

The Effect of IP Box Regimes on International IP Payments and Foreign Research and Development

Eric Ohrn
Grinnell College

August 2016

While all Intellectual Property (IP) Box regimes provide substantially reduced rates of corporate tax for income derived from IP, boxes can differ significantly in how they define qualifying IP income. Some boxes apply to income derived from IP that existed prior to the box and to IP acquired after the box was implemented, others only to new IP. Additionally, several IP box regimes apply to IP revenue as opposed to IP income (revenue minus costs). This paper tests how U.S. payments to foreign countries for the use of IP and research and development activities of foreign affiliates of U.S. multinational enterprises (MNEs) respond to the implementation of IP Box regimes and IP Box characteristics. The results indicate that U.S. payments for the use of IP only increase in response to boxes that apply to income derived from existing or acquired IP. On the other hand, only boxes that either (1) only apply to newly developed R&D or (2) boxes that apply to IP revenue – as opposed to IP income – stimulate U.S. MNE affiliate R&D.

Keywords : intellectual property, international taxation, multinationals

JEL Classification : H25; H32; O34

Acknowledgments: I thank Jim Hines, Jack Mutti, and Rosanne Altshuler for their invaluable feedback during this project. In addition, I thank Brent LeMoine for his tireless and timely data collection efforts.

Disclosure: Funding for this project was provided by the International Tax Policy Forum, which supports nonpartisan research on international tax issues. The author is solely responsible for the methodology used and conclusions drawn herein.

1 Introduction

Intellectual Property (IP) Box Regimes provide substantially reduced corporate income tax rates on income derived from IP. According to Bradley, Dauchy and Robinson (2015), IP Boxes “are designed to accomplish the dual goals of (1) fostering domestic innovation and creating high-value jobs and (2) limiting erosion of the corporate tax base that occurs when mobile income is relocated to low-tax jurisdictions via transfer pricing and cost sharing arrangements.”

This project directly explores whether IP Box Regimes accomplish these goals by examining the impact of IP Box regimes on (1) research and development (R&D) activities by U.S. majority owned foreign affiliates as a proxy for domestic innovation and jobs and (2) payments from the U.S. to foreign countries for the use of intellectual property as a proxy for the corporate tax base (and its potential erosion). The study relies on a difference-in-differences methodology to estimate the effects of implementing the average IP Box Regime and a triple-differences methodology to further explore responses to certain common regime characteristics.

The empirical analysis suggests that only certain formulations of IP Boxes can accomplish their two stated goals. The formulations that best encourage R&D are those that create the largest R&D incentives: those that only apply to income derived from IP that was developed *after* box implementation and those that apply to IP revenue (as opposed to IP net income) which is unaffected by increased R&D costs. The IP Boxes that best limit base erosion / increase the tax corporate tax base, on the other hand, are those that apply to existing and acquired IP.

Although the empirical results of this study come as no surprise to economists and policy-makers, they are nonetheless important for the design of tax policy and provide a novel contribution to three related literatures. The first is a small and growing body of research that investigates the impact of IP Box Regimes. Thus far, the IP Box literature has shown how the regimes alter effective tax rates (Evers, Miller and Spengel (2014)) and that patent applications are responsive to IP Boxes (Bradley et al. (2015)). The second is a larger literature that explores how corporate taxation alters ownership of IP (Griffith, Miller and O’Connell (2014)), the location of IP within multinational firms (Dischinger and Riedel (2011)), and patenting locations (Böhm, Karkinsky, Knoll and Riedel (2015)). Finally, this study contributes to a set of papers that explore how the location of R&D responds to taxation (see, for example, Hines Jr (1997)).

The remainder of paper is organized as follows. Section 2 explains the characteristics that differentiate the IP Box Regimes and drive the empirically observed responses. Section 3 develops four empirically testable hypotheses based on these characteristics. Data sources and descriptive statistics are presented in Section 4. The difference-in-differences and triple-differences empirical methodologies are described in Section 5. Section 6 presents visual and empirical results and discusses the magnitudes and implications of the estimated responses. Section 7 concludes.

2 IP Box Characteristics

While all Intellectual Property (IP) Box regimes provide substantially reduced corporate tax rates for income derived from IP, boxes can differ significantly in how they define qualifying IP income. Three critical distinctions are (1) whether income generated by IP that exists prior to implementation qualifies, (2) whether income generated by IP acquired after implementation qualifies, and (3) whether the preferential rate applies to Net IP Income (IP revenue minus IP costs) or to Gross IP Income (IP revenue).

Table 1 details the IP Box Regimes that were in place in Europe in 2014. Of these 12 regimes, only six applied the preferential tax rate to income derived from existing IP. Five of these six countries also applied the preferential rate to income derived from IP acquired after IP Box implementation. Hungary, Liechtenstein, and Malta applied the rate acquired but not existing IP, while Spain allowed the lower rate on existing IP income but not acquired IP income. Only three IP Box Regimes – Belgium, Hungary, and Portugal – used the Gross as opposed to Net Income definition.

TABLE 1: IP BOX REGIMES IN PLACE IN EUROPE 2014

COUNTRY	YEAR	IP BOX %	MAIN TAX %	EXISTING IP	ACQUIRED IP	INCOME
BELGIUM	2007	6.8	33.99	No	No	GROSS
CYPRUS	2012	2.5	12.5	YES	YES	NET
FRANCE	2000	16.76	35.41	YES	YES	NET
HUNGARY	2003	9.5	19	YES	YES	GROSS
LIECHTENSTEIN	2011	2.5	12.5	No	YES	NET
LUXEMBOURG	2008	5.84	29.22	No	YES	NET
MALTA	2010	0	35	No	YES	NET
NETHERLANDS	2007	5	25	No	No	NET
PORTUGAL	2014	15	30	No	No	GROSS
SPAIN	2008	12	30	YES	No	NET
NIDWALDEN	2011	8.8	12.66	YES	YES	NET
U.K.	2013	10	21	YES	YES	NET

Notes: Table taken from Evers et al. (2014). Main Tax % includes the corporate income tax rate and if applicable, surcharges, local income taxes, and other income taxes. “Year” is the year in which the IP Box is implemented. When Existing IP is coded as “Yes,” income derived from existing IP (when the box is implemented) qualifies from the preferential IP box tax rate. When Acquired IP is coded as “Yes,” income derived from acquired IP (after the box is implemented) qualifies from the preferential IP box tax rate. When IP income is defined as gross income, IP related expenses may be deducted at the Main Tax %. When IP income is defined as net, IP related income must be deducted at the IP box %.

The following section predicts how these characteristics might shape the flow of IP Payments into an IP Box country and affect foreign R&D decisions. Critically, only IP Regimes with certain characteristics are predicted to increase innovation through R&D and limit base erosion through increased international IP Payment flows.

3 Hypotheses Development

When a country implements an IP Box, payments for the use of IP that flow into the country are taxed at a lower rate. This produces two potential responses that are governed by characteristics of the IP Box. The first potential response is an intensive margin increase in the use of IP located within the IP Box country. Because the IP is taxed at a lower rate, it is more affordable in an after-tax sense and will garner more use by both related and unrelated parties. This intensive margin response, however, will only be present when the preferential IP box tax rate applies to existing IP income. If the preferential rate only applies to new IP, on the other hand, then there will be no intensive margin response to the box’s implementation. This relationship between IP box regime characteristics and IP Payments generates the first empirically testable hypothesis that is explored in Section 6.

Hypothesis 1a. *Payments for the use of foreign intellectual property will increase more in response to IP boxes that apply to income derived from existing IP.*

A second potential response is on the extensive margin; additional IP may be either relocated to the IP box country or produced in the IP Box country itself. Both responses increase the stock of IP and, in turn, payments for the use of IP. Like the internal margin response, whether these responses are observed may depend on the characteristics of the IP Box in question. If an IP Box regime allows for the preferential rate on acquired IP, then, assuming relocating IP is less expensive than producing it, the first of these responses would be predicted to be the larger of the two, especially inside a multinational group. Thus, a second hypotheses could read “Payments for the use of foreign IP will increase more in response to IP Boxes that apply to acquired IP.” Unfortunately, from an empirical perspective, the IP Boxes that apply to acquired IP are also those that apply to existing IP. Thus, instead of a second empirical hypothesis, Hypothesis 1a is rewritten as:

Hypothesis 1a. redux *Payments for the use of foreign intellectual property will increase more in response to IP boxes that apply to income derived from existing IP and to income from acquired IP.*

Before exploring the second extensive margin response –increases in IP development – consider how a second IP Box characteristic may affect international payments for the use of IP: whether the preferential tax regime applies to Gross or Net IP income. If the tax regime applies to Net IP Income, then firms have an incentive to increase IP revenue while decreasing IP costs. If the rate

applies to Gross income, then firms have an incentive to increase IP revenue but do not have an additional incentive created by the box to decrease costs. Because payments for the use of IP *are* IP revenues, whether the box applies to Gross or Net IP income does not matter. IP Payments should increase in either type of box. Thus, the second IP Payment hypothesis is

Hypothesis 1b. *Increases in payments for the use of foreign intellectual property will not be differentially responsive to IP Boxes based on whether they apply to Gross as opposed to Net Income.*

One caveat to both Hypotheses 1a. and 1b. is that payments from a U.S. headquartered MNC to an international affiliate are taxed as Subpart F income under the internal revenue code. Subpart F income is immediately taxed at the 35% U.S. worldwide tax rate. Thus, U.S. MNCs would not be predicted to respond in accord with either of the hypotheses. On the other hand, foreign affiliates have a strong incentive to respond in accord with both predictions as not only are the receipts of IP payments taxed at a lower rate, but the expenses are (potentially) deducted at the 35% U.S. corporate statutory tax rate. The hypotheses also accurately predict the effects of IP Box regime characteristics on transactions between unrelated parties.

To explore the second extensive margin, IP development, I now consider how foreign R&D by U.S. MNEs will respond to the implementation of IP Box Regimes with a special focus on the effects of IP Box characteristics. Of the three potential responses to IP Boxes – increased use of existing IP, relocation of IP, and development of IP – the third is certainly the most costly and therefore will only be used to take advantage of an IP Box when the other options are not allowed. This logic leads to the first of two R&D hypotheses.

Hypothesis 2a. *Research and development that takes place in U.S. MNE affiliates will increase less in response to IP Boxes that apply to income derived from existing IP and income from acquired IP.*

If multinational groups can garner the preferential IP tax rate using existing or acquired IP, then developing IP in the IP Box country in response to implementation would be an inefficient activity (especially considering IP Box countries may not be technologically conducive to R&D development).

While the Gross vs. Net distinction did not matter for IP payments, it matters for R&D because R&D is a cost. If R&D takes place in a country with a Net Income IP Box, then the cost of the R&D subtracts from the income that receives the preferential tax treatment; the income generated by the R&D receives the preferential treatment but the R&D costs are also subtracted at the preferential rate thus the tax effects on R&D of a net income box are minimal. On the other hand, under a Gross Income IP box, income generated by new IP receives the lower rate while the R&D is deducted at the higher non-IP Box rate and the regime provides a strong incentive to use R&D in the IP Box country to generate new IP and IP related income. This observation is the basis for the fourth and last hypothesis;

Hypothesis 2b. *Research and development that takes place in U.S. MNE affiliates will increase more in response to IP boxes that apply to Gross as opposed to Net IP income.*

All four hypotheses are summarized in Figure 1.

FIGURE 1: EMPIRICALLY TESTABLE HYPOTHESES

	EXISTING/ACQUIRED IP	GROSS INCOME DEFINITION
ROYALTY PAYMENTS	+ (1A)	NO EFFECT (1B)
RESEARCH AND DEVELOPMENT	− (2A)	+ (2B)

Figure 1 summarizes empirically testable Hypotheses 1a–2b. Each column represents a different IP box characteristics. Each row represents an outcome variable. Each cell includes a predicted sign and a reference to relevant hypothesis. The predicted sign specifies how the row outcome will change in response to an IP box with the column characteristic relative to a baseline IP box that does not allow income from existing IP and defines IP income using the net income definition.

4 Data

Several sources of data are utilized to explore the impact of IP Box regimes on international payments for the use of IP and foreign R&D. Data on IP Box Regimes is taken from Evers et al. (2014). The U.S. Bureau of Economic Analysis (BEA) provides data on international payment flows and R&D. These data are matched to country corporate tax data from the Oxford Centre for Business Taxation, GDP data from the World Bank, and population data from various sources including the United Nations.

4.1 IP Box Regime Data

Evers et al. (2014) detail which nations implement IP Boxes, when the IP Boxes were introduced, the IP tax rate, whether the preferential tax rate applies to income derived from existing IP, whether the IP Box applies to income derived from acquired IP, and whether IP income is defined on a gross or net basis. These data are summarized in Table 1. As discussed in the following subsections, due to data constraints, the effect of an IP Box on payments for the use of IP and R&D can only be estimated based on the implementation of a subset of these regimes. Table 2 details this subset.

From these data, three variables are constructed. **IP Box** is the first and is an indicator equal to one if the country has implemented an IP Box Regime. **Gross** is an indicator equal to one if the IP Box that has been implemented applies to IP revenue as opposed to IP Net Income (revenue minus costs). **Existing/Acquired** is equal to one if the IP Box regime applies the preferential rate to income derived from existing IP and/or income derived from acquired IP. If **Existing/Acquired**

is equal to zero, then only IP income derived from newly developed IP is subject to the preferential rate.

4.2 Payments for the Use of IP Data

Data on the payments between the U.S. and foreign nations is available via the BEA. The BEA data details both import and export “charges for the use of IP” between the U.S. and other countries.¹ The **Log Payments** outcome variable measures the gross payment flows between the U.S. and other countries and is constructed as the log of charges for imported IP minus charges for exported IP. This bilateral data is available for 32 U.S. country pairs during the years 1999–2014 (505 total observations). The BEA data allows for analysis of the introduction of IP boxes in Belgium, France, the Netherlands, Spain, and the United Kingdom. The BEA data, however, does not include flows between the U.S. and Cyprus, Hungary, Liechtenstein, Luxembourg, Malta, Portugal, and the Nidwalden area of Switzerland and therefore does not allow for an empirical analysis of the effect of the introduction of IP boxes in those areas.² Not all of these flows are to or from affiliates of U.S. located MNEs. However, a majority or total payments flow between related parties. In 2013, 61% of all payments were to affiliated parties and 77% of payments to European countries were to related parties. Thus, at least 23% of payments are made between unrelated parties and are not subject to Subpart F rules. In addition, some portion of payments between related parties are made from U.S. subsidiaries and Foreign (from the perspective of the U.S.) parents. These are also not subject to Subpart F rules. Thus, IP Box Regimes will impact at least 23% of Log Payments.

4.3 Research and Development Data

R&D data is also available from the BEA. The BEA’s U.S. Direct Investment Abroad survey details the activities of U.S. Multinational Enterprises (MNEs). Survey responses of unique MNEs are aggregated up to the affiliate-country level then made available on the BEA’s website.³ The outcome variable **Log R&D**, is equal to the log of the aggregate research and development conducted by affiliates of U.S. multinational enterprises. Log R&D is available during the years 2004–2013 for up to 116 different countries (844 total observations). The dataset contains R&D data for 7 countries that implemented IP Box Regimes. 5 of these countries implemented the boxes during the sample time frame. Table 2 details the characteristics of the IP regimes that are included in the sample.

¹bea.gov → U.S. Economic Accounts; International; Balance of Payments → Interactive Tables: International Transactions → Begin using the data ... → International Services → Table 2.2. U.S. Trade in Services, by Type of Service and by Country or Affiliation → download all data for tables → Table 2.2. U.S. Trade in Services, by Type of Service and by Country or Affiliation.

²Payments to and from Belgium and Luxembourg are reported as a single annual observation. As affiliated U.S. capital expenditure in Belgium is an order of magnitude larger than capital expenditure in Luxembourg, this observation is re-classified as flows to Belgium.

³<http://www.bea.gov/international/dilusdop.htm>

TABLE 2: IP BOX REGIMES INCLUDED IN ROYALTY PAYMENT AND R&D DATA

COUNTRY	YEAR	EXISTING/ ACQUIRED	ROYALTY PAYMENTS		R&D	
			GROSS INCLUDED	CHANGED DURING	INCLUDED	CHANGED DURING
BELGIUM	2007	NO	GROSS	✓	✓	✓
FRANCE	2000	YES	NET	✓	✓	✓
HUNGARY	2003	YES	GROSS		✓	
LUXEMBOURG	2008	NO	NET		✓	✓
NETHERLANDS	2007	NO	NET	✓	✓	✓
SPAIN	2008	YES	NET	✓	✓	✓
U.K.	2013	YES	NET	✓	✓	✓

Notes: Table 2 describes the tax regimes that are used to estimate the royalty payment and R&D response to IP Boxes and IP box characteristics.

4.4 Controls Variables

Data on country corporate tax rates and regimes are provided by the Oxford Centre for Business Taxation. All regressions included two tax controls, **Tax Diff** and **Territorial**, based on these data. Tax Diff is equal to the difference between the U.S. statutory corporate tax rate (35%) and the statutory corporate tax rate in the adjoining country. If Tax Diff increases, it creates an incentive for affiliated parties to increase IP payments and R&D that is unrelated to IP Boxes. Territorial is an indicator equal to one if the country in question has a territorial (as opposed to worldwide) corporate tax system. During the period, several countries, including Great Britain and Japan, switched from a worldwide to a territorial tax system.

To control for country productivity and size, **Log GDP per capita** and **Log Population** are also included in all specifications. GDP per capita data are taken from The World Bank. Population data is taken from the United Nations.

4.5 Descriptive Statistics

Table 3 presents descriptive statistics for both the Payments and the the R&D datasets. On average, net payments for the use of IP from the U.S. to foreign countries is equal to \$858.44 million dollars (per year), meaning that the U.S. is a net user of foreign IP. This outflow is in line with the incentives created by worldwide tax climate. U.S. based multinationals would prefer to purchase IP from foreign affiliates so they can book a cost in the U.S. at a high tax rate and book the related

revenue in a lower cost jurisdiction. The tax wedge also creates the incentive for a foreign firm to locate IP in a low tax country. The descriptive statistics also show that foreign affiliates of U.S. multinationals do a significant amount of R&D. On average, U.S. affiliates in each foreign country do \$420 million of R&D per year.

TABLE 3: DESCRIPTIVE STATISTICS

PANEL A: PAYMENTS DATASET					
	OBS.	MEAN	STD DEV	MIN	MAX
PAYMENTS	420	858.44	1,699.10	0.00	12,406.00
CORP TAX RATE	420	29.13	7.66	0.00	52.30
$\mathbb{1}[\text{TERRITORIAL}]$	420	0.82	0.38	0.00	1.00
GDP PER CAPITA	420	27.10	22.65	0.45	102.83
POPULATION	420	14,259.15	32,143.41	6.45	136,427.00
IP BOX	420	0.09	0.29	0.00	1.00

PANEL B: RESEARCH AND DEVELOPMENT DATASET					
	OBS.	MEAN	STD DEV	MIN	MAX
R&D	844	419.99	1,069.05	0.00	8,272.00
CORP TAX RATE	844	25.42	8.95	0.00	55.00
$\mathbb{1}[\text{TERRITORIAL}]$	844	0.93	0.26	0.00	1.00
GDP PER CAPITA	844	19.21	21.82	0.24	157.09
POPULATION	844	5,832.37	19,354.47	3.65	135,738.00
IP BOX	844	0.06	0.23	0.00	1.00

Notes: Table 3 provides descriptive statistics for both the payments dataset (Panel A) and the R&D dataset. Payments, R&D, and Population are reported in millions. GDP per capita is reported in thousands.

5 Empirical Design

To test the four hypotheses developed in Section 3, this study utilizes a triple-differences approach. But first, consider how a difference-in-difference methodology could be used to test for the effect of an IP Box on an outcome of interest. To estimate a plausibly causal effect, one would estimate

$$\text{Outcome}_{jt} = \beta_0 + \beta_1 IP_{jt} + \sum_{s=2}^n \beta_s \text{Control}_s + \eta_j + \gamma_t + \epsilon_{jt}$$

where j denotes country, t denotes time, η_j is a country-fixed effect, γ_t is a time fixed effect, and IP_{jt} is a variable equal to one in an IP Box country only after the IP Box regime has been implemented. The β_1 estimate generated by this specification would describe how the outcome variable changed, on average, for countries that implemented an IP Box relative to those countries that did not in the same year. Although one could implement this regression, it is hard to predict how IP Payments or R&D might respond to any given IP Box. For instance, if the box applies to all types of income, there is less reason to increase R&D in response to the IP Box.

This difference-in-differences setup is extended to test the Section 3 predictions by adding an additional interaction term to the regression equation. To test Hypotheses 1a and 2a, IP_{jt} is interacted with the Existing/Acquired indicator as in

$$\text{Outcome}_{jt} = \beta_0 + \beta_1 IP_{jt} + \beta_2 [IP_{jt} \times \text{Existing/Acquired}_j] + \sum_{s=3}^n \beta_s \text{Control}_s + \eta_i + \gamma_t + \epsilon_{it}.$$

Now, the β_2 coefficient (the triple-differences estimate) describes how the outcome variable changes when an IP Box that applies to existing or acquired IP is implemented relative to how the outcome variable changes for a country that implements an IP Box that does not apply to existing or acquired IP.

A similar triple-differences methodology is employed uncover the effect of a Gross IP Box relative to a Net Income IP Box. Now, the estimating equation is

$$\text{Outcome}_{jt} = \beta_0 + \beta_1 IP_{jt} + \beta_2 [IP_{jt} \times \text{Gross}_j] + \sum_{s=3}^n \beta_s \text{Control}_s + \eta_i + \gamma_t + \epsilon_{it}$$

where the triple-differences term is $IP_{jt} \times \text{Gross}_j$. β_2 now describes how the outcome variable changes for a country that implements a Gross IP Box relative to how the outcome variable changes for a country that implement a Net Income IP Box. This estimator is used to test Hypotheses 1b and 2b.

The triple-differences estimation strategy that is used to test the four empirical hypotheses rests on the assumption that no other country-level shocks to IP Payments or R&D are contemporaneous

to only Existing/Acquired or Gross IP Box Regimes. This assumption allays many but not all most salient empirical concerns. For instance, it may be the case the countries only implement IP Box Regimes when they need to increase revenue. As long as the choice of what *type* of IP box to implement (Existing/Acquired or Net) is unrelated to the state of the economy, then the assumption behind the triple-differences estimator holds.

One potential violation of this assumption is due to a lack of data on Gross IP Box implementing countries. While three countries – Belgium, Hungary, and Portugal – have implemented Gross IP Boxes, only one country – Belgium – is observed prior to and after implementation in both datasets. Thus, the β_2 term on the Gross interaction is identified from how the outcome variable changes for Belgium relative to other IP Box countries upon implementation. The Belgium IP Box is different because it applies to Gross IP income but may also be different for a variety of other reasons. Thus, the triple-differences strategy cannot attribute the estimate with 100% certainty to the Gross characteristic of Belgium’s IP Box Regime. Note, however, there is a tremendous difference in the generosity and incentives between Gross and Net Income boxes. As a result, the β_2 estimate is most likely caused in large part by this distinction in characteristics.

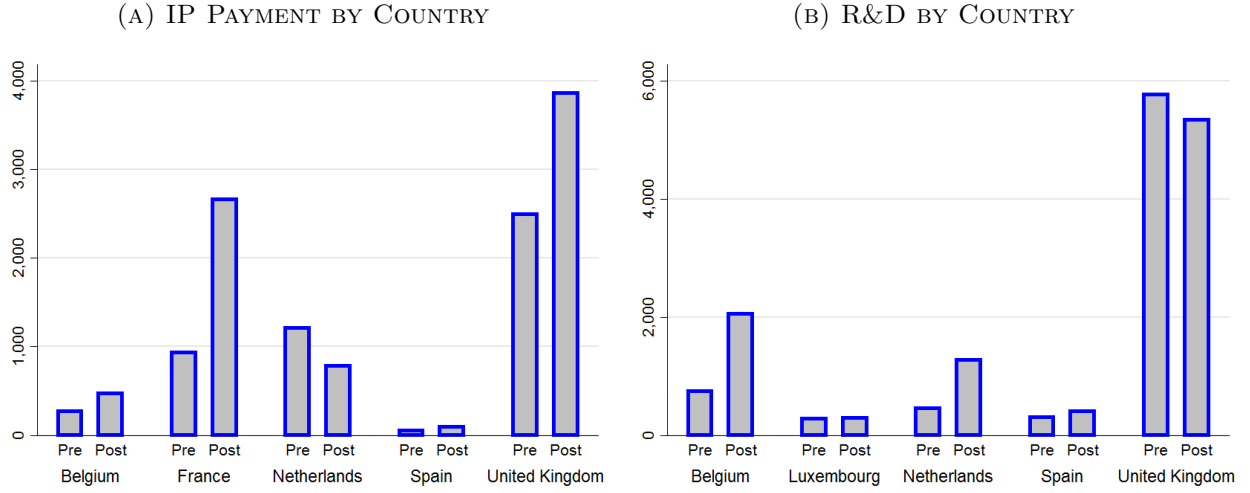
6 Results

6.1 Graphical Results

Before implementing the triple-differences estimating strategy graphically and then empirically, Figure 2 presents IP Payments and R&D before and after the introduction of the five different IP Boxes detailed in each dataset. Panel (A) shows that while Belgium, France, and the United Kingdom saw increases in net IP Payments from the U.S. after IP Box introduction, the Netherlands saw a decline and Spain saw very little change. Panel (B) shows that Belgium and the Netherlands see significantly increased R&D after IP box introduction while Spain sees a moderate increase, Luxembourg sees no change, and the United Kingdom sees a decrease. This simple graphical exploration shows that it is unclear how IP Boxes, in and of themselves, affect IP Payments and R&D and motivates the need for additional empirical exploration based on IP Box characteristics.

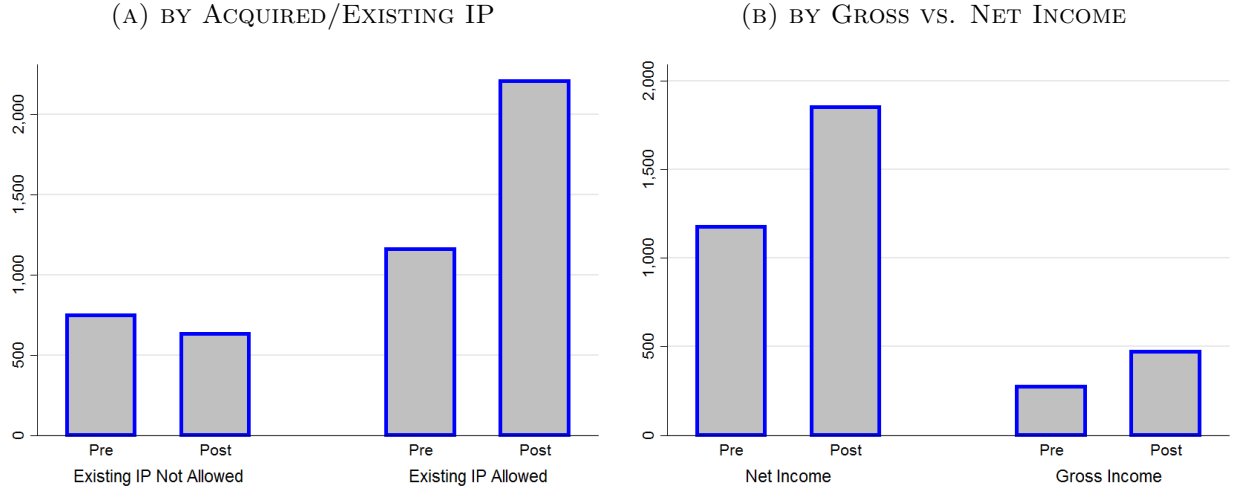
Figures 3 and 4 present a visual implementation of (a simplified version of) this research design. In Panel (A) of Figure 3, net payments for the use of IP from the U.S. to foreign IP Box countries is broken down pre and post implementation and based on whether the IP Box applies to existing and/or acquired IP. Two empirical observations are clear from this simple crosstab. First, payments for the use of IP do not increase to countries that implemented regimes that only apply to income generated by newly developed IP. In contrast, when an IP Box that applies to income derived from existing/acquired IP is introduced, payments increase substantially. These two facts suggest that Empirical Hypothesis 1a – that IP Box regimes that apply to existing/acquired IP will generate more IP revenue – is supported in the data.

FIGURE 2: U.S. PAYMENTS FOR THE USE OF IP AND U.S. FOREIGN AFFILIATE R&D



Notes: Figure 2(A) present payments from the U.S. to foreign countries for IP before and after IP Box implementation. Panel (B) present R&D by foreign affiliates of U.S. MNEs before and after IP Box implementation.

FIGURE 3: IP BOX CHARACTERISTICS AND U.S. PAYMENTS FOR THE USE OF IP



Notes: Figure 3 (A) presents payments from the U.S. to foreign countries for IP before and after IP box implementation split based on whether the IP Box applies to income derived from existing and/or acquired IP. Panel (B) splits the same data based on whether the preferred IP tax rate is applied to net or gross income.

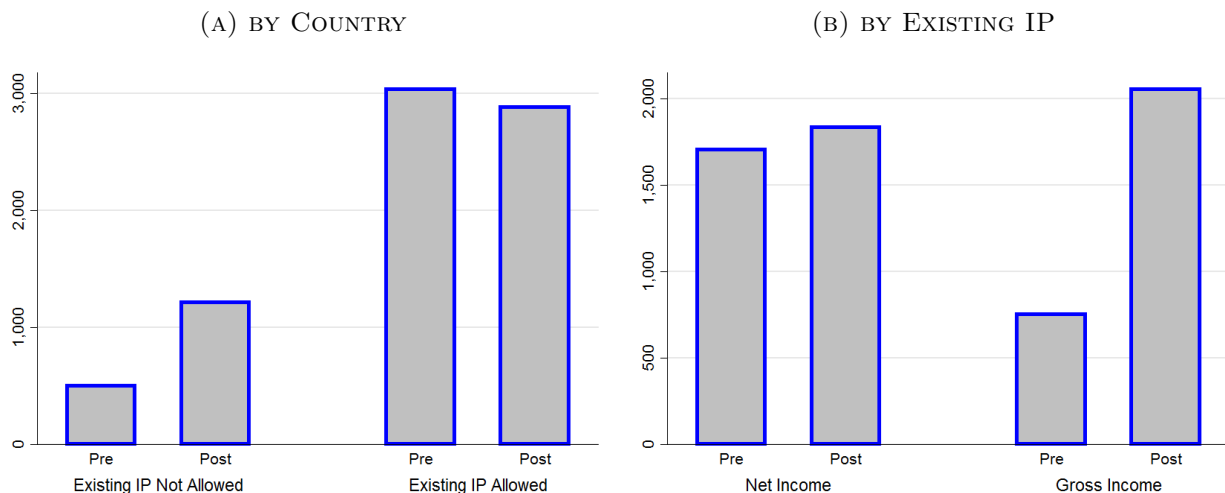
Panel (B) of Figure 3 performs a similar analysis but splits the data based on whether the IP Box applies to Gross or Net IP income. The panel shows that in response to either type of IP Box (Gross or Net), IP Income increases after introduction. That there is no differential income response based on this characteristic supports Empirical Hypothesis 1b. The absence of a

differential response across the Gross vs. Net Income IP Boxes seems intuitive as both types of income are equally increased by additional payments for the use of IP.

Figure 4 examines how different IP Box characteristics affect U.S. MNE foreign R&D in IP Box countries. Panel (A) shows that when IP Boxes that do not apply to existing IP income are implemented, there is a significant uptick in R&D activity but when the IP Boxes that apply to existing income are implemented, R&D does not increase. This result supports Empirical Hypothesis 2a and the logic that U.S. MNEs are only going to increase R&D to generate IP income in countries where they can't take advantage of existing or acquired IP.

Panel (B) shows a second differential R&D response across Net vs. Gross IP Boxes. When a Net Income IP Box is implemented, there seems to be little or no change in R&D. On the other hand, when a Gross Income IP Box is implemented, R&D increases substantially. These contrasting responses are in line with Empirical Hypothesis 2b and suggest that U.S. MNEs choose to increase R&D upon IP Box implementation only when additional R&D costs do not decrease the base upon which the preferential tax rate operates.

FIGURE 4: IP BOX CHARACTERISTICS AND U.S. MNE RESEARCH AND DEVELOPMENT



Notes: Figure 3 (A) presents R&D by foreign affiliates of U.S. MNEs before and after IP box implementation split based on whether the IP Box applies to income derived from existing and/or acquired IP. Panel (B) splits the same data based on whether the preferred IP tax rate is applied to net or gross income.

In sum, the graphical evidence supports all four empirical hypotheses and suggests that the type of IP Box – as defined by the types of income to which it applies (its characteristics) – affects the international response to the box. In the following section, the empirical results from the triple-differences estimation strategy described in Section 5 are presented.

6.2 Empirical Results and Discussion

Table 4 presents the IP Payments empirical results. Overall, the results in Table 4 support both Hypotheses 1a and 1b and suggest that IP Payments increase in response to IP Boxes that apply the preferential rate to existing and acquired IP.

In all Table 4 specifications, the outcome variable is Log Payments. Specification (1) performs the difference-in-differences IP Box estimate. Specifications (2) and (3) add Existing/Acquired triple-interaction term. Specifications (4) and (5) include the Gross triple-interaction instead. All specifications include foreign country controls as well as country and year fixed effects. Specifications (3) and (5) limit the analysis to only OECD countries. Across all specifications, standard errors are clustered at the country-level following the recommendations in Cameron and Miller (2015).

The Specification (1) point estimates suggest that implementing *an* IP Box actually decreases net IP Payments from the U.S. by 26.2%. However, this estimate is not statistically different from zero at even the 10% level. Specifications (2) and (3) suggest that implementing an IP Box that applies to existing and acquired IP income increases IP Payments by 58.7% / 61.2% more than implementing an IP Box that only applies to newly derived IP. By combining these differential estimates with the coefficient on IP Box, a estimate of the net effect of an Existing / Acquired IP box can be approximated. An Existed/Acquired IP box increases IP Payments by between 16 and 21%.

To better understand the scale of this response, consider that IP Boxes that applied to existing and acquired income decreased IP income tax rates by 65%, on average. In order for this to be a revenue neutral response, IP income would have to increase to these box countries by a symmetrical 65%. If U.S. payments are an appropriate proxy for the IP payments of all countries worldwide then the empirical estimates suggest that the international IP income response was not even one third of this hypothetical revenue neutral target.⁴

Table 5 presents the foreign R&D empirical results. The setup of the table is analogous to the IP Payments table but now the outcome variable in every regression is Log R&D and the dataset upon which the analysis is performed captures only the activities of U.S. MNEs, not unaffiliated parties. Like the IP Payments results, the R&D results strongly support the empirical hypotheses (here 2a and 2b, in particular) and suggest that the type of IP Box – not simply the implementation of *an* IP Box – matters in stimulating R&D.

⁴There are reasons that U.S. flows may underestimate or overestimate the worldwide IP Payment response. The U.S. response may be an overestimate due to the high corporate tax rates on U.S. firms. U.S. firms have one of the highest incentives to purchase IP from foreign sources. At the same time, U.S. firms may not have an incentive to purchase IP from foreign affiliates due to its definition as Subpart F income.

TABLE 4: US PAYMENTS FOR THE USE OF FOREIGN INTELLECTUAL PROPERTY

DEPENDENT VARIABLE: SPECIFICATION	LOG PAYMENTS				
	(1)	(2)	(3)	(4)	(5)
IP BOX	-0.262 (0.199)	-0.370 (0.225)	-0.445* (0.227)	-0.353 (0.231)	-0.433* (0.222)
TAX DIFF	0.003 (0.011)	0.001 (0.011)	0.001 (0.015)	0.005 (0.010)	0.008 (0.013)
TERRITORIAL	-0.142 (0.147)	-0.185 (0.148)	-0.219 (0.129)	-0.132 (0.147)	-0.151 (0.134)
EXISTING/ACQUIRED x IP BOX		0.587** (0.277)	0.612** (0.244)		
GROSS x IP BOX				0.336 (0.230)	0.390* (0.219)
OECD ONLY			✓		✓
COUNTRY, YEAR FE	✓	✓	✓	✓	✓
CONTROLS	✓	✓	✓	✓	✓
R-SQUARED	0.466	0.477	0.545	0.471	0.537
COUNTRIES	31	31	17	31	17
COUNTRIES x YEARS	420	420	243	420	243

Notes: The dependent variable in all specifications is the log of U.S. payments for the use of foreign intellectual property. Observations are at the foreign country-year level. Specifications (3) and (5) limit the analysis to OECD countries. All specifications include country and year fixed effects as well as controls for foreign affiliate GDP per capita and population. Standard errors are clustered at the country level. *** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.

In Specification (1), the coefficient on the difference-in-differences term “IP Box” is equal to 0.264 and is statistically significant at the 10% level. This estimate suggests that implementing an IP Box increases foreign R&D by U.S. MNEs by 26.4%. Moving to Specifications (2) and (3), implementing an IP Box that only applies to newly developed IP increases U.S. MNE foreign R&D by 48.5% for all countries and by 46.3% for OECD countries; both coefficients are statistically different from zero at the 95% confidence level. In contrast, point estimates suggest that implementing an IP box that applies to income derived from existing or acquired IP as well as newly developed IP decreases R&D between 10 and 22%, although these estimated effects cannot be statistically

distinguished from zero. If U.S. foreign MNE R&D is representative of all MNE R&D, then the Specification (2) and (3) suggest that if countries want to increase R&D activities by foreign firms then implementing a box that only applies to newly developed homegrown R&D is an attractive policy option.

TABLE 5: US MNE RESEARCH & DEVELOPMENT IN FOREIGN AFFILIATES

DEPENDENT VARIABLE:	LOG RESEARCH AND DEVELOPMENT				
SPECIFICATION	(1)	(2)	(3)	(4)	(5)
IP BOX	0.264*	0.485**	0.463**	0.142	0.134
	(0.153)	(0.195)	(0.180)	(0.150)	(0.175)
TAX DIFF	-0.001	-0.001	0.001	-0.001	0.007
	(0.002)	(0.002)	(0.009)	(0.002)	(0.009)
TERRITORIAL	0.013	0.032	0.016	0.019	-0.008
	(0.066)	(0.063)	(0.082)	(0.065)	(0.082)
EXISTING/ACQUIRED X IP BOX		-0.586***	-0.682***		
		(0.202)	(0.195)		
GROSS X IP BOX				0.616***	0.597***
				(0.153)	(0.176)
OECD ONLY			✓		✓
COUNTRY, YEAR FE	✓	✓	✓	✓	✓
CONTROLS	✓	✓	✓	✓	✓
R-SQUARED	0.466	0.491	0.411	0.485	0.399
COUNTRIES	116	116	32	116	32
COUNTRIES X YEARS	844	844	280	844	280

Notes: The dependent variable in all specifications is the log of U.S. MNE research and development taking place at foreign affiliates. Observations are at the foreign country-year level. Specifications (3) and (5) limit the analysis to OECD countries. All specifications include country and year fixed effects as well as controls for foreign affiliate GDP per capita and population. Standard errors are clustered at the country level. *** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.

Specifications (4) and (5) explore the differential R&D response across Gross Income and Net Income IP Boxes. The coefficients on “IP Box” suggest perhaps there is a small (statistically insignificant) R&D response to an IP Box that defines IP income net of IP costs, such as R&D. In contrast, implementing an IP Box that applies to IP revenue has a very large and statistically

significant effect. Among all countries, implementing a Gross IP Box increases R&D by 75.8%; 61.6% more than a Net Income IP Box. Among OECD countries the Gross IP Box raises R&D by 73.1% or by 59.7% more than a Net Income IP Box. The results support Hypothesis 2b, the strongest R&D incentives are created by IP Boxes that tax income from R&D at a preferential rate while still allowing R&D costs to be deducted at the higher statutory corporate income tax rate.

In sum, implementing *an* IP Box seems to empirically increase foreign R&D by U.S. MNEs. However, all of the R&D response is driven by IP Boxes that do not apply to income derived from existing and acquired IP and from IP Boxes that apply to IP revenue as opposed to IP net income. Importantly, the R&D response to these types of IP Box regimes is fairly certain to represent real economic activity. The IP Payments response may result from either (1) real increases in IP stocks created by increased development, or acquisitions or from (2) reallocation of profits to IP Box countries via transfer pricing activities. Increased R&D, on the other hand, is more likely to represent real activity because shifting R&D via transfer pricing would require firms in low-tax countries to increase payments to high-tax IP Box countries, thereby decreasing profits in the low-tax jurisdiction.

7 Conclusions

This study set out to use two sources of readily available data, international flows of IP payments from the U.S. to foreign countries and R&D activities of foreign affiliates of U.S. MNEs, to explore how IP Boxes affect income flows and real economic activities. The results suggest that while the average IP Box does not have a statistically significant effect on IP Payments or foreign R&D, certain types of regimes can have dramatic effects. IP Payments increase significantly in response to the implementation of boxes that apply to income from existing and acquired IP. R&D responds strongly to IP regimes that apply only to newly developed R&D and that apply to IP Revenue as opposed to IP Net income.

IP Box regimes are designed to accomplish two goals: (1) to stimulate domestic innovation and (2) to limit base erosion. The results contained in this study suggest that an IP Box can accomplish both goals but only when it applies to income derived from existing and acquired IP, which limits base erosion by increasing net inflows of IP Payments, and when it applies to Gross as opposed to net IP income, which stimulates R&D. Unfortunately, this type of IP Box is no magic bullet as both of these characteristics expand the base upon which the preferred tax rate applies and thus is the most costly regime.

References

- Böhm, Tobias, Tom Karkinsky, Bodo Knoll, and Nadine Riedel**, “Corporate Taxes and Strategic Patent Location within Multinational Firms,” Technical Report, Working Paper. Oxford University Centre for Business Taxation, Oxford, UK 2015.
- Bradley, Sebastien J, Estelle Dauchy, and Leslie Robinson**, “Cross-Country Evidence on the Preliminary Effects of Patent Box Regimes on Patent Activity and Ownership,” *National Tax Journal*, 2015, 68 (4).
- Cameron, A Colin and Douglas L Miller**, “A practitioners guide to cluster-robust inference,” *Journal of Human Resources*, 2015, 50 (2), 317–372.
- Dischinger, Matthias and Nadine Riedel**, “Corporate taxes and the location of intangible assets within multinational firms,” *Journal of Public Economics*, 2011, 95 (7), 691–707.
- Evers, Lisa, Helen Miller, and Christoph Spengel**, “Intellectual property box regimes: Effective tax rates and tax policy considerations,” *International Tax and Public Finance*, 2014, 22 (3), 502–530.
- Griffith, Rachel, Helen Miller, and Martin O’Connell**, “Ownership of intellectual property and corporate taxation,” *Journal of Public Economics*, 2014, 112, 12–23.
- Jr, James R Hines**, “International taxation and corporate R&D: Evidence and implications,” *Borderline case: International tax policy, corporate research and development, and investment*, 1997, pp. 39–52.