

Stimmelmayer, Michael; Koethenbuerger, Marko; Liberini, Federica

Conference Paper

Is it Luring Innovations or just Profit? The Case of European Patent Boxes

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel - Session: Innovation and the Global Economy, No. A03-V1

Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

Suggested Citation: Stimmelmayer, Michael; Koethenbuerger, Marko; Liberini, Federica (2016) : Is it Luring Innovations or just Profit? The Case of European Patent Boxes, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel - Session: Innovation and the Global Economy, No. A03-V1, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel und Hamburg

This Version is available at:

<https://hdl.handle.net/10419/145582>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Is it Luring Innovations or just Profit?

The Case of European Patent Boxes

This version: February 2016

Preliminary Draft

Abstract

The effectiveness of European patent boxes in triggering R&D and fostering new patentable innovations is the subject of a growing debate. These regimes are considered liable of tax-favouring already successful ideas, without imposing a nexus between the final location of the intellectual property (IP) and its related innovation. This paper brings the debate forward onto the assessment of the quantitative impact of patent box regimes on profit shifting by multinational firms. Our empirical strategy builds on a difference-in-difference model comparing the pre-tax profit of European subsidiaries affiliated to firm conglomerates that owned patents long before the introduction of IP boxes, to that of European subsidiaries affiliated to firm conglomerates with no historical record of patent ownership. We find that European subsidiaries affiliated to foreign IP owners report, after the introduction of a local patent box, on average 2.5 to 3.9 percent higher profit compared to European subsidiaries affiliated to non-IP-owning conglomerates. For countries where the patent box regime incorporates a nexus clause, i.e. grants the IP related tax benefit only to newly created IP, we find no significant difference in the profits of the two groups.

JEL-Classification: H25, H26, F23, C21, C23

Keywords: corporate tax avoidance, patent box, multinational enterprise, profit shifting

1 Introduction

The economic literature has established significant evidence for income shifting of multinational firms (MNEs) (see Hines (1997), Gresik (2001) and Dharmapala (2015), among others, for an overview of the literature). The consensus is that MNEs face a significantly lower tax burden, compared to domestic firms which do not have access to international tax avoidance strategies. Mintz and Smart (2004) show that the elasticity of taxable income with respect to tax rates is equal to 4.9 for multidivisional firms, compared to 2.3 for firms that are required by the law to file consolidated corporate accounts. Egger et al. (2010) estimate that foreign ownership reduces the tax burden by about 56 percent.

The most common channels to transfer profits from high-tax to low-tax jurisdictions encompass the manipulation of transfer pricing for intra-firm trade, the design of tax-driven financial policies - such as internal lending -, or the use of royalty payments for intangible assets - such as trademarks and patents. These practices are particularly harming since, as defined in the OECD 2015 BEPS report, they are used to “achieve low or no taxation by shifting profits away from the jurisdictions where the activities creating those profits take place”. Over the last decade, the introduction of so-called Patent Boxes has contributed in shifting the attention on the increasing role of intangible assets as a non-negligible tool for profit shifting. Popular in the early 2000s, Patent Box regimes were initially designed as an incentive to boost European research and development activity¹: aside of differences in details, they generally grant preferential tax treatments to income originating from intellectual property (IP).² The EU (Ecofin assessment 2014) and OECD consent that aspects of these regimes are harmful to tax base erosion, particularly, in light of their ability to attract patents created through innovative activity conducted elsewhere than the final country of registration. To resolve this drawback, the OECD and the G20 member countries endorsed the modified nexus approach (OECD, 2015). The latter stipulates that substantial economic activities related to the innovation need to be undertaken in the country offering the favourable tax regime, thereby linking the tax benefit directly to R&D expenditures.

The sequential introduction of Patent Boxes, as witnessed in most European countries over the last decade, has brought along a new strand of literature, focused on unveiling the phenomenon of tax-driven creation and location of patents. Karkinsky and Riedel (2012) find that patent applications are more likely filed by MNE’s affiliates located in low tax countries, whereas Griffith and al. (2014) estimate a negative elasticity of patent location to corporate tax

¹Between 2001 and 2015 Belgium, Cyprus, France, Hungary, Ireland, Lichtenstein, Luxembourg, Malta, the Netherlands, Portugal, Spain, Switzerland and the United Kingdom implemented Patent Box regimes.

²A rather broadly defined patent box may additionally include existing trademarks, trade secrets, know-how, designs and models, copyright, domain names, etc., while a narrowly defined patent box may grant the tax benefit only for newly developed patents and associated patent rights (see also Alstadsaeter et al. 2015).

rates. Alstadsaeter et al. (2015) decompose the effects of corporate tax rate and tax advantages offered by patent boxes on the number of registered patents. They find that patent boxes have a considerable effect on attracting patents, while deterring local innovative activities. Besides these valuable insights, the literature has yet to establish the actual quantitative role of patents and patent box regimes for profit shifting of worldwide MNEs.

Our paper fills this gap by directly estimating the difference in profits of European affiliates of worldwide MNEs which do (do not) own patents within their multinational conglomerate. Precisely, we collect information on firms that qualify as subsidiaries controlled by foreign corporations and are located in European countries which introduced patent boxes between 2007 and 2013 (our observational period). Our empirical strategy is to compare the profit of subsidiaries with low cost of accessing the IP related tax relief, due to patent ownership within their conglomerate, to the profit of firms with high cost of benefiting from the patent box regime, due to complete absence of patents within their conglomerate. We use historical information on research and development activity as well as on patent ownership and financial performance to classify the observed subsidiaries into these two groups. Our historical data refers to the decade preceding the introduction of any patent box regime in Europe (pre-2000).³ We use the *coarsened exact matching* (CEM) method propose by King, Iacus and Porro (2008) to construct our sample, and estimate a profit shifting equation in the spirit of Hines and Rice (1994) using a difference-in-difference approach. In detail, our empirical strategy builds on a difference-in-difference model with the introduction of the patent box regime in the various European countries as the treatment effect. Patent ownership in the year 2000 at direct and indirect level, via the majority shareholder, defines our treatment group, and a matched sample of firms with no patent ownership (at any level in the conglomerate) serves as control group.

A very robust picture emerges from our regression analysis. We find that firms who pre-own patents either directly or indirectly within the conglomerate report on average a 2.5 to 3.9 percent higher pre-tax profits compared to firms that do not pre-own patents within their conglomerate. This result is robust with regard to various different specifications. Further, we are able to show that, if the patent box regime incorporates a clause granting the IP related tax benefit only to newly created patents (essentially disqualifying pre-existing and acquired patents), the difference in profits between the two groups disappears. Hence, our findings additionally provide evidence of those features which turn patent boxes into a suitable device for profit shifting rather than being an instrument which fosters R&D activities. To our knowledge, our paper is the first one which directly isolates the effect of IP and patent box regimes on profit

³With the exception of France and Ireland, which introduced the patent box regime already in the 1970s. Nevertheless, both countries had major amendments to their existing patent box regime within the analysed period.

shifting of worldwide MNEs. In doing so, our paper links directly to the seminal work by Hines and Rice (1994) and Grubert and Mutti (1991) which manifests the pioneering research on multinational income shifting.

The paper proceeds as follows. Section 2 specifies the empirical strategy and Section 3 describes the data. Estimation results are presented in Section 4 and Section 5 concludes.

2 Empirical Strategy and Specification

The existing patent box regimes in Europe have in common a reduced tax burden on income generated through intellectual property vis-a-vis income derived from the firm's standard business activity. In doing so, France, the Netherlands and the United Kingdom have introduced a separate rate of 15, 5 and 10 percent, respectively, for taxing income from intellectual property. All other European countries adjust the tax base, that is, they exempt between 50 and 80 percent of the income derived from IP when computing taxable income. These tax rate or tax base adjustments give rise to an effective tax burden as low as only 3 percent on IP income, as in the case of Ireland, Lichtenstein and Cyprus. The BeNeLux countries and Switzerland charge slightly higher, effective tax rates on IP income of between 5 to 6 percent, while the remaining countries, such as France, Hungary, Portugal, Spain and the United Kingdom, stipulate effective tax rates between 10 and 15 percent on IP income (see also Ernst & Young, 2015, World Corporate Tax Guide).

Besides the magnitude of the effective tax burden on IP income, a second dimension along which European patent box regimes diverge is the type of income eligible for the tax benefit. Narrowly defined patent boxes grant preferential tax treatment only to income derived from newly developed patents (i.e. IPs registered *after* the introduction of the patent box regime) and associated IP rights, as it is the case in Belgium and the Netherlands, for instance. Other countries, like Luxembourg and Portugal, also do not grant any tax benefit to pre-existing patents, but instead provide a more generous and broad definition of the patent box itself. That is, besides income from patents, also income arising from trademarks, trade secrets, know-how, designs and models, copyright, domain names, etc., qualifies for the preferential tax treatment (Ernst & Young, 2015). This rather broad definition of the patent box seems to be the rule rather than the exception within European patent box designs, giving rise to the suspicion that fostering innovative activity is not the only purpose of these regimes.

Given the institutional design of the European patent box regimes, we argue that these regimes facilitate profit shifting into exactly those European affiliates that can benefit from a reduced tax burden on income stemming from IP and IP related royalties. Our empirical strategy consists in comparing the pre-tax profit of those affiliates of multinational conglomerates,

which have a rather easy access to patent-box-related tax benefit, with the pre-tax profit of other European affiliates, which do not have this access. To sort firms into these two groups, we exploit firms heterogeneity in terms of industrial sector, age, size, profitability, R&D expenditure, innovation and IP creation. Specifically, we expect that affiliates who have an established path of R&D expenditure and IP creation would be able to benefit from the patent box regime more easily than affiliates that operate on a similar scale in the same country and industry, but do not have the required set-up (i.e. IP ownership) needed to benefit from the preferential tax clause accompanying the patent box regime. For this second group of companies, the available options are to undergo structural changes and launch the research and development necessary to produce patentable innovations (i.e. establishment of R&D divisions, employment of high skilled labor), to purchase external patents or alternatively to acquire the control of firms who have the technology and the know-how to produce new patents. These options might all be sufficiently costly to offset the advantages offered by the patent box regime. To estimate the differential profit among the two groups of firms we specify the following difference-in-difference regression model:

$$\pi_{isct} = \gamma_0 + \gamma_1 TR_{isct} + \gamma_2 PB_{ct} + \beta_1 k_{isct} + \beta_2 \ell_{isct} + \beta_3 \tau_{isct} + X'_{isct} \delta + \eta_i + t_t + \iota_{sct} + u_{isct} \quad (1)$$

where π_{isct} is unconsolidated pre-tax profit reported in year t by the European affiliate i operating in sector s of country c , k_{isct} is the log of fixed assets, ℓ_{isct} is the log of labor compensation, τ_{isct} is a tax indicator accounting for differences between the tax system of the affiliate and that of its shareholders, and X_{isct} is a time varying set of firm specific controls. The variable TR_{isct} is (the treatment) dummy that takes value 1 after the introduction of patent boxes for all affiliates that owned IPs before the year 2000 and 0 otherwise, whereas PB_{ct} is a dummy that takes value 1 in all periods where the patent box was in place in country c and 0 otherwise. The model also accounts for affiliate fixed effects, η_i , country-industry-year fixed effects, ι_{sct} , and year fixed effects t_t . We expect the parameter γ_2 to be significant and positive, showing that, after the introduction of patent boxes, affiliates with IPs report higher profit than affiliates without IPs.

The baseline specification of eq. (1) follows the literature on income shifting and adopts the ‘‘Hines-Rice’’ (1994) approach in assuming that observed unconsolidated pre-tax profit is the sum of two unobserved components, one derived from true economic activity and the other shifted from the firm’s affiliates (most likely its majority shareholder, or ‘‘parent’’ firm).⁴ The portion of profit generated through the production process is a function of capital and labor inputs, proxied in our analysis by fixed assets and labor cost. The portion of profit shifted

⁴For a review of the literature see, for instance, Dharmapala (2014).

from other affiliates is, instead, dependent on the tax incentives faced by the conglomerate as a whole. The tax indicator τ captures the part of tax incentives due to the differences in tax rates between the affiliate and its shareholders, and independent on the introduction of patent boxes. With the TR_{icst} dummy, instead, we capture the change in reported pre-tax profit due to the introduction of patent boxes. We follow the existing literature and limit our analysis to the sample of affiliates who report positive pre-tax profits for at least three consecutive years during our observational period 2007-2013.

In defining our treatment group, we account for the ability of multinational conglomerates to relocate patents among their affiliates, and to register international patents into European offices. Specifically, we do not limit IP ownership to the establishment of the European affiliate, but compute the number of patents, both European and international, owned by each shareholder linked to the affiliate. This represents a novelty in the literature, as it allows us to directly account for the ability of the multinational headquarter to react to the introduction of patent box regimes with a redistribution of its own patents among the European affiliates located in countries offering the reduced tax rates on IP income and royalties.

Table 1: **Historical Patent Ownership (prior to 2000)**

	All Patents		EU Patents	
	Yes	No	Yes	No
Direct Ownership Only	2,784	9,931	2,353	10,362
Direct & Second-Tier Ownership	2,899	9,816	2,453	10,262
<i>Direct ownership refers to all cases where the patent is registered under the European affiliate itself or under its foreign majority shareholder (parent). Second-tier ownership refers to cases where patents are additionally registered under any domestic minority shareholder of the European affiliate. Full sample size is 12,715 European affiliates.</i>				

Table 1 describes the sample composition across the group of European affiliates that reported historical patent ownership and the group of affiliates that did not. The year 2000 is chosen for the identification of historical patent ownership, because it is antecedent to the introduction of any patent boxes in all European countries.⁵ According to our empirical strategy, the treatment group includes those affiliates that have low costs of accessing the tax benefits associated with the introduction of a patent box (during the period 2007-2013). As it becomes obvious from Table 1, most of the patents accessible for the affiliates in our treatment group are either directly owned by the affiliate or its majority (first-tier) shareholder. Only a very tiny fraction of less than 5 percent is owned by second-tier, i.e. minority, shareholders of the respective affiliate.

⁵The concept of patent box was first introduced in 2000 by the Irish and in 2001 by the French Tax Authorities as a reduced rate on revenue from IP licensing or the transfer of qualified IP.

The average yearly pre-tax profit and average yearly earning before interests and taxes (EBIT), respectively, for the two, un-matched groups are depicted in Figures 1 and 2. The graphs show that profits of our treatment group remained steadily above the profit of all other affiliates during the five years preceding and following the introduction of the patent box regime. As expected, we only observed a small blip in the pre-tax profit of the affiliates in the treatment group around the year of introduction of the patent box regime (normalized across countries in these and following figures).

Figure 1: **Profit Before Taxes across unmatched Groups (in real 2005 EUR)**

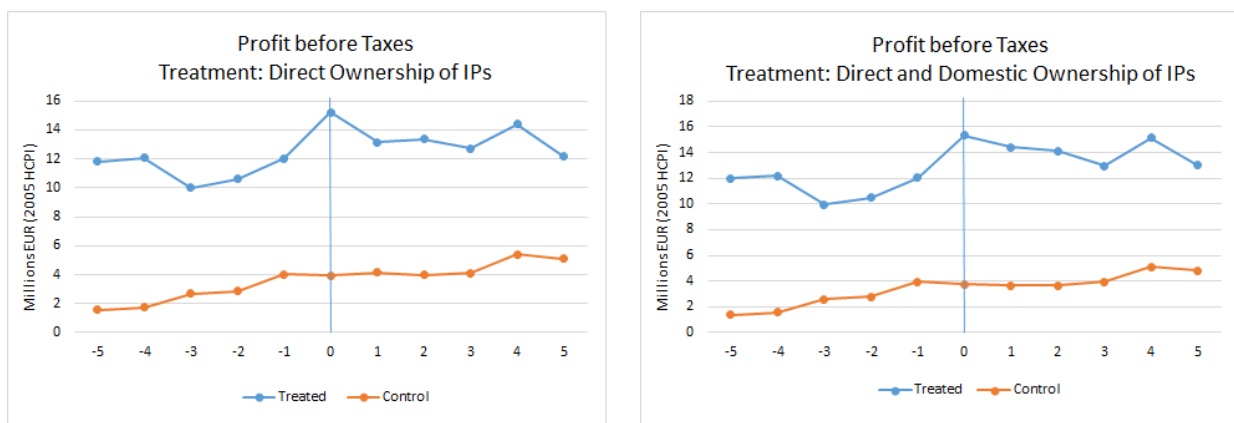
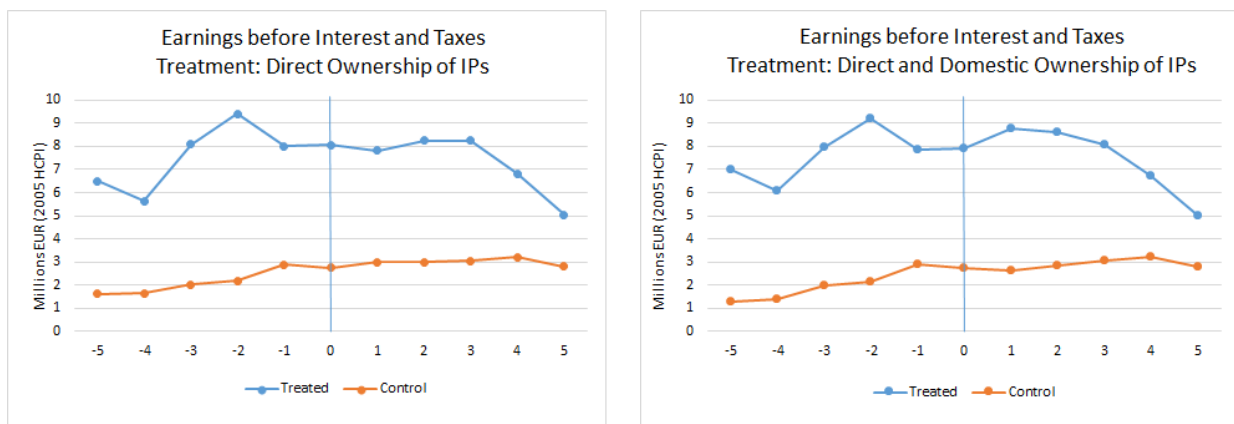


Figure 2: **Earnings Before Interests & Taxes across unm. Groups (in real 2005 EUR)**



2.1 Matching

Our definition of the treatment and control group is based on historical information which is antecedent to the introduction (or a major amendment) of any European patent box regime. The latter were introduced during the rather narrow time span of between 2008 and 2013. We, nevertheless, argue that the assignment of an affiliate into the treatment group is affected by firms structural characteristics and is therefore endogenous to a series of factors.

The innovation literature has a long tradition in the analysis of the features distinguishing firms involved in R&D and IP production. Early works such as Pakes (1980), Bound et al. (1982) and Acs and Audretsch (1988) show that innovators are influenced by the patent system, as well as by the industry structure. More recently, the attention has shifted on the relationship between productivity and innovation, and models drawing from the literature on trade and heterogeneous firms have been used to explain the entry of firms into innovative activities. Studies have shown that firms who patent are generally large, highly productive, intensive in research & development, involved in international trade and unaffected by major financial frictions (Peeters and van Pottelsberghe, 2006, Hall and Lerner, 2009, Atkeson, Andrew & Ariel Toms Burstein, 2010 and Gorodnichenko & Schnitzer, 20013). These findings are key to our analysis, as they support the argument that among our control group there are affiliates that will never consider or be able to afford the costs needed to produce or acquire intellectual property. As we have self-selection of firms into the group of patent owners, not accounting for the absence of random treatment assignment would bias our estimates of the impact arising from the introduction of a patent box regime.

To achieve balance between the treated and control group, we proceed with implementing *coarsened exact matching* (CEM) based on the affiliates structural characteristics, such as country of incorporation, industrial sector, and historical size and performance. Exact matching would be problematic in our application, as we intend to account for multiple characteristics of the observed subsidiaries, and this would produce very few matches. On the other hand, propensity score matching (PSM) would be impractical, as we intent to match affiliates within country and industrial sector. By this means, CEM constitutes a valuable alternative, as it belongs to the class of matching methods called monotonic imbalance bounding (MIB). This method bounds the maximum imbalance in some feature of the empirical distributions, in our case through coarsening on the ex-ante chosen characteristics. The main advantage of this approach stands in the fact that increasing balance on one variable cannot increase imbalance on another (this can happen in propensity matching).

To reduce the imbalance in the pre-treatment variables, we coarsened on firm-specific characteristics that proxy for the type of business lead by the affiliate, its performance and its R&D intensity. We coarsen affiliates according to their country, industrial sector (in 2 digit NACE code) and age in the year 2000. We collect affiliate specific averages over the 1996-2006 decade for performance indicators such as size, profit margin and intangible to total asset ratio.⁶ The volume of sales is used as a proxy for size, and the ratio of pre-tax profit to sales as a proxy of operating profit margin. Further, we use the volume of intangible assets, rather than R&D

⁶Taking the ten-years average guarantees independence from the business cycle.

expenditure, because the latter is mostly missing in the historical financial accounts. Finally, we collect information on the ratio of European to internationally registered IPs owned by the conglomerate as a whole, and about the number of patents owned by foreign minority shareholders, as registered before the year 2000. Before the matching, we measure global imbalance through the \mathcal{L} statistic introduced by Iacus, King and Porro (2008), based on the difference between the multidimensional histogram of the chosen pre-treatment characteristics. While $\mathcal{L} = 0$ indicates complete imbalance, and $\mathcal{L} = 1$ perfect balance, the value computed on the full sample is only used as a reference point to the value obtained after the matching is completed.

Table 2: **Coarsened Exact Matching**

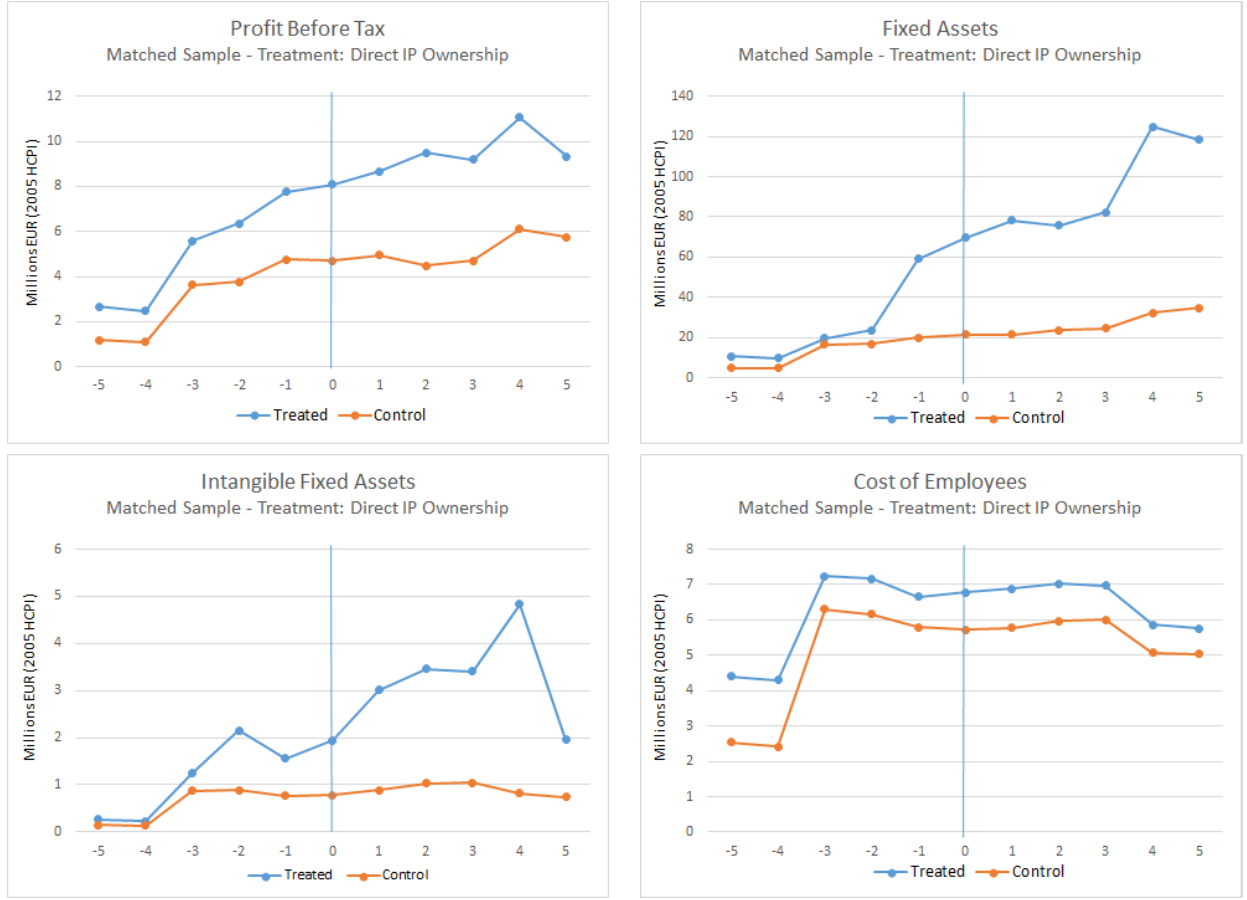
	\mathcal{L}	Full Sample Mean Diff.	T-test	\mathcal{L}	Matched Sample Mean Diff.	T-test
Country	0.088	-0.136	-	0.000	0.000	-
Industrial Sector	0.253	-7.804	-	0.062	0.186	-
Age in year 2000	0.134	4.572	0.000	0.034	0.044	0.997
Int. to Tang Asset Ratio	0.043	0.011	0.000	0.029	0.001	0.988
Profit Margin	0.001	425.13	0.086	0.009	-1.060	0.482
Log(Sales)	0.256	1.236	0.000	0.050	0.064	0.228
Number of Indirect Patents	0.028	55.367	0.000	0.007	0.628	0.516
Share of EU Patents	0.047	0.024	0.000	0.007	0.000	0.807

The group of treated subsidiary is defined according to the direct ownership of patents in the year 2000, and the presence of at least 2 consecutive years of financial accounts between 1996 and 2006 with record of positive profit. The initial sample size for the treated group is of 2,784. For 2,296 of these firms we find a one-to-one match among the 9,931 affiliates in the control group. The t -statistic in the third and sixth columns reports the result from a two sided test for the equality of means between the treated and untreated group, before and after the matching.

Table 2 reports the results from the CEM based on the above described pre-treatment variables. The first and third column report the \mathcal{L} , as computed for each single variable, before and after the matching. The second and fourth column report the difference in means between treated and control group, also before and after the matching. Our one-to-one matching solution resulted in a reduction of the overall \mathcal{L} statistic from 0.7972 to 0.6940. From the full sample of 2,784 treated and 9,931 control affiliates, this methodology allows us to select 2,296 one-to-one matches. Comparing columns two and four from Table 2, it is evident that the matched sample achieves increased balance in all pre-treatment covariates. As indicated from the results in columns 6, after matching we do not find a statistically significant difference in the means of the treated and matched control group.

Figure 3 compares the evolution of yearly pre-tax profit, fixed assets, intangible fixed assets and labor compensation during the period 2007-2013 (normalized around the year of introduction of the patent box regime) for the 2,296 matched European subsidiaries.

Figure 3: **Comparison of Matched Groups (in real 2005 EUR)**



3 Data

Our source is the Bureau van Dijk database ORBIS, which provides historical information on corporate ownership structure for the years 2007-2013, along with information on firms financial accounts and patent registration for the years 1996-2013. As we do not observe any ownership link beyond the most recent seven years interval, we only select active firms that are located in countries that introduced patent box regimes between 2007 and 2013 and whose majority shareholder is an active foreign firm. The unit of observation is therefore a European affiliate of a multinational conglomerate.⁷ As discussed in Section 2, our approach is to use the historical data from the period 1996-2006 to create a synthetic control group, matched to the group of affiliates that owned patents before the year 2000. With this sample, we then estimate a profit shifting equation for the years 2007-2013, and measure the effect of the introduction of patent boxes on unconsolidated pre-tax profit. In line with the empirical literature on profit shifting, we exclude affiliates who only record consolidated accounts, and affiliates that report persistent financial losses. Based on records on the year of incorporation, we can identify whether the

⁷We only use first level links, and do not investigate on whether domestic shareholders are themselves linked to any foreign corporation.

observed affiliates are newly created establishments, namely if legally incorporated around the year of entry into the database.⁸ Note that newly created affiliates can be controlled by foreign majority shareholders who themselves owned patents before the year 2000, so they can be in both groups, the treatment or the control group.

In order to identify the European subsidiaries of foreign corporations, we use the historical ownership links available in Orbis. We discard links to individuals, mutual funds or employees, insurance companies or corporations with unidentified location. We also exclude all European firms that are independent standalone units or that are uniquely controlled by other domestic firms. Finally, for the cases where ownership of the subsidiary was equally distributed among foreign shareholders, we select as parent the firm that is also listed as global ultimate owner (GUO). Once the sample of European affiliates is constructed, we proceed with collecting unconsolidated financial accounts. A description of the variables used in our estimation is reported in Table 3.

Table 3: **Definition of Variables**

Variable	Definition
Pre-Tax Profit	Pre-Tax Profit in logs
EBIT	Earnings Before Interests and Taxes in logs
Financial leverage	Ratio of total debt to total assets
Capital	Amount of fixed assets in log
Labour	Total Cost of Employees in log
Sales	Volume of Sales in log
Number of Patents	Sum of all patents owned by affiliate
Tax Rates*	Top statutory tax rate on corporate income (between 0 and 1)

*Data source is the historical database Orbis. All financial accounts were originally provided in EUR units, and then converted to 2005 EUR units. * Tax Rates are collected from the Worldwide Corporate Tax Guide, Ernst & Young*

Geographically, we include affiliates located in Belgium, the Netherlands, Luxembourg, Ireland, Spain, Hungary and France. Other European countries, notably Liechtenstein, Switzerland, Cyprus, Portugal, Malta and the United Kingdom, have patent box regimes in place, but introduced them before or after our observational period and are for this reason excluded from our analysis. Across the seven countries considered, patent boxes differ substantially in terms of both the time of their introduction and the details of their design, as shown in Table 4. It follows that the affiliates contained in our sample are differently exposed to the tax incentives associated with R&D investment, IP creation or relocation. In particular, the pioneers of policies designed to intensify R&D expenditure, Ireland, France the Netherlands and Hungary, all amended previously existing patent box regimes and lowered the rate on IP income over

⁸We define an affiliate as newly created if its incorporation date is in the year before or in the year of entry into the database.

our observational period. In addition, all countries provide reduced tax rates on income and royalties derived from IPs, but different types of IPs qualify for this preferential treatment. Ireland, Spain, Hungary and France allow pre-existing patents to qualify, whereas all countries except Spain also allow acquired patents to qualify. We exploit these differences in our empirical analysis, by allowing the effect of the patent box regime to vary according to whether the country qualifies pre-existing patents. This is particularly relevant for our analysis, as it gives a premium advantage to those affiliates who already had patents registered in 2000 or earlier.

Table 4: **European Patent Box Regimes Characteristics**

	BE	ES	FR*	HU*	IE*	LU	NL
Top CIT Rate	0.330	0.280	0.333	0.190	0.125	0.292	0.250
WT on Royalties	0.250	0.240	0.333	0.000	No	No	No
Effective Tax rate on IP	0.660	0.112	0.150	0.950	0.025	0.058	0.050
Base Exempted from CIT	0.800	0.600	0.000	0.500	0.800	0.800	0.000
Separate Rate on IP	No	No	Yes	No	No	No	Yes
IP Box: Base Adjustment	Yes	Yes	No	Yes	Yes	Yes	Yes
New Patents	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Existing Patents	No	Yes	Yes	Yes	Yes	No	No
Acquired Patents	Yes	No	Yes	Yes	Yes	Yes	Yes
Trademarks	No	Yes	No	Yes	Yes	Yes	No
Know-How	No	Yes	No	Yes	Yes	Yes	No
Development Nexus	Yes	Yes	No	No	No	No	Yes
Year	2008	2008	2010	2012	2008	2008	2010

The table only lists the countries that introduced or majorly reformed their patent box regime in the period 2007-2013. () indicates that the country introduced a reform in the year reported in the last row with amendments to the patent box regime in place.*

For each firm in ORBIS we collect data on the number of patents (IPs) owned and their year of registration. We use these information to define local, direct and indirect patent ownership. In particular, we look at whether the affiliates or any of their shareholders had any patent registered before the year 2000, as well as during each of the years used in our analyses (2007-2013). As we do not have data on links among patents, we simply construct indicator variables that take value 1 if any patent is owned at each control level and 0 otherwise. This partly resolves the issues related to patent quality, patent double counting and skewness in the distribution of patent numbers. We further distinguish between European and international patents. We define “direct” patent ownership the case where the IP is registered under the subsidiary directly, its foreign majority shareholder, or any other domestic shareholder. We define “indirect” (or, second-tier) patent ownership for the case where the IP is registered under any of the subsidiary’s foreign minority shareholders. Finally, we define the case of absence of IP where no patent is registered under any firm of the conglomerate the subsidiary is affiliated to. For the purpose of our analysis, we identify as low-cost subsidiaries as those who had direct patent ownership before the year 2000.

Table 5 reports descriptive statistics for the geographical location of European affiliates included in our (unmatched) sample, and for the distribution of historical IP ownership. Only about 2% of the observed 12,715 affiliates had IPs directly owned within their establishment by the year 2000. 21% (10%) of the observed affiliates were majority (minority) controlled by shareholders who had IPs recorded in the year 2000.

The concentration of IP ownership on majority shareholders has been largely documented in the innovation literature, but, to our knowledge, it has not been exploited in the profit-shifting literature. Our approach accounts for exactly this link of IP ownership, as we argue that those affiliates with their majority shareholder already owning intangible assets face comparably low costs associated with profit shifting.

Table 5: **Patent Ownership across Countries**

	Number of Affiliates	Direct IPs		Majority Shrd's IPs		Minority Shrd's IPs	
		Pre-2000	Post-PB	Pre-2000	Post-PB	Pre-2000	Post-PB
Belgium	2,084	0.015	0.028	0.294	0.377	0.119	0.447
Spain	2,136	0.018	0.037	0.195	0.262	0.114	0.378
France	6,290	0.024	0.045	0.195	0.244	0.076	0.312
Hungary	500	0.000	0.018	0.322	0.352	0.152	0.414
Ireland	457	0.013	0.024	0.175	0.219	0.144	0.368
Luxembourg	920	0.001	0.008	0.068	0.087	0.042	0.238
Netherlands	328	0.027	0.052	0.247	0.317	0.134	0.421
Total	12,715	0.019	0.037	0.207	0.262	0.093	0.345

The table shows the geographical distribution of European affiliates controlled by foreign shareholder and reporting financial unconsolidated accounts without persistent losses. Column two, three and four also report the percentage of affiliates linked to IPs registered before the year 2000, against those owned after the introduction of the PB regime. We distinguish between patents directly owned by the affiliate, patents owned by the affiliate's foreign majority shareholder and patents owned by the affiliate's minority shareholders (domestic or foreign). Total sample size is 12,715 affiliates.

Table 6 compares patent ownership computed on the basis of historical data reported as in the year 2000 with patent ownership reported after the introduction of a patent box regime within one of the seven European countries included in our dataset. Strikingly, we observe that 85% of affiliates with complete absence of IPs have not created or acquired any new IPs since the year 2000. Rather, it is the affiliates controlled by shareholders who did own patents before 2000 that report higher shares of direct IP ownership after the introduction of the patent box regimes. On the one hand, this evidence validates our empirical strategy, as it shows that there is a very low transition between different IP ownership statuses over time; on the other hand, however, this statistic suggests that patent box regimes fail to promote innovation among firms that are not already invested in patentable R&D activity, as suggested by Alstadster et al. (2015).

Table 6: **Change in Patent Ownership (pre-2000 vs post-PB)**

Before year 2000	After Introduction of PB Regimes			
	No IPs	Direct IPs	Majority Shrl'd's IPs	Minority Shrl'd's IPs
No IPs	0.852	0.012	0.076	0.139
Direct IPs	0	1.000	0.441	0.496
Majority Shrl'd's IPs	0.018	0.073	0.959	0.980
Minority Shrl'd's IPs	0.041	0.072	0.535	0.959

The table reports the share of affiliates who owned patents after the introduction of a patent box regime in their country, conditional on the patent ownership reported as before the year 2000. Direct patent ownership indicates IPs are registered at the affiliate's establishment, majority and minority shareholder (shrl'd) patent ownership indicates the IPs are registered under the foreign majority shareholder or any of the (domestic or foreign) minority shareholder. Total sample size is 12,715 affiliates.

Table 7 reports unconditional IP ownership rates across the three groups of treated, non-treated and matched control affiliates. After the introduction of the patent box regime, the rate of direct patent ownership in the treated group has raised by 3 percentage points, while the patent ownership at the majority shareholder level has raised by 10 percentage points in the matched control group.

Table 7: **Patent Ownership Rates across Treated and Control Groups**

	Treated N=2,249	Not Treated N=9,931	Matched Control N=2,249
	Before year 2000		
No Patents at All	-	0.944	0.939
Direct Patents	0.076	-	-
Majority Shareholder Patents	0.951	-	-
Minority Shareholder Patents	0.179	0.056	0.061
	After Introduction of PB Regime		
No Patents at All	0.016	0.808	0.780
Direct Patents	0.106	0.013	0.028
Majority Shareholder Patents	0.921	0.079	0.104
Minority Shareholder Patents	0.943	0.183	0.200

The table reports the share of affiliates who owned patents in the three groups of Treated, Control and Matched Control. The method used to match the 2,249 treated affiliates is the CEM, described in section 2.1. N indicates the sample size for each of the three groups. Patent ownership is defined as in the previous table.

3.1 Corporate Tax Indices

Following the literature on profit shifting (Huizinga and Laeven, 2008), we construct affiliate-time specific tax measures that account for the different profit shifting incentives faced by the affiliate's foreign majority shareholder. We use the Orbis ownership structure database to reconstruct the list of subsidiaries owned by the foreign majority shareholders at each year

between 2007 and 2013. For the European subsidiary i affiliated to corporation c with parent located in country p and N subsidiaries located in countries $j = 1, \dots, J, \forall j \neq i$, we construct the simple difference between the corporate statutory tax rate levied in the country of the European subsidiary and that of the country of the foreign majority shareholder ($\tau_i - \tau_p$). We also construct the difference between the tax rate levied by the country of the European subsidiary and the lowest tax rate faced by the entire corporation ($\tau_i - \tau_{min}$), where $\tau_{min} = \min\{\tau_j\}_{j=1}^J$. Finally, we construct a composite tax index accounting for the number of subsidiaries owned by the foreign majority shareholder in each country other than the one where the European subsidiary object of our analysis is located:

$$\tau_{c,t} = \sum_{j=1}^J (\tau_i - \tau_j) \frac{N_j}{N+1} + (\tau_i - \tau_p) \frac{1}{N+1} \quad (2)$$

The composite corporate tax index can be constructed using different weights, according to assumptions made on the relative importance of the tax incentive presented by each subsidiary linked to a given shareholder and on the profit shifting concealment cost function. In equation (2) we assume that owning multiple subsidiaries within a low-tax specific country strengthens the incentive to shift profit into this location, with respect to the case where a single subsidiary is owned per location. This approach differs from Huizinga and Laeven (2008), who show that shifting costs in a given country is not affected by the aggregation of local controlled establishments.

Table 8 reports average statutory tax rates faced by the treatment and (matched and unmatched) control groups used in our analysis, averaged over the years 2007-2013. Comparing the second and third column, we see that the affiliates in the treated group on average face a tax rate that is lower than the one of their parents but higher (by 2 percentage points only) than the one of the group affiliate facing the lowest tax rate.

Table 8: **Tax Rates across Treatment and Control Groups (2007-2013 average)**

	Full Sample N=12,715	Treated N=2,249	Control N=9,931	Matched Control N=2,249
τ_i	31.05	31.44	31.03	31.44
τ_{min}	28.26	29.49	27.91	27.87
$(\tau_i - \tau_{min})$	2.79	1.96	3.11	3.57
τ_p	29.80	31.88	29.22	29.42
$(\tau_i - \tau_p)$	1.25	-0.44	1.80	2.02
$\tau_{c,t}$	3.25	3.21	3.39	3.81

4 Results

4.1 Baseline Results

We start our analysis by estimating a baseline pre-tax profit equation, following the Hines-Rines (1994) approach. We repeat this analysis on three different samples: First, the full unmatched sample of 12,715 European affiliates; Second, the sample of 4,498 European affiliates matched on the basis of a treatment definition that classifies affiliates as “low-cost” if they either owned patents before the year 2000 directly, or through their majority foreign shareholder; Third, the sample of 4,620 European affiliates matched on the basis of a treatment definition that also considers affiliates as “low-cost”, if they owned patents before 2000 only indirectly (second-tier) through domestic minority shareholders. For simplicity, we refer to these three samples as the Full Sample, the Matched Sample 1 and the Matched Sample 2, respectively. The following baseline analysis allows us to assess whether the profit-shifting incentives, arising from the differential statutory corporate tax rate between the conglomerate and the affiliate, vary across the three samples.

In Table 9 we report the results from a simple linear panel specification, estimating the correlation between pre-tax profit, fixed assets and total cost of employees (all measured in logarithmic form). The same specification is estimated while including only year-specific dummies (column [1]), industry-year and country-year fixed effects (column [2]), and industry-country-year fixed effects (column [3]). Table 9 shows that the correlation between pre-tax income and the inputs for production is unaltered over the different samples. Industrial sectors are always defined by the 2-digit NACE rev. 2 code.

We proceed with augmenting the pre-tax profit equation, while controlling for fixed assets, cost of labour, country-year and industry-year fixed effects, by adding also affiliate-specific, time variant tax-differential indicators. These measures account for changes in the tax rate levied in the country the affiliate is located in, changes in the tax rates of all other countries which host part of the respective firm conglomerate, as well as changes in the ownership structure of the conglomerate itself. Following the literature on profit shifting, we expect the tax-differential coefficient to capture the size of the profit shifting incentives faced by the conglomerate the affiliate is linked to. Our respective results are presented in Table 10.

Once again, the model is estimated separately on the three samples introduced in Table 9. Different tax-differential indicators are used: the model displayed in column [2] uses an indicator dummy that equals 1 when the tax rate of the affiliate is lower or equal than the one of its majority foreign shareholder; the model of column [3] uses an indicator dummy that equals 1 when the tax rate of the affiliate is lower or equal than the smallest tax rate faced by the whole conglomerate (i.e. if the affiliate resembles the “tax-haven” subsidiary), and finally,

the model in column [4] uses an indicator dummy that equals 1 when the weighted average of the tax differential between the subsidiary and the rest of the conglomerate is negative.

In line with the existing literature, we find that higher pre-tax profit is associated with those affiliates, facing a local tax rate lower than the one of their parents. In detail, we find that affiliates with a lower tax rate than their foreign majority shareholder report on average a 3.6% higher pre-tax profit and subsidiaries facing the lowest tax rate of the entire conglomerate report on average a 2% higher pre-tax profit than all other subsidiaries. These semi-elasticities appear to have a larger size in the matched rather than in the full sample, possibly due to the higher concentration of intangible assets, R&D expenditures and patent ownership by those affiliates included in the former sample. Note, in fact, that the results from Table 10 suggest that, within the Matched Sample 1, the affiliates with a tax rate lower than the one of their foreign majority shareholder report on average an 8% higher profit than the other affiliates. Our Diff-in-Diff strategy attempts to disentangle the two types of profit shifting incentive, as the introduction of patent boxes should enhance the ability of firms with historical patents to exploit the concentration of intellectual property as a valuable instrument to reduce their effective tax base.

4.2 Diff-in-Diff Results

Table 11 reports our main result for the diff-in-diff presented in equation (1) and estimated on the Matched Sample 1 with a linear panel fixed effect model. We include all control variables from Table 9, along with country-year and industry-year pairs fixed effects. We also control for the differential tax rate indicator which equals 1 in all cases where the affiliate faces a lower tax rate than its foreign majority shareholder. Finally, we normalize the treatment year across the seven countries in the sample, and use year-specific dummies to account for the fact that the introduction of the patent box regime was not simultaneous across affiliates.

Our strategy is to exploit the heterogeneity among affiliates, in terms of historical direct or indirect patent ownership and to single out those conglomerates which easily benefit from IP-related tax benefits. In this way, we identify the profit shifting incentive due to the introduction of a patent box by estimating the increase in pre-tax profit reported after its occurrence. In line with our hypothesis, in the baseline specification (column [1]), we find that those affiliates, who had historical record of patent ownership (dated as before the year 2000), report 3% higher pre-tax profit after the introduction of the patent box compared to similar affiliates, who did not own any patent in the year 2000. This result is significant at the 10% level, and leaves some room for doubt that the effect of interest is unambiguously identified. In fact, the accumulation of intellectual property and the related innovation activity conducted over the years might

have affected the productivity of the treated affiliates, which could explain the higher reported pre-tax profits of the latter.

To insure identification of the effect of interest, we extend the specification of column [1] in several ways. First, we intend to investigate whether the introduction of a patent box has the ability of altering the tax-advantage associated with a specific country. In particular, in a scenario where countries compete over corporate tax rates in order to attract foreign capital, a patent box could be seen as a way of selecting firms with higher productivity and to attract them through a preferential tax treatment of IP income. In this context, we would not expect a significant change in reported profit of affiliates who already benefited from a preferential tax treatment. Column [2] extends the diff-in-diff equation by allowing the effect of the introduction of the patent box to vary, according to whether the top statutory tax rate of the affiliate is lower than the one of its foreign majority shareholder. The results strikingly suggest that, with the introduction of the patent box, the treated affiliates located in countries where the top statutory rate is higher than the one of their parents, report an 8% higher pre-tax profit than the affiliates in the control group. Contrary to that, treated affiliates located in countries where the top statutory rate is lower than the one of their parents report a 2% *lower* pre-tax profit compared to the affiliates in the control group. These results are statistically significant, and robust to a redefinition of the tax indicator. In column [3], in fact, we replace the interacted tax dummy with an indicator equal to 1 whenever the affiliate is located in the country with the lowest statutory tax rate of the entire conglomerate, and find similar results.

Second, we exploit differences in the type of IP ownership and in the patent box legislation. This approach serves to disentangle the confounding effect that increased innovation activity at the affiliate level could have on the reported pre-tax profit (for example, due to increased capital expenses). In column [4], we allow the effect of the introduction of the patent box to differ, according to whether the affiliates in the treated group directly owned any of the IPs registered before the year 2000, or not. Our hypotheses is that affiliates that historically have been directly involved in the registration of patents, are more likely to conduct local R&Ds. In fact, we find that the affiliates in the treated group that directly owned patents in the year 2000 report 7% lower profit than the affiliates in the control group. On the contrary, the affiliates that had been selected into the treatment group because of IPs being registered by their foreign majority shareholder before the year 2000, report, after the introduction of patent boxes, a 4% higher profit than the affiliates in the control group.

To confirm the validity of this result, we further specify a model (Column [5]) where the effect of the introduction of the patent box is allowed to vary, according to whether the implementing country qualifies income derived by acquired and pre-existing patents for the preferential tax

treatment. Consistently with our previous result, we find that the affiliates in the treatment group that can only file for newly created patents report, after the introduction of the patent box, a 6% lower profit than the affiliates in the control group. All other treated affiliates report, instead, a 5% higher profit than the affiliates in the control group.

To exploit further the possibility that the results of our analysis are mostly driven by the interaction of the tax advantages and the intensity of innovation activity taking place at the affiliate level, we estimate a final model, where we allow the effect of the patent box to vary, according to whether the affiliate was newly created. In the case of newly created firms, the selection into the treatment group solely depends on whether the foreign majority shareholder had any patent registered before the year 2000. The results are reported in column [6], but we do not estimate any significant coefficient (most likely due to the small number of entrants in the sample).

As a robustness check of the results presented in Table 11. We re-estimate the models in columns [1] - [6] after substituting our dependent variable with earnings before interest and taxes (EBIT). Additionally, we run the set of models for both specification of the dependent variable using the Matched Sample 2, which also includes European affiliates in the treatment group that own patents only indirectly (second-tier) through domestic minority shareholders with pre-2000 registered patents. As shown in Table 12, the results are throughout consistent with our findings discussed in this paper. The only difference arising is that we find larger effects of the introduction of the patent box on EBIT compared to profit before taxes. Also, the interaction effect found for the nexus clause (Col. [5]) loses its significance.

5 Conclusion

In this paper we apply a difference-in-difference model to identify the role of European patent box regimes for the innovative activity and profit shifting of European affiliates of foreign MNEs. Our insights are threefold and highly policy relevant. First, we conclude that not the direct pre-ownership of IP at the level of the affiliate induces major profit shifting incentives after the introduction of a patent box regime, but the access to IP within a firm conglomerate, most likely the IP ownership at the level of the foreign majority shareholder. In fact, our estimates show that affiliates belonging to the treatment group that directly owned patents in the year 2000, report 7% lower profit than the affiliates in the control group after the introduction of patent box, while affiliates selected into the treatment group because of IP being registered by their foreign majority shareholder before the year 2000, report a 4% higher profit than the affiliates in the control group after the introduction of patent box.

Second, the patent box regime seems to be a particularly suitable instrument for luring

internationally mobile profits to those countries, which are not necessarily perceived as low tax countries. We find that, with the introduction of the patent box, the treated affiliates located in countries where the top statutory rate is higher than the one of their parents, report an 8% higher pre-tax profit than the affiliates in the control group. Contrary to that, treated affiliates located in countries where the top statutory rate is lower than the one of their parents report a 2% *lower* pre-tax profit compared to the affiliates in the control group.

Third, the modified nexus approach (OECD, 2015) endorsed by the OECD and the G20 member countries seems to be a fruitful path to undermine the profit shifting incentives originating from those, broadly defined, patent boxes which also grant a preferential tax treatment to acquired pre-existing IP. We find that affiliates in the treatment group that can only file for newly created patents report, after the introduction of the patent box, a 6% lower profit than the affiliates in the control group. Most obviously, the reduced profit of the affiliates in the treatment group filing new patents is the mirror image of the R&D expenditures which were necessary for the respective IP creation and hence could justify the preferential tax treatment offered by a patent box.

References

- [1] Acs, Z. J., and D. B. Audretsch (1988), Innovation in Large and Small Firms: An Empirical Analysis, *The American Economic Review*, 78 (4), 678-690.
- [2] Alstadsaeter, A., Barrios, S., Nicodeme, G., Skonieczna, A.M., and A. Vezzani (2015), Patent Boxes Design, Patents Location and Local R&D, IPTS Working Papers on Corporate R&D and Innovation, No. 6/2015.
- [3] Atkeson, A., and A. T. Burstein (2010), Innovation, Firm Dynamics, and International Trade, *Journal of Political Economy*, 118 (3), 433-484.
- [4] Blackwell, M., Iacus, S., King, G., and G. Porro (2009), CEM: Coarsened exact matching in Stata, *The Stata Journal* 9(4), 524-546.
- [5] Bound, J. et al. (1984), Who Does R&D and Who Patents? R&D, Patents and Productivity, edited by Zvi Griliches. *Chicago: University of Chicago Press*, 21-54.
- [6] Egger, P., W. Eggert, and H. Winner (2010), Saving taxes through foreign plant ownership, *Journal of International Economics*, 81, 99-108.
- [7] Ernst & Young, (2015), World Corporate Tax Guide.
- [8] Gorodnichenko, Y. and M. Schnitzer (2013), Financial Constraints And Innovation: Why Poor Countries Don't Catch Up, *Journal of the European Economic Association*, 11 (5), 1115-1152.
- [9] Gresik, T. (2001), The taxing task of taxing transnationals, *Journal of Economic Literature*, 39, 800-838.

- [10] Griffith, R., Miller, H., and M. O'Connell (2014), Ownership of Intellectual Property and Corporate Taxation, *Journal of Public Economics* 112, 1223.
- [11] Grubert, H. and J. Mutti (1991), Taxes, Tariffs and Transfer Pricing in Multinational Corporate Decision Making, *Review of Economics and Statistics* 80, 365-373.
- [12] Hines, J. (1997), Tax policy and the activities of multinational corporations, in Auerbach, A. (Ed.) *Fiscal Policy: Lessons from Economic Research*. Cambridge: MIT Press, 401-445.
- [13] Hines and Rice (1994)
- [14] Iacus, S., King, G., and G. Porro (2011), Causal Inference Without Balance Checking: Coarsened Exact Matching, *Political Analysis*, mpr013.
- [15] Karkinsky, T. and N. Riedel (2012), Corporate Taxation and the Choice of Patent Location within Multinational firms, *Journal of International Economics*, 88, 176-185.
- [16] Mintz, J. and M. Smart (2004), Income shifting, investment, and tax competition: theory and evidence from provincial taxation in Canada, *Journal of Public Economics*, 88, 1149-1168.
- [17] Pakes, A. and Z. Griliches (1980), Patents and R and D at the Firm Level: A First Report, *Economics Letter*, 5, 377-381.
- [18] Peeters, C. and B. van Pottelsberghe (2006), Innovation strategy and the patenting behavior of firms, *Journal of Evolutionary Economics*, 16 (1), 109-135.

Table 9: Baseline Model - Dependent Variable: (Unconsolidated) Profit Before Taxes

Dep. Var: P/L Before Taxes	Unmatched Sample			Matched Sample 1			Matched Sample 2		
	[1]	[2]	[3]	[1]	[2]	[3]	[1]	[2]	[3]
Fixed Assets	0.0385*** (0.0041)	0.0369*** (0.0042)	0.0382*** (0.0042)	0.0399*** (0.0068)	0.0404*** (0.0069)	0.0472*** (0.0071)	0.0467*** (0.0070)	0.0484*** (0.0071)	0.0563*** (0.0074)
Cost of Employees	0.2898*** (0.0086)	0.2916*** (0.0086)	0.2898*** (0.0088)	0.3070*** (0.0158)	0.2980*** (0.0160)	0.2944*** (0.0167)	0.3128*** (0.0155)	0.3034*** (0.0157)	0.3048*** (0.0162)
Financial Leverage	-0.1027*** (0.0077)	-0.1037*** (0.0078)	-0.1011*** (0.0079)	-0.0975*** (0.0127)	-0.0965*** (0.0128)	-0.0873*** (0.0132)	-0.0911*** (0.0128)	-0.0917*** (0.0129)	-0.0913*** (0.0133)
Constant	8.3300*** (0.1220)	8.0608*** (0.1752)	8.1848*** (0.3829)	8.4843*** (0.2311)	7.1890*** (0.4579)	7.8001*** (0.9813)	8.2950*** (0.2272)	7.0175*** (0.4591)	7.5102*** (0.9890)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INDxCountryxYear FE	No	No	Yes	No	No	Yes	No	No	Yes
INDxYear FE	No	Yes	No	No	Yes	No	No	Yes	No
CountryxYear FE	No	Yes	No	No	Yes	No	No	Yes	No
Observations	85,944	85,944	85,944	30,798	30,798	30,798	31,606	31,606	31,606
Number of affiliates	12,715	12,715	12,715	4,498	4,498	4,498	4,620	4,620	4,620

Table 10: Profit Shifting Estimates- Dependent Variable: (Unconsolidated) Profit Before Taxes

Dep. Var.: P/L Before Tax	Full Sample				Matched Sample 1				Matched Sample 2			
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
lnkasset	0.0369*** (0.0042)	0.0371*** (0.0042)	0.0370*** (0.0042)	0.0369*** (0.0042)	0.0404*** (0.0069)	0.0406*** (0.0069)	0.0405*** (0.0069)	0.0405*** (0.0069)	0.0484*** (0.0071)	0.0487*** (0.0071)	0.0486*** (0.0071)	0.0483*** (0.0071)
lnempl	0.2916*** (0.0086)	0.2916*** (0.0086)	0.2917*** (0.0086)	0.2917*** (0.0086)	0.2980*** (0.0160)	0.2975*** (0.0160)	0.2981*** (0.0160)	0.2981*** (0.0160)	0.3034*** (0.0157)	0.3032*** (0.0157)	0.3034*** (0.0157)	0.3033*** (0.0157)
lnleverage	-0.1037*** (0.0078)	-0.1040*** (0.0078)	-0.1038*** (0.0078)	-0.1038*** (0.0078)	-0.0965*** (0.0128)	-0.0970*** (0.0128)	-0.0966*** (0.0128)	-0.0966*** (0.0128)	-0.0917*** (0.0129)	-0.0919*** (0.0129)	-0.0918*** (0.0129)	-0.0916*** (0.0129)
Dummy: $1[\tau_s < \tau_p]$		0.0363*** (0.0130)				0.0795*** (0.0201)				0.0493** (0.0203)		
Dummy: $1[\tau_s < \tau_{min}]$			0.0204** (0.0100)				0.0397*** (0.0153)				0.0356** (0.0154)	
Dummy: $1[\tau_s < \tau_w]$				0.0147 (0.0178)				0.0277 (0.0266)				-0.0252 (0.0267)
Constant	8.0608*** (0.1752)	8.0398*** (0.1754)	8.0490*** (0.1753)	8.0570*** (0.1753)	7.1890*** (0.4579)	7.1493*** (0.4579)	7.1624*** (0.4580)	7.1717*** (0.4582)	7.0175*** (0.4591)	6.9911*** (0.4592)	6.9928*** (0.4592)	7.0336*** (0.4595)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INDxYear FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CountryxYear FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	85,944	85,944	85,944	85,944	30,798	30,798	30,798	30,798	31,606	31,606	31,606	31,606
R-squared	0.0383	0.0384	0.0383	0.0383	0.0500	0.0506	0.0503	0.0500	0.0493	0.0496	0.0495	0.0494
Num. of affiliates	12,715	12,715	12,715	12,715	4,498	4,498	4,498	4,498	4,620	4,620	4,620	4,620

Table 11: **Difference-in-Difference Estimation on Profit before Taxes - Sample Matched on the basis of Direct IP Ownership before the year 2000**

Dep. Var.: P/L Before Tax	Baseline [1]	Parent Tax [2]	Min. Tax [3]	Direct IPs [4]	New IPs [5]	Entrant [6]
Treated * Post	0.0320* (0.0181)	0.0808*** (0.0264)	0.0668*** (0.0242)	0.0414** (0.0186)	0.0525*** (0.0201)	0.0236 (0.0198)
Treat. * Post * Tax		-0.1024*** (0.0373)	-0.0894** (0.0373)			
Treat. * Post * Direct IPs				-0.1101** (0.0461)		
Treat.* Post * New IPs					-0.1082** (0.0458)	
Treat. * Post * Entrant						0.0572 (0.0473)
Treated * Tax *		-0.0403 (0.0448)	-0.0122 (0.0385)			
Post	0.1064 (0.0967)	0.1017 (0.0984)	0.0971 (0.0980)	0.1066 (0.0967)	0.2201** (0.0996)	0.0922 (0.0969)
Post * Tax		0.0341 (0.0272)	0.0358 (0.0277)			
Post * New IPs					-0.0691 (0.1370)	
Post * Entrant						0.0601* (0.0330)
Fixed Assets	0.0406*** (0.0069)	0.0406*** (0.0069)	0.0403*** (0.0069)	0.0405*** (0.0069)	0.0406*** (0.0069)	0.0401*** (0.0069)
Cost of Employees	0.2976*** (0.0160)	0.2978*** (0.0160)	0.2983*** (0.0160)	0.2971*** (0.0160)	0.2968*** (0.0160)	0.2943*** (0.0160)
Financial Leverage	-0.0970*** (0.0128)	-0.0968*** (0.0128)	-0.0966*** (0.0128)	-0.0967*** (0.0128)	-0.0964*** (0.0128)	-0.0953*** (0.0128)
Tax Dummy	0.0802*** (0.0201)	0.1202*** (0.0339)	0.0593** (0.0293)	0.0818*** (0.0201)	0.0800*** (0.0201)	0.0778*** (0.0201)
Constant	7.1489*** (0.4579)	7.1370*** (0.4578)	7.1646*** (0.4579)	7.1571*** (0.4578)	7.0693*** (0.4674)	7.1796*** (0.4578)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
IND. x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
CNTR x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.0507	0.0512	0.0508	0.0509	0.0509	0.0512
Observations	30,798	30,798	30,798	30,798	30,798	30,798
Num. of affiliates	4,498	4,498	4,498	4,498	4,498	4,498

Table 12: **Diff-in-Diff Estimation - Robustness Checks**

	Baseline [1]	Parent Tax [2]	Min. Tax [3]	Direct IPs [4]	New IPs [5]	Entrant [6]
<i>On Matched Sample 1, Dep. Var. : EBIT</i>						
Treated * Post	0.0500*** (0.0158)	0.1015*** (0.0231)	0.0941*** (0.0212)	0.0568*** (0.0162)	0.0623*** (0.0175)	0.0415** (0.0173)
Post	0.0641 (0.0853)	0.0325 (0.0867)	0.0248 (0.0863)	0.0644 (0.0853)	0.0803 (0.0871)	0.0531 (0.0854)
Treated * Post * Tax		-0.1163*** (0.0327)	-0.1168*** (0.0326)			
Treated * Post * Direct IPs				-0.0791* (0.0405)		
Treated * Post * New IPs					-0.0666 (0.0405)	
Treated * Post * Entrant						0.0559 (0.0416)
Tax Dummy	0.0822*** (0.0175)	0.1048*** (0.0295)	0.0187 (0.0255)	0.0834*** (0.0175)	0.0822*** (0.0175)	0.0801*** (0.0175)
R-squared	0.0660	0.0669	0.0662	0.0662	0.0661	0.0665
Observations	29,710	29,710	29,710	29,710	29,710	29,710
Num. of Affiliates	4,415	4,415	4,415	4,415	4,415	4,415
<i>On Matched Sample 2, Dep. Var. : P/L Before Tax</i>						
Treated * Post	0.0392** (0.0180)	0.0792*** (0.0240)	0.0651*** (0.0217)	0.0518*** (0.0184)	0.0477** (0.0199)	0.0328* (0.0198)
Post	-0.0426 (0.0968)	-0.0204 (0.0982)	-0.0308 (0.0978)	-0.0421 (0.0968)	0.0237 (0.1000)	-0.0635 (0.0970)
Treated * Post * Tax		-0.0708** (0.0331)	-0.0580* (0.0301)			
Treated * Post * Direct IPs				-0.1545*** (0.0469)		
Treated * Post * New IPs					-0.0464 (0.0461)	
Treated * Post * Entrant						0.0484 (0.0466)
Tax Dummy	0.0498** (0.0203)	0.0822*** (0.0235)	0.0635*** (0.0199)	0.0519** (0.0203)	0.0499** (0.0203)	0.0478** (0.0203)
R-squared	0.0497	0.0501	0.0500	0.0501	0.0498	0.0505
Observations	31,606	31,606	31,606	31,606	31,606	31,606
Num. of Affiliates	4,620	4,620	4,620	4,620	4,620	4,620