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Corporate Taxes, Patent Shifting and Anti-Avoidance Rules: Empirical Evidence

Abstract

We empirically assess international corporate tax avoidance by strategic location of innovative output. The analysis draws on the universe of patent applications to the European Patent Office linked with data on multinational entities (MNEs) in Europe. Four findings emerge: Firstly, patent holdings are distorted towards low-tax countries. Secondly, patent location in low-tax countries is correlated with a geographic separation of R&D output and input. Thirdly, MNEs systematically sort high-value (low-value) patents to low-tax (high-tax) countries. Fourthly, the propensity to locate patent ownership in low-tax countries is significantly decreased if controlled foreign company rules are enacted in the MNE's parent country. The tightening of transfer pricing legislations, in turn, exerts a weak negative effect on the location of patent ownership only.

JEL-Codes: H300, H700, J500.

Keywords: corporate patents, patent taxation, profit shifting, anti-avoidance rules.

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1 Introduction

Intellectual property (IP) and other intangible assets are key drivers of corporate success in the modern economy. The income derived from intangible assets is at the same time internationally highly mobile as intellectual property has no trade costs and can thus be held at locations other than the inventor country or the country where the IP is used. Media reports and parliamentary investigations into the tax structures of large multinational companies like Google, Apple, Starbucks and others suggest that MNEs exploit this mobility and strategically locate ownership of their intangible property at tax-haven affiliates, with the intention of minimizing their corporate tax burden (The Guardian (2009), Bloomberg Businessweek (2010), New York Times (2013)).

Policy makers have raised increasing concerns about these relocation activities. Several countries enacted patent box regimes which levy reduced tax rates on IP income. Others introduced or tightened unilateral anti-avoidance measures to prevent associated profit outflow. On top, the G20/OECD designed an action plan against Base Erosion and Profit Shifting (BEPS), which, among others, combats income shifting involving high-value intangible assets by revising and tightening transfer pricing rules and controlled foreign company (CFC) laws.

The aim of this paper is to empirically assess multinational IP shifting strategies and the effectiveness of governments' countermeasures to combat them. The analysis focuses on corporate patents and draws on information on the universe of patent applications to the European Patent Office (EPO) linked with data on MNEs in Europe. Estimating conditional and mixed logit models, we find that low corporate tax rates are instrumental in attracting patents. The analysis, moreover, assesses practitioners' claims that attractive patent relocation schemes often involve a geographic separation of R&D input and output location (implemented e.g. through contract research or cost sharing agreements), as this allows firms to benefit from low tax rates on patent income while keeping their R&D departments in high-tax countries, which often provide non-tax benefits like access to high-quality infrastructure and high-skilled labor or geographic proximity to the MNEs' headquarters. Confirming these considerations, we find that a significant fraction of patented technologies owned at tax-haven affiliates was invented in a foreign country (while the fraction of 'foreign-invented' patents in high-tax economies is small). The propensity to separate patent

ownership from the inventor country and to locate it in a tax haven economy is moreover positively correlated with the inventor country's corporate tax rate, which underpins that tax considerations determine the corporate decision to engage in such schemes.

In addition, we provide evidence that MNEs systematically sort high-value (low-value) patents to low-tax (high-tax) countries. The results suggest that the propensity to shift patent ownership from the R&D location to a low-tax economy significantly increases with the value and earnings potential of the patent as measured by its family size, the number of forward citations and the number of technology classes on the patent application.[1] Quantifying tax-motivated patent shifting based on simple patent counts consequently underestimates the income-shifting effect of interest. On top, the finding supports recent theoretical claims that corporate taxation distorts the location of heterogeneous assets and functions (see e.g. Haufler & Stähler (2013) and Becker & Fuest (2007)).[2]

Finally, we study the effectiveness of anti-avoidance legislations in limiting corporate income shifting through strategic patent location. Our findings suggest that CFC laws – by making tax haven income from patents and other passive sources taxable in the MNE's parent country – are effective in diverting patent holdings from tax haven economies. The strictness of transfer pricing laws and their enforcement, in turn, exerts a relatively mild negative effect on multinational patent holdings only. This result is in line with the perceived shortcomings of existing transfer pricing rules which build on the arm's length principle and hence require prices for intra-firm trade to correspond to prices for comparable extra-firm trade. Since patents and other IP are by their very definition firm-specific in nature, comparable third-party trade, however, does not exist. This implies that arm's length prices can only be determined based on indirect methods and scope for strategic tax-motivated mispricing may thus prevail even in the presence of transfer pricing legislations. Finally, we use our estimates to conduct ex ante policy analysis and determine how the location of intellectual property responds to three tax policy experiments: firstly, the Trump administration's recent corporate tax cut; secondly, an international harmonization of patent income tax rates; and thirdly, the multilateral OECD/G20 BEPS effort to tighten and streamline transfer pricing laws.

[1] The number of technology classes proxies for the scope of the patented technology, which has been shown to correlate with its earnings potential (see e.g. Lerner (1994)).

[2] Previous empirical work has not been able to identify related effects as a negative correlation between corporate tax rates and firms' observed pre-tax profitability may reflect paper profit shifting as well as sorting of assets and functions of different underlying profitability.

Our analysis contributes to an emerging literature on multinational profit shifting (see e.g. Dharmapala (2014)). Closely related to our work are papers by Dischinger & Riedel (2011), Karkinsky & Riedel (2012), Griffith et al. (2014), Alstadsæter et al. (2015) which provide evidence that corporate income tax rates negatively impact on IP holdings of multinational affiliates.[3] Our paper extends previous studies in several ways. Firstly, we underpin the importance of patent shifting strategies that involve a geographic split of the location of R&D activities and the resulting patent income. This finding supports the G20/OECD's BEPS-notion that MNEs' innovative output is often geographically separated from the inventor location for income shifting purposes and the related BEPS-focus on the design of anti-profit shifting measures that hinder this separation (e.g. by strengthening the role of conduct relative to contractual relations in determining the allocation of income across group affiliates). Our evidence, moreover, suggests that analyzing simple patent counts when assessing patent shifting strategies, either in academic research or in tax authority auditing, does not capture the full scope of patent-related income shifting practices as MNEs have an incentive to systematically sort high-value patents to low-tax entities. Finally, we extend the literature by studying the impact of anti-shifting provisions, namely CFC and transfer pricing laws, on multinational patent location choices.

The remainder of the paper is structured as follows: Section 2 presents theoretical considerations. Section 3 describes our data and provides preliminary descriptive evidence. Sections 4 and 5 present the estimation approach and the empirical results. Section 6 concludes.

2 Theoretical Considerations

The purpose of our paper is to empirically investigate whether and to what extent multinational corporations exploit patents to transfer corporate income to tax favourable locations.

From a theoretical point of view, shifting income by strategic patent location is attractive for several reasons. Firstly, R&D activities earn above average returns (see e.g. Hall et al. (2009)) and many patents carry substantial industrial value. Multinationals thus have an incentive to locate

[3] In related papers, Pfeiffer & Voget (2016) and Heckemeyer et al. (2017) provide evidence for a negative tax effect on the location of trademarks within multinational firms. Schwab & Todtenhaupt (2016), on top, study cross-border externalities of patent box regimes and show that the introduction of patent boxes in one of the group's foreign host countries significantly increases multinational research activity at the parent location.

patents at low-tax affiliates for tax-saving purposes, especially if the patent has a high expected earnings potential. Secondly, trade costs for the intellectual property protected by the patents are close to zero and their geographical location can thus be separated from operating affiliates (in high-tax countries) at low costs. Thirdly, locating patents at low-tax affiliates may open up additional profit shifting opportunities as protected intellectual property often serves as a common input factor for operating affiliates within the multinational group which are forced, by the transfer price system, to pay a royalty to the patent owner. As patented innovations are firm-specific in nature, related arm's length prices fail to exist and firms have leeway to distort royalty prices in a tax-favourable way. If the patent is held by a tax-haven entity, MNEs may overstate the royalty prices charged to production and sales affiliates in high-tax countries in order to strip additional income from the operating affiliates to the low-tax economy.

In terms of organisational structures, multinational groups can draw on various strategies to locate patent income at affiliates in low-tax economies. First, they can obviously shift whole R&D units to low-tax entities. This strategy may, however, involve considerable costs as many low-tax countries tend to be unattractive locations for R&D activities in other dimensions, for example featuring inferior public infrastructure provisions or limited access to high-skilled labor. In line with these considerations, several studies suggest that a significant fraction of R&D activities is undertaken in high-tax economies, often at the headquarter's location of the multinational group (see e.g. Abramovsky et al. (2008)).[4]

MNEs may thus find it attractive to set up tax saving strategies which allow disentangling the location of patent-related income from the location of R&D units within their group. One common organisational structure to achieve this is to locate an R&D office in a low-tax country, which then engages in subcontracting agreements with operating R&D units in other (high-tax) economies. The operating units conduct the R&D and earn a fixed margin on their costs while the R&D office in the low-tax country provides finance and bears the project risk, consequently receiving the associated patent rights and all residual profits. Alternatively, MNEs may channel patent ownership and patent-related income to low-tax subsidiaries by setting up favourable cost sharing agreements.

[4]The bundling of patents at the multinational headquarters location may minimize agency costs and help reaping benefits from the co-location of patents (see e.g.Dischinger et al. (2014)).

Both strategies imply that the location of patent applicant and patent inventor is geographically separated for tax saving purposes. In the empirical analysis to come, we will quantitatively assess the importance of such geographic separations.

The last decades have moreover seen a rapid emergence of anti-profit shifting laws that aim to hamper income relocation to low-tax entities. Strategic patent location at low-tax countries has thereby mainly been addressed by the implementation of CFC rules and transfer pricing laws. CFC legislations directly target passive income from patents and other IP earned at tax haven affiliates by making this income taxable in the MNE's parent country. Transfer pricing laws aim to decrease the attractiveness of patent location at tax haven entities by reducing the scope for strategic mispricing of royalty payments associated with this IP (and the mispricing of the IP itself if it is transferred to a tax haven entity during or after the development process). The design of transfer pricing legislations varies across countries but all rules prescribe MNEs to document their intra-firm transfer prices and to prove that price calculations comply with enacted provisions which build on the arm's length principle in most countries. Since IP is firm-specific in nature, third-party transactions, however, hardly exist, implying that some scope for strategic corporate mispricing may prevail.

In the following, we will empirically assess tax-motivated multinational patent shifting strategies through strategic patent location and analyze the effectiveness of governments' countermeasures to combat them against the background of this theoretical discussion.

3 Data

To investigate the questions outlined above, we exploit patent data from the European Patent Office's (EPO) Worldwide Patent Statistical Database (PATSTAT) for the period 1990-2006.[5]

PATSTAT contains information on all patent applications to the EPO, including information about the patent applicant and the inventor of the patented technology, the application date, the technology classes of the patent and patent citations. The data version used in this paper is October 2007 and comprises up to 100,000 patent applications per year (from corporate and non-corporate patent applicants). Firms seeking patent protection in a number of European states may file an

[5]While these data are available for the period 1978 to 2006, our analysis is restricted to the years from 1990 onwards as we lack concise tax information for earlier years.

application directly at the EPO and designate the relevant national offices (among those covered by the EPO) in which protection is sought.[6] Filing a patent with the EPO offers two main advantages: Firstly, firms can make a single application which is cheaper than filing separately in each national office, and secondly, firms can delay the decision over which national states to further the application in. Thus, it is especially attractive to file the valuable patents with the EPO which a firm intends to exploit in several European markets.

Our empirical analysis draws on the set of corporate patent applications which were granted by the EPO. The patent data is, moreover, linked to Bureau van Dijk's AMADEUS database[7], comprising accounting and ownership information on firms in Europe. Specifically, the AMADEUS firm name is matched to the name of the patent applicant who is the legal owner of the patent and consequently subject to taxation (see e.g. Quick & Day (2006)). Note that the name matching accounts for firms in AMADEUS as well as for their subsidiaries inside and outside Europe, implying that patent-firm-matches, while Euro-centric in nature, are not limited to Europe (see Thoma et al. (2010)) for details). The AMADEUS data is moreover used to define the subset of patent applications from multinational firms. For that purpose, we identify the global ultimate owner of each firm (i.e. the entity which ultimately owns at least 50% of ownership shares). Groups operating in at least two countries are defined as multinational corporations. Finally, we exploit the patent information on the technology inventor and his/her host country. The latter will be assumed to host the R&D unit that developed the patented invention.[8]

Following the previous literature (see e.g. Hall et al. (2007)), we furthermore construct correlates of the earnings potential of each patent, namely the patent's family size, its forward citations and the number of technology classes on the patent. The patent's family size captures the number of countries in which the firm seeks patent protection for a particular technology. Since patent applications are associated with significant filing costs (comprising e.g. costs for patent attorneys, filing fees at tax offices and costs for the translation of documents), the number of markets in which

[6]The EPO is not a body of the European Union and as a result the states which form part of the European Patent Convention (the legal basis for the EPO) are distinct from those in the European Union. See http://www.epo.org/about-us/epo/member-states.html.

[7]We thank Grid Thoma for providing us with this information.

[8]While the patent applicant may be a person or a firm, the patent inventor is necessarily a person – in case of corporate patent applications the (leading) employee(s) who developed the invention. The inventor country information is taken from the inventors' address data, which plausibly comprises the firm addresses in most corporate cases. Even if home addresses are stated, it seems reasonable to assume that – apart from individual exceptions – researchers live and work in the same country.

patent protection is sought positively correlates with the value of the patent. The construction of our family size measure accounts for equivalent patent applications filed outside of the EPO at an earlier time (priority applications) as well as for applications that report the considered EPO application as a priority. After removing any double counting, the sum of the two measures constitute the size of the patent family. The number of forward citations, in turn, indicates the number of future inventions for which the patented technology served as a basis. It hence proxies for the technical innovativeness of the patented technology and positively correlates with its industrial value. Following previous studies, its construction accounts for forward citations within a five year period from the publication date (see Hall et al. (2007)).[9] Finally, we rely on the number of technological classes on the patent as a third value indicator, which captures the broadness of the patented technology and has been shown to proxy for technological quality similar to the number of forward citations (see Lerner (1994)). To guarantee a reasonable level of precision, the construction of this quality measure accounts for the eight-digit IPC classification.

Based on this information, factor analysis is used to derive a composite quality indicator. Assuming that the variation in the indicators consists of a quality related component and an idiosyncratic component, the estimation of the factor model exploits that variation in patent quality induces variation common to all indicators and thus yields estimates for patent quality conditional on the indicators (see Hall et al. (2007) and Lanjouw & Schankerman (2004)). Following previous studies, our quality measures, moreover, condition on technology class and year fixed effects.

Finally, we augment our data by host country information for both, inventor and applicant country. Most importantly, we include information on the tax rate levied on patent income, obtained from the Corporate Tax Guides of Ernst & Young. While most countries tax patent income at the same rate as other corporate income, a growing number of countries have adopted 'patent box

[9]These citations have an important legal function in the sense that they limit the scope of property rights which are awarded to a patent. In the case of EPO patents, inventors are not required to cite prior technology used in the development of their patent and the references are consequently usually added by patent examiners. This implies that not necessarily all innovations which draw on an existing patent in fact acknowledge the reference whereas it has the benefit of a consistent and objective patent citation practice. Note that previous studies have also used backward citations as a measure for patent quality. However, while some scholars have suggested that a large number of backward citations may, for example, reflect a more derivative nature of a patent and a lower degree of innovation (see e.g. Lanjouw & Schankerman (2004)), a large number of citations may also reflect an innovative combination of existing ideas. Consequently, the literature has provided mixed results regarding the correlation between backward citations and patent value (see e.g. Harhoff et al. (1999)). Following this argumentation, our patent quality indicators do not account for backward citations. Furthermore note that, since our data ends in 2007, patents with a publication date after 2002 have less than five years to 'collect' forward citations in our data. This is accounted for by defining the patent quality index relative to a technology-class-year average (see the next paragraph).

regimes' involving special low tax rates for patent income (e.g. Belgium, UK and the Netherlands, among others). Our tax measure accounts for these special low rates where applicable (namely, in France and Ireland during our sample period).

Information on CFC laws was collected from Sandler (1998), Lang et al. (2004) and the International Bureau of Fiscal Documentation (IBFD). As described above, for CFC rules to be binding, they have to be implemented in the subsidiary's parent country and three additional criteria have to be fulfilled: (1) The parent firm has to hold a sufficiently large ownership share in the subsidiary. (2) The income earned in the subsidiary has to be mainly passive in nature. (3) The subsidiary's host economy has to be classified as a tax haven by its parent country. If CFC rules are enacted in the MNE's parent country, we consider condition (1) to be fulfilled as we account for parent-subsidiary relationships characterised by majority-ownership only. Condition (2) is also assumed to be fulfilled as royalty income is prone to be classified as passive. The construction of our CFC variable consequently focuses on the classification of countries as tax havens under existing CFC provisions (implemented through black lists or absolute/relative threshold values for host countries' effective corporate tax rates). See Table A1 in the online appendix for the provisions in our most important sample countries.

On top, we include information on the strictness and scope of transfer pricing rules, namely the corporate 'transfer pricing risk'-index defined by Mescall & Klassen (2018). The variable is a summary measure that captures decreases in future corporate cash flow resulting from tax policies and authorities' administrative actions related to corporate transfer pricing activities in a given country (including e.g. the risk that transfer pricing positions are denied by tax authorities and that penalties are incurred).[10] For the construction of the index, transfer pricing experts were asked to assess countries' overall transfer pricing risk on a range between 1 and 5, with 1 being the least risky and 5 being the most risky. This measure is then related to specific characteristics of existing transfer pricing regulations (among others, the existence of transfer price documentation rules, the age of the transfer price regulations and the availability of advanced pricing agreements) and a

[10] As described above, identifying comparable external transaction is the Achilles heel of the current arm's length system and often proves difficult in practice, with assessments commonly relying on assumptions and judgments. This may offer some room for strategic mispricing of intra-firm trade by corporate tax payers in manners that reduce tax costs. Companies may, on the flipside, however also be vulnerable to aggressive tax assessments by authorities. See also the discussion in Mescall & Klassen (2018).

measure for the strictness of transfer price enforcement. The coefficient estimates from that model are used to predict the overall transfer pricing risk in out-of-sample years based on the transfer pricing system's baseline characteristics and the level of transfer price enforcement (obtained from Deloitte's transfer pricing matrix and Ernst & Young's transfer pricing guides), from 2000 onwards.

Last, we include information on inventor and applicant country characteristics like GDP per capita (as a proxy for economic development), the size of the population (as a proxy for country size) and governance indicators (to capture the institutional quality in a country) which are obtained from the World Development Indicator Database and the Heritage Foundation respectively. Table 1 contains descriptive statistics for all corporate patents as well as for the subset of patents matched to AMADEUS and identified as being filed by a multinational firm.

– Table 1 about here –

4 Estimation Methodology and Results

The empirical analysis to come will firstly assess the quantitative importance and the determinants of corporate tax avoidance schemes that geographically separate patent ownership from the location of the technology inventor(s) and assign it to a low-tax jurisdiction. Complementarily, we estimate location choice models that quantify the role of host country characteristics, in particular of patent income tax rates and anti-profit shifting provisions, in attracting ownership of (foreign-invented) patents. The latter estimates are then used for ex ante policy analysis.

4.1 Geographic Separation of Patent Ownership and Inventor Location

Our data indicates that geographic separation of patent ownership and inventor location plays an important role in tax avoidance strategies. Specifically, we find that the large majority of patents owned in tax haven economies was invented abroad. In the average tax haven, 78.52% of locally-owned patents are foreign-invented, compared to 6.45% in non-haven countries.[11] This pattern

[11] Note that we follow a strict definition of foreign-inventorship: Patents are classified as foreign-invented in cases where all inventors are located in a different country than all patent applicants (with most patents having one inventor and one applicant only). Similar results, however, emerge if this definition is relaxed.

emerges in small island tax havens as well as in large haven economies like Switzerland or Ireland (where foreign-invented patents make up 78.7% and 41.1% of locally owned patents). Along the same lines, the binned scatter plot in Figure 1 shows a negative correlation between a country's patent income tax rate and its fraction of foreign-invented patents (conditional on baseline country controls, namely indices for the freedom of corruption, business freedom, political stability as well as GDP growth and the logarithm of GDP and GDP per capita).

– Figure 1 and 2 about here –

The absolute number of patents where ownership is geographically separated from the inventor location and assigned to a tax-haven economy is, in turn, modest. Among patents with inventors in non-haven countries within the EU or OECD, only 2.0% are owned in a tax haven economy (following the tax haven definition in Dharmapala & Hines Jr. (2006)), cf. Table 1. Restricting the sample to patents filed by multinational firms raises this fraction to 4.8%, which reflects that national firms may face prohibitively high costs of engaging in related international tax avoidance schemes. Defining tax havens as countries with patent income tax rates in the lowest quartile of the sample distribution in all sample years increases the latter fraction to – a still moderate – 10.7%. The small number of patents in low-tax countries points to other important determinants of the patent location decision, including agency costs when valuable assets are relocated from the headquarters location (see e.g. Dischinger et al. (2014)) or benefits from the co-location of patents.

In the following, we will turn to analyzing the determinants of the described tax avoidance construct. As laid out in Section 2, the attractiveness of international tax avoidance schemes is expected to rise in the earnings potential of the patented technology and MNEs may thus have an incentive to sort their high-value patents to low-tax countries. This notion is confirmed by the binned scatter plot in Figure 2, which shows a negative correlation between countries' corporate tax rates and the average quality of hosted patents.

To corroborate this evidence, we identify patents that were developed in non-haven economies in the EU or the OECD and set up a formal empirical model where firms decide whether to assign patent ownership of these patents to a tax haven economy that is geographically separated from

the inventor location. The latent benefits $\Delta\pi^*_{nft}$ from moving ownership of patent n invented by multinational firm f at time t to a haven economy reads

$$\Delta\pi^*_{nft} = \alpha_0 + \alpha_1 Q_{nft} + \beta X_{nft} + \epsilon_{nft} \tag{1}$$

where Q_{nft} depicts the quality of the patent and X_{nft} includes a full set of technology class fixed effects and time fixed effects to account for systematic variation of $\Delta\pi^*_{nft}$ across industries and across time. On top, a full set of inventor country fixed effects is included to absorb time-constant heterogeneity in the propensity for ownership relocations to tax haven economies across inventor countries. ϵ_{nft} is the error term which follows the standard normal distribution. Defining

$$\Delta\pi_{nft} = \begin{cases} 1 & \text{if} \quad \Delta\pi^*_{nft} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

the model reads $\Pr(\Delta\pi_{nft} = 1) = \Phi(\alpha_0 + \alpha_1 Q_{nft} + \beta X_{nft})$, where Pr denotes probability, and Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution.

The results of this probit model are presented in Tables 2A-B and 3A-B. Tables 2A-B (Tables 3A-B) depict coefficient estimates and average marginal effects for specifications run on the full sample of corporate patents (on the subsample of patents matched to AMADEUS and identified as being filed by a multinational firm). The baseline models in Column (1) of all tables regress an indicator for geographic ownership relocation to a tax haven economy (following the Dharmapala-Hines definition) on the composite patent quality index as well as a full set of year fixed effects, technology class fixed effects and inventor country fixed effects. In line with the theoretical notion spelled out above, all specifications suggest that the propensity to assign patent ownership to a haven economy and separate it from the inventor location increases in the earnings potential of the patent. Quantitatively, an increase in patent quality by one standard deviation raises the propensity for the described tax avoidance scheme by 12.1%, evaluated at the sample mean, hence pointing to a sizeable effect (cf. Column (1), Table 2B). Similar results emerge when tax havens are defined as countries with patent income tax rates in the lowest sample quartile in all sample years (cf. the

results in Columns (2) of Tables 2A-B and 3A-B).[12]

– Tables 2A-B and 3A-B about here –

On top, we run specifications that augment the model by regressors capturing (time-varying) inventor country characteristics[13], where the variable of main interest is the inventor country's patent income tax rate. Theoretically, we expect that rising inventor country taxes increase the propensity for ownership relocations to haven economies, especially for patents with a high earnings potential. In terms of anti-profit shifting provisions, binding CFC legislations in the MNE's parent country (often coinciding with the inventor economy) are expected to hamper patent relocation to haven economies, while the role of inventor country transfer pricing rules is theoretically ambiguous. On the one hand, ownership relocation to tax havens becomes less attractive when inventor countries tighten their transfer price provisions as opportunities for strategic mispricing and income shifting between inventor and haven country decline. On the other hand, tighter transfer pricing laws in the inventor's host country and the associated increase in tax compliance costs make it less attractive to retain patent ownership in the inventor country (as all related intra-firm transactions would be subject to the tightened transfer pricing provisions). In turn, the MNE has an incentive to relocate ownership to a foreign (haven) economy with lax transfer pricing laws (and sell the right to use the patented technology from there to other group affiliates). Formally, the modified model reads

$$\Delta\pi^*_{n\ell ft} = \alpha_0 + \alpha_1 Q_{nft} + \alpha_2 \tau_{\ell t} + \alpha_3 \tau_{\ell t} \times Q_{nft} + \alpha_4 CFC_{ft} + \alpha_5 TPL_{\ell t} + \beta X_{n\ell ft} + \epsilon_{n\ell ft} \qquad (3)$$

where the variable definition corresponds to Equation (2). Subscript ℓ denotes the inventor country. $\tau_{\ell t}$ stands for the inventor country's patent income tax rate, $\tau_{\ell t} \times Q_{nft}$ for the interaction term between $\tau_{\ell t}$ and the patent quality measure.[14] Moreover, CFC_{ft} is a dummy variable indicating

[12] Note that the sample size differs for the models presented in Columns (1) and (2) as patents only enter the sample if all inventors are located in non-tax haven economies, see above (and the definition of tax havens differs between the two sets of specifications).

[13] Including inventor country characteristics in the estimation model follows the notion that MNEs condition on the location of the R&D units (determined by historic group structures, the location of the multinational headquarters or other business considerations) when deciding on international tax avoidance schemes – which is consistent with anecdotal evidence, see e.g. Walpole & Riedel (2014).

[14] The impact of inventor country taxes on the relocation decision is presumed to be positive and to increase in the value of the patent and hence $\alpha_2, \alpha_3 > 0$. Moreover, we expect $\alpha_1 < 0$ as the incentive to relocate patent ownership from inventor countries levying a zero tax rate on patent income declines in the earnings potential of the patent (–

the existence of CFC laws in the MNE's parent country and $TPL_{\ell t}$ depicts the tightness of transfer pricing provisions in inventor country ℓ as captured by the transfer pricing index described above. $X_{n\ell ft}$ depicts a vector of patent and inventor-country specific control variables, including a full set of year fixed effects, technology class fixed effects and inventor country fixed effects. All specifications moreover account for the inventor country control variables described in the previous section.

The results are presented in Specifications (3) to (6) of Tables 2A-B (which again depict the coefficient estimates and marginal effects for models run on the full sample of corporate patents) and in Specifications (3) and (4) of Tables 3A-B (which again depict the coefficient estimates and marginal effects for models run on the subset of patents filed by multinational firms). In line with the hypotheses spelled out above, we find that the propensity to locate patent ownership in foreign tax haven economies increases in the inventor country's patent income tax rate and that this correlation becomes stronger the higher the underlying patent value. For high-earnings patents with a patent value of 2.5, an increase in the inventor country's patent income tax rate by 10 percentage points is e.g. suggested to raise the propensity to locate patent ownership in a foreign haven economy by 16.5%, evaluated at the sample mean (cf. Specification (5) of Table 2B). Marginal effects evaluated at different values of the patent quality distribution are graphically depicted in Figure A1 in the online appendix. Similar results moreover emerge when the sample is restricted to the subset of patents filed by multinational groups (cf. Specifications (3) and (4) of Tables 3A-B).

Specifications (5) and (6) of Tables 3A-B furthermore test whether our results are robust to controlling for multinational group headquarters in tax haven economies. This accounts for the possibility that multinational parent locations may be distorted towards low-tax countries and that our results capture relocation incentives to parent firms rather than low-tax economies. As depicted in Columns (5) and (6), this notion is rejected by our estimation results though. Finally, we yield findings similar to our baseline estimates when patent quality is proxied by family size instead of the composite quality index (cf. Columns (7) and (8) of Tables 3A-B).

Specifications (9) and (10) of Tables 3A-B furthermore augment the models by a dummy variable indicating whether CFC laws are implemented in the MNE's parent country. The results suggest

note, however, that related results are out-of-sample-predictions as our sample does not include inventor countries that levy a zero patent income tax rate).

that CFC laws exert a strong and negative effect on firms' propensity to geographically separate inventor and owner location and assign the latter to a tax haven economy. Quantitatively, the marginal effects presented in Column (10) of Table 3B indicate that the propensity to hold patents at low-tax countries increases by 4.0 percentage points if CFC laws are abolished.[15]

Finally, Specifications (11) and (12) of Tables 3A-B augment the set of regressors by the strictness of inventor countries' transfer pricing provisions. As data on transfer pricing rules is available from 2000 onwards only, this modification reduces the size of the sample – leaving the baseline results on the effect of inventor country taxes and CFC legislations largely unchanged though. Transfer pricing rules are, moreover, found to exert no statistically significant impact on the propensity that patent ownership is shifted to low-tax economies.

4.2 Location Choice Models

Complementary to the analysis so far, we also estimate location choice models that assess the role of host country tax characteristics, namely patent income taxes and binding anti-profit shifting legislations, in attracting/deterring patent ownership, conditional on the inventor location. Following McFadden (1974), we assume that multinational firm f obtains payoff from locating a patent n in a host country j at time t

$$\pi_{nfjt} = V_{fjt} + \epsilon_{nfjt} \tag{4}$$

V_{fjt} is a function of observable host country attributes (that may depend on firm characteristics, as will be explained below, and are therefore indexed with f). ϵ_{nfjt} is unknown and treated as random. The MNE chooses the location that yields the highest payoff, $\arg\max(\pi_{nf1t}, \pi_{nf2t}, ...\pi_{nfJt})$. The probability that alternative i is chosen for patent n is thus given by

$$P_{nit} = Pr(\pi_{nit} > \pi_{njt}) = Pr(\epsilon_{njt} - \epsilon_{nit} < V_{fit} - V_{fjt}), \forall j \neq i \tag{5}$$

[15]Note that our sample period ends in 2006. Our empirical analysis hence assesses the role of CFC legislations before the Cadbury Schweppes judgement of the European Court of Justice.

Assuming that the random terms are IID type I extreme value distributed, yields the conditional logit model: $P_{nfit} = \frac{exp(V_{fit})}{\sum_J^{j=1} exp(V_{fjt})}$ with V_{fjt} being defined as

$$V_{fjt} = \kappa \cdot \tau_{jt} + \gamma \cdot CFC_{fjt} + \delta \cdot TP_{jt} + \mathbf{x'_{jt}}\beta \tag{6}$$

where τ_{jt} stands for the patent income tax rate in country j, CFC_{fjt} captures the additional tax burden related to binding CFC legislations in the MNE's parent country (further specified below) and TP_{jt} captures the strictness of transfer pricing regimes in country j. The vector $\mathbf{x_{jt}}$ furthermore includes the host country controls described in Section 3 as well as two dummy variables indicating wether the considered country hosts the parent firm of the MNE or the inventor of the protected technology, presuming that both raise the propensity that patent ownership is assigned to the respective economy.

In addition to this baseline model, we estimate two further model variants. Firstly, we allow the impact of host country tax characteristics (τ_{jt}, CFC_{fjt} and TP_{jt}) on patent location choices to vary in the patent's earnings potential by adding interaction terms with patent quality to the vector of regressors. In a second step, marginal effects and related elasticities are determined for varying levels of patent quality. Following our theoretical considerations in Section 2, the impact of taxes and anti-shifting rules is presumed to be quantitatively larger, in absolute terms, the higher the earnings potential of the underlying patent.

Secondly, we assess the robustness of our results to the conditional logit model's assumption that the stochastic error term is IID distributed, which rules out correlation in latent payoffs and endows the model with the independence of irrelevant alternatives (IIA) property. We rerun the model defining the parameters on the corporate tax rate, the CFC and the TP legislations (as well as the control variables) as firm-specific random coefficients, assumed to be normally distributed, which yields the mixed logit model (see Train (2003)). The product of random coefficients and regressors can be thought of as an error component, which thus drops the IIA property and yields a correlation in profits over alternatives.

Descriptive statistics for the data in long format are depicted in Table 4. Table 5A presents the coefficient estimates from the described conditional logit models. In Table 5B, we calculate

marginal effects for selected model specifications and report the elasticities of patent location choices to changes in patent income taxes and anti-profit shifting provisions.[16] The results suggest that patent income taxes exert a negative impact on the international location of patents, with the quantitative effect varying across host countries (cf. Columns (1) of Tables 5A-B) and with the underlying value of the patent (cf. Column (2) of Table 5A and Columns (2a)-(2d) in Table 5B, where the latter columns report the tax elasticities of patent location choices evaluated at different patent quality values: -0.5, 0.5, 1.5 and 2.5). For Austria, the results e.g. suggest that the average tax elasticity of patent location choices amounts to -1.03 and that this tax responsiveness increases, in absolute terms, from -0.67 to -3.70 when patent quality rises from -0.5 to 2.5.

Specification (3) of Table 5A furthermore shows that similar coefficient estimates are obtained when patent quality is proxied by the family size of the patent (instead of the composite patent quality index). Specification (4) reestimates the baseline model with a CFC-adjusted patent income tax variable, where the host country's patent income tax rate is replaced by the parent country patent income tax if CFC legislations are identified as binding (i.e. if the parent country's CFC laws classify the considered host economy as tax haven, cf. Section 3). The results are qualitatively and quantitatively comparable to the previous specifications, see also the corresponding elasticities reported in Columns (4a) to (4d) in Table 5B. Specifications (5) and (6) of Table 5A reiterate this evidence by estimating models that separately include the patent income tax and a dummy variable indicating whether CFC provisions are binding (Specification (5)) and a measure for the additional effective tax burden related to CFC-provisions (Specification (6)) respectively.[17]

– Tables 5A-B about here –

On top, Column (7) of Table 5A presents coefficient estimates from a model that augments the set of regressors by the strictness of countries' transfer pricing regulations. Analogously to the binary regressions, this reduces the sample to years after 2000. The prior results for the impact of patent income taxes and CFC provisions remain unaffected by this modification and transfer pricing

[16] Note that the numbering of the columns in Table 5B corresponds to Table 5A, i.e. Column (1) in Table 5B presents the marginal effects for the model in Column (1) of Table 5A and so on).

[17] The latter is calculated as the difference between the patent income tax of the MNE's parent country and the patent income tax of the considered host location if CFC rules are binding and takes on the value zero otherwise.

provisions are found to significantly deter patent location choices. Quantitatively, the latter effect turns out small, however, and does not significantly differ across high-value and low-value patents – which may potentially indicate that it is compliance costs, not reduced income shifting opportunities that deter patent location. The quantitatively small effect is, moreover, in line with the notion that tighter transfer pricing provisions based on the arm's length principle have comparably limited effectiveness in containing mispricing activities related to firm-specific assets like patents.

Specification (8) of Table 5A also reestimates the latter model in the sub-sample of high-value patents (featuring a composite patent quality index in the highest quartile of the sample distribution). Similar to the previous specifications, we find that an increase in patent income taxes and binding CFC legislations significantly lowers location propensities, while transfer pricing legislations exert a moderate effect only. See also Columns (8a) to (8c) of Table 5B.

Finally, Table 6 shows that these results are robust to dropping the IIA assumption and estimating a mixed logit model which defines the parameters on the patent income tax, the CFC and the transfer pricing variables (as well as controls) as random coefficients.[18] In line with the prior results, we find that patent income taxes, CFC legislations and transfer pricing laws exert a negative impact on the propensity for patent location. The estimated standard deviations are, moreover, statistically significant, pointing to heterogeneity in the size of the policy effects across entities.

– Tables 6-8 about here –

Dropping the IIA assumption, moreover, allows for the calculation of realistic substitution patterns across countries. Tables 7 reports own- and cross-country elasticities of a change in the statutory patent income tax on the international location of patents. Tables A2 and A3 in the online appendix show analogous elasticity estimates for the additional tax burden imposed by CFC laws and a change in the strictness of countries' transfer pricing regimes. The entries on the main diagonal refer to the estimated own-country elasticities. For example, a one percent increase in the patent income tax (the CFC-related tax burden) in Austria is suggested to lower the probability to choose Austria as a patent location by 4.2% (1.3%). A one percent increase in the strictness

[18] Note that we also ran mixed logit models that extend the random coefficient modelling to all control regressors, which yields similar results to the ones presented below.

of transfer pricing provisions (as measured by our transfer pricing index), in turn, reduces the location propensity by a moderate 0.09% only.[19] The tables moreover report some heterogeneity in cross-country elasticities of statutory patent income taxes, the CFC-related tax component and TP provisions across countries changing their policies (across columns) as well as across countries facing externalities exerted by other countries (in rows). The differences in estimated cross-elasticities may, among others, reflect differences or similarities in factor endowments or closeness in terms of language, culture, or distance.

5 Simulation

As described above, we moreover use the reported own- and cross-country elasticities from the mixed logit model for policy simulations. Three policy reforms are assessed: firstly, the sharp decline in the US corporate tax rate recently enacted by the Trump administration and US congress; secondly, an international harmonization of patent income tax rates and thirdly, a tightening and international harmonization of transfer pricing laws as envisaged by the OECD/G20 BEPS process.

In the first policy experiment, we consider the permanent reduction of the US corporate tax rate from 35 to 21%, signed into law by the US president in December 2017. Debates around the reform proposals focused on potential effects of the reform on corporate investment activity and multinational profit shifting. Drawing on our mixed logit estimates and endowing the model with the current international tax environment (i.e. assigning current values for patent income tax rates, CFC provisions and the strictness of transfer pricing rules), we simulate how the international location of patents is changed by the reduction in the US corporate tax rate. Table 8 reports the absolute and relative change in the predicted location propensities ('delta' and 'delta rel') per country.[20] The propensity to locate patents in the US is predicted to strongly increase in the wake of the reform (by 64.2%), while other countries lose, in particular economies like Canada and Ireland which are

[19] Note that the estimated elasticities for the patent income tax are, in absolute terms, at the upper end of the existing literature (cf. e.g. Karkinsky & Riedel (2012) and Griffith et al. (2014), Alstadsæter et al. (2015)). Furthermore note that the coefficient estimate for the patent income tax rate turns out larger, in absolute terms, than the coefficient estimate for the CFC-related tax burden, which might reflect that CFC laws are not always fully applicable to the income earned by our sample patents.

[20] The estimated base location probabilities for all countries in our final sample year are reported in Table A4 in the online appendix.

arguably close substitutes to the US economy.[21] The last two columns of Table 8 moreover rerun the analysis assuming a still smaller US-after reform tax rate on patent income of 13.125%, which refers to the FDII element of the US tax reform ('Foreign Derived Intangible Income') prescribing that foreign income derived from US-held intangible assets is taxed at an especially low effective tax rate of 13.125%. The simulation results in this case show even larger shifts in patent location propensities, with the probability for patent location in the US almost doubling at the expense of other countries.

As a second policy experiment, we quantify patent location responses to an international harmonization of patent income tax rates. While attempts for international corporate tax rate harmonizations have been hampered by political obstacles in the past and successful renewals of these efforts are unlikely to emerge in the near future, this analysis – inversely – helps to understand how observed international differences in patent income tax rates impact on the location of patents across countries relative to a 'harmonised counterfactual'. Table 8 reports the absolute and relative change in the predicted location propensities in the wake of an international harmonization of the patent income tax rate, where we again account for the current international tax environment and the 'harmonization rate' is the average patent income tax rate in our sample countries in 2016. In line with intuition, high-tax countries gain from such a policy change, including among others the US, Australia and Japan, while current low-tax countries observe significant declines in patent location propensities (especially Ireland, Luxembourg and Switzerland).

Finally, Table 8 also presents simulations that assess how international patent location propensities change when transfer pricing provisions are harmonised and tightened as envisaged in the G20/OECD BEPS process. While the reforms in the BEPS process cannot be related to a particular score of the Mescall/Klassen-transfer pricing index, the BEPS initiative, in general, aimed at tightening and internationally harmonising transfer pricing provisions. Endowing the model with the current international tax environment, we assess how the international location of patents is changed when countries with no or lax transfer pricing provisions extend the scope of these laws

[21] Note that the US tax bill includes other reform elements which may impact on profit shifting incentives and hence on the location of IP within multinational groups – most importantly the enacted change from worldwide to territorial taxation. Our estimation model does not account for the latter effects and the simulation results hence capture effects related to changes in the corporate tax rate only.

such that the Mescall-Klassen-transfer pricing index takes on the sample average in 2016.[22] The results in Table 8 suggest that the impact on the location propensities in many high-tax countries is quantitatively limited, while the propensity that patent ownership is located in low-tax economies like Switzerland and Ireland significantly declines.

– Table 8 about here –

6 Conclusion

Concluding, this paper assessed multinational tax avoidance strategies that involve a relocation of patent income to low-tax countries. The analysis draws on the universe of patent applications to the European Patent Office linked with data on multinational entities (MNEs) in Europe. A number of findings emerge. Firstly, patent holdings are distorted towards low-tax countries and patent location in low-tax countries, moreover, correlates with a geographic separation of R&D output and input. On top, we report evidence that MNEs systematically sort high-value (low-value) patents to low-tax (high-tax) countries and show that the propensity to locate patent ownership in low-tax countries is significantly decreased if controlled foreign company rules are enacted in the MNE's parent country, while the tightening of transfer pricing legislations exerts a comparably weak effect on the location of patent ownership only.

These findings link in with several strands of the economic literature. Firstly, the paper supports recent claims that corporations engage in significant income shifting to low-tax countries through the distortion of patent holdings. Low patent income taxes are thus instrumental in attracting patent income to a country, in turn implying that governments have incentives to lower their patent income tax rates to attract the mobile tax base. The predicted race-to-the bottom in patent taxes is consistent with the emergence of patent box regimes and the implied downward trend in patent income tax rates observed in Europe over recent years. Secondly, the evidence suggests that firms

[22] In the wake of the publication of the OECD's BEPS report and its endorsement by the G20 finance ministers in 2015, the OECD founded to the so-called Inclusive Framework, which allows all interested countries to work on equal footing with the G20 and the OECD on the implementation of BEPS measures. So far, more than 100 countries joined the Inclusive Framework and thus committed to the BEPS process. The BEPS project hence extends beyond OECD and G20 countries.

strategically select patents with a high earnings potential for relocation to countries with low patent income taxes which confirms recent theoretical predictions suggesting that taxation does not only affect the size of investment activities but also their quality (i.e profitability), see e.g. Haufler & Stähler (2013) and Becker & Fuest (2007). Thirdly, our analysis shows that firms geographically split the location of R&D units and patent holdings. Following the argumentation in Hong & Smart (2010), the presence of tax haven countries and multinational profit shifting activities might thus actually increase the welfare of well-developed high-tax countries as the possibility to relocate income prevents firms from relocating the real economic activity (in our case the R&D unit) itself. Finally, we provide evidence that CFC laws are effective in diverting patent ownership from tax haven economies, while the scope of transfer pricing provisions in reducing patent ownership in low-tax economies is more limited. Given the importance of (patented) intellectual property for the value creation in modern MNEs, the latter finding may question whether anti-profit shifting legislations can close down all important profit shifting channels within the multinational firm.

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7 Appendix

Table 1: Descriptive Statistics I

	N	Mean	St. dev.	Min	Max
All Corporate Patent Applications					
Foreign Patent	437,417	0.081	0.272	0.000	1.000
Foreign Patent plus Tax Haven	437,417	0.020	0.141	0.000	1.000
Foreign Patent plus Low Tax Country	436,217	0.045	0.208	0.000	1.000
Patent Quality (Composite Index)	437,417	-0.019	0.806	-2.529	7.767
Patent Quality (Family Size)	437,417	-0.008	0.547	-1.956	6.267
Parent in Tax Haven	437,417	0.029	0.167	0.000	1.000
All Corporate Patent Applications – Inventor Country Characteristics					
Patent Income Tax	437,417	0.421	0.099	0.095	0.597
Transfer Price Regulation	287,128	2.488	1.428	1.000	4.424
CFC Dummy	437,417	0.505	0.500	0.000	1.000
Freedom from Corruption	437,417	65.899	19.822	10.000	100.000
Business Freedom	437,417	74.949	8.410	55.000	100.000
Political Stability	437,417	0.623	0.551	-1.302	1.668
Log GDP per Capita	437,417	10.467	0.144	9.007	10.832
Log GDP	437,417	28.780	1.003	24.350	30.346
GDP Growth	437,417	2.171	1.689	-7.016	10.731
MNE	437,417	0.423	0.494	0.000	1.000
Corporate Patent Applications by Multinational Firms					
Foreign Patent	185,099	0.191	0.393	0.000	1.000
Foreign Patent plus Tax Haven	185,099	0.048	0.214	0.000	1.000
Foreign patent plus Low Tax Country	183,899	0.107	0.309	0.000	1.000
Patent Quality (Composite Index)	185,099	-0.123	0.755	-2.529	7.602
Patent Quality (Family Size)	185,099	-0.042	0.520	-1.956	6.031
Parent in Tax Haven	185,099	0.068	0.252	0.000	1.000
Applications by Multinational Firms – Inventor Country Characteristics					
Patent Income Tax	185,099	0.402	0.117	0.095	0.597
Transfer Price Regulation	137,962	2.004	1.310	1.000	4.424
CFC Dummy	185,099	0.688	0.463	0.000	1.000
Freedom from Corruption	185,099	68.744	19.988	10.000	100.000
Business Freedom	185,099	72.839	7.883	55.000	100.000
Political Stability	185,099	0.703	0.547	-1.302	1.668
Log GDP per capita	185,099	10.451	0.121	9.007	10.832
Log GDP	185,099	28.243	0.927	24.350	30.346
GDP Growth	185,099	2.067	1.540	-7.016	10.731

Notes: The upper part of the table depicts descriptive statistics for the full sample of corporate patents, whose inventors are located in non-tax haven countries within the EU and/or the OECD. The lower part of the table reports descriptive statistics for the sub-sample of patents that were successfully matched to ownership information in AMADEUS and whose owners are identified as being part of a multinational group. The former sample is used for the regressions presented in Tables 2A-B, the latter for the regressions in Tables 3A-B. 'Foreign Patent' indicates patents where inventor and applicant are located in different countries. 'Foreign Patent plus Tax Haven' ('Foreign Patent plus Low Tax Country') indicates patents where the location of the patent applicant is geographically separated from the location of the patent inventor and simultaneously assigned to a tax-haven economy following the Dharmapala-Hines definition (to a country with a patent income tax rate in the lowest quartile of the sample distribution in all sample years). 'Patent Quality (Composite Index)' ('Patent Quality (Family Size)') depict the composite patent quality index derived based on factor analysis (the quality index capturing the patent's family size only), see Section 3 for details. 'Parent in Tax Haven' is an indicator variable, which takes on the value 1 if the patent is filed by an MNE whose parent is located in a tax haven economy (following the Dharmapala-Hines definition). 'Patent Income Tax' stands for the tax rate on patent income in the inventor country, 'Transfer Price Regulation' is the transfer pricing score in the inventor country obtained from Mescall & Klassen (2018) and CFC dummy is a dummy variable which takes on the value 1 if the multinational firm's parent country has CFC laws in place (for patents matched to multinational groups in AMADEUS; otherwise CFC legislations in the inventor country are considered). 'Freedom from Corruption', 'Business Freedom' and 'Political Stability' stand for the respective governance indicators in the patents' inventor country, taken from the Heritage Foundation. 'Log GDP per capita', 'Log GDP' and 'GDP Growth' capture the natural logarithm of the gross domestic product (GDP, in current US Dollars), the natural logarithm of GDP per capita (in current US Dollars) and GDP growth, all obtained from the World Bank's World Development Indicator Database. MNE is a dummy variable which takes on the value 1 if the patent-filing firm was matched to AMADEUS and simultaneously identified to be part of a multinational group (see Section 3 for details).

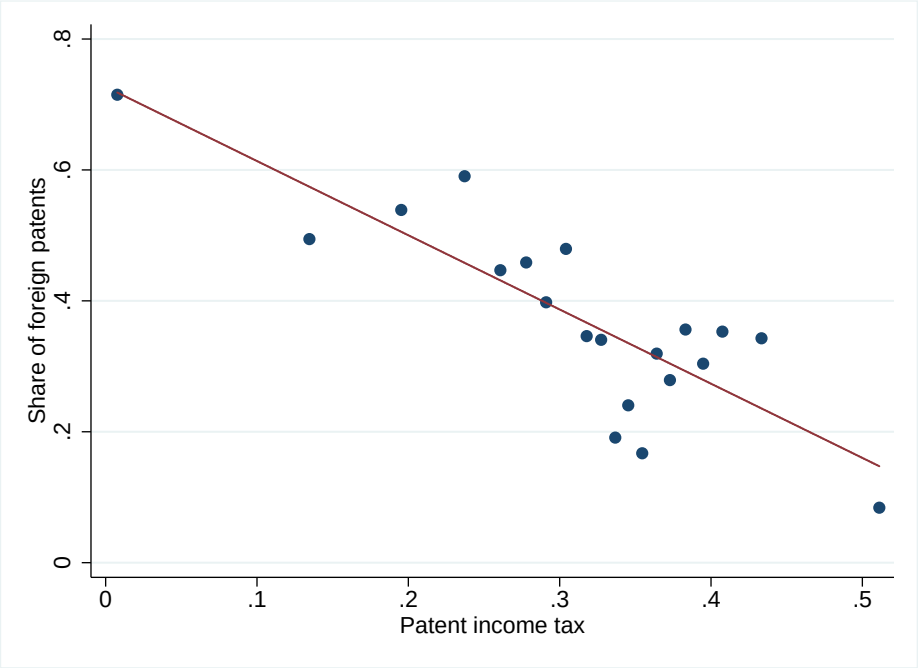

Figure 1: Foreign Patents vs. Patent Income Tax Rates

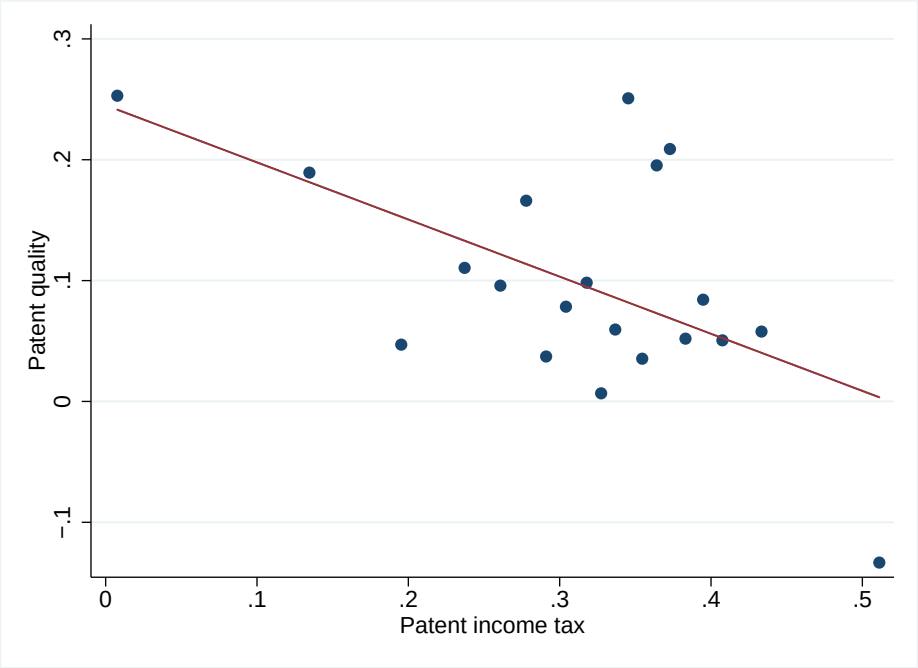

Figure 2: Patent Quality vs. Patent Income Tax Rates

Table 2A: Ownership Location in a Tax Haven Country – All Corporate Patent Applications

	(1)	(2)	(3)	(4)	(5)	(6)
	tax haven	low tax	tax haven	low tax	tax haven	low tax
Patent Quality (Composite)	0.064***	0.047***	0.065***	0.047***	-0.002	-0.095***
	(0.006)	(0.007)	(0.006)	(0.007)	(0.026)	(0.035)
Patent Income Tax			0.088	0.078	0.117	0.159
			(0.162)	(0.205)	(0.162)	(0.205)
Patent Quality (Composite) x Patent Income Tax					0.169***	0.351***
					(0.063)	(0.084)
Macro controls	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Inv. Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	437,417	394,802	437,417	394,802	437,417	394,802
χ^2	6553.763	5216.755	6543.392	5164.352	6537.522	5164.956
Pseudo-R2	0.098	0.118	0.099	0.119	0.099	0.119

Notes: The table presents coefficient estimates from the probit models described in Section 4, run on the full sample of corporate patents. Standard errors in brackets below the coefficient estimates. ***, **, * indicates significance at the 1, 5, 10% significance level. See the notes to Table 1 for a definition of the variables. Macro controls is the vector of control variables described in Section 3. 'Year Fixed Effects', 'Inv. Country Fixed Effects', 'Industry Fixed Effects' are full sets of year, inventor country and technology class fixed effects respectively. 'tax haven' ('low tax') indicates that the dependent variable is 1 for patents where ownership is geographically separated from the inventor location and assigned to a tax haven economy as defined in Dharmapala and Hines (2006) (assigned to a low tax country with a patent income tax in the lowest sample quartile in all sample years), and zero otherwise. The number of observations differ between the two sets of regressions as the sample is restricted to patents that were invented in a country within EU or OECD which is not a tax haven economy and not a low tax country respectively, following the above definitions.

Table 2B: Ownership Location in a Tax Haven Country – All Corporate Patent Applications: Marginal Effects

	(1)	(2)	(3)	(4)	(5)	(6)
	tax haven	low tax	tax haven	low tax	tax haven	low tax
Patent Quality (Composite Index)	0.003***	0.002***	0.003***	0.002***		
	(0.000)	(0.000)	(0.000)	(0.000)		
Patent Income Tax			0.004	0.003		
			(0.007)	(0.007)		
Patent Income Tax – Patent Quality (Composite Index) = -1.5					-0.005	-0.010
					(0.007)	(0.007)
Patent Income Tax – Patent Quality (Composite Index) = -.5					0.001	-0.001
					(0.007)	(0.006)
Patent Income Tax – Patent Quality (Composite Index) = .5					0.010	0.011
					(0.008)	(0.007)
Patent Income Tax – Patent Quality (Composite Index) = 1.5					0.020*	0.026***
					(0.011)	(0.010)
Patent Income Tax – Patent Quality (Composite Index) = 2.5					0.033**	0.043***
					(0.014)	(0.013)
Obs.	437,417	394,802	437,417	394,802	437,417	394,802

Notes: The table presents marginal effects for the probit models in Table 2A. Column numbers refer to the same models in Tables 2A and 2B, i.e. Column (1) of Table 2B presents the marginal effects for the model in Column (1) of Table 2A etc. Standard errors in brackets. ***, **, * indicates significance at the 1, 5, 10% significance level. See the notes to Table 1 for a definition of the variables. 'tax haven' ('low tax') indicates that the dependent variable captures patents for which ownership is geographically separated from the inventor location and assigned to a tax haven economy as defined in Dharmapala and Hines (2006) (and assigned to a low tax country with a patent income tax in the lowest sample quartile in all sample years).

Table 3A: Ownership Location in a Tax Haven Country – Patents Filed by Multinational Firms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	tax haven	low tax	tax haven	low tax	tax haven	low tax	tax haven	low tax	tax haven	low tax	tax haven	low tax
Patent Quality (Composite Index)	0.066***	0.043***	0.012	-0.084**	-0.090***	-0.136***			-0.100***	-0.123**	-0.099	-0.180*
	(0.007)	(0.008)	(0.027)	(0.037)	(0.031)	(0.044)			(0.034)	(0.048)	(0.064)	(0.095)
Patent Quality (Family Size)							0.063	-0.156**				
							(0.045)	(0.062)				
Patent Income Tax			0.144	0.263	0.209	0.340	0.175	0.303	0.286	0.370	0.416	-0.031
			(0.182)	(0.230)	(0.196)	(0.259)	(0.196)	(0.258)	(0.206)	(0.266)	(0.397)	(0.452)
Patent Quality (Composite Index) x Patent Income Tax			0.137**	0.308***	0.358***	0.411***			0.374***	0.375***	0.319*	0.464*
			(0.066)	(0.089)	(0.073)	(0.104)			(0.081)	(0.114)	(0.172)	(0.251)
Patent Quality (Family Size) x Patent Income Tax							0.206*	0.629***				
							(0.107)	(0.148)				
CFC Dummy									-1.062***	-0.766***	-1.107***	-0.754***
									(0.017)	(0.021)	(0.026)	(0.030)
Transfer Price Regulation											-0.027	-0.002
											(0.019)	(0.022)
Parent in Tax Haven					1.399***		1.397***		0.837***		0.778***	
					(0.015)		(0.015)		(0.017)		(0.027)	
Parent in Low Tax Ctry						1.795***		1.794***		1.401***		1.433***
						(0.019)		(0.019)		(0.022)		(0.030)
Macro controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inv. Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	185,099	154,749	185,099	154,749	185,099	154,749	185,099	154,749	185,099	154,749	73,737	62,834
χ^2	8094.947	5001.188	8155.459	5024.527	16213.203	13738.635	16271.468	13736.174	17754.950	14998.010	8332.650	7815.037
Pseudo-R2	0.127	0.125	0.128	0.126	0.252	0.323	0.253	0.324	0.319	0.358	0.336	0.353
R2												

Notes: The table presents coefficient estimates from the probit model presented in Section 4, run on the sample of patents filed by multinational firms. Standard errors in brackets below the coefficient estimates. ***, **, * indicates significance at the 1, 5, 10% significance level. See the notes to Table 1 for a definition of the variables. Macro controls is the vector of control variables described in Section 3. 'Year Fixed Effects', 'Inv. Country Fixed Effects', 'Industry Fixed Effects' are full sets of year, inventor country and technology class fixed effects respectively. 'Parent in Tax Haven' ('Parent in Low Tax Ctry') indicate that the parent firm of the multinational group is located in a tax haven economy, following the Dharmapala and Hines (2006) definition (in a low tax country with a patent income tax in the lowest sample quartile in all sample years). 'tax haven' ('low tax') indicates that the dependent variable is 1 for patents where ownership is geographically separated from the inventor location and assigned to a tax haven economy as defined in Dharmapala and Hines (2006) (assigned to a low tax country with a patent income tax in the lowest sample quartile in all sample years), and zero otherwise. The number of observations differ between the two sets of regressions as the sample is restricted to patents that were invented in a country within EU or OECD which is not a tax haven economy and not a low tax country respectively, following the above definitions.

Table 3B: Ownership Location in a Tax Haven Country – Patents Filed by Multinational Firms: Marginal Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	tax haven	low tax	tax haven	low tax	tax haven	low tax	tax haven	low tax	tax haven	low tax	tax haven	low tax
Patent Quality (Composite Index)	0.006***	0.003***										
	(0.001)	(0.001)										
Patent Income Tax – Patent Quality (Composite Index) = -1.5			-0.005	-0.013	-0.023	-0.014	-0.007	-0.028*	-0.018	-0.010	-0.005	-0.048
			(0.015)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)	(0.035)	(0.038)
Patent Income Tax – Patent Quality (Composite Index) = -0.5			0.006	0.007	0.002	0.007	0.005	-0.001	0.007	0.009	0.019	-0.017
			(0.016)	(0.016)	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.030)	(0.030)
Patent Income Tax – Patent Quality (Composite Index) = 0.5			0.020	0.031*	0.031*	0.031**	0.023	0.037**	0.035**	0.030**	0.044	0.013
			(0.018)	(0.018)	(0.016)	(0.015)	(0.017)	(0.016)	(0.016)	(0.015)	(0.031)	(0.031)
Patent Income Tax – Patent Quality (Composite Index) = 1.5			0.036	0.057***	0.064***	0.057***	0.049*	0.086***	0.066***	0.052***	0.069*	0.043
			(0.022)	(0.022)	(0.020)	(0.019)	(0.026)	(0.025)	(0.019)	(0.019)	(0.037)	(0.038)
Patent Income Tax – Patent Quality (Composite Index) = 2.5			0.055*	0.088***	0.103***	0.086***	0.084**	0.152***	0.101***	0.077***	0.095**	0.072
			(0.029)	(0.029)	(0.026)	(0.025)	(0.042)	(0.040)	(0.025)	(0.024)	(0.046)	(0.051)
CFC dummy									-0.075***	-0.040***	-0.083***	-0.049***
									(0.001)	(0.001)	(0.002)	(0.002)
Transfer price regulation											-0.002	-0.000
											(0.001)	(0.001)
Obs.	185,099	154,749	185,099	154,749	185,099	154,749	185,099	154,749	185,099	154,749	73,737	62,834

Notes: The table presents marginal effects for the probit models in Table 3A. Column numbers refer to the same models in Tables 3A and 3B, i.e. Column (1) of Table 3B presents the marginal effects for the model in Column (1) of Table 3A and so on. Standard errors in brackets. ***, **, * indicates significance at the 1, 5, 10% significance level. See the notes to Table 1 for a definition of the variables. 'tax haven' ('low tax') indicates that the dependent variable captures patents for which ownership is geographically separated from the inventor location and assigned to a tax haven economy as defined in Dharmapala and Hines (2006) (and assigned to a low tax country with a patent income tax in the lowest sample quartile in all sample years).

Table 4: Descriptive Statistics II – Conditional and Mixed Logit Models

	N	Mean	St. dev.	Min	Max
Patent Income Tax	4,872,321	0.326	0.107	0.000	0.597
Transfer Price Regulation	3,688,269	1.843	1.232	1.000	4.424
Binding CFC Rule	4,784,082	0.179	0.383	0.000	1.000
Patent Quality (Composite Index)	4,872,321	-0.094	0.759	-2.529	7.943
Patent Quality (Family Size)	4,872,321	-0.033	0.527	-1.797	6.226
Inventor Country	4,872,321	0.041	0.198	0.000	1.000
Parent Country	4,872,321	0.039	0.193	0.000	1.000
Log GDP pC	4,872,321	10.336	0.379	9.148	11.414
Log GDP	4,872,321	26.845	1.485	22.821	30.346
GDP Growth	4,872,321	3.112	2.281	-7.016	11.178
Freedom from Corruption	4,872,321	71.849	18.835	27.000	100.000
Business Freedom	4,872,321	75.545	9.091	54.500	100.000
Political Stability	4,872,321	0.851	0.538	-0.196	1.668

Notes: The table shows descriptive statistics in long-format (for the conditional and mixed logit models). We account for 25 potential host countries (in which more than 10 patents were filed during our sample period), namely Austria (AT), Australia (AU), Belgium (BE), Canada (CA), Switzerland (CH), Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), Great Britain (GB), Greece (GR), Hungary (HU), Ireland (IE), Iceland (IS), Italy (IT), Japan (JP), South Korea (KR), Luxembourg (LU), Netherland (NL), Norway (NO), Portugal (PT), Sweden (SE), Slovenia (SI) and the United States (US). 'Patent Income Tax' is the patent income tax in the considered host country, 'Transfer Price Regulation' is the transfer pricing score obtained from Mescall & Klassen (2018), see main text and 'Binding CFC Rule' takes on the value 1 if CFC rules in the group's parent country are binding w.r.t. a considered host location. 'Patent Quality (Composite Index)' ('Patent Quality (Family Size)') depicts the composite patent quality measure (the family size measure) as defined in Section 3. 'Inventor Country' and 'Parent Country' are dummy variables indicating that the considered host economy hosts the inventor of the patented technology and the parent firm of the multinational group respectively. For the definition of the host country control variables, see the variable definitions in the notes of Table 1.

Table 5A: Conditional Logit Model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Patent Income Tax	-1.048***	-1.166***	-1.131***		-0.857***	-0.721***	-4.157***	-4.599***
	(0.056)	(0.056)	(0.056)		(0.061)	(0.065)	(0.126)	(0.225)
Patent Income Tax x Patent Quality (Composite Index)		-1.044***			-1.455***	-1.436***	-1.124***	
		(0.057)			(0.064)	(0.068)	(0.135)	
Patent Income Tax x Patent Quality (Family Size)			-1.894***					
			(0.082)					
Patent Income Tax (CFC Adj.)				-0.685***				
				(0.063)				
Patent Income Tax (CFC Adj.) x				-1.427***				
Patent Quality (Composite Index)				(0.066)				
Inventor Country	4.265***	4.259***	4.254***	4.264***	4.246***	4.246***	3.889***	3.583***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.018)	(0.030)
Parent Country	3.511***	3.505***	3.502***	3.505***	3.543***	3.547***	3.424***	3.322***
	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.020)	(0.032)
Binding CFC Rule					0.216***			
					(0.019)			
Binding CFC Rule ×					-0.338***			
Patent Quality (Composite Index)					(0.021)			
CFC Tax Component						1.414***	-0.983***	-1.846***
						(0.103)	(0.172)	(0.322)
CFC Tax Component x						-1.639***	-1.446***	
Patent Quality (Composite Index)						(0.130)	(0.223)	
Transfer Price Regulation							-0.126***	-0.096***
							(0.008)	(0.013)
Transfer Price Regulation x							0.002	
Patent Quality (Composite Index)							(0.008)	
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4,872,321	4,872,321	4,872,321	4,872,321	4,784,082	4,770,435	2,047,380	563,919
χ^2	234966.851	235007.620	234190.847	233600.547	230485.180	228590.171	93595.911	28395.294
Pseudo-R2	0.816	0.816	0.816	0.816	0.817	0.817	0.804	0.750

Notes: The table presents coefficient estimates from conditional logit model described in Section 4. Standard errors in brackets below the coefficient estimates. ***, **, * indicates significance at the 1, 5, 10% significance level. See the notes to Tables 1 and 4 for a definition of the variables. 'Patent Income Tax (CFC Adj.)' captures the patent income tax of the considered host economy, which is replaced by the patent income tax of the MNE's parent location if CFC rules in the MNE's parent country are binding w.r.t. the considered host economy (i.e. if the rules classify the host country as a tax haven economy). 'Binding CFC Rule' is a dummy variable which takes on the value 1 if parent country CFC provisions are binding w.r.t. the considered host economy. 'CFC Tax Component' captures the additional tax burden on firms related to CFC provisions: i.e. the variable is defined as the difference between the patent income tax in the MNE's parent country and the patent income tax in the considered host economy if parent country CFC legislations are binding and is zero otherwise.

Table 5B: Conditional Logit Model – Elasticity Estimates

variable	(1) tax rate	(2a)	(2b)	(2c) tax rate	(2d)	(4a)	(4b)	(4c) adj. tax rate	(4d)	(8a) tax rate	(8b) CFC	(8c) TP
at quality =		-.5	+.5	+1.5	+2.5	-.5	+.5	+1.5	+2.5			
AT	-1.031	-.633	-1.659	-2.682	-3.703	.0274	-1.3736	-2.7687	-4.1579	-4.5135	-1.8121	-.094
	(.056)	(.06)	(.069)	(.12)	(.181)	(.0653)	(.0791)	(.1447)	(.228)	(.2202)	(.3269)	(.0112)
AU	-1.033	-.635	-1.663	-2.688	-3.712	.0275	-1.3772	-2.7761	-4.1692	-4.515	-1.8127	-.0941
	(.057)	(.061)	(.07)	(.122)	(.185)	(.0654)	(.0809)	(.1486)	(.2355)	(.2484)	(.3285)	(.0121)
BE	-1.034	-.635	-1.664	-2.693	-3.722	.0275	-1.3783	-2.7815	-4.1828	-4.5429	-1.8239	-.0946
	(.055)	(.059)	(.067)	(.11)	(.158)	(.0655)	(.0778)	(.1355)	(.2045)	(.2065)	(.3286)	(.0137)
CA	-1.031	-.633	-1.661	-2.689	-3.718	.0274	-1.3754	-2.7775	-4.1799	-4.5415	-1.8234	-.0946
	(.054)	(.058)	(.064)	(.102)	(.141)	(.0654)	(.0745)	(.1251)	(.1813)	(.2194)	(.3195)	(.0114)
CH	-1.003	-.618	-1.608	-2.581	-3.535	.0269	-1.3411	-2.6943	-4.0327	-4.2491	-1.706	-.0885
	(.063)	(.063)	(.08)	(.142)	(.222)	(.0639)	(.0814)	(.1466)	(.2283)	(.2492)	(.2949)	(.0129)
CZ	-1.044	-.641	-1.681	-2.72	-3.759	.0278	-1.3926	-2.8116	-4.2291	-4.5778	-1.838	-.0954
	(.055)	(.059)	(.069)	(.123)	(.186)	(.0662)	(.0795)	(.1489)	(.2364)	(.4089)	(.3489)	(.0118)
DE	-.48	-.284	-.822	-1.463	-2.208	.0119	-.6673	-1.4938	-2.4679	-2.9154	-1.1705	-.0607
	(.026)	(.027)	(.033)	(.056)	(.083)	(.0284)	(.036)	(.0646)	(.0973)	(.1395)	(.2043)	(.0086)
DK	-1.03	-.633	-1.656	-2.676	-3.693	.0274	-1.3717	-2.7619	-4.1424	-4.5196	-1.8146	-.0941
	(.058)	(.061)	(.073)	(.13)	(.199)	(.0652)	(.0826)	(.1553)	(.2497)	(.3181)	(.3346)	(.0153)
ES	-1.039	-.638	-1.672	-2.705	-3.737	.0276	-1.385	-2.7945	-4.201	-4.524	-1.8164	-.0942
	(.057)	(.06)	(.071)	(.123)	(.184)	(.0658)	(.0802)	(.1474)	(.2322)	(.2431)	(.3287)	(.0149)
FI	-1.027	-.631	-1.651	-2.664	-3.671	.0274	-1.3698	-2.7594	-4.1413	-4.4646	-1.7925	-.093
	(.061)	(.063)	(.077)	(.138)	(.215)	(.0651)	(.0817)	(.1496)	(.2361)	(.2715)	(.3243)	(.0139)
FR	-.99	-.61	-1.584	-2.533	-3.456	.0266	-1.3218	-2.6451	-3.9412	-4.1677	-1.6733	-.0868
	(.06)	(.062)	(.077)	(.139)	(.217)	(.0632)	(.0797)	(.1469)	(.2331)	(.2859)	(.2848)	(.012)
GB	-1.019	-.626	-1.638	-2.643	-3.642	.0272	-1.3566	-2.7261	-4.0801	-4.4105	-1.7708	-.0919
	(.058)	(.061)	(.074)	(.13)	(.199)	(.0646)	(.0817)	(.1537)	(.2472)	(.2771)	(.3206)	(.0132)
GR	-1.043	-.64	-1.679	-2.717	-3.756	.0277	-1.3908	-2.8082	-4.2249	-4.5813	-1.8394	-.0954
	(.053)	(.058)	(.064)	(.11)	(.161)	(.0661)	(.0756)	(.1353)	(.2076)	(.2488)	(.3393)	(.0147)
HR	-1.044	-.641	-1.68	-2.718	-3.755	.0278	-1.3925	-2.8109	-4.2273	-4.57	-1.8348	-.0952
	(.058)	(.061)	(.076)	(.144)	(.23)	(.0662)	(.0812)	(.1569)	(.2544)	(.3182)	(.3356)	(.0141)
HU	-1.042	-.64	-1.676	-2.708	-3.735	.0277	-1.3902	-2.8054	-4.2179	-4.5535	-1.8282	-.0949
	(.064)	(.065)	(.085)	(.163)	(.269)	(.066)	(.0825)	(.156)	(.2515)	(.3425)	(.311)	(.0144)
IE	-1.043	-.641	-1.678	-2.707	-3.724	.0278	-1.393	-2.8112	-4.2264	-4.5656	-1.8331	-.0951
	(.073)	(.071)	(.102)	(.215)	(.378)	(.0661)	(.0847)	(.1682)	(.2808)	(.4487)	(.2911)	(.0158)
IS	-1.042	-.64	-1.676	-2.71	-3.742	.0277	-1.3884	-2.8006	-4.2081	-4.578	-1.838	-.0954
	(.056)	(.06)	(.073)	(.141)	(.229)	(.066)	(.0806)	(.1595)	(.2648)	(.2991)	(.3239)	(.0135)
IT	-1.029	-.631	-1.657	-2.684	-3.713	.0273	-1.3724	-2.7734	-4.1766	-4.5406	-1.823	-.0946
	(.055)	(.058)	(.064)	(.098)	(.13)	(.0652)	(.074)	(.1192)	(.1652)	(.2393)	(.3291)	(.0117)
JP	-1.024	-.628	-1.651	-2.676	-3.705	.0272	-1.3679	-2.7668	-4.1704	-4.4859	-1.8011	-.0934
	(.055)	(.058)	(.064)	(.094)	(.118)	(.0649)	(.073)	(.1125)	(.1478)	(.245)	(.3177)	(.0131)
KR	-1.043	-.64	-1.679	-2.716	-3.752	.0278	-1.3911	-2.8072	-4.2203	-4.58	-1.8388	-.0954
	(.059)	(.062)	(.075)	(.135)	(.209)	(.066)	(.0844)	(.1615)	(.2631)	(.31)	(.3482)	(.0128)
LU	-1.042	-.64	-1.677	-2.714	-3.751	.0277	-1.3889	-2.8033	-4.2156	-4.5887	-1.8423	-.0956
	(.057)	(.059)	(.074)	(.13)	(.193)	(.0661)	(.0821)	(.1546)	(.2432)	(.4037)	(.3642)	(.0148)
NL	-1.009	-.62	-1.621	-2.618	-3.61	.0269	-1.3438	-2.7013	-4.0458	-4.2983	-1.7257	-.0895
	(.058)	(.061)	(.072)	(.121)	(.178)	(.064)	(.0811)	(.1452)	(.2253)	(.2196)	(.3102)	(.0118)
NO	-1.026	-.63	-1.648	-2.659	-3.662	.0273	-1.368	-2.7549	-4.1332	-4.4568	-1.7894	-.0928
	(.063)	(.064)	(.08)	(.142)	(.22)	(.065)	(.084)	(.1534)	(.2414)	(.2648)	(.3269)	(.0132)
PL	-1.042	-.64	-1.678	-2.714	-3.75	.0277	-1.39	-2.8054	-4.2185	-4.5616	-1.8315	-.095
	(.059)	(.061)	(.075)	(.132)	(.2)	(.066)	(.0827)	(.1551)	(.2464)	(.3818)	(.3291)	(.0123)
PT	-1.038	-.637	-1.67	-2.702	-3.734	.0276	-1.3834	-2.7915	-4.197	-4.5264	-1.8173	-.0943
	(.055)	(.06)	(.067)	(.115)	(.17)	(.0657)	(.0787)	(.1413)	(.2193)	(.2561)	(.3346)	(.0125)
SE	-1.018	-.626	-1.635	-2.635	-3.627	.0272	-1.3574	-2.7312	-4.0944	-4.3484	-1.7459	-.0906
	(.059)	(.062)	(.075)	(.134)	(.209)	(.0646)	(.0796)	(.1455)	(.2294)	(.2525)	(.3162)	(.0116)
SI	-1.044	-.641	-1.681	-2.719	-3.756	.0278	-1.3934	-2.8131	-4.2315	-4.5883	-1.8422	-.0956
	(.059)	(.062)	(.077)	(.147)	(.238)	(.0662)	(.0793)	(.1501)	(.2405)	(.3248)	(.3305)	(.0152)
US	-1.008	-.619	-1.622	-2.623	-3.625	.0269	-1.3444	-2.7093	-4.0695	-4.403	-1.7678	-.0917
	(.058)	(.06)	(.071)	(.114)	(.162)	(.0639)	(.0785)	(.1359)	(.2033)	(.2363)	(.3099)	(.0128)

Notes: The table reports elasticity estimates for the patent income tax rate ('tax rate'), the CFC-adjusted patent income tax rate ('adj. tax rate'), the CFC-related tax component ('CFC') and the transfer pricing risk measure ('TP'). See also the variable definitions in Tables 4 and 5A. The elasticities in Column (1) refer to the model presented in Column (1) of Table 5A, the elasticities in Columns (2a)-(2d) to the model presented in Column (2) of Table 5A, the elasticities in Columns (4a)-(4d) to the model in Column (4) of Table 5A, and the elasticities in Columns (8a)-(8c) analogously to the model in Column (8) of Table 5A. Countries are indicated by their isocode2-abbreviations, see the notes to Table 4. Specifications (2a)-(2d) and (4a)-(4d) moreover report the elasticities evaluated at different levels of 'Patent Quality (Composite Index)', namely -0.5, 0.5, 1.5 and 2.5.

Table 6: Mixed Logit Models

	(1)		(2)		(3)	
	Mean	SD	Mean	SD	Mean	SD
Patent Income Tax			-4.344***	1.897***	-4.315***	2.871***
			(0.128)	(0.336)	(0.133)	(0.260)
Patent Income Tax (CFC Adj.)	-3.931***	3.124***				
	(0.130)	(0.265)				
Binding CFC Rule			-0.323***	0.836***		
			(0.036)	(0.102)		
CFC-Tax Component					-1.269***	0.030
					(0.182)	(0.163)
Transfer Price Regulation	-0.113***	0.238***	-0.126***	0.219***	-0.123***	0.239***
	(0.008)	(0.028)	(0.008)	(0.032)	(0.008)	(0.032)
Inventor Country	4.030***		4.031***		4.016***	
	(0.022)		(0.023)		(0.023)	
Parent Country	3.447***		3.491***		3.502***	
	(0.021)		(0.022)		(0.021)	
Log GDP p.c.	-0.136***	0.004	-0.265***	0.003	-0.236***	0.000
	(0.047)	(0.006)	(0.050)	(0.008)	(0.049)	(0.008)
Log GDP	0.445***	0.004	0.502***	0.006	0.511***	0.007
	(0.010)	(0.004)	(0.011)	(0.008)	(0.011)	(0.009)
Political Stability	0.152***	0.388**	0.225***	0.574***	0.235***	0.626***
	(0.030)	(0.158)	(0.033)	(0.137)	(0.033)	(0.124)
GDP Growth	-0.253***	0.002	-0.283***	0.004	-0.284***	0.007
	(0.008)	(0.011)	(0.009)	(0.011)	(0.009)	(0.010)
Business Freedom	-0.064***	0.024***	-0.062***	0.024***	-0.062***	0.023***
	(0.002)	(0.005)	(0.002)	(0.005)	(0.002)	(0.006)
Freedom from Corruption	0.027***	0.000	0.029***	0.001	0.028***	0.001
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Obs.	2,115,954		2,049,978		2,047,380	
Cluster	82,255		79,703		79,602	
χ^2	49,664.303		44,407.463		46,181.217	

Notes: Standard errors in brackets below the coefficient estimates. ***, **, * indicates significance at the 1, 5, 10% significance level. See the notes to Tables 4 and 5A for a definition of the variables. The column-header 'Mean' indicates the mean of the estimated random coefficients and the column-header 'SD' the standard deviation.

Table 7: Own and Cross-Country Elasticities: Patent Income Tax Rate

Country	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	GR	HR
AT	-4.232	0.062	0.054	0.054	0.069	0.124	0.049	0.061	0.055	0.064	0.075	0.061	0.055	0.066
AU	0.022	-4.461	0.018	0.019	0.024	0.021	0.017	0.022	0.019	0.023	0.027	0.023	0.018	0.024
BE	0.088	0.090	-3.830	0.074	0.107	0.116	0.077	0.096	0.088	0.099	0.106	0.089	0.087	0.109
CA	0.016	0.017	0.013	-3.755	0.016	0.013	0.013	0.016	0.012	0.016	0.019	0.017	0.013	0.015
CH	0.342	0.355	0.324	0.279	-4.555	0.320	0.286	0.389	0.332	0.416	0.438	0.346	0.333	0.446
CZ	0.000	0.000	0.000	0.000	0.000	-4.918	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DE	1.500	1.561	1.403	1.335	1.718	2.224	-2.303	1.569	1.459	1.606	1.829	1.566	1.436	1.713
DK	0.095	0.101	0.088	0.083	0.117	0.109	0.081	-4.413	0.093	0.111	0.120	0.102	0.091	0.115
ES	0.036	0.036	0.036	0.029	0.044	0.038	0.032	0.039	-4.101	0.038	0.047	0.039	0.040	0.051
FI	0.125	0.132	0.116	0.106	0.158	0.073	0.104	0.143	0.119	-4.491	0.157	0.130	0.118	0.155
FR	0.476	0.498	0.413	0.402	0.560	0.482	0.374	0.488	0.455	0.501	-4.786	0.517	0.434	0.583
GB	0.350	0.373	0.312	0.314	0.399	0.238	0.291	0.371	0.344	0.369	0.462	-4.163	0.326	0.418
GR	0.004	0.004	0.004	0.003	0.005	0.010	0.003	0.004	0.005	0.005	0.005	0.004	-4.036	0.005
HR	0.009	0.008	0.009	0.006	0.011	0.000	0.007	0.008	0.011	0.009	0.012	0.008	0.010	-5.057
HU	0.017	0.017	0.016	0.013	0.022	0.064	0.013	0.018	0.017	0.020	0.023	0.017	0.016	0.023
IE	0.018	0.020	0.017	0.014	0.029	0.022	0.013	0.026	0.017	0.027	0.026	0.019	0.018	0.026
IS	0.003	0.004	0.003	0.003	0.005	0.005	0.003	0.005	0.003	0.005	0.004	0.003	0.003	0.005
IT	0.087	0.089	0.075	0.078	0.091	0.082	0.071	0.083	0.083	0.084	0.109	0.093	0.078	0.100
JP	0.062	0.062	0.054	0.057	0.066	0.050	0.051	0.061	0.053	0.063	0.071	0.062	0.054	0.063
KR	0.005	0.005	0.004	0.004	0.005	0.006	0.004	0.004	0.005	0.004	0.007	0.006	0.005	0.006
LU	0.006	0.006	0.006	0.005	0.008	0.027	0.005	0.007	0.005	0.008	0.006	0.005	0.006	0.006
NL	0.318	0.332	0.293	0.277	0.375	0.353	0.272	0.335	0.299	0.350	0.393	0.328	0.296	0.368
NO	0.061	0.063	0.060	0.049	0.083	0.060	0.052	0.071	0.060	0.078	0.076	0.060	0.061	0.080
PL	0.001	0.001	0.000	0.000	0.001	0.053	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.000
PT	0.015	0.015	0.013	0.013	0.017	0.039	0.013	0.015	0.012	0.016	0.017	0.014	0.013	0.016
SE	0.254	0.263	0.226	0.215	0.304	0.060	0.204	0.267	0.236	0.282	0.324	0.261	0.231	0.309
SI	0.003	0.003	0.003	0.003	0.004	0.008	0.003	0.004	0.003	0.004	0.004	0.003	0.003	0.004
US	0.320	0.347	0.271	0.322	0.316	0.323	0.264	0.313	0.315	0.292	0.426	0.391	0.289	0.355

Country	HU	IE	IS	IT	JP	KR	LU	NL	NO	PL	PT	SE	SI	US
AT	0.080	0.093	0.077	0.053	0.050	0.063	0.059	0.058	0.064	0.135	0.060	0.066	0.067	0.053
AU	0.028	0.034	0.020	0.019	0.018	0.022	0.020	0.021	0.023	0.023	0.021	0.024	0.024	0.019
BE	0.118	0.138	0.115	0.075	0.073	0.089	0.092	0.087	0.101	0.123	0.089	0.097	0.104	0.075
CA	0.018	0.021	0.019	0.015	0.014	0.016	0.015	0.015	0.015	0.014	0.016	0.017	0.016	0.016
CH	0.507	0.654	0.487	0.278	0.274	0.342	0.374	0.342	0.418	0.335	0.350	0.398	0.431	0.275
CZ	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.000	0.000	0.000	0.000
DE	1.954	2.228	1.810	1.340	1.280	1.568	1.500	1.487	1.627	2.360	1.522	1.623	1.689	1.362
DK	0.132	0.169	0.125	0.081	0.079	0.098	0.102	0.094	0.110	0.116	0.096	0.107	0.118	0.084
ES	0.050	0.057	0.046	0.032	0.029	0.041	0.036	0.034	0.041	0.049	0.035	0.038	0.044	0.034
FI	0.176	0.227	0.161	0.104	0.102	0.126	0.134	0.125	0.148	0.074	0.126	0.143	0.155	0.105
FR	0.684	0.850	0.575	0.413	0.376	0.528	0.450	0.450	0.516	0.548	0.465	0.525	0.555	0.427
GB	0.470	0.575	0.397	0.316	0.295	0.388	0.341	0.338	0.374	0.262	0.344	0.381	0.406	0.336
GR	0.006	0.007	0.005	0.003	0.003	0.004	0.004	0.004	0.005	0.011	0.004	0.004	0.005	0.003
HR	0.014	0.015	0.010	0.007	0.006	0.010	0.008	0.008	0.010	0.000	0.008	0.010	0.011	0.007
HU	-5.744	0.037	0.023	0.013	0.012	0.017	0.018	0.016	0.020	0.072	0.017	0.020	0.022	0.013
IE	0.037	-6.840	0.039	0.013	0.013	0.017	0.024	0.017	0.026	0.024	0.019	0.023	0.029	0.013
IS	0.006	0.009	-5.171	0.002	0.003	0.003	0.005	0.003	0.005	0.005	0.004	0.004	0.005	0.002
IT	0.105	0.117	0.075	-3.707	0.075	0.096	0.076	0.082	0.087	0.093	0.083	0.091	0.091	0.083
JP	0.073	0.082	0.073	0.055	-3.538	0.062	0.060	0.059	0.063	0.050	0.061	0.066	0.064	0.055
KR	0.007	0.007	0.006	0.005	0.004	-4.550	0.004	0.005	0.005	0.008	0.005	0.005	0.005	0.005
LU	0.008	0.011	0.010	0.004	0.005	0.005	-4.263	0.005	0.007	0.027	0.006	0.006	0.008	0.004
NL	0.428	0.505	0.384	0.276	0.266	0.327	0.320	-3.875	0.353	0.379	0.328	0.354	0.363	0.278
NO	0.091	0.116	0.086	0.049	0.049	0.059	0.069	0.062	-4.624	0.063	0.063	0.072	0.079	0.048
PL	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	-5.274	0.001	0.000	0.001	0.000
PT	0.020	0.023	0.019	0.012	0.012	0.014	0.015	0.015	0.016	0.042	-4.278	0.017	0.016	0.011
SE	0.349	0.433	0.298	0.215	0.207	0.262	0.252	0.248	0.285	0.061	0.253	-4.420	0.296	0.215
SI	0.005	0.007	0.004	0.003	0.003	0.003	0.004	0.003	0.004	0.008	0.003	0.004	-4.940	0.003
US	0.379	0.431	0.308	0.325	0.288	0.390	0.282	0.297	0.300	0.363	0.301	0.326	0.336	-3.524

Notes: The table reports own and cross-country elasticities capturing effects of the patent income tax rate on the international location of patents. Policy-changing jurisdictions are depicted in columns, countries facing externalities in rows.

Table 8: Simulation – Changes in Tax Rates and Transfer Pricing Legislation

	Reduction of the US Tax Rate				Tax Harmonization		TP Harmonization	
	Reduction to 21%		Reduction to 13.125%					
Application Country	delta	delta-rel	delta	delta-rel	delta	delta-rel	delta	delta-rel
AT	-.0003043	-.0183756	-.0004749	-.0286797	.0009195	.0555314	.000039	.0023558
AU	-.0000642	-.0568775	-.0000974	-.0862829	.0004886	.4330714	.0000344	.0304758
BE	-.0009364	-.0428676	-.0014746	-.0675116	-.0058778	-.2690932	-.0003255	-.0149014
CA	-.0002214	-.0987009	-.0003288	-.1465322	.0003927	.1750066	.0000449	.020012
CH	-.0018878	-.0311753	-.0029668	-.0489931	-.0121482	-.2006145	-.0047108	-.0777933
DE	-.0049385	-.0105072	-.0079272	-.0168662	.0249214	.0530235	.0024426	.0051969
DK	-.0001392	-.012424	-.0002137	-.01908	.0001563	.0139532	.0000839	.0074872
ES	-.0004296	-.0435571	-.0006644	-.0673703	-.0025588	-.2594532	.0001627	.016498
FI	-.0002023	-.0173437	-.0003107	-.0266443	-.0000218	-.0018653	.0001143	.0098051
FR	-.0021969	-.0155277	-.0035419	-.0250339	-.0073424	-.0518959	.0013708	.0096886
GB	-.0023327	-.0433848	-.003687	-.0685744	-.0086949	-.1617142	-.0014197	-.0264043
GR	-.0000814	-.0575671	-.000124	-.0876775	.0005069	.358524	-.0002471	-.1747509
HU	-.0000811	-.0436343	-.0001257	-.0676611	-.0005136	-.2764321	.0000279	.0150161
IE	-.0000773	-.0756631	-.0001189	-.1164441	-.0004681	-.4582944	-.0003313	-.3243555
IS	-8.05e-06	-.0545582	-.0000125	-.0848001	1.22e-08	.0000825	3.64e-06	.0246788
IT	-.0007005	-.0429811	-.0010977	-.0673568	-.0004683	-.0287328	.0003678	.022568
JP	-.0007061	-.0453739	-.0010962	-.0704451	.0048071	.3089077	.0003616	.0232339
KR	-.0001809	-.1074306	-.0002661	-.1580768	-.0003551	-.2109292	.0000544	.0323231
LU	-.0000988	-.0448538	-.0001524	-.0692245	-.0005793	-.2631108	-.0002148	-.0975719
NL	-.001917	-.0232582	-.0030536	-.0370477	-.0157002	-.1904817	.0008891	.0107864
NO	-.0002793	-.0473789	-.0004258	-.0722493	.0007006	.1188681	.000126	.0213838
PT	-.0002973	-.0697906	-.0004626	-.1085823	-.0014513	-.3406442	-.0000133	-.0031206
SE	-.0007681	-.0219405	-.0011962	-.034168	.0009044	.0258315	.0003659	.0104512
SI	-.0000142	-.0269863	-.0000224	-.0425142	-.0000445	-.0844608	.0000113	.021513
US	.0188631	.6009151	.0298417	.9506596	.0224266	.7144384	.0007622	.0242815

Notes: The table reports changes in the absolute and relative patent location propensity per choice country ('delta' and 'delta-rel') when patent income tax rates in the US are reduced from 35% to 21% (Columns (3) and (4)) and 35% to 13.125% (Columns (5) and (6)) respectively. The simulation considers the current tax environment (i.e. current patent income tax rates, CFC provisions and transfer pricing scores). Choice countries are indicated by their 2-digit isocode (see also the notes to Table 4). Columns (7) and (8) show results of simulations when patent income tax rates are harmonised across countries and columns (9) and (10) refer to a harmonized transfer pricing scores across countries (see main text).

Online Appendix

Table A1: CFC Legislation in 2003

Country	CFC Dummy	Tax Haven Definition
Belgium	0	-
Czech Republic	0	-
Denmark	1	Effective tax <75% of Danish tax
Finland	1	Effective tax <60% of Finish tax
France	1	Effective tax <66% of French tax
Germany	1	Effective tax <25%
Great Britain	1	Effective tax <75% of British tax
Greece	0	-
Ireland	0	-
Italy	1	Black list
Luxembourg	0	-
Netherlands	0	-
Norway	1	Effective tax <66% of Norwegian tax
Poland	0	-
Portugal	1	Effective tax <60% of Portuguese tax
Spain	1	Effective tax <75% of Spanish tax
Sweden	1	Effective tax <55% of Swedish tax
Switzerland	0	-
Austria	0	-
Canada	1	Always binding
Japan	1	Effective tax <25%
United States	1	Effective tax <75% of US tax

Notes: CFC Dummy takes on the value 1 if the parent country has enacted CFC legislations and the value 0 otherwise. In the case of Norway, the 66% rule does not apply if a bilateral tax treaty exists between Norway and the country of the controlled subsidiary, unless the majority of the income in that subsidiary is passive. In the case of Italy, the black list of tax havens is too long to be reported, but it is based on and is very similar to the OECD tax haven list.

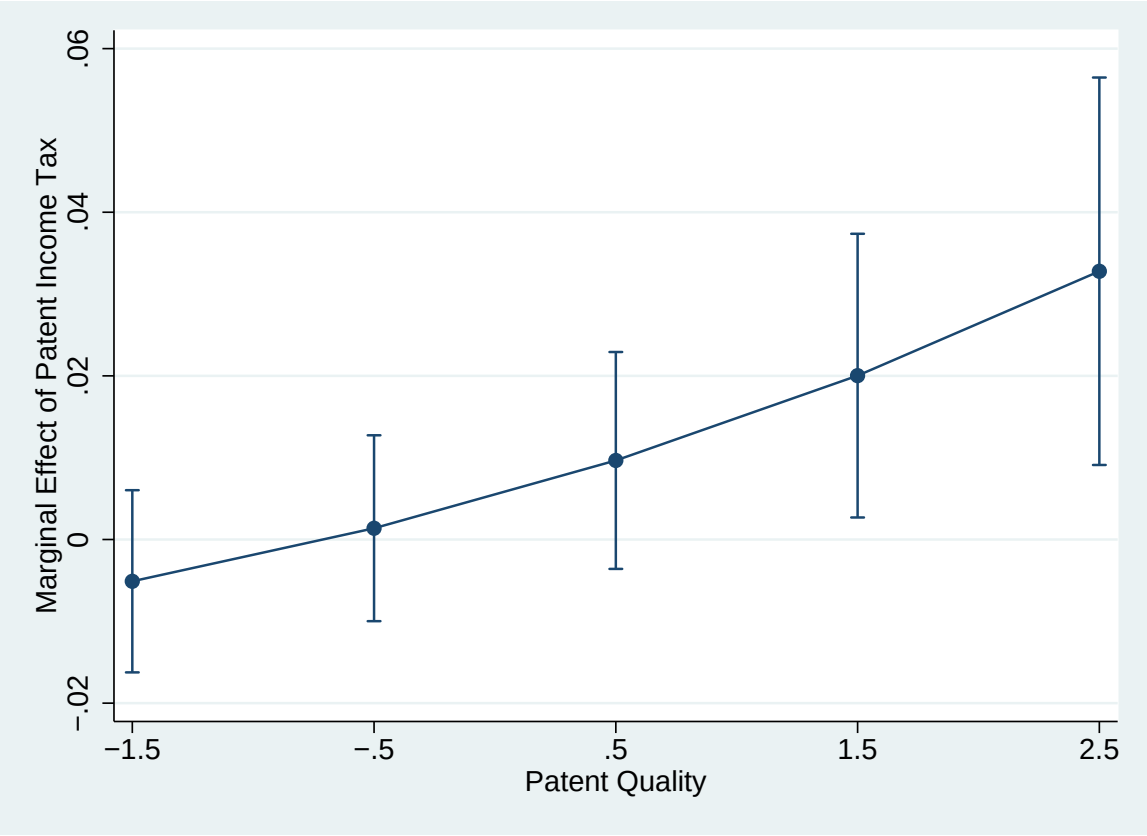

Figure A1: Marginal effects of relocation choice – MNE-sample

Table A2: Own and Cross-Country Elasticities: CFC Tax Component

Country	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	GR	HR
AT	-1.251	0.017	0.017	0.018	0.017	0.034	0.017	0.017	0.017	0.017	0.018	0.017	0.017	0.016
AU	0.006	-1.263	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
BE	0.026	0.025	-1.242	0.024	0.027	0.031	0.026	0.027	0.027	0.027	0.025	0.025	0.027	0.027
CA	0.005	0.005	0.005	-1.263	0.004	0.004	0.005	0.005	0.004	0.005	0.005	0.005	0.004	0.004
CH	0.108	0.106	0.112	0.100	-1.149	0.087	0.107	0.115	0.108	0.120	0.107	0.102	0.111	0.116
CZ	0.000	0.000	0.000	0.000	0.000	-1.262	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DE	0.404	0.405	0.411	0.404	0.403	0.536	-0.852	0.404	0.407	0.404	0.397	0.401	0.408	0.394
DK	0.029	0.029	0.030	0.029	0.031	0.029	0.029	-1.237	0.029	0.031	0.029	0.029	0.030	0.029
ES	0.011	0.010	0.012	0.010	0.011	0.010	0.011	0.011	-1.255	0.011	0.011	0.011	0.013	0.013
FI	0.039	0.039	0.040	0.038	0.042	0.020	0.039	0.042	0.038	-1.226	0.038	0.038	0.039	0.041
FR	0.161	0.161	0.155	0.159	0.159	0.141	0.154	0.155	0.161	0.155	-1.099	0.164	0.158	0.164
GB	0.106	0.108	0.104	0.109	0.104	0.063	0.105	0.107	0.107	0.103	0.110	-1.157	0.106	0.107
GR	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.002	0.001	0.001	0.001	-1.267	0.001
HR	0.002	0.002	0.002	0.002	0.003	0.000	0.002	0.002	0.003	0.002	0.003	0.002	0.003	-1.265
HU	0.004	0.004	0.004	0.004	0.005	0.013	0.004	0.005	0.004	0.005	0.005	0.004	0.005	0.005
IE	0.004	0.004	0.004	0.003	0.006	0.004	0.003	0.005	0.004	0.006	0.005	0.004	0.004	0.005
IS	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
IT	0.026	0.025	0.024	0.027	0.023	0.023	0.025	0.023	0.025	0.023	0.025	0.026	0.024	0.025
JP	0.020	0.019	0.019	0.021	0.018	0.015	0.019	0.018	0.018	0.019	0.018	0.019	0.019	0.017
KR	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.002	0.001	0.002	0.002	0.001	0.002
LU	0.002	0.002	0.002	0.002	0.002	0.007	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
NL	0.094	0.094	0.095	0.093	0.095	0.093	0.095	0.094	0.091	0.096	0.091	0.091	0.093	0.092
NO	0.018	0.018	0.019	0.016	0.021	0.015	0.018	0.020	0.018	0.021	0.018	0.017	0.019	0.020
PL	0.000	0.000	0.000	0.000	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PT	0.004	0.004	0.004	0.004	0.004	0.010	0.004	0.004	0.004	0.005	0.004	0.004	0.004	0.004
SE	0.079	0.078	0.078	0.077	0.080	0.016	0.077	0.078	0.076	0.080	0.078	0.076	0.077	0.081
SI	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
US	0.099	0.102	0.093	0.113	0.084	0.088	0.097	0.092	0.100	0.084	0.102	0.112	0.095	0.092

Country	HU	IE	IS	IT	JP	KR	LU	NL	NO	PL	PT	SE	SI	US
AT	0.017	0.017	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.034	0.018	0.018	0.017	0.017
AU	0.006	0.006	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
BE	0.026	0.025	0.028	0.025	0.026	0.025	0.027	0.026	0.027	0.030	0.026	0.026	0.027	0.024
CA	0.004	0.004	0.005	0.006	0.006	0.005	0.005	0.005	0.005	0.003	0.005	0.005	0.005	0.006
CH	0.116	0.124	0.124	0.099	0.104	0.100	0.117	0.110	0.119	0.083	0.110	0.113	0.116	0.095
CZ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000
DE	0.400	0.388	0.415	0.405	0.407	0.401	0.405	0.410	0.404	0.530	0.409	0.403	0.401	0.402
DK	0.030	0.032	0.031	0.028	0.029	0.028	0.031	0.029	0.031	0.029	0.029	0.030	0.031	0.028
ES	0.011	0.011	0.011	0.011	0.011	0.012	0.011	0.011	0.011	0.012	0.010	0.010	0.012	0.011
FI	0.040	0.042	0.041	0.037	0.038	0.037	0.042	0.040	0.042	0.019	0.040	0.040	0.041	0.036
FR	0.166	0.168	0.156	0.162	0.157	0.167	0.153	0.157	0.158	0.147	0.157	0.160	0.160	0.162
GB	0.106	0.107	0.099	0.109	0.107	0.110	0.105	0.105	0.103	0.064	0.105	0.105	0.106	0.113
GR	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.001
HR	0.003	0.003	0.002	0.002	0.002	0.003	0.002	0.002	0.003	0.000	0.002	0.002	0.003	0.002
HU	-1.263	0.006	0.005	0.004	0.004	0.004	0.005	0.004	0.005	0.014	0.005	0.005	0.005	0.004
IE	0.006	-1.259	0.007	0.003	0.003	0.004	0.005	0.004	0.005	0.004	0.004	0.005	0.006	0.003
IS	0.001	0.001	-1.267	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
IT	0.023	0.021	0.019	-1.242	0.026	0.026	0.023	0.025	0.023	0.023	0.025	0.024	0.023	0.027
JP	0.017	0.016	0.019	0.020	-1.248	0.019	0.019	0.020	0.019	0.013	0.020	0.019	0.018	0.019
KR	0.001	0.001	0.001	0.002	0.001	-1.267	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.002
LU	0.002	0.002	0.003	0.001	0.002	0.001	-1.267	0.002	0.002	0.007	0.002	0.002	0.002	0.001
NL	0.094	0.092	0.093	0.092	0.094	0.091	0.095	-1.172	0.095	0.093	0.097	0.095	0.093	0.090
NO	0.020	0.021	0.021	0.016	0.017	0.016	0.020	0.019	-1.248	0.014	0.019	0.019	0.020	0.015
PL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.255	0.000	0.000	0.000	0.000
PT	0.004	0.004	0.005	0.004	0.004	0.004	0.004	0.005	0.004	0.010	-1.264	0.005	0.004	0.004
SE	0.080	0.081	0.076	0.076	0.077	0.076	0.079	0.079	0.080	0.015	0.079	-1.188	0.079	0.074
SI	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	-1.268	0.001
US	0.087	0.082	0.079	0.113	0.106	0.112	0.089	0.094	0.084	0.091	0.093	0.091	0.090	-1.145

Notes: The table reports own and cross-country elasticities capturing effects of the CFC tax component on the international location of patents. Policy-changing jurisdictions are depicted in columns, countries facing externalities in rows.

Table A3: Own and Cross-Country Elasticities: Transfer Pricing Legislations

Country	AT	AU	BE	CA	CH	CZ	DE	DK	ES	FI	FR	GB	GR	HR
AT	-0.087	0.001	0.003	0.000	0.003	0.003	0.002	0.003	0.003	0.003	0.001	0.001	0.003	0.003
AU	0.000	-0.080	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.001
BE	0.002	0.002	-0.181	0.000	0.004	0.002	0.003	0.004	0.004	0.004	0.002	0.002	0.005	0.004
CA	0.000	0.000	0.000	-0.019	0.001	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.001	0.000
CH	0.007	0.006	0.016	0.001	-0.185	0.005	0.012	0.017	0.017	0.019	0.007	0.006	0.017	0.018
CZ	0.000	0.000	0.000	0.000	0.000	-0.123	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DE	0.027	0.023	0.057	0.005	0.063	0.059	-0.098	0.061	0.063	0.063	0.025	0.023	0.065	0.059
DK	0.001	0.001	0.004	0.000	0.004	0.002	0.003	-0.193	0.004	0.004	0.001	0.001	0.004	0.004
ES	0.001	0.001	0.002	0.000	0.002	0.002	0.001	0.002	-0.200	0.002	0.001	0.001	0.002	0.002
FI	0.001	0.001	0.005	-0.001	0.005	0.001	0.004	0.005	0.005	-0.198	0.001	0.001	0.005	0.00
FR	0.013	0.012	0.024	0.004	0.027	0.013	0.019	0.026	0.027	0.027	-0.072	0.012	0.027	0.028
GB	0.009	0.009	0.017	0.004	0.018	0.006	0.014	0.019	0.019	0.018	0.009	-0.069	0.019	0.019
GR	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	-0.206	0.000
HR	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.001	-0.199
HU	0.000	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.001
IE	0.000	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001
IS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IT	0.002	0.002	0.004	0.001	0.004	0.002	0.004	0.004	0.004	0.004	0.002	0.002	0.004	0.004
JP	0.001	0.001	0.003	0.000	0.003	0.001	0.002	0.003	0.003	0.003	0.001	0.001	0.003	0.003
KR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LU	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NL	0.007	0.006	0.014	0.002	0.016	0.011	0.011	0.015	0.015	0.016	0.007	0.006	0.016	0.015
NO	0.002	0.001	0.003	0.000	0.004	0.001	0.002	0.003	0.003	0.004	0.001	0.001	0.003	0.004
PL	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PT	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.000	0.001	0.001
SE	0.005	0.005	0.012	0.001	0.013	0.002	0.009	0.012	0.012	0.013	0.005	0.005	0.012	0.013
SI	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
US	0.005	0.005	0.012	0.000	0.011	0.007	0.009	0.012	0.014	0.011	0.005	0.006	0.013	0.013

Country	HU	IE	IS	IT	JP	KR	LU	NL	NO	PL	PT	SE	SI	US
AT	0.002	0.003	0.003	0.001	0.001	0.001	0.003	0.002	0.003	0.003	0.002	0.002	0.003	0.001
AU	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000
BE	0.004	0.004	0.005	0.001	0.002	0.001	0.004	0.003	0.005	0.002	0.003	0.003	0.004	0.001
CA	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.001	0.000
CH	0.015	0.019	0.019	0.003	0.005	0.005	0.018	0.010	0.018	0.004	0.009	0.010	0.018	0.002
CZ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
DE	0.051	0.060	0.069	0.011	0.022	0.020	0.064	0.037	0.064	0.053	0.035	0.037	0.063	0.009
DK	0.003	0.004	0.004	0.000	0.001	0.001	0.004	0.002	0.004	0.002	0.002	0.002	0.004	0.000
ES	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.001	0.002	0.002	0.001	0.001	0.002	0.001
FI5	0.004	0.006	0.006	0.000	0.001	0.001	0.006	0.003	0.005	0.001	0.003	0.003	0.005	0.000
FR	0.024	0.029	0.027	0.007	0.011	0.011	0.026	0.017	0.027	0.011	0.016	0.018	0.028	0.006
GB	0.016	0.019	0.018	0.005	0.008	0.008	0.019	0.013	0.018	0.006	0.012	0.012	0.019	0.005
GR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
HR	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000
HU	-0.170	0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.000
IE	0.001	-0.200	0.002	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
IS	0.000	0.000	-0.211	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IT	0.004	0.004	0.003	-0.037	0.002	0.002	0.004	0.003	0.004	0.001	0.003	0.003	0.004	0.001
JP	0.002	0.002	0.003	0.001	-0.072	0.001	0.003	0.002	0.003	0.001	0.001	0.002	0.003	0.001
KR	0.000	0.000	0.000	0.000	0.000	-0.069	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LU	0.000	0.000	0.000	0.000	0.000	0.000	-0.204	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NL	0.013	0.015	0.016	0.003	0.006	0.006	0.016	-0.113	0.016	0.010	0.009	0.010	0.016	0.003
NO	0.003	0.004	0.004	0.001	0.001	0.001	0.004	0.002	-0.200	0.001	0.002	0.002	0.004	0.001
PL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.110	0.000	0.000	0.000	0.000
PT	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.001	-0.116	0.000	0.001	0.000
SE	0.011	0.013	0.013	0.002	0.004	0.004	0.013	0.008	0.013	0.001	0.008	-0.115	0.013	0.002
SI	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.205	0.000
US	0.010	0.011	0.011	0.002	0.004	0.004	0.012	0.008	0.011	0.007	0.007	0.007	0.012	-0.031

Notes: The table reports own and cross-country elasticities capturing effects of changes in transfer pricing regulations on the international location of patents. Policy-changing jurisdictions are depicted in columns, countries facing externalities in rows.

Table A4: Simulation – Baseline Location Propensity

Application Country	Baseline Loc. Prop.
AT	.0165589
AU	.0011283
BE	.0218429
CA	.0022436
CH	.060555
DE	.4700068
DK	.0112003
ES	.0098621
FI	.0116616
FR	.1414826
GB	.0537668
GR	.0014138
HU	.0018579
IE	.0010214
IS	.0001476
IT	.0162974
JP	.0155617
KR	.0016837
LU	.0022016
NL	.0824239
NO	.005894
PT	.0042604
SE	.03501
SI	.0005273
US	.0313905

Notes: The table reports the patent location propensity per choice country based on the current tax environment (i.e. current patent income tax rates, CFC provisions and transfer pricing scores). Choice countries are indicated by their 2-digit isocode (see also the notes to Table 4).