0.05	0.05	0.03
Finland	0.02	0.03	-2.20	0.02	0.02	0.04	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.02
France	0.14	0.19	0.18	-2.05	0.13	0.18	0.16	0.18	0.17	0.18	0.16	0.18	0.17	0.18	0.12
Germany	0.40	0.54	0.52	0.41	-1.69	0.55	0.45	0.62	0.51	0.51	0.46	0.52	0.52	0.52	0.33
Ireland	0.01	0.02	0.02	0.01	0.01	-1.44	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.01
Italy	0.18	0.25	0.24	0.19	0.17	0.25	-2.07	0.26	0.23	0.24	0.21	0.24	0.23	0.24	0.15
Luxembourg	0.01	0.01	0.01	0.01	0.01	0.02	0.01	-1.86	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Netherlands	0.09	0.13	0.13	0.09	0.09	0.15	0.10	0.15	-2.19	0.12	0.10	0.12	0.13	0.12	0.08
Norway	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-2.24	0.01	0.01	0.01	0.01	0.01
Spain	0.13	0.18	0.18	0.14	0.13	0.19	0.15	0.19	0.17	0.17	-2.14	0.18	0.17	0.18	0.11
Sweden	0.06	0.08	0.09	0.06	0.05	0.10	0.07	0.09	0.08	0.09	0.07	-2.17	0.09	0.08	0.05
Switzerland	0.07	0.11	0.12	0.07	0.07	0.18	0.08	0.17	0.10	0.11	0.09	0.12	-1.54	0.11	0.06
UK	0.21	0.29	0.29	0.22	0.19	0.32	0.24	0.31	0.27	0.29	0.24	0.30	0.29	-2.07	0.18
US	0.58	0.74	0.72	0.60	0.53	0.65	0.64	0.71	0.69	0.72	0.65	0.72	0.64	0.74	-1.48

Notes: Elasticity represents a percentage change in the trademark location relative to a percentage change in the tax rate. Each cell shows the elasticity of trademark applications in the country in column 1 with respect to the tax change in country in row 1.

TABLE 6

Semi-Elasticities of Location Choices with Respect to a Tax Rate Change

	Patents	Trademarks
Belgium	-3.4	-5.9
Denmark	-3.4	-7.9
Finland	-2.7	-7.7
France	-3.1	-5.8
Germany	-1.7	-4.6
Ireland	-0.6	-6.7
Italy	-3.3	-6.1
Luxembourg	-3.4	-7.7
Netherlands	-3.2	-7.1
Norway	-2.8	-7.6
Spain	-3.3	-6.4
Sweden	-2.7	-7.5
Switzerland	-1.7	-6.3
UK	-3.2	-7.0
US	-3.4	-3.8

Notes: Semi-elasticity represents a percentage change in the patent or trademark location relative to a unit (i.e. percentage-point) change in the tax rate. The average tax rates of the whole time period were used for these calculations.

TABLE 7

Robustness Tests

Panel A	Conditional Logit		Nested Logit		Negative Binominal		OLS	
	Patents	Trademarks	Patents	Trademarks	Patents	Trademarks	Patents	Trademarks
	I	II	III	IV	V	VI	VII	VIII
Tax Rate	-4.896***	-7.801***	-5.213***	-10.590***	-0.347***	-2.008***	-0.605***	-2.948***
	(0.065)	(0.129)	(0.063)	(0.496)	(0.063)	(0.079)	(0.0566)	(0.0830)
*Tax Rate*Quality*	-2.655***	-2.720***	-0.532***	0.686	-0.022	-0.130*	-1.293***	-0.744**
	(0.120)	(0.245)	(0.206)	(0.738)	(0.07)	(0.077)	(0.134)	(0.323)
Quality					0.432***	2.835***	1.884***	2.886***
					(0.025)	(0.027)	(0.0475)	(0.111)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects					Yes	Yes	Yes	Yes
Firm Fixed Effects					Yes	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes				
Number of Intangibles	413,274	135,512	413,274	135,512				
Number of Observations	6,199,110	2,032,680	6,199,110	2,032,680	1,246,253	1,918,535	1,246,253	1,918,535

Panel B	No Controls		Only Firms with Both		Simple CIT		CIT Difference	
	Patents	Trademarks	Patents	Trademarks	Patents	Trademarks	Patents	Trademarks
	IX	X	XI	XII	XIII	XIV	XV	XVI
Tax Rate	-1.960***	-7.326***	-0.954***	-4.470***	-1.546***	-2.874***	-4.801***	-7.217***
	(0.048)	(0.105)	(0.150)	(0.188)	(0.116)	(0.162)	(0.076)	(0.114)
*Tax Rate*Quality*			-0.188	-2.212***	-2.532***	-5.903***	-2.264***	-3.085***
			(0.174)	(0.393)	(0.166)	(0.440)	(0.093)	(0.262)
Tax Rate (Std.Dev.)	6.654***	6.207***	8.242***	8.986***	10.970***	20.310***	4.313***	6.235***
	(0.056)	(0.133)	(0.136)	(0.232)	(0.152)	(0.216)	(0.101)	(0.139)
Controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Intangibles	413,274	135,512	212,695	48,659	413,274	135,512	413,274	135,512
Number of Observations	6,199,110	2,032,680	3,190,425	729,885	6,199,110	2,032,680	6,199,110	2,032,680

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robustness tests are shown only for non-large firms of the engineering sector. In columns I-IV and IX-XVI, the dependent variable is the intangible's location choice in one of 15 countries shown in Table 1. In columns V-VIII, the dependent variable is the number of intangibles held by

a firm in the given year. *Tax Rate* in columns I-XII stands for a host country's tax rate levied on the income from intangible assets and accounts for IP Boxes and CFC rules. In columns XIII-XIV, it represents a simple CIT rate without considering IP Boxes and CFC rules. In columns XV-XVI, it stands for the tax differential between the tax rate of the firm's host country and the tax rate of the country of its parent company. *Quality* is a dummy variable that indicates intangible assets of a high quality (applications filed at multiple offices). *Controls* includes *High IP Rights Protection*, *GDP*, *BERD*, and *Real Activity* (for patents). Columns XI-XII show the results when considering only the sample of firms that have at least one patent and one trademark.

TABLE 8

Extended Analysis: Agglomeration Effect

	Patents		Trademarks	
	I	II	III	IV
Tax Rate	-4.611***	-8.313***	-7.785***	-11.490***
	(0.107)	(0.128)	(0.118)	(0.236)
*Tax Rate*Quality*	-1.973***	-1.534***	-3.714***	-3.529***
	(0.193)	(0.194)	(0.267)	(0.269)
Tax Rate (Std.Dev.)	7.929***	7.639***	6.223***	6.343***
	(0.108)	(0.111)	(0.141)	(0.141)
New Location	-7.291***	-9.315***	-2.445***	-3.809***
	(0.034)	(0.057)	(0.017)	(0.078)
*Tax Rate*New Location*		6.782***		3.994***
		(0.135)		(0.221)
Real Activity	5.394***	5.350***		
	(0.026)	(0.025)		
Real Activity (Std.Dev.)	1.748***	1.717***		
	(0.024)	(0.023)		
High IP Rights Protection	1.111***	1.084***	0.155***	0.152***
	(0.049)	(0.049)	(0.042)	(0.042)
GDP	0.477***	0.517***	-0.006	-0.004
	(0.020)	(0.019)	(0.006)	(0.006)
BERD	-0.210***	-0.110	0.213***	0.217***
	(0.066)	(0.067)	(0.037)	(0.037)
Location Fixed Effects	Yes	Yes	Yes	Yes
Number of Intangibles	413,274	413,274	135,512	135,512
Number of Observations	6,199,110	6,199,110	2,032,680	2,032,680

Notes: *** p<0.01, ** p<0.05, * p<0.1 Results are based on non-large firms of the engineering sector. Dependent variable is the intangible's location choice in one of 15 countries shown in Table 1. *Tax Rate* stands for the corporate income tax rate and accounts for IP Boxes and CFC rules. *Quality* is a dummy variable that indicates intangible assets of a high quality (applications filed at multiple offices). *New Location* is a binary variable and takes on a value of one if a firm has never applied for intangible assets in the given country and zero otherwise. *Real Activity* is a binary variable, which equals one if at least one of the intangible's inventors resides in the given country and zero otherwise. *High IP Rights Protection* represents an indicator of a country's level of intellectual property rights protection. *GDP* denotes a country's gross domestic product. *BERD* stands for a country's business expenditure on R&D in relation to its GDP.

TABLE 9

Legal vs. Economic Ownership of Intangible Assets

Country	Separation Exists	Details
Belgium	Yes	Adopts the OECD TP guidelines on economic and legal ownership.
Denmark	No	Denmark gives preference to legal ownership but refers to the control ownership when it is difficult to determine a legal owner of intellectual property.
Finland	Yes	Adopts the OECD TP guidelines on economic and legal ownership.
France	No	Does not recognize economic ownership concept, only recognizes legal ownership.
Germany	Yes	Adopts the OECD TP guidelines on economic and legal ownership.
Ireland	Yes	Adopts the OECD TP guidelines on economic and legal ownership.
Italy	No	Does not recognize economic ownership concept, only recognizes legal ownership.
Luxembourg	Yes	Adopts the OECD TP guidelines on economic and legal ownership.
Netherlands	Yes	Adopts the OECD TP guidelines on economic and legal ownership.
Norway	No	There is no distinction between economic and legal ownership written into civil and tax law.
Spain	No	Under Spanish CIT law, there is no specific regulation on the treatment of IP ownership (in terms of legal/economic ownership).
Sweden	Yes	Adopts the OECD TP guidelines on economic and legal ownership.
Switzerland	Yes	Adopts the OECD TP guidelines on economic and legal ownership.
UK	Yes	Recognizes legal and beneficial ownership but gives preference to economic ownership.
US	Yes	Pioneered and substantially advanced the concept of economic ownership.

Notes: TP stands for transfer pricing. CIT stands for corporate income tax rate. See OECD (2010) for OECD TP guidelines. Sources: van Gorp (2012) and our own survey of the Big 4 tax experts.

TABLE 10

Extended Analysis: Legal vs. Economic Ownership

	Separation of Ownership		Separation and Agglomeration			
	Patents	Trademarks	Patents		Trademarks	
	I	II	III	IV	V	VI
Tax Rate	-14.430***	-16.590***	-13.410***	-14.470***	-20.680***	-21.160***
	(0.195)	(0.297)	(0.211)	(0.265)	(0.367)	(1.027)
*Tax Rate*Quality*	-2.694***	-3.060***	-1.566***	-1.389***	-3.490***	-3.470***
	(0.110)	(0.262)	(0.193)	(0.196)	(0.269)	(0.268)
Tax Rate (Std.Dev.)	3.683***	6.212***	7.478***	7.669***	6.349***	6.248***
	(0.104)	(0.137)	(0.111)	(0.110)	(0.138)	(0.139)
*Tax Rate*Separation*	10.260***	9.293***	6.137***	6.535***	8.955***	9.678***
	(0.184)	(0.269)	(0.192)	(0.269)	(0.272)	(1.031)
New Location			-9.270***	-8.685***	-3.884***	-4.290***
			(0.056)	(0.077)	(0.078)	(0.337)
*Tax Rate*New Location*			6.690***	7.149***	4.246***	4.792***
			(0.134)	(0.247)	(0.222)	(1.015)
*Separation * New Location*				-1.667***		0.581*
				(0.077)		(0.342)
*Tax Rate*Separation* New Location*				1.903***		-0.824
				(0.261)		(1.028)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Intangibles	413,274	135,512	413,274	413,274	135,512	135,512
Number of Observations	6,199,110	2,032,680	6,199,110	6,199,110	2,032,680	2,032,680

Notes: *** p<0.01, ** p<0.05, * p<0.1 Results are based on non-large firms of the engineering sector. Dependent variable is the intangible's location choice in one of 15 countries shown in Table 1. *Tax Rate* stands for the corporate income tax rate and accounts for IP Boxes and CFC rules. *Quality* is a dummy variable that indicates intangible assets of a high quality (applications filed at multiple offices). *Separation* is a binary variable and it is based on Table 9; it equal one if the separation between the concepts of legal and economic ownership exists in a country and zero otherwise. *New Location* is a binary variable and takes on a value of one if a firm has never applied for intangible assets in the given country and zero otherwise. *Controls* includes *High IP Rights Protection*, *GDP*, *BERD*, and *Real Activity* (for patents).

Appendix A. Replication of Griffith et al. (2014)

This study is based on the identification strategy applied by Griffith et al. (2014). Even though the estimation approaches are similar, they differ in terms of the sample selection. To account for these differences, we replicate the estimates of Griffith et al. (2014). Table 11 presents the results of replicating Griffith et al. (2014) and moves gradually from their sample to the sample used in this paper. As for the robustness checks and additional analysis, all estimations in Table 11 use data on non-large firms of the engineering sector as a representative sample. Column I of Table 11 presents the results reported by Griffith et al. (2014).[43] Column II shows the closest replication of these results that we achieve. Column III adds the data from the US patent and trademark office to the sample (the study by Griffith et al. (2014) only uses data from the European patent office). Our results show that the gradual alteration of the original sample does not significantly influence the key findings. More specifically, the coefficient for *Tax Rate* and its interaction with a *Quality* are still negative and statistically significant.

The last two columns of Table 11 present the baseline results of our study. The major difference between column III and column IV lies in the period of observation. Another minor difference is the one related to *IP Rights Protection*. Following Griffith et al. (2014), in the sample of 1985-2005 this control variable is based on a measure developed by Ginarte and Park (1997) and Park (2008). However, since the equivalent data are not available for a later timeframe, we use statistics from the Heritage Foundation. As shown in column IV, the change in the time period slightly increases (in absolute terms) the coefficient on *Tax Rate* in the case of patents. In column V we show the main results of our paper, which lies in estimating the impact of taxation on trademark location choices. The coefficient on *Tax Rate* in column V is

[43] See Griffith et al. (2014), p.20.

larger. This is consistent with the idea that trademarks are more sensitive to taxation than patents.

Table 11.

Replication of Griffith et al. (2014)

	1985-2005	Our Replication (1985-2005)		Our Results (1996-2012)	
	Griffith et al. (2014)	Closest Replication of Griffith et al.(2014)	Column II + USPTO Data	Patents (Column IV, but different time period)	Trademarks
	I	II	III	IV	V
Tax Rate	-4.88***	-3.471***	-3.481***	-4.969***	-7.217***
	(0.24)	(0.049)	(0.049)	(0.074)	(0.114)
*Tax Rate*Quality*	-0.66**	-2.924***	-2.925***	-2.804***	-3.085***
	(0.28)	(0.059)	(0.060)	(0.113)	(0.262)
Tax Rate (Std.Dev.)	3.17***	1.766***	2.859***	4.233***	6.235***
	(0.27)	(0.138)	(0.095)	(0.102)	(0.139)
Real Activity	7.03***	8.628***	8.736***	8.362***	
	(0.09)	(0.065)	(0.065)	(0.063)	
Real Activity (Std.Dev.)	2.96***	4.420***	4.627***	4.273***	
	(0.08)	(0.050)	(0.050)	(0.049)	
High IP Rights Protection	0.19*	0.452***	0.423***	0.963***	0.176***
	(0.10)	(0.011)	(0.010)	(0.036)	(0.041)
GDP	0.43***	-0.014*	0.055***	1.128***	0.001
	(0.05)	(0.008)	(0.007)	(0.019)	(0.006)
BERD	0.09**	3.49e-05	0.004	-0.517***	0.203***
	(0.04)	(0.021)	(0.021)	(0.053)	(0.037)

Notes: *** p<0.01, ** p<0.05, * p<0.1 Results are based on non-large firms of the engineering sector. Dependent variable is the intangible's location choice in one of 15 countries shown in Table 1. Location-industry-firm size fixed effects are included in all estimations. *Tax Rate* stands for a host country's tax rate levied on the income from intangible assets and accounts for IP Boxes and CFC rules. *Quality* is a dummy variable that indicates intangible assets of a high quality (applications filed at multiple offices). *Real Activity* is a dummy variable, which equals one if at least one of the intangible's inventors resides in the given country and zero otherwise. *High IP Rights Protection* represents an indicator of a country's level of intellectual property rights protection. *GDP* denotes a country's gross domestic product. *BERD* stands for a country's business expenditure on research and development in relation to its GDP.

Appendix B. Results with American Multinationals

Our baseline analysis does not include subsidiary data from US parents according to the approach in Griffith et al., (2014)However, we additionally test whether the inclusion of these firms have a relevant impact on our result.

Table 12 present the results, showing that theinclusion of firms with American parents in our sample does not influence the main findings. Again, trademarks (Panel B of Table 12) show a more negative tax sensitivity than patents (see Panel A of Table 12). This result holds across all industries and firm sizes. Further, the effect size for patents and trademarks appears to be larger (in absolute terms) than the effect we obtained in our baseline estimations (Table 4. This suggests that companies with American parents are even more responsive to changes in taxation for trademarks location choices than subsidiaries of firms located in other countries.

Table 12.

Results with American Multinationals

Panel A. Patents

Industry	Electrical		Engineering		Chemical	
Size	Large	Non-Large	Large	Non-Large	Large	Non-Large
Tax Rate	-5.554***	-6.118***	-5.681***	-3.475***	-4.792***	-4.758***
	(0.054)	(0.048)	(0.063)	(0.031)	(0.099)	(0.054)
*Tax Rate*Quality*	-2.052***	-0.478***	-3.351***	-1.429***	-2.066***	0.297***
	(0.067)	(0.061)	(0.069)	(0.038)	(0.111)	(0.067)
Tax Rate (Std.Dev.)	1.584***	1.809***	3.884***	1.820***	2.182***	1.693***
	(0.071)	(0.058)	(0.065)	(0.051)	(0.129)	(0.092)
Real Activity	4.940***	6.382***	6.116***	9.872***	6.957***	8.254***
	(0.022)	(0.025)	(0.036)	(0.059)	(0.096)	(0.072)
Real Activity (Std.Dev.)	2.349***	2.835***	3.271***	5.609***	4.714***	4.535***
	(0.025)	(0.020)	(0.035)	(0.045)	(0.098)	(0.058)
High IP Rights Protection	0.213***	0.419***	0.134***	0.153***	0.453***	0.098**
	(0.027)	(0.030)	(0.039)	(0.019)	(0.063)	(0.041)
GDP	0.471***	0.221***	-0.035***	0.266***	-0.057***	0.281***
	(0.008)	(0.005)	(0.008)	(0.004)	(0.011)	(0.007)
BERD	0.286***	0.715***	0.459***	0.139***	0.240***	0.752***
	(0.018)	(0.019)	(0.023)	(0.012)	(0.037)	(0.022)

Panel B. Trademarks

Industry	Electrical		Engineering		Chemical	
Size	Large	Non-Large	Large	Non-Large	Large	Non-Large
Tax Rate	-9.974***	-10.930***	-9.123***	-10.160***	-8.587***	-8.755***
	(0.158)	(0.072)	(0.163)	(0.079)	(0.147)	(0.078)
*Tax Rate*Quality*	-3.074***	-3.767***	0.522	-2.975***	-4.499***	-2.265***
	(0.303)	(0.132)	(0.337)	(0.179)	(0.205)	(0.170)
Tax Rate (Std.Dev.)	4.780***	-0.604*	4.098***	3.787***	3.012***	2.791***
	(0.158)	(0.318)	(0.182)	(0.084)	(0.185)	(0.104)
High IP Rights Protection	0.039	0.196***	0.352***	-0.012	-0.234***	0.047
	(0.089)	(0.039)	(0.072)	(0.037)	(0.082)	(0.037)
GDP	0.058***	0.096***	0.042***	0.076***	0.070***	0.027***
	(0.008)	(0.004)	(0.008)	(0.004)	(0.009)	(0.004)
BERD	-0.578***	0.274***	-0.105**	0.292***	0.094*	0.159***
	(0.049)	(0.024)	(0.049)	(0.025)	(0.050)	(0.026)

Note: *** p<0.01, ** p<0.05, * p<0.1 The samples include 3,899,752 patent applications and 1,012,287 trademark applications (the number of observations is 58,496,280 for patents and 15,184,305 for trademarks). Dependent variable is the intangible's location choice in one of 15 countries shown in Table 1. Location-industry-firm size fixed effects are included in all estimations. Large stands for companies with a total number of applications above the 80th percentile in each industry. Non-Large companies are enterprises of other sizes. *Tax Rate* stands for a host country's tax rate levied on the income from intangible assets and accounts for IP Boxes and CFC rules. *Quality* is a dummy variable that indicates intangible assets of a high quality (applications filed at multiple offices). *Real Activity* is a binary variable, which equals one if at least one of the intangible's inventors resides in the given country and zero otherwise. *High IP Rights Protection* represents an indicator of a country's level of intellectual property rights protection. *GDP* denotes a country's gross domestic product. *BERD* stands for a country's business expenditure on R&D in relation to its GDP.