The Impact of IP Box Regimes on the M&A Market

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Abstract

IP box regimes reward ownership of successful technology by imposing a lower tax rate on income derived from the commercialization of patented products relative to other sources of business income. Coupled with explicit provisions regarding the eligibility of acquired intellectual property, IP boxes may affect merger and acquisition (M&A) incentives through multiple channels. Applying panel difference-in-differences and event study methods at the firm level, we examine the effects of these modified incentives on the probability that a firm is acquired in the context of international and domestic acquisitions. In IP box regimes with strict nexus requirements, reducing the tax rate on patent income by 1 percentage point is associated with a 2.5 percent reduction in the probability of being acquired for patent-owning firms due to the potential loss of eligibility for preferential taxation. This effect dissipates where nexus requirements are relaxed. Significant positive effects of IP box tax savings on M&A activity in the latter more permissive regimes are indicative of increased after-tax valuations of merger-driven synergies.

Keywords: IP box, tax policy, acquisition, M&A, innovation, patent
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1 Introduction

Innovation is widely perceived as the key to economic growth. The tax system can be a powerful policy instrument for spurring innovation. Indeed, one of the most visible tax policy issues today is taxing mobile income—i.e., income arising from ownership of valuable intellectual property (IP). A common theme present in relatively new back-end tax policies for innovation is to impose a lower tax rate on income from the license or use of IP, in contrast to the traditional front-end policy approach of providing up-front subsidies for research and development (R&D) investment. Indeed, seventeen countries have adopted so-called "IP boxes" over the period 2000-2016 as a way to promote innovation and strengthen their domestic tax base (Bradley, Dauchy and Robinson (2015); Merrill (2016)). The extent to which these regimes focus on rewarding owners rather than creators of IP could impact the market for proven technologies. We examine in this paper whether IP box regimes create tax-induced distortions to ownership of IP via mergers and acquisitions (M&A).

IP boxes have two complementary objectives with respect to base erosion and profit shifting, and the extent to which countries prioritize those objectives influences the design of these preferential regimes. One objective is to protect the existing domestic tax base. Tørsløv, Wier and Zucman (2018) estimate that around $600 billion in multinational firm profits are shifted annually to tax havens, with the European Union bearing the greatest revenue loss. Imposing a lower tax rate on income from IP discourages outbound profit shifting related to domestic research activities. A second objective is to attract mobile income, by encouraging inbound shifting related to foreign research activities. To the extent that the latter objective dominates the first as motivation to enact an IP box regime, the design will necessarily place weaker (or non-existent) restrictions on the application of preferential tax treatment to acquired IP. In the absence of such restrictions, firms can conduct R&D in one country and subsequently transfer any resulting IP assets, thereby allowing certain countries to operate as tax havens for IP assets without

necessarily spurring incremental domestic innovation (Graetz and Doud, 2013).

We hypothesize that IP box regimes may alter M&A patterns through several channels. The first of these—the nexus channel—relates to the influence on M&A activity arising from the treatment of acquired IP described above and reflects the application of specific legal provisions. The stance that each country takes with respect to acquired IP in designing its IP box regime is referred to as a "nexus requirement." Broadly speaking, nexus requirements in the context of taxation seek to align the location of taxable profits (e.g., income from IP assets) with related economic activities (e.g., R&D expenditures). To explicitly disallow acquired IP is tantamount to rewarding taxpayers who are themselves the IP creators, whereas to explicitly allow acquired IP rewards taxpayers who own IP, even absent any role in its creation. A middle-ground approach involves the imposition of "further development conditions," whereby acquired IP may qualify for the preferential rate provided that the acquiring taxpayer continues to develop or improve the asset.[1] We expect nexus requirements to unambiguously disincentive M&A, in proportion to the strength of these rules.

The second channel, the tax planning channel, relates to the relative attractiveness of IP-holding target firms in IP box countries across domestic and foreign deals. In general, M&A-driven restructurings may constitute an important opportunity for relocating IP income in a tax-efficient manner (i.e., by masking the arm's-length price of specific assets). Hence, if the ability to relocate IP income to low-tax jurisdictions constitutes a comparative advantage for foreign relative to domestic bidders, then the introduction of an IP box in the target country should reduce foreign acquirers' advantage in bidding for IP-owning targets. On the other hand, targets in IP box countries could be more attractive to foreign bidders intending to shift their own IP income into the target country in order to access the IP box.

[1]Historically, European Union (EU) member states—which serve as the focus of our analysis and include 12 IP box countries—have been constrained by the EU Treaty in their ability to condition preferential tax treatment on *domestic* R&D activity. Nevertheless, different regimes in the EU have imposed more or less stringent nexus rules.

The third and final channel, the net income expansion channel, relates to the expected value of deal-specific synergistic gains. For example, an IP-holding target may be able to extract higher pre-tax returns from its IP assets after being acquired by increasing sales, raising prices through increased market concentration, or cutting costs. If M&A transactions are expected to create higher pre-tax returns to assets that are taxed at preferential rates, then the introduction of an IP box regime should unambiguously raise the likelihood of acquisition by increasing the after-tax value of these gains.

In this paper, we aim to quantify the extent to which reductions in the tax rate on IP income relative to the ordinary corporate tax rate (i.e., the"IP box tax savings rate") and the presence of nexus requirements affect the likelihood of a target firm being acquired in an M&A deal.[2,3] We hence exploit firm-level panel difference-in-differences (DiD) and event study methodologies to estimate the probability that a firm is acquired as a function of country-level characteristics (including characteristics of any applicable IP box regime) and firm-level characteristics (including measures of IP holdings). Consistent with the literature, we use patent holdings as a readily-measurable proxy for IP ownership and because patents—unlike other IP assets—are consistently treated as qualifying IP across all IP box regimes. Our estimation strategy thus focuses on interactions of patent ownership, IP box tax savings rates, and nexus requirements in the context of either international or domestic deals in order to distinguish among the hypothesized channels summarized above.

We consistently find that strict nexus requirements unambiguously weaken incentives to engage in all types of M&A deals. Specifically, reducing the tax rate on IP income by 1 percentage point is associated with a 2.5 percent reduction in the probability of being acquired due to the potential loss of eligibility for preferential taxation. This negative

[2]We evaluate the related probability that a firm *makes* an acquisition in Appendix A.1.

[3]We focus on the market for corporate control as a surrogate for the market for proven technologies given that certain types of qualifying IP income are not separately identifiable or transferrable, such as IP income embedded in the sale of goods and services, or IP infringement income. Additionally, M&A-driven restructurings may constitute an important opportunity for relocating IP income. As a practical matter, M&A transactions are observed more reliably than purchases of IP assets.

effect is generally less pronounced in the context of domestic deals. This may reflect either i) a lower likelihood of post-deal restructuring that would involve moving the IP asset(s) to a newly-established entity, or ii) a higher likelihood of satisfying weak nexus requirement (if applicable) in a domestic deal. While the positive aspects of IP boxes have been emphasized in the existing literature (e.g., Ernst, Richter and Riedel (2014); Bradley, Dauchy and Robinson (2015); Chen et al. (2017); Alstadsæter et al. (2018); Bornemann, Laplante and Osswald (2017)), we are the first to point to this potential downside of IP boxes in the context of M&A and the implications of nexus requirements.

This finding is enormously important in light of the Organization for Economic Co-operation and Development's (OECD) 2015 report on Action 5 of the Base Erosion and Profit Shifting (BEPS) project. The OECD concluded that IP boxes without nexus requirements constitute a harmful preferential tax regime (Merrill, 2016), and OECD member countries have agreed that IP boxes must be (re)designed to require a link between R&D expenditures, IP assets, and IP income (i.e., implement the OECD's "modified nexus approach"). Concretely, under the modified rules, qualifying taxpayers may only claim preferential tax treatment for IP income in proportion to the ratio of qualifying to total expenditures, and IP acquisition costs may not be considered a qualifying expenditure.[4] This suggests that countries without nexus requirements prior to 2015 risk introducing new disincentives for M&A activity under the revised rules. To the extent that this might deter tax-motivated M&A transactions, this may be desirable; however, a casualty of these revisions might also be deals driven by opportunities for synergistic (non-tax) gains. Moreover, if firms' incentives to conduct R&D increase with the probability that they become targets of M&A deals (Phillips and Zhdanov, 2013), overly strict nexus requirements could indirectly stifle domestic innovation.

In IP box regimes where acquired IP is not subject to strict nexus requirements, we instead find statistically insignificant or significantly positive effects of regime generosity

[4]Countries otherwise retain latitude to decide how to define qualifying expenditures, income from IP assets, as well as rules for tracing and documenting qualifying expenditures.

on the probability of being acquired, and this effect is generally stronger and more persistent in the context of domestic M&A deals. Our analyses thus highlight a significant increase in the probability of being acquired as a function of the IP box tax savings rate in the period immediately surrounding regime adoption. We interpret these results as suggesting a strong positive influence of the net income expansion channel, especially where synergistic gains attributable to both the target and acquirer's IP are eligible for preferential taxation, as in the case of domestic deals. Conversely, we find no apparent evidence of important tax planning effects, even in countries without nexus requirements, such that the deterrent effect of these requirements may primarily affect deals that would otherwise be productivity-enhancing.

Overall, the importance of our study can be viewed through the lens of capital ownership neutrality (Desai and Hines (2003, 2004); Weisbach (2014)). Given the increasing relevance of M&A transactions as a mode of foreign direct investment, capital ownership neutrality (as distinct from capital export or import neutrality) is viewed as a desirable characteristic of tax systems to avoid distortions to international capital flows. According to this principle, assets should be owned—independent of tax considerations—by firms with the highest reservation prices. Otherwise, tax policies such as IP boxes which distort asset ownership necessarily imply suboptimal exploitation of productive assets and thus, economic inefficiency.[5] This debate is of particular importance in the context of IP assets as they provide varying degrees of strategic (non-tax) and tax-related ownership advantages. For instance, Guadalupe, Kuzmina and Thomas (2012) find that multinational subsidiaries generally outperform comparable domestic firms due to the superior technologies, organizational practices, and market access afforded by their foreign owners. Yet, at the same time, foreign ownership of innovative assets facilitates base erosion and

[5]Consistent with this prediction, Todtenhaupt and Voget (2017) find that tax incentives to engage in M&A distort the subsequent allocation of productive factors and thereby mitigate potential productivity improvements resulting from M&A transactions. More broadly, empirical evidence of tax-induced distortions to asset ownership via M&A remains relatively sparse, and pertains primarily to general features of international tax systems. (See Huizenga and Voget (2009); Voget (2011); Hanlon, Lester and Verdi (2015); Bird (2016); Feld et al. (2016); or Arulampalam, Devereux and Liberini (2017).)

profit shifting (e.g., Grubert and Mutti (2009); Dischinger and Riedel (2011); Griffith, Miller and O'Connell (2014)).

Finally, by bringing to light the importance of nexus requirements in tax policy surrounding IP, we posit that future work could examine the extent to which the foreign-derived intangible income (FDII) provisions of the recent U.S. tax reform may increase U.S. ownership of IP assets with no change in U.S. research activity. FDII, which has been described by certain commentators as a "stingy patent box" (Sheppard, 2018), encourages U.S. companies to export services and products related to intangible income that is owned in the U.S. by allowing a preferential tax rate on a portion of that income. Because the FDII provisions are not an IP box per se and do not require linking the income to specific IP assets, the rules effectively lack nexus requirements. Future work might also examine how revised IP box regimes treat acquisition costs of IP assets via asset versus stock deals (i.e., the interaction of changes in control of IP assets and accessibility to the benefits of an IP box regime). How these nuances are explicitly handled by each country has the potential to affect deal structures.

The remainder of the paper is organized as follows: Section 2 describes the origins and general characteristics of IP box regimes, Section 3 presents a simple model of target acquisition and defines distinct channels through which to view the effects of tax and non-tax motives on M&A activity in relation to the adoption of an IP box, Section 4 describes our data and basic estimation methodology, Section 5 lays out our main results, and Section 6 concludes.

2 IP Box Regimes

Tax policy has long sought to promote innovation given its perceived role as a key driver of productivity and economic growth. Historically, these policies have largely focused on subsidizing investment in R&D, and a large literature examines their effects on the

location of R&D (e.g., Hines (1997)).[6] In addition to important non-tax determinants of R&D activity—such as the presence of an educated labor force and high quality infrastructure—generous rules surrounding the deductibility or creditability of R&D expenditures also attract R&D activity (e.g., Bloom, Griffith and van Reenen (2002); Ernst and Spengel (2011)). More recently, concerns about profit shifting have led policymakers and researchers to turn their attention to the effects of tax policy on the location of IP *ownership* (Dischinger and Riedel (2011); Karkinsky and Riedel (2012); Griffith, Miller and O'Connell (2014)). Ultimately, where IP is created versus owned depends on multiple factors, including investment subsidies, R&D labor costs, the strength of IP protection, and the ease of re-locating IP in relation to tax incentives and anti-avoidance provisions (Ernst and Spengel (2011); De Simone and Sansing (2018)).

By imposing a lower tax rate on IP income, IP box regimes promote *domestic* R&D investment relatively indirectly compared to investment subsidies.[7] Notwithstanding findings of real effects on patenting activity (Bradley, Dauchy and Robinson (2015); Bornemann, Laplante and Osswald (2017); Alstadsæter et al. (2018)),[8] it is commonly argued that IP boxes are poorly designed for stimulating new innovation (Gravelle (2016), Merrill (2016)). Nevertheless, the popularity of these regimes as a complement to traditional up-front R&D investment subsidies and as a tool to protect and expand the domestic tax base has grown extensively over the past decade, particularly in Europe.

Table 1 describes the most salient characteristics of the 12 regimes adopted in the EU prior to 2016.[9] The single unifying feature across regimes is the applicability of a

[6] See European Commission (2014) for a literature review.

[7] In concept, IP boxes may increase R&D investment domestically either if nexus requirements are binding, or if related-party transfers of ownership of R&D outputs (e.g. patents) from abroad for purposes of receiving preferential tax treatment are expected to be subject to costly transfer pricing regulations (Griffith, Miller and O'Connell, 2014).

[8] Although specific provisions differ, IP box regimes generally grant preferential tax treatment to other types of IP income in addition to patents (hence the interchangeable use of the terms patent box, innovation box, or IP box). Patent application data has traditionally been the most accessible measure of IP activity, and researchers have only recently turned to alternative measures of IP (e.g., Pfeiffer and Voget (2016)).

[9] Given the recent introduction of many of these regimes, there is still disagreement among researchers and practitioners as to what constitutes an IP box. Thus, for example, the list of IP boxes in Merrill

lower preferential tax rate for patent income, albeit with considerable variation in the rate. Regimes otherwise differ widely in the breadth of other types of IP income that may qualify for the IP box, the treatment of acquired IP (and nexus requirements more broadly), and the treatment of related R&D expenses. We return to a more detailed discussion of some of these points of divergence below.

3 M&A Incentives

3.1 Model

Though relatively rare, M&A transactions enable firms to rapidly expand or reorganize in response to changes in the market environment and have the potential to radically reshape industries. Understanding the determinants of M&A activity—including the role of taxation at multiple levels—thus features prominently in the literature at the intersection of finance, accounting, and economics, with the basic unifying premise that M&A transactions create economic value when the entities involved are worth more together than apart.[10] The premia that rival bidders are willing to pay for a target company over and above the target's own reservation price (i.e. the target's outside option) are a function of the extent to which an acquisition will generate incremental after-tax cash flows through deal-specific synergies. Deal incentives—and the role of tax and non-tax considerations—can be readily understood as follows through a stylized model of target firm valuations.

(2016) excludes Cyprus but includes Israel, whereas most other lists feature the reverse (e.g. Chen et al. (2017)). China's preferential tax rate for "high-tech" firms has many of the features of an IP box, but is generally not classified as such. We take the consensus view and focus on EU member states only. Non-EU countries with IP boxes (largely more recent and outside the realm of our analysis) include Israel, Liechtenstein, South Korea, Switzerland (Nidwalden Canton), and Turkey.

[10] We abstract from shareholder-level taxation in the discussion that follows. Though generally important for deal pricing (see, e.g., Landsman and Shackelford (1995); Erickson (1998); Ayers, Lefanowicz and Robinson (2003)), this is independent of whether firms are eligible for preferential taxation of IP. Likewise, we do not explicitly consider firms' tax status or target's tax attributes, which can also influence transaction structure and pricing (e.g., Hayn (1989); Erickson and Wang (2000)) but not differentially so with respect to IP boxes.

Target i's period-0 reservation price, RP_{i0}, equals the present value of its expected stream of after-tax profits, discounted at the world after-tax rate of return:

$$RP_{i0} = E\left[\sum_{s=0}^{\infty} \frac{(1-\tau_{is})(P_{is}Q_{is} - C_{is}(Q_{is}))}{(1+r_s(1-\tau^*_{is}))}\right] \tag{1}$$

τ_{is} represents i's average effective tax rate (ETR); P_{is} and Q_{is} represent i's profit-maximizing output price and quantity;[11] $C_{is}(\cdot)$ captures i's total cost of production; r_s is the real interest rate on a risk-free asset (common to all firms); and τ^*_{is} measures i's marginal (statutory) tax rate on passive income. Acquirer j's reservation price for target i, Bid_{ji0}, incorporates the target's own valuation, RP_{i0}, plus an acquirer-specific bid premium which reflects any expected changes in the target's after-tax profitability resulting from the change of ownership and managerial control.

$$\begin{aligned} Bid_{ji0} =& RP_{i0} \\ &+ E\left[\sum_{s=0}^{\infty} \frac{(1-\tau_{is})\cdot\Delta_j\big(P_{is}Q_{is} - C_{is}(Q_{is})\big) - \Delta_j(\tau_{is})\cdot\big(P_{is}Q_{is} - C_{is}(Q_{is})\big)}{\big(1+r_s(1-\tau^*_{is})\big)}\right] \end{aligned} \tag{2}$$

where the Δ_j terms serve as shorthand notation denoting changes in the relevant determinants of target profitability brought about by acquirer j.[12,13] Decomposition of the second term in (2) illustrates the primary mechanisms affecting bid premia ($E[\cdot] = Bid_{ji0} - RP_{i0}$):[14]

(I) *Nexus*: $\Delta_j(\tau_{is}) > 0 \Rightarrow Bid_{ji0} < RP_{i0}$

[11] In the case of a multi-product firm, P and Q can be interpreted as referring to a composite output.

[12] More formally, one can think of P, Q, $C(Q)$, and τ as *functions* of the identity of the firm owner, and the Δ_j terms denote total derivatives with respect to the identity of owner j of the associated expressions. E.g., $\Delta_j\big(P_{is}Q_{is} - C_{is}(Q_{is})\big)$ measures the total change in pre-tax cash flow in period s resulting from acquisition by firm j.

[13] This formulation attributes all benefits of the acquisition to the target. A more general formulation would also recognize impacts of the acquisition on the profitability of the acquirer's pre-merger operations. We do not model these here for brevity, but these carry similar implications (albeit likely weaker given i and j's relative position in the merged entity).

[14] Unfortunately, we are not able to check the effect of IP boxes on bid premia empirically, since we observe bid premia only for 74 targets in our sample.

(II) *Tax Planning*: $\Delta_j(\tau_{is}) < 0 \Rightarrow Bid_{ji0} > RP_{i0}$

(III) *Net Income Expansion*: $\Delta_j\big(P_{is}Q_{is} - C_{is}(Q_{is})\big) > 0 \Rightarrow Bid_{ji0} > RP_{i0} \Leftrightarrow$

i. Competition: $\Delta_j(P_{is}) > 0$ and/or

ii. Volume: $\Delta_j(Q_{is}) > 0$ and/or

iii. Efficiency: $\Delta_j\big(C_{is}(Q_{is})\big) < 0$

Ultimately, an M&A deal between acquirer j and target i must necessarily yield the largest bid premium net of transaction costs of any other possible transaction involving either firm. Thus, acquirer j is the firm that can extract the largest tax savings from target i via tax planning, for example, or provides the most cost-effective distribution network, reduces market competition to the greatest degree, etc. (or some combination thereof). Conversely, any policy or regulation which diminishes acquirer j's tax advantages or limits the exercise of market power, for instance, will reduce j's willingness to pay and hence, reduce the probability of successful acquisition.

3.2 Channels

Nexus requirements constitute just one such regulation. IP box regimes differ widely in the extent to which R&D investment by the taxpaying entity constitutes a pre-condition for IP box eligibility. Thus, whereas some regimes were designed to grant preferential tax treatment to acquired IP in a permissive manner, others have required owners of acquired IP to engage in further development, while others largely exclude acquired IP altogether. We classify countries' treatment of acquired IP in Table 1 as "permitted" (no nexus), "restricted" (limited nexus), or "disallowed" (strict nexus), respectively.[15]

The *nexus channel* (I) reflects the idea that nexus requirements implicitly reduce the share of IP income that is eligible for preferential tax treatment following an acquisition

[15]Self-development conditions constitute at least a partial nexus requirement, whereby some research activity must be carried out in the respective country for the resulting IP to be taxed at the lower IP box rate. These rules have elsewhere been shown to affect domestic patenting activity (Alstadsæter et al., 2018) and patent transfers (Gaessler, Hall and Harhoff, 2017), as well as patenting by foreign affiliates (Schwab and Todtenhaupt, 2018).

(without the acquirer engaging at a minimum in costly further development),[16] thereby raising the ETR for a target firm whose IP previously qualified for the IP box (i.e., $\Delta_j(\tau_{is}) > 0$). This threat of a *loss* of tax advantages in the target as a result of being acquired should unambiguously reduce M&A activity, with more negative effects on the probability of acquisition where nexus requirements are more restrictive. Domestic deals may hence be less negatively impacted than cross-border deals, since self-development conditions may be easier to satisfy when both the acquirer and target already have a substantial presence in the IP box country.

Hypothesis 1 (H1): *(Nexus channel) The presence of nexus requirements—whereby acquired IP may be ineligible for preferential tax treatment without further development by the acquirer—should disincentivize M&A deals because of the potential resulting loss of tax advantages in the target following M&A deals. This unambiguously decreases the likelihood for potential targets in IP box countries with nexus requirements to be acquired, with stronger negative effects in more strict nexus regimes.*

The *tax planning* channel (II) captures the idea that a tax-sophisticated acquirer may be able to effect reductions in the target firm's ETR by extending superior tax minimization strategies to the target (Belz et al., 2017). Tax planning opportunities may be especially attractive where acquirers and targets are subject to different tax systems and statutory rates, thereby introducing the possibility of new tax synergies (Huizenga and Voget (2009); Voget (2011); Feld et al. (2016); Hanlon, Lester and Verdi (2015)). This argument is not unique to M&A deals and extends more broadly to all opportunities

[16]Under the UK's restrictive regime, for instance, Her Majesty's Revenue and Customs provides the following guidance regarding the applicability of development conditions to acquired IP: "The company must have carried out the qualifying development activity and since that time not ceased to be, *or become*, a controlled member of a group" unless "[t]he company....has, for 12 months from the day it has ceased to be, *or become*, a controlled member of a group, performed activities of the same type as those that constituted the qualifying development activities." (Own emphasis added; see `https://www.gov.uk/hmrc-internal-manuals/corporate-intangibles-research-and-development-manual/cird210200`.) The disallowance of preferential tax treatment for IP acquired in the course of a company acquisition is designed to mirror the application of nexus requirements to purchased assets (Merrill, 2016).

for strategic income reallocation between affiliates of multinational groups, where IP and intangible assets are thought to play a major role (Grubert, 2003). However, whereas transfer pricing rules are likely to constrain relocation of IP within an existing multinational entity (or in the context of asset purchases), the complexity of M&A transactions may facilitate the relocation of IP and related income by masking the arm's length price of the underlying asset(s). Cross-border M&A transactions can thus present special opportunities for restructuring operations in a tax-efficient manner. To the extent that rival (foreign) bidders' maximum bid prices differ solely due to differences in expected incremental *after-tax* cash flows, this introduces the possibility of cross-border deals failing to maximize pre-tax returns, in violation of capital ownership neutrality. Without significant tax differences to arbitrage, domestic deals should be less susceptible to tax planning considerations and therefore present less concern.[17]

By lowering the tax rate on the IP-related income and thus the ETR of a potential target, the adoption of an IP box makes it more difficult for a foreign acquirer to exploit sophisticated income reallocation strategies to extract further tax reductions in relation to the target's assets, thereby weakening tax planning motives. Empirical evidence for the relevance of this argument is presented in Figure 1. As expected, average firm-level ETRs decline significantly as a reaction to an introduction of an IP box regime.

The coefficients in Figure 1 are estimated from a firm fixed effects regression with parsimonious controls for the ordinary corporate income tax rate and lagged pre-tax returns on assets and are allowed to vary according to the treatment of current R&D expenses across IP box countries (see Table 1) as well as patent ownership. The graph depicts the estimated firm-level ETR effects of a 1 percentage point reduction in the preferential tax rate on IP income following adoption of an IP box regime. As shown, average firm-level ETRs decline significantly in all cases—even among patentless firms—yet they

[17]For purposes of our empirical analysis, our definition of domestic deals excludes cases where the acquirer is located in the same country as the target, but the acquirer is either itself a subsidiary of a foreign parent or owns foreign subsidiaries. We describe our deal characterization further in Section 4.

decline further among patent-owning firms,[18] especially where current R&D expenses are deductible against gross income (i.e., at the standard corporate tax rate). Belgium's 27.2 percentage point reduction in the tax rate on IP income, for instance, is thus associated with an average post-IP box ETR reduction of roughly 9 percentage points among patent-owning firms.[19] Naturally, these tax savings should be immediately capitalized into firms' own reservation prices, thereby reducing the likelihood of being acquired by a more tax-efficient firm for the purpose of increasing target after-tax profitability through tax planning.

On the other hand, allowing for deals to also influence acquirers' original operations (not modeled), the introduction of an IP box could conceivably render target firms more attractive to foreign bidders for purposes of shifting IP income *into* the targets, much as though these were tax haven affiliates. Whether IP box regimes increase or decrease cross-border M&A activity for tax planning purposes is hence potentially ambiguous and depends on the degree to which M&A transactions facilitate reallocating assets relative to other common multinational strategies.

Hypothesis 2 (H2): *(Tax planning channel) The adoption of an IP box makes it more difficult for a (foreign) acquirer to exploit strategic income reallocation to extract further tax reductions from the target. This should reduce the likelihood for potential targets in IP box countries to be acquired. On the other hand, the introduction of an IP box could conceivably render target firms more attractive to foreign bidders for purposes of shifting IP income into the targets, which could increase the likelihood for such targets to be acquired. On balance, the former effect likely dominates given the existence of alternative solutions involving tax haven affiliates to achieve the latter, but this remains ambiguous.*

[18] Evidence of smaller, yet non-zero, reductions in ETRs for patentless firms corroborates the general point that patents are not the only source of eligible IP income in most IP box regimes.

[19] Evers, Miller and Spengel (2015) provide a detailed discussion of various IP box provisions and calculate their combined theoretical impact on ETRs for IP income. Our estimates fall well below Evers, Miller and Spengel's (2015) theoretical calculations of potential ETR reductions, but this is unsurprising given our (obligatory) calculation of ETRs based on all sources of income and wide variation across firms in terms of the share of income that might be attributed to qualifying IP.

The *net income expansion* channel (III) encompasses changes in the market environment resulting from an acquisition that contribute to increased *pre-tax* cash flows through higher prices (i) or sales volume (ii), lower non-tax costs (iii), or any combination thereof. In practice, (i) may arise through consolidation of market power and reduction in competition, thereby enabling the merged entities to raise prices in an imperfectly competitive manner. (ii) represents opportunities for market expansion (e.g. by expanding distribution and sales networks). (iii) reflects various cost efficiencies or synergies, whereby the acquiring firm may confer cost savings on the target through the extension of process improvements, management best practices, supply chain integration, elimination of redundant operations, economies of scale in production and distribution, etc. The relative importance of these effects may depend on the type of M&A transaction (i.e., whether a horizontal, vertical, or conglomerate merger) or whether the merging entities are located in the same or different countries. Whereas cross-border M&A deals may produce larger synergistic gains because of the greater "gains from trade" (Ernst and Young (EY), 2015), it is also possible that target assimilation is more difficult for cross-border deals. In practice, whereas numerous empirical studies document substantial improvements in target firm productivity following domestic acquisitions (e.g., Maksimovic and Phillips (2001); Wang and Wang (2015)), most studies fail to find evidence of further positive effects resulting specifically from foreign acquisitions (Harris and Robinson (2002); Wang and Wang (2015)).

The adoption of an IP box unambiguously increases the after-tax gains from the net income expansion channel as long as deal synergies can be attributed to qualifying IP in the target country. Gains of this sort are therefore likely to be relatively larger for domestic deals where increased returns to both the target and acquirer are eligible for preferential taxation.

Hypothesis 3 (H3): *(Net income expansion channel) Attribution of increased pre-tax cash flows to qualifying IP in the target country increases the after-tax value of deal-*

specific synergies. In the absence of strict nexus requirements, this unambiguously increases the likelihood for potential targets in IP box countries to be acquired, with larger effects on domestic deals.

Table 2 summarizes our forgoing predictions about the effects of preferential taxation of IP income on acquisition probabilities via the nexus, tax planning, and net income expansion channels. Differentiation between domestic and international deals serves to highlight variation in the role of these different channels. We assume for purposes of exposition that potential targets own eligible IP; however, we explicitly account for this in our analysis below and exploit patent ownership as a source of identification (with the caveat that patent ownership does not perfectly capture all eligible IP).

4 Data and Methodology

4.1 Data Sources

The data for this analysis are drawn from multiple sources and combine unconsolidated firm-level financial statement and M&A transaction data from Bureau van Dijk's Orbis and Zephyr databases for the period 1994-2014 along with patent application information from PATSTAT for which Bureau van Dijk has assigned unique applicant firm identifiers. We hence start from approximately 45 million patent applications linked to a business owner and registered with patent offices around the world over the years 1978 to 2016—of which 14.7 million are recorded as granted (i.e., awarded legal protection)—and we merge these according to the identity of patent applicant(s)[20] to the universe of actual and

[20] As discussed in Quick and Day (2006), legal patent ownership generally accrues to the applicant(s) registering the patent. We hence refer to patent applicants and owners interchangeably throughout. Historically, for patents filed in particular countries, such as the U.S., patent inventors were also required to be listed among the set of patent applicants but these inventor-applicants would typically relinquish their rights to all associated income under the terms of their employment contracts. This issue does not arise in our sample of firms located exclusively in the EU.

potential M&A target and acquiring firms covered by the Bureau van Dijk data.[21]

We complement these firm-level data with a set of country-level macroeconomic control variables drawn from the World Bank's World Development Indicators database. We also employ the Fraser Institute's Economic Freedom Index to capture variation in a general set of conditions thought to be conducive to economic development and business, and we use data from the European Commission on block-exempted state-aid for innovation as a measure of non-tax sources of government support for R&D. Evers, Miller and Spengel (2015) and Merrill and Shanahan (2012) serve as the main sources of information on preferential IP box tax rates and special provisions, while additional corporate and withholding tax rate data are compiled from several sources, including corporate tax guides from Ernst and Young and PwC, as well as Comtax.

4.2 Sample Restrictions

Variation in statutory requirements for filing unconsolidated financial statements gives rise to wide variation across countries in the number of useable observations available through Orbis. As a result, U.S. firms, for instance, are vastly underrepresented in our initial matched Orbis-Zephyr-PATSTAT sample. Taken in conjunction with the fact that IP box regimes remain predominantly an EU phenomenon, we consequently restrict our analysis exclusively to the EU-28 member states.

Furthermore, given our desire to exploit patent ownership as a source of identification in mediating the effects of IP boxes on M&A activity, we emphasize primarily the role of granted patents. Due to lags in the compilation of patent application information and an average period of 2.37 years between the time of application, the receipt of legal patent protection (if granted), and publication, we therefore terminate our sample estimation period in 2014. This excludes from possible consideration the initial impacts of the most recent IP box adoptions in the EU (i.e. Italy in 2015 and Ireland in 2016). Nevertheless,

[21] We exclude patents granted prior to 1978 from our calculation of firm patent stocks based on WIPO's definition of the duration of patent protection, which ranges between 15 and 20 years for most countries.

our sample encompasses the termination of Ireland's first preferential regime in 2010 plus the adoption of 10 new IP boxes that were in effect as of 2014. The distribution of firms in each of these EU IP boxes in our estimation sample appears in Table 1.

In order to improve the power of our analysis, we focus exclusively on manufacturing-sector firms where patent ownership is most heavily concentrated and where IP boxes are consequently most likely to constitute a relevant consideration. Concretely, we select firms falling in sectors 32 and 33 according to the North American Industry Classification System (NAICS).[22] These sectors account for just 6.5 percent of all firms in Orbis, yet they encompass 77.7 percent of all granted patents, 43.8 percent of patent-owning firms, and 19.1 (21.5) percent of M&A targets (acquirers) over our sample period.

After applying each of the abovementioned country, year, and industry restrictions, we preserve only those firms whose financial statements meet minimal data quality requirements in three consecutive years. We thus retain only those firms that report non-missing and non-zero information for total assets, earnings before interest and taxes (EBIT), and taxes paid over a three-year period, and we exclude any remaining such firms that never report more than $1 million in total assets (near the median value of firm size in our matched sample).[23] Observations for firms that report being in a net loss position over at least three prior years are likewise omitted.

Our final sample consists of just over 1.2 million observations, representing nearly 230,000 individual firms. Despite applying these multiple sample restrictions, patent ownership and M&A transactions nevertheless remain rare events. Just 12.6 percent of firms ever own patents in our sample, and a mere 0.19 percent of firms are acquired in any given year. Making an acquisition is somewhat more likely, with an unconditional probability of 0.51 percent. Among the set of firms that are acquired (become acquirers), however, 28.7 (50.8) percent were patent owners at the time of acquisition, consistent

[22]These sectors encompass all manufacturing except food, beverages, tobacco, textiles, apparel, and leather products.

[23]Results involving only the largest 20 percent of firms as measured by total assets (not shown) are qualitatively unchanged.

with the notion that ownership of IP is an important determinant of M&A activity.

4.3 Empirical Model and Variable Definitions

Following the set of predictions discussed in Section 3, we model the probability of being acquired as a function of target firm characteristics related to strategic non-tax and tax motives and extend the prior literature by exploiting cross-sectional and time-series variation in the implementation of IP box regimes in order to identify their particular incentive effects as they pertain specifically to the ownership of innovative assets (i.e. patents). From the target's perspective, the probability that firm i in industry j and country c is acquired in year t is thus:

$$Pr(Acquired_{ijct} = 1) = \alpha + \vec{\beta} \cdot \mathbf{I\vec{P}Box_{ct}} + \gamma \cdot Patent_{ijct-1} + \vec{\delta} \cdot \mathbf{I\vec{P}Box_{ct}} \times Patent_{ijct-1} + \vec{\theta} \cdot \mathbf{\vec{Tax}_{ct}} + \vec{\psi} \cdot \mathbf{\vec{W}_{ct}} + \vec{\rho} \cdot \mathbf{\vec{X}_{ijct-1}} + \mu_j + \eta_c + \zeta_t + \varepsilon_{ijct} \quad (3)$$

where $\mathbf{I\vec{P}Box_{ct}}$ represents a vector of IP-specific country-level tax characteristics featuring interactions of our categorical nexus requirement indicators, $I[LimitedNexus]$ and $I[NoNexus]$, with measures of either the existence of IP box legislation or the generosity thereof relative to the treatment of other sources of income (defined as the difference between the statutory corporate tax rate, CIT, and the tax rate applied to patent income), $IPBoxSavings$. $Patent_{ijct-1}$ characterizes patent holdings of the target firm. $\mathbf{\vec{Tax}_{ct}}$ represents a vector of country-level tax characteristics unrelated to IP boxes, while $\mathbf{\vec{W}_{ct}}$ includes additional time-varying target country non-tax characteristics. $\mathbf{\vec{X}_{ijct-1}}$ represents a vector of firm-level pre-acquisition financial characteristics. Time-invariant target industry fixed effects (defined at the NAICS 4-digit level) and country fixed effects are captured in μ_j and η_c, respectively. Year fixed effects are absorbed in ζ_t. Our complete set of regression variables are defined in Tables 3 and 4.

In practice, $\mathbf{\vec{Tax}_{ct}}$ consists of the statutory corporate income tax rate (alone and

interacted with $Patent_{ijct-1}$), which should affect "ordinary" tax motives for M&A activity, as well as an indicator for whether royalties received by the target firm would be taxed abroad at a rate in excess of the tax rate on patent income, $I[HighRoyaltyTax]$ (in which case preferential taxation of patent income in the target country would be less likely to yield benefits from foreign market expansion following acquisition). In our primary specification, $Patent_{ijct-1}$ is measured as a binary indicator identifying a target firm's directly-owned patent ownership as of the prior year, $I[OwnPatent]_{t-1}$. Alternate measures of $Patent_{ijct-1}$ related to firm-level patenting potential and patent quality extend our main analyses.

$\vec{\mathbf{X}}_{\mathbf{ijct-1}}$ and $\vec{\mathbf{W}}_{\mathbf{ct}}$ consist of a large set of firm- and country-level controls common to the literature on M&A activity.[24] These include measures of firms' tax sophistication (based on effective tax rates), multinational status, profitability, size, cash holdings, leverage, the relative importance of intangible versus fixed assets intensity, capital expenditures and asset growth, and whether the firm is publicly listed. Besides the aforementioned country-specific tax variables, country-level controls also include measures of economic output; the size of the labor force; unemployment; the importance of aggregate stock market capitalization, exports, and block-exempted state aid for innovation relative to GDP; inflation; the real effective exchange rate; and an index of economic freedom.

Beyond the inclusion of these numerous controls, it is important to note that the use of country, industry, and year fixed effects implies that the source of identification for our analysis is based on within-country variation in the tax treatment of patent income combined with cross-sectional variation in firm-level patent holdings. Our empirical strategy thus consists of a panel triple-differenced specification whereby target firms are differentiated by the timing and country of eligibility for preferential treatment of patent income *and the applicability (among patent owners) thereof.*

[24]See Harford (1999) for a list of typical financial factors affecting acquisition decisions. Our analysis closely follows the set of controls included in Arulampalam, Devereux and Liberini (2017) and Belz et al. (2017).

4.4 Descriptive Statistics

Figure 2 depicts the distribution across countries of observations included in our final estimation sample, while Figure 3 shows the corresponding percentage of firms that are ever acquired in an M&A transaction over the period 1994-2014. Whereas Italy, Spain, and France account for more than half of all observations in our sample,[25] the concentration of M&A activity is relatively more diffuse. Consistent with more general patterns of business dynamism, northern EU member states thus show generally higher rates of M&A activity than the more southern or eastern member states. Conversely, there is no clear evidence in this unconditional graphical framework of either higher or lower rates of M&A activity in IP box regime countries.

A snapshot of the mean values of our regression variables are presented in Table 5, with sample means computed separately depending on whether firms were acquired in the corresponding period. Columns 1-3 hence show a comparison of variable means over the full sample period between the set of firms that were not acquired (Column 1) versus those that were acquired, either as part of an international (Column 2) or domestic (Column 3) deal. Statistically-significant differences in means between non-acquired and acquired firms of each type are designated in a conventional manner. Columns 4-6 present comparable information exclusively for firms at the end of our sample period.

As shown, target firms—especially those that are acquired in international deals—are significantly different from non-acquired firms along numerous dimensions. Focusing on 2014 values to avoid compositional effects related to historical variation in M&A activity, target firms are nearly twice as likely to hold patents and more than twice as likely to have

[25]The (over)representation of Italian or Spanish firms in our sample (relative to German firms, for example) largely reflects the set countries for which financial statement information is most widely available through Orbis, either because of country-specific requirements pertaining to financial statements, variation in the prevalence of privately-held businesses, or simple variation in data collection effort and technology on the part of Bureau van Dijk. Lack of a more representative distribution of observations across countries would only be problematic insofar as acquired or acquiring firms are differentially more or less likely to be included in the sample due to unobserved factors related to international taxation, which appears unlikely.

applied for a new patent in the last five years, face lower effective tax rates, earn higher rates of return, and they are generally larger and less leveraged. Targets acquired through international deals are also significantly more likely to be multinationals themselves, are more intangible intensive, and hold a smaller share of their assets in cash. They also reside in countries with lower corporate tax rates and unemployment and face lower average withholding tax rates on royalty receipts and greater aggregate stock market capitalization. Notably, target firms do *not* differ in a statistically-significant manner in terms of capital expenditures or growth, or in the probability of being publicly-listed.

Among the subset of firms located in IP box countries, target firms are disproportionately concentrated in regimes offering *less* generous treatment of patent income, especially for international deals. This is loosely suggestive of a potential role played by tax planning opportunities in motivating cross-border M&A transactions (i.e. through reductions in the appeal thereof in countries granting more favorable taxation of IP). However, to the extent that any of these characteristics may be spuriously correlated with the temporal or geographic distribution of IP box regimes and M&A activity, these statistics confirm the importance of controlling for these many attributes in our analyses of M&A probabilities using panel estimation methods.

5 Results

5.1 Panel DiD - Patent Ownership

Table 6 presents ordinary least squares regression estimates for our main empirical specification involving interactions of IP box tax savings rates, $IPBoxSavings$, with indicators for the stringency of nexus requirements, $I[LimitedNexus]$ and $I[NoNexus]$, and an indicator of (lagged) patent ownership, $I[OwnPatent]_{t-1}$, to assess their combined impact on a firm's likelihood of being acquired.[26] IP box regimes with strict nexus requirements

[26]We estimate equation (3) as a linear probability model in order to allow for consistent estimation of country, industry, and year fixed effects, along with a set of non-linear patent ownership and tax

constitute the omitted reference group. Using these interactions, along with comparisons between outcomes involving all deals versus strictly international or domestic deals, we intend to tease out the various hypothesized effects in Table 2. For purposes of legibility, the dependent variable is set equal to 100 for firms acquired in an M&A deal and zero otherwise.[27]

For brevity, we report coefficient estimates for the key interaction terms in the upper half of Table 6 followed by their implied marginal effects, expressed as the relevant sum of partial effects attributable to a one unit change in $IPBoxSavings$, scaled by the corresponding unconditional probability of acquisition for patent-less and patent-owning firms. The latter overall marginal effects in the bottom half of Table 6 hence measure the effect of a one percentage point change in $IPBoxSavings$ as a percent change in the predicted probability of acquisition. Robust standard errors are calculated allowing for two-way clustering at the country and year levels. The full set of coefficient estimates, including our numerous control variables, are shown in appendix Table A.1. These generally have the predicted sign, but given the rarity of M&A transactions, the overall predictive fit of the model remains low.

As one would expect, results from more basic specifications that exclude tax and patent interaction terms (unreported) do not reveal any significant effects on deal probabilities. Without considering interactions among patent ownership, tax savings, and nexus requirements, these specifications cannot distinguish among the various channels summarized in Table 2. In contrast, looking first at Column 1 of Table 6, we see that—holding ordinary corporate tax rates fixed—lower tax rates on IP income (i.e. larger $IPBoxSavings$) have a negative impact on the probability of a target firm being acquired in an M&A deal when $I[LimitedNexus]$ and $I[NoNexus]$ are both zero (i.e.

interactions. Binary dependent variable models (probit or logit) are not well suited to fixed effects estimation, nor do they yield readily-interpretable marginal effects for interacted regressors. Linear probability model generally perform well for these types of applications (Wooldridge (2010); p. 563).

[27]Multiplication of our binary dependent variable by 100 merely rescales all of our coefficient estimates accordingly, such that these have the direct interpretation of *percentage point* impacts on the probability of acquisition.

acquired IP is disallowed preferential tax treatment). Moreover, this negative effect is significantly more pronounced where the target is also a patent owner, consistent with the idea that IP-owning target firms may become less attractive in IP box countries where acquisitions risk triggering a loss of IP box eligibility for IP income.[28]

In terms of economic magnitude, the combined coefficients on $IPBoxSavings$ and $IPBoxSavings \times I[OwnPatent]_{t-1}$ in Column 1 imply that a 1 percentage point increase in IP box regime generosity is associated with an overall reduction in the probability of being acquired for a patent-owning firm of approximately 2.428 percent (p-value < 0.01). Assuming an average level of $IPBoxSavings$ of 18.5 percentage points, the implication is that the exclusion of acquired IP from preferential taxation is associated with a roughly 50 percent reduction in the probability of being acquired for patent-owning firms. We find a similar average effect (unreported) where we flag the existence of an IP box irrespective of the tax savings rate using a binary indicator variable.

When we further differentiate among countries extending preferential treatment to acquired IP, the negative effect of IP box regimes on the likelihood of being acquired dissipates, especially in the most permissive regimes, as indicated by the positive coefficient across all deal types on the triple interaction, $I[NoNexus] \times IPBoxSavings \times I[OwnPatent]_{t-1}$. The net effect on deal probabilities for IP-owning targets resident in more permissive IP box countries with either limited or no nexus requirements is hence

[28]Our theory predicts that the nexus channel would have a negative effect on deal probabilities for IP-owning target firms in countries that do not extend preferential treatment to acquired IP. The significant negative coefficient on the uninteracted $IPBoxSavings$ term (-0.4729; p-value < 0.05) suggests either the influence of other channels not directly related to target patent ownership, or—as is generally true across all of our specifications—this may reflect in part the limitations associated with using patent ownership as a proxy for IP box eligibility. First, as discussed previously, many IP box regimes encompass various forms of IP besides patents, which we do not observe. Second, our ability to identify patent-owning firms is limited by Bureau van Dijk's gradual process of updating firm identifiers in the patent application data to facilitate merging Orbis and PATSTAT data. Thus, some of our patent-less firms may in fact own patents, or be on the verge of receiving patent protection for a prior application. Depending on the prevalence of this form of measurement error, this will result in smaller estimates of the differential effects of patent ownership. Indeed, when we broaden our definition of IP box eligibility to include patent owners as well as recent patent applicants, we find marginally weaker baseline IP box tax savings effects among patent-less firms and stronger differential tax savings effects among patent owners/applicants (results available upon request).

not significantly different from zero.[29] Thus, we find strong support for the importance of the nexus channel as a deterrent to M&A activity in countries with strict nexus requirements. Contrasting these results across international (Column 2) and domestic (Column 3) deals, it is clear that the negative effect of nexus requirements arises primarily in cross-border deals, consistent with the idea that further development conditions may be more easily satisfied in domestic deals due to the pre-existing presence of both target and acquirer operations in the IP box country.

Naturally, the nexus channel—even the absence of nexus requirements—is insufficient to justify *increased* M&A activity. The positive and significant coefficient on the interaction term, $I[NoNexus] \times IPBoxSavings \times I[OwnPatent]_{t-1}$ in Column 3 therefore provides evidence of the relative importance of the net income expansion channel for domestic deals. In contrast to international deals, all synergistic gains attributable to both the target and the acquirer's original IP are potentially eligible for preferential taxation in the context of domestic deals, and these incentives are particularly strong in countries extending preferential treatment to acquired IP ($I[NoNexus] = 1$). Despite large standard errors, the point estimates in Column 3 on the marginal effect of $IPBoxSavings$ in patent box regimes with no nexus requirements thus suggest a positive overall impact of tax savings on the probability of being acquired in a domestic deal (i.e. net semi-elasticity = 3.602; p-value = 0.164 for patent-owning firms).

5.2 Panel DiD - Patent Quality

Differentiating firms according to a binary indicator of patent ownership has the virtue of drawing a sharp distinction between firms with and without access to an essential source of IP box-eligible IP income. Nevertheless, this distinction also masks potentially

[29] The overall effect on international deals for patent-less firms in countries without nexus requirements, however, remains negative (p-value < 0.1), perhaps suggesting a disincentive for foreign acquirers to purchase targets with "yet-to-be-patented" technologies. Given OECD recommendations (and eventual agreement to adopt the OECD's modified nexus approach for the calculation of qualifying income), potential acquirers may have expected nexus requirements to strengthen over time, meaning that acquired in-process IP might fail to qualify for preferential taxation in the future.

important variation in patent value; indeed, the strength of the aforementioned M&A incentive effects should be increasing in the amount of income attributable to firms' patent holdings. We test this prediction using two very different measures of firm-level average patent quality, the results of which are reported in Tables 7 and 8. These results largely bear out the prediction and help to further corroborate our main findings as reflecting a direct consequence of IP box adoption.

The first measure, $GrantedShare_{t-1}$, uses information on all patent *applications* and computes the fraction of each firms' applications that are eventually granted (allowing for at least a two-year delay between application and publication dates). As shown in Table 7, a higher granted share is generally associated with an amplification of the effects reported for patent owners in Table 6—negative or positive. Thus, for instance, in the scenario where we expect the net income expansion channel to play the strongest role,[30] a 1 percentage point increase in $IPBoxSavings$ in a country with no nexus requirements yields a 5.404 percent increase in the probability of acquisition for a firm whose patent applications have all been granted ($GrantedShare_{t-1} = 1$) as part of a domestic M&A deal (p-value < 0.1). Despite its appealing simplicity, however, $GrantedShare$ fails to distinguish highly innovative firms with a high patent success rate across multiple applications versus firms with a single (successfully-granted) patent application.[31]

Our second proxy for patent quality, $I[HighCites]_{t-1}$, is explicitly intended to differentiate amongst firms with the highest quality patents based on a vintage-adjusted count of patent citations, $AdjustedCites_{t-1}$, and is equal to 1 for those firms in the top 95$^{\text{th}}$ percentile of the adjusted citations count distribution.[32] Table 8 reports the coefficients

[30]The strongest effect should occur for patent owning firms resident in patent box countries without nexus requirement. ($I[NoNexus] \times IPBoxSavings \times GrantedShare_{t-1}$) indicates the economic effect of the patent box tax savings rate for such firms. The corresponding semi-elasticities are shown in the last row of Table 7.

[31]Similarly, $GrantedShare_{t-1} = 0$ conflates firms with zero patents with those whose applications have never been granted.

[32]Adjusted citation counts are defined at the patent level by subtracting the average citation count across all patents that were granted in the same year, and we average these across all patents held at the firm-level. Skewness in the citation distribution produces a large mass of patent owners with an average adjusted citation count of ≤ 0 (i.e. at or below the vintage average) below the 85$^{\text{th}}$ percentile.

for the key $IPBoxSavings$, nexus, patent ownership, and high-quality patent indicator interactions, with estimates of marginal changes in predicted probabilities of acquisition among patent-owning firms below. Among firms with $I[HighCites]_{t-1} = 0$ (i.e., all but the highest-quality patent-owning firms), we see very similar implied marginal effects as in the more general results from Table 6. This is unsurprising given the close similarity between samples. Among firms with $I[HighCites]_{t-1} = 1$, however, we see even more marked amplification of the negative effects which we attribute to the nexus channel and—to a lesser degree—the positive effects which we attribute to the net income expansion channel.[33] Overall, these results confirm that IP box regimes have especially large effects on M&A activity where "blockbuster" patents are involved.

Regardless of our measurement of IP box eligibility, comparisons of outcomes between international versus domestic deals yields little conclusive evidence about the importance of the tax planning channel. Nexus requirements appear to yield stronger disincentives for international acquisitions, whereas the net income expansion channel appears to play a stronger role in promoting domestic deals. Absent stronger evidence of a significant negative effect of IP box tax savings on international deals in countries without nexus requirements, the relative strength of the nexus and net income expansion channels across deal types masks any effects attributable to tax planning incentives. We return to this consideration at the conclusion of our event study analysis in the next section.

5.3 Intertemporal Effects

To the extent that details of IP box regime characteristics were known before formally going into effect, firms may have acted in *anticipation* of regime implementation by either accelerating or delaying M&A transactions to best exploit the relevant IP box

[33]The estimated 6.805 percent increase in the probability of domestic acquisition of high patent citation firms in countries without nexus requirements resulting from a 1 percentage point increase in $IPBoxSavings$ is marginally insignificant at conventional levels (p-value = 0.11). Only 11 of the 81 acquisitions of high-citation patent owners in our estimation sample are domestic, hence the relatively low power for tests of domestic deal probability effects.

tax advantages or disadvantages. For example, firms might conceivably have sought to pre-empt the imposition of nexus requirements by acquiring IP prior to regime implementation. Anticipation effects of this sort would constitute a violation of the parallel trends assumption underlying our panel DiD identification strategy and would tend to bias our estimated IP box effects toward zero. More broadly, simple pre-/post-IP box comparisons—as the preceding analysis implicitly emphasizes—might correspondingly fail to pick up important trends in firm responses arising both before and after regime adoption.

We consequently extend our previous analyses from Section 5.1 by applying an event study design, which allows us to test explicitly for leads and lags of IP box incentive effects. For each IP box country, we define period $t = 0$ as the year of regime adoption, and we construct a full set of binary indicator variables flagging periods $t = -2$ through $t = 2$ centered around the year of adoption. To these we add two endpoint indicators which take on values of 1 for all periods at least 3 years before or after regime adoption. Each of these indicators are then used to construct interactions with our measures of period $t = 0$ IP box tax savings and nexus requirement indicators.[34] As a final normalization, we constrain our estimates of IP box effects in period $t = -3$ (including earlier years) to be zero, such that our remaining estimates for periods $t = -2$ through $t = 3+$ should be interpreted as differential effects relative to this base period.[35] This yields a modified empirical model in which each component of the vector of IP box characteristics, $\mathbf{IP\vec{B}ox_{ct}}$, from equation (3) is replaced with 6 period-specific regressors. As before,

[34]Spain introduced an IP box in 2008. Using a Spanish firm as an example, we would have $IPBoxSavings_{-3} = 0.18$ for all years ≤ 2005 and 0 otherwise; $IPBoxSavings_{-2} = 0.18$ in 2006 and 0 otherwise; $IPBoxSavings_{-1} = 0.18$ in 2007 and 0 otherwise; etc., until we get to $IPBoxSavings_{+3} = 0.18$ for all years ≥ 2011 and 0 otherwise. Among countries that never adopt an IP box, all of these terms are uniformly zero. For IP box regimes that change provisions over time, we use the set of provisions that were in effect at the time of initial regime adoption.

[35]This normalization implicitly assumes that firms could not have anticipated the effects of IP box adoption more than 3 years prior to implementation. This appears plausible given the typical time elapsed between serious tax policy reform discussions, policy enactment, and implementation. Extending the analysis to test for earlier anticipation effects is confounded by changes in sample composition due to our sample period beginning in 1997, 3 years prior to the first new IP box enactment (France).

each of these terms are further interacted with $I[OwnPatent]_{t-1}$ when we consider acquisitions of targets to differentiate intertemporal IP box effects as a function of patent ownership. This yields a total of 36 period-specific IP box-related regressors in a single specification. All other elements of our main empirical specifications including controls and fixed effects remain unchanged.

Results from our event study analyses examining the effects of IP box regime characteristics on the likelihood of being acquired are depicted graphically in Figure 4. Panels (a), (c), and (e) on the left report the estimated effects of regime adoption on international deals, assuming an IP box tax savings rate near the median level of regime generosity (i.e. $IPBoxSavings = 0.15$), while our results for domestic deals (based again on the set of 36 period-specific IP box-related coefficient estimates discussed above) are split across the three panels on the right. Panels (a) and (b) depict the baseline IP box effect *in countries with strict nexus requirements*, while the panels in the middle and bottom rows report the relevant comparable effects in countries with limited nexus requirements and no nexus requirements, respectively (i.e. summing coefficients for $IPBoxSavings_{ct_s} + IPBoxSavings_{ct_s} \times I[LimitedNexus]_{ct_s}$ (middle row) and $IPBoxSavings_{ct_s} + IPBoxSavings_{ct_s} \times I[NoNexus]_{ct_s}$ (bottom row), with the tax savings rate set to 0.15). Whisker bars extending around each point estimate denote 95 percent confidence intervals.

Examination of Figure 4 brings additional useful nuance to our results discussed in Section 5.1. First, it appears that anticipation effects—though present in some cases—were not enormously influential, thereby offering some reassurance regarding the validity of our general panel DiD approach. Significant IP box effects are thus primarily concentrated immediately around the period of regime adoption. Second, many of the patterns discussed in the context of our DiD results are well corroborated by the trends in IP box effects. For example, panels (a) and (b) both confirm the general negative effects of IP box adoption on the probability of being acquired in countries with strict

nexus requirements, especially among patent-owning firms. However, we also see that this negative effect is felt most strongly in the year of IP box adoption and the following two years before dissipating partially by the end of the event period. Furthermore, international deals appear more suddenly and significantly affected on impact than domestic deals, which again emphasizes expected differences in the cost of complying with nexus requirements as a function of the location of the acquiring firm.

A similar time pattern of adjustment between international and domestic deals also manifests itself in IP box regimes that impose limited nexus requirements on acquired IP or none at all, albeit with a one-year delay for domestic deals relative to international deals. Anticipation effects appear to play a more important role in countries where acquired IP is granted preferential tax treatment subject to certain self-development requirements (panels (c) and (d)), as evidenced by spikes in IP box-driven acquisition probabilities prior to the year of regime adoption, but these effects arise a year earlier in the context of international deals (p-value > 0.1) than for domestic deals. These peak effects also arise a year or more sooner than in the most permissive regimes. This suggests that firms were more likely to seek to pre-empt the loss of IP box eligibility for acquired IP in countries where at least some nexus requirements were expected to be imposed, and where acquirers could devote the requisite 12 months of further development (as under the UK regime, for instance) to secure the preferential taxation of acquired IP.

Irrespective of the timing of firm responses, it is also noteworthy that the impact of the implementation of IP box regimes—at least among regimes offering close to the average level of tax savings—was positive among patent-owning targets, albeit typically in only a single period surrounding regime adoption. The lack of more persistent positive effects is likely responsible for our inability to find evidence of more pronounced positive effects of IP box tax savings in our general DiD analysis, but this is consistent with the net income expansion channel triggering a short-lived spike in M&A activity as marginal transactions whose restructuring costs previously outweighed the expected after-tax value

of synergistic gains suddenly become attractive on an after-tax basis. Despite heightened ongoing incentives, such a spike in M&A activity might subsequently induce a mechanical decline in acquisitions due to a temporary depletion of the pool of potential deals, thereby resulting in an apparent zero effect of IP box provisions on the probability of being acquired in the medium term.

Translated into percent changes in the probability of acquisition, the estimates depicted in Figure 4 for international and domestic deals are of a relatively similar magnitude (i.e. given that the unconditional probability of being acquired is roughly twice as large for international deals as for domestic deals). To the extent that the tax planning channel ought to impact international and domestic deals differently, a final implication of Figure 4 is to reinforce the conclusion that tax planning does not appear to play an important role in modulating the effects of IP box regimes on the probability of being acquired. Instead, the significant positive impact of IP box tax savings on acquisitions of patent-owning firms in countries without nexus requirements in the period immediately surrounding regime adoption emphasizes the importance of the net income expansion channel for all deals.

6 Conclusion

IP box regimes reward ownership of successful technology by imposing a lower tax rate on income derived from the commercialization of IP assets relative to other sources of business income. With respect to base erosion and profit shifting, these preferential tax regimes have two complementary objectives: (1) to protect the domestic tax base by decreasing incentives to engage in outbound income shifting to lower tax rate countries, and (2) to attract mobile income from higher tax rate countries by increasing incentives to engage in inbound income shifting. This latter objective, however, comes at the expense of increased base erosion elsewhere in the world, and enables IP box countries

to operate as tax havens for IP assets without resulting in any incremental innovation. Concerns about this fact have recently led the participants in the OECD's BEPS Inclusive Framework (115 countries) to agree upon a set of minimum standards for preferential tax regimes—key among these being that all IP box regimes must adopt nexus rules. These requirements stipulate that taxpayers may only claim preferential tax treatment for IP income in proportion to the ratio of qualifying to total expenditures, and IP acquisition costs may not be considered a qualifying expenditure. The objective is to reduce incentives for solely tax motivated location decisions regarding IP ownership by requiring a link between R&D expenditures, IP assets, and IP income, in order to gain access to the IP box.

A potential unintended consequence of this recent emphasis, however, is that imposing restrictions on preferential tax treatment for acquired IP may lead to distortions in the M&A market and thereby violate the principle of capital ownership neutrality. As we show, IP box regimes with strict nexus requirements (i.e., where acquired IP is strictly ineligible for preferential taxation) have a significant negative effect on the probability of firms being acquired. In contrast, in regimes without nexus requirements, we see a general positive impact of IP boxes on M&A activity for both international and domestic deals, with relatively larger and more persistent effects arising in the domestic context. We attribute these positive effects to increased after-tax valuations of merger-driven synergies, which may confer larger benefits to the merging parties in situations where both the acquirer and target are directly eligible for the IP box, as in domestic deals. Opportunities for tax planning, meanwhile, appear to play a negligible role. Strict nexus requirements may consequently discourage precisely the wrong types of M&A transactions from an efficiency standpoint: namely, deals which might otherwise generate important synergies and productivity improvements.

Our study has important implications regarding appropriate tax policies that limit distortions to ownership of valuable IP assets and create incentives for incremental in-

novation. As countries look to modify their IP box regimes to include detailed nexus requirements, our results demonstrate the importance of distinguishing methods of IP acquisition by explicitly differentiating the treatment of IP acquired via M&A versus asset purchases (with appropriate guardrails to prevent re-characterization of the latter as the former). Our results also suggest that recent tax policy for innovation introduced by the U.S. through its so-called FDII rules, without any nexus requirements at all, would be expected to preserve and/or improve the domestic tax base via U.S. IP ownership, but with no significant increase in U.S. research activity. Innovation tax policies that reward IP ownership, but do not ultimately generate additional research activity are distortive and undesirable from an economic efficiency standpoint.

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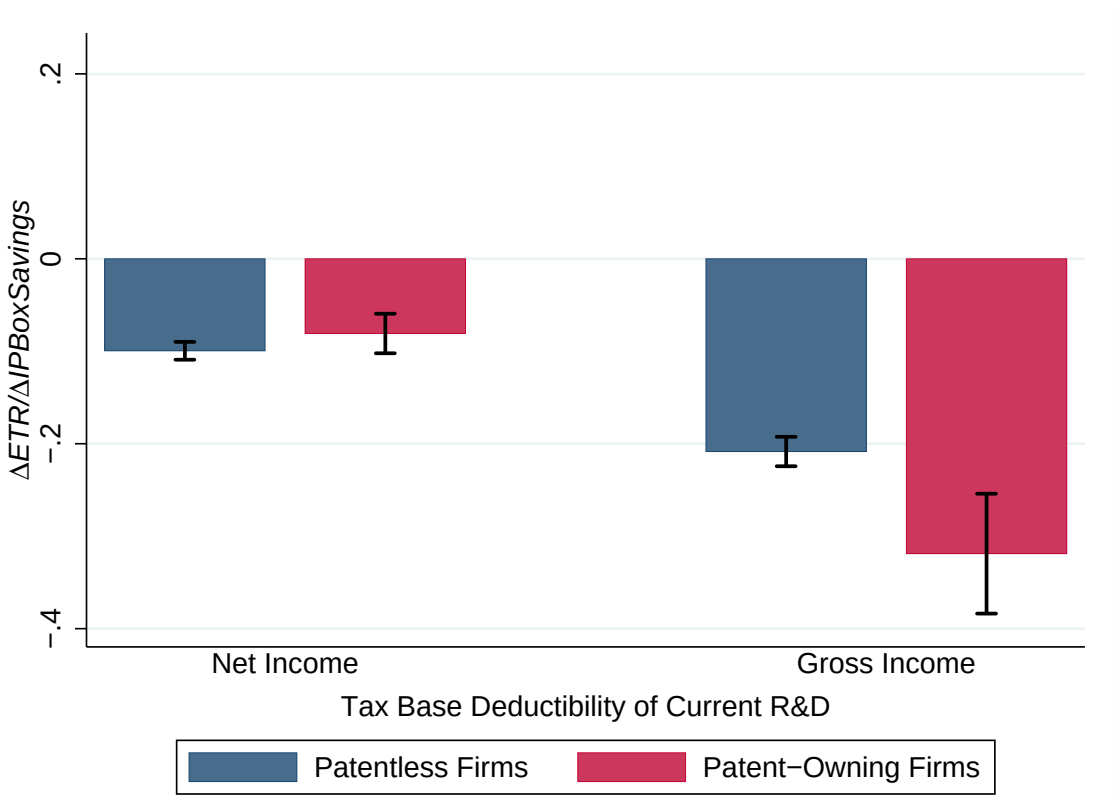
Figure 1. Effect of IP Box Tax Savings on Firm ETRs



Reported coefficient estimates and 95% confidence intervals (whisker bars) are drawn from a firm fixed effects regression, using ordinary corporate income tax rates and lagged pre-tax returns on assets as controls. See Table 1 for the categorization of current R&D expense deductibility and Table 4 for the definition of $IPBoxSavings$.

Figure 2. Sample Distribution by Country: 1994-2014

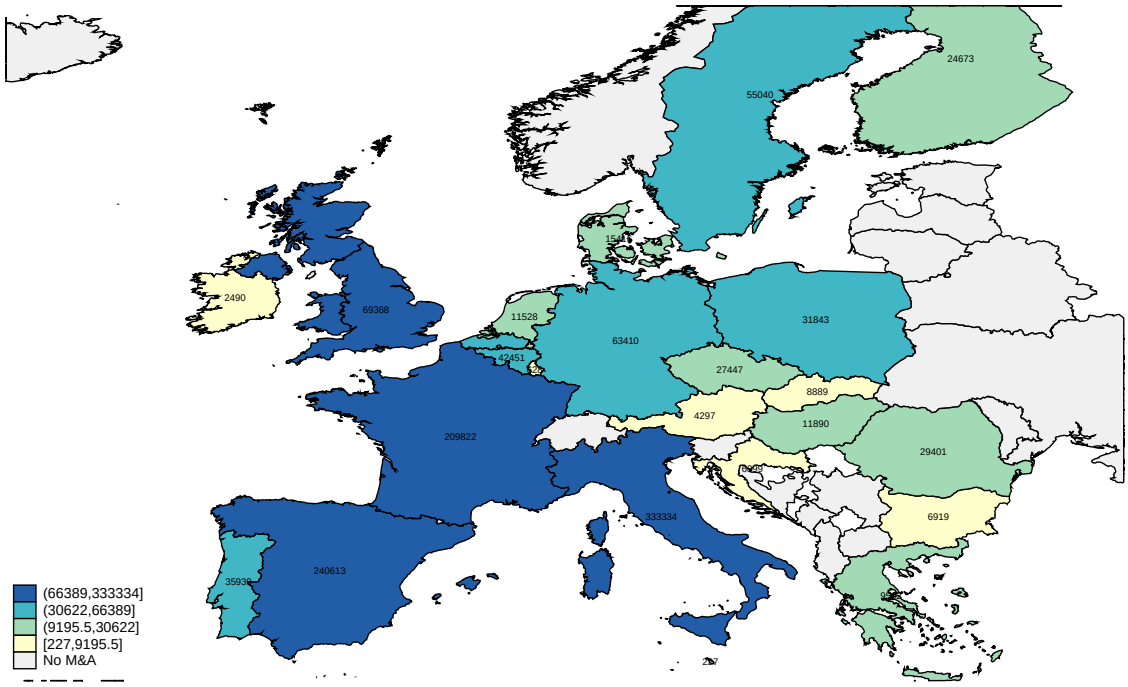


Figure 3. Share of Acquired Firms by Target Country: 1994-2014

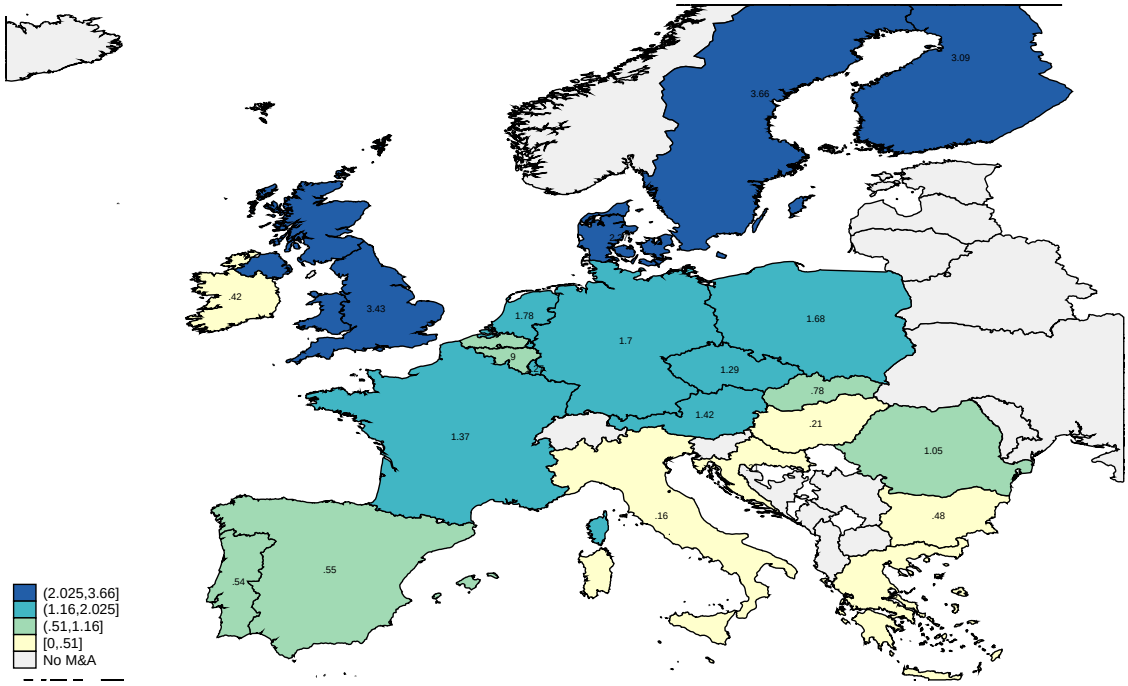
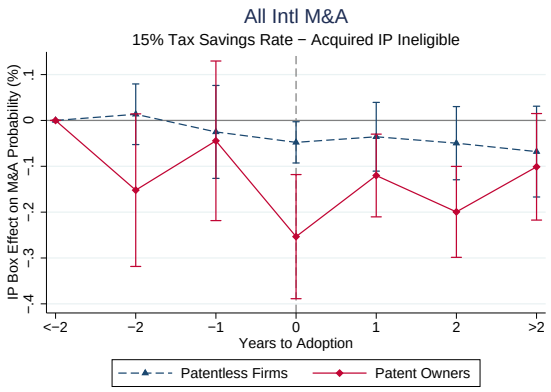
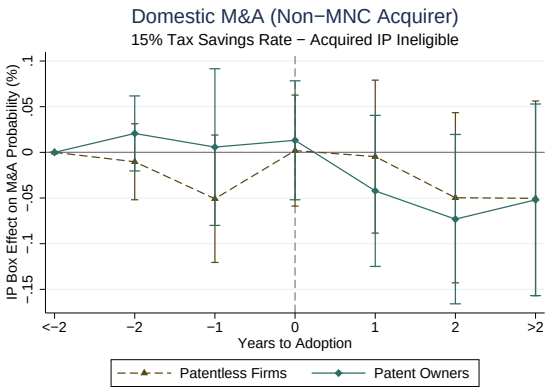


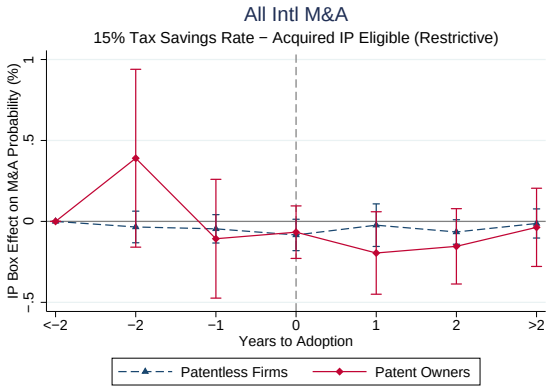
Figure 4. IP Box Effects on the Likelihood of Target Acquisition: Event Study Estimates



(a)



(b)



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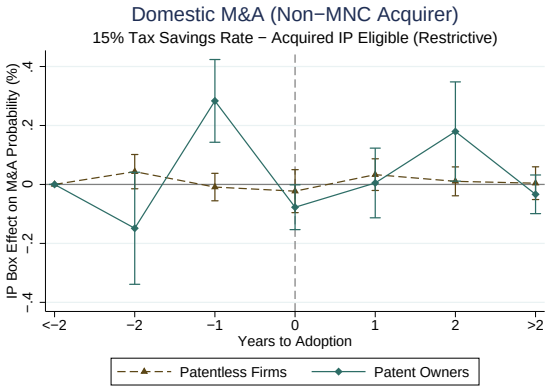
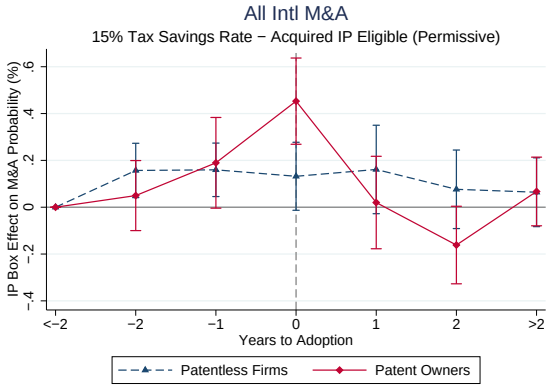


(d)



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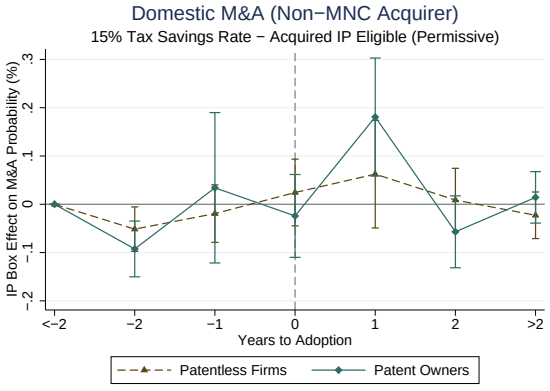


(f)

Whisker bars represent 95% confidence intervals.

Table 1. Selected Characteristics of EU IP Box Regimes
and Distribution of Sample Firms (1994-2014)

Country	Years	Number of Sample Firms	Tax Rate (Percent) IP Income	Main	Eligible IP Acquired IP[d]	Existing IP	Qualifying Income IP Types[e]	Tax Base Deductibility of Current R&D
BE	2007 -	7106	6.8	34	Restricted	No	Narrow	Gross income
CY	2012 -	29	2.5	12.5	Permitted	Yes	Broad	Net income
ES	2008 -	31038	12	30	Disallowed	Yes	Narrow	Net income
FR	2000 -	29037	16.76	38	Permitted	Yes	Narrow	Net income
HU	2003 -	2908	9.5	19	Permitted	Yes	Broad	Gross income
IE[a]	1973 - 2010	712	0	12.5	Permitted	Yes	Broad	Net income
IT	2015 -	80800	15.65	31.3	Restricted	Yes	Broad	Net income
LU	2008 -	158	5.84	29.3	Restricted	No	Broad	Net income
MT	2010 -	59	0	35	Permitted	No	Broad	Not deductible
NL[b]	2007 -	2417	5	25	Restricted	No	Narrow	Net income
PT	2014 -	6120	11.5	30	Disallowed	No	Narrow	Gross income
UK[c]	2013 -	12957	10	21	Restricted	Yes	Broad	Net income

Sources: Merrill and Shanahan (2012); Evers, Miller and Spengel (2015); PwC (2015); Schwab and Todtenhaupt (2018); and Chen et al. (2017). Corporate tax rates are based on applicable rates for the last year in our sample (2014) using data from Comtax and the OECD. Tax rates on IP income are based upon full phase-in of IP box provisions (e.g. NL, IT, UK).

[a] Prior to enacting a new IP box regime in 2016, Ireland had an IP box that it terminated in 2010 after an EC case challenging the country's original nexus requirements (which led to an initial lack of nexus requirements throughout EU IP box regimes). Irish nexus requirements under its original regime were terminated in 2008.

[b] The Netherlands lowered its IP box tax rate to 5 percent in 2010.

[c] The UK regime is being phased in over five years. In 2013, companies were only entitled to 60 percent of the full benefit, increasing to 70 percent, 80 percent and 90 percent in subsequent years, becoming fully available (i.e., at the 10 percent rate) in 2017. The relevant tax base for the deductibility of current R&D expenses is net income *before interest*.

[d] Our characterization of the treatment of acquired IP treats divergent classifications in Schwab and Todtenhaupt (2018) and Chen et al. (2017) as constituting an intermediate (i.e., "restrictive") regime. Specific provisions vary widely between countries. Pursuant to the OECD's 2015 Action 5 report, all new and existing IP box regimes are required to institute new nexus provisions. These requirements post-date our analysis and are not reflected here.

[e] "Narrow" qualifying IP is limited to patents and may extend to patentable or protected inventions such as SPC (supplementary protection certificates), software, and designs/models. "Broad" qualifying IP is not limited to patents but extends to other types of IP such as trademarks, know-how, business secrets, business formulas, and copyrights.

Table 2. Channels through Which IP Box Regimes Could Impact M&A

Probability of being acquired:	Channel		
	Nexus	Tax Planning	Net Income Expansion
Domestic deal	-	No effect	+
International deal	−	±	+

Table 3. Firm-Level Variable Names and Definitions

Variable Name	Description	Timing
$I[OwnPatent]_{t-1}$	Binary indicator equal to 1 for direct ownership of at least 1 granted patent	1-year lag
$GrantedShare_{t-1}$	Share of patent applications resulting in granted patent(s)	1-year lag
$AdjustedCites_{t-1}$	Average vintage-adjusted patent citation counts	1-year lag
$E\bar{T}R_{-3}$	Effective tax rate: equal to taxes paid divided by pre-tax income (EBIT) and winsorized to [0,1]	Lagged 3-year average
$R\bar{O}A_{-3}$	Profit rate: equal to pre-tax income (EBIT) divided by total assets	Lagged 3-year average
$\log(\bar{Assets})_{-3}$	Firm size: equal to the natural log of total assets	Lagged 3-year average
$\bar{Intan}_{-3}$	Intangibles intensity: equal to intangible assets divided by total assets	Lagged 3-year average
$\bar{Cash}_{-3}$	Cash holdings: equal to cash and cash equivalents divided by total assets	Lagged 3-year average
$I[HighGrowth]_{t-1}$	Binary indicator equal to 1 for firms experiencing above-median growth in total assets	1-year difference
$CapitalSpend_{-3}$	Capital expenditures: equal to the change in fixed assets	Lagged 3-year difference
$I[Listed]_{t-1}$	Binary indicator equal to 1 for publicly-listed firms	1-year lag
$\bar{Leverage}_{-3}$	Leverage: equal to total liabilities divided by total assets	Lagged 3-year average
$\bar{Tangibility}_{-3}$	Tangibility: equal to fixed assets divided by total assets	Lagged 3-year average
$I[MNC]$	Binary indicator equal to 1 for multinational firms (based on existence of foreign subsidiaries)	
$I[HavenSubs]$	Binary indicator equal to 1 for firms with at least one foreign tax haven subsidiary	

Table 4. Country-Level Variable Names and Definitions

Variable Name	Description
$I[IPBox]$	Binary indicator equal to 1 in IP box regime countries
CIT	Statutory corporate income tax rate
$IPBoxSavings$	IP box tax savings: equal to CIT minus tax rate on patent income (IP box rate or CIT)
$I[LimitedNexus]$	Binary indicator equal to 1 in IP box countries that grant preferential treatment to acquired IP (modestly restrictive)
$I[NoNexus]$	Binary indicator equal to 1 in IP box countries that grant preferential treatment to acquired IP (unrestricted)
$I[HighRoyaltyTax]$	Binary indicator equal to 1 in countries whose average bilateral royalty withholding tax rate on royalty receipts exceeds the tax rate applied to patent income
$MarketCap$	Market capitalization as a share of GDP
$\Delta MarketCap$	Annual change in market capitalization as a share of GDP
$\log(LaborForce)$	Natural log of total labor force
$Unemp$	Unemployment rate
$Exports$	Exports as a share of GDP
$\log(GDP)$	Natural log of real GDP per capita (PPP)
CPI	Inflation, measured according to consumer price index
$REER$	Real effective exchange rate
EFI	Fraser Institute Economic Freedom Index
$R\&DStateAid$	Block-exempted state aid for innovation as a share of GDP

Table 5. Variable Means by Deal Type

Variable Name	Full Sample			2014 Only		
	No Deal	Intl	Domestic	No Deal	Intl	Domestic
	(1)	(2)	(3)	(4)	(5)	(6)
Firm-Level Characteristics:						
$I[OwnPatent]_{t-1}$	0.120	0.315***	0.216***	0.158	0.279***	0.188
$GrantedShare_{t-1}$	0.059	0.140***	0.097***	0.074	0.121***	0.076
$I[MNC]$	0.093	0.243***	0.185***	0.100	0.305***	0.083
$I[HavenSubs]$	0.016	0.048***	0.038***	0.017	0.033	0.021
$\bar{ETR}_{-3}$	0.384	0.304***	0.302***	0.386	0.312***	0.281***
$\bar{ROA}_{-3}$	0.102	0.127***	0.119***	0.090	0.123***	0.125**
$\log(\bar{Assets})_{-3}$	8.240	9.830***	9.140***	8.540	9.890***	9.090***
$\bar{Intan}_{-3}$	0.028	0.038***	0.027	0.026	0.044***	0.017
$\bar{Cash}_{-3}$	0.115	0.110	0.129	0.131	0.111*	0.201**
$I[HighGrowth]_{t-1}$	0.530	0.530	0.501	0.504	0.506	0.458
$CapitalSpend_{-3}$	0.001	0.007	0.014*	-0.069	0.008	-0.003
$Listed_{t-1}$	0.011	0.032***	0.075***	0.008	0.020	0.063
$\bar{Leverage}_{-3}$	0.610	0.567***	0.559***	0.586	0.559*	0.476***
$\bar{Tangibility}_{-3}$	0.281	0.284	0.285	0.280	0.249**	0.253
Country-Level Characteristics:						
CIT	0.310	0.297***	0.295***	0.299	0.274***	0.290
$I[HighRoyaltyTax]$	0.073	0.035***	0.034***	0.113	0.058***	0.063
$MarketCap$	63.80	76.90***	83.40***	54.30	72.80***	83.10***
$\Delta MarketCap$	0.114	0.239***	0.216***	0.363	0.382	0.379
$\log(LaborForce)$	16.70	16.60***	16.40***	16.80	16.80	16.60
$Unemp$	0.100	0.083***	0.084***	0.119	0.096***	0.094***
$Exports$	0.338	0.379***	0.370***	0.377	0.388	0.399
$\log(GDP)$	10.40	10.50***	10.50***	10.50	10.50***	10.50***
CPI	0.023	0.023	0.022	0.003	0.006***	0.006***
$REER$	0.994	1.020***	1.020***	0.996	1.020***	1.010*
EFI	7.360	7.520***	7.540***	7.360	7.500***	7.500***
$R\&DStateAid$	0.008	0.008	0.006***	0.022	0.025***	0.022
IP Box Characteristics:[a]						
$IPBoxSavings$	0.185	0.175***	0.181	0.182	0.141***	0.177
Observations	1,240,177	1,706	685	94,798	154	48

Sample means computed separately depending on whether firms were acquired in the corresponding period. Significance levels are designated as *** p<0.01, ** p<0.05, and * p<0.1 and refer to tests of differences in means (assuming unequal variances) between the no-deal and international (domestic) deal means.

[a] IP box characteristics are for the subset of observations in IP box countries only and consist of 350,644, 426, 188, 39,581, 62, and 30 firms, respectively.

Table 6. IP Box Effects on the Likelihood of Target Acquisition

$Y = Pr(Acquired = 1), Y \in \{0, 100\}$	All Deals (1)	Deal Type International (2)	Domestic (3)
LPM Coefficient Estimates			
$IPBoxSavings$	-0.4729**	-0.5703***	0.0975
	(0.2130)	(0.1660)	(0.1789)
$I[LimitedNexus] \times IPBoxSavings$	0.3777	0.4603*	-0.0826
	(0.3111)	(0.2458)	(0.1843)
$I[NoNexus] \times IPBoxSavings$	0.0116	-0.0385	0.0501
	(0.4141)	(0.3059)	(0.3194)
$IPBoxSavings \times I[OwnPatent]_{t-1}$	-0.6374**	-0.5589*	-0.0784
	(0.2933)	(0.2921)	(0.0874)
$I[LimitedNexus] \times IPBoxSavings$	0.3007	0.3227	-0.0220
$\times I[OwnPatent]_{t-1}$	(0.4756)	(0.4742)	(0.1401)
$I[NoNexus] \times IPBoxSavings$	0.7978**	0.5110	0.2868**
$\times I[OwnPatent]_{t-1}$	(0.3455)	(0.3368)	(0.1330)
	⋱	⋱	⋱
Unconditional Pr(Acquired = 1) (Percent):			
All firms	0.192	0.137	0.055
Patent-less firms	0.156	0.107	0.049
Patent-owning firms	0.457	0.359	0.099
Marginal Change in Predicted Pr(Acquired = 1)[a]*:*			
Patent-less firms; Acquired IP disallowed	-3.029**	-5.331***	1.983
Patent-less firms; Limited nexus	-0.609	-1.028	0.303
Patent-less firms; No nexus	-2.955	-5.692*	3.003
Patent-owning firms; Acquired IP disallowed	-2.428***	-3.15***	0.192
Patent-owning firms; Limited nexus	-0.944	-0.966	-0.866
Patent-owning firms; No nexus	-0.658	-1.832	3.602
Observations	1,242,568	1,242,568	1,242,568
R-squared	0.0035	0.0028	0.0011

Significance levels are designated as *** p<0.01, ** p<0.05, and * p<0.1. Standard errors (in parentheses) are clustered at the country and year levels.
All specifications include a full set of time-varying firm- and country-level controls along with country, year, and industry fixed effects. Complete results are reported in Appendix Table A.1.
[a] Marginal changes in $Pr(Acquired = 1)$ are computed as the effect of a 1 unit (100 percentage point) change in $IPBoxSavings$, summing coefficients over relevant interaction terms and scaling by the unconditional mean probability of acquisition among patent-less or patent-owning firms, as appropriate.
E.g. $\left\{ \frac{\partial Pr(Acquired=1)}{\partial IPBoxSavings} \cdot \frac{1}{Y} \right\}_{|I[OwnPatent]=0, I[LimitedNexus]=0, I[NoNexus]=0} = -\frac{0.4729}{0.156} = -3.029.$

Table 7. IP Box Effects on the Likelihood of Target Acquisition
Patent Quality - Share of Granted Patents

$Y = Pr(Acquired = 1), Y \in \{0, 100\}$	Deal Type: All Deals (1)	International (2)	Domestic (3)
LPM Coefficient Estimates			
$IPBoxSavings$	-0.5428**	-0.6336***	0.0908
	(0.2373)	(0.1756)	(0.1828)
$I[LimitedNexus] \times IPBoxSavings$	0.4033	0.4657	-0.0624
	(0.3299)	(0.2763)	(0.1929)
$I[NoNexus] \times IPBoxSavings$	-0.0139	-0.0441	0.0301
	(0.4324)	(0.3234)	(0.3277)
$IPBoxSavings \times GrantedShare_{t-1}$	-0.7106*	-0.6642*	-0.0464
	(0.3724)	(0.3675)	(0.1411)
$I[LimitedNexus] \times IPBoxSavings$	0.5244	0.8790	-0.3546*
$\times GrantedShare_{t-1}$	(0.8318)	(0.8027)	(0.1879)
$I[NoNexus] \times IPBoxSavings$	1.5078***	1.0484***	0.4594*
$\times GrantedShare_{t-1}$	(0.3543)	(0.2956)	(0.2483)
	⋱	⋱	⋱
Marginal Change in Predicted Pr(Acquired = 1):[a]			
$GrantedShare_{t-1} = 0$;*Acquired IP disallowed*	-3.581**	-6.153***	1.868
$GrantedShare_{t-1} = 0$;*Limited nexus*	-0.92	-1.63	0.584
$GrantedShare_{t-1} = 0$;*No nexus*	-3.673	-6.581**	2.488
$GrantedShare_{t-1} = 0.5$; *Acquired IP disallowed*	-1.964***	-2.694***	0.684
$GrantedShare_{t-1} = 0.5$; *Limited nexus*	-0.509	-0.169	-1.742
$GrantedShare_{t-1} = 0.5$; *No nexus*	-0.346	-1.354	3.314
$GrantedShare_{t-1} = 1$; *Acquired IP disallowed*	-2.741**	-3.62***	0.449
$GrantedShare_{t-1} = 1$; *Limited nexus*	-0.712	0.131	-3.771**
$GrantedShare_{t-1} = 1$; *No nexus*	0.526	-0.819	5.404*
Observations	1,227,684	1,227,684	1,227,684
R-squared	0.0034	0.0028	0.0012

Significance levels are designated as *** p<0.01, ** p<0.05, and * p<0.1. Standard errors (in parentheses) are clustered at the country and year levels.
All specifications include a full set of time-varying firm- and country-level controls along with country, year, and industry fixed effects. Complete results are reported in Appendix Table A.1.
[a] Marginal changes in $Pr(Acquired = 1)$ are computed as the effect of a 1 unit (100 percentage point) change in $IPBoxSavings$, summing coefficients over relevant interaction terms and scaling by the unconditional mean probability of acquisition among patent-less or patent-owning firms, as appropriate.

Table 8. IP Box Effects on the Likelihood of Target Acquisition
Patent Quality - High Vintage-Adjusted Citations

$Y = Pr(Acquired = 1), Y \in \{0, 100\}$	Deal Type: All Deals (1)	International (2)	Domestic (3)
LPM Coefficient Estimates			
$IPBoxSavings$	-0.4781*	-0.5622***	0.0842
	(0.2317)	(0.1908)	(0.1847)
$I[LimitedNexus] \times IPBoxSavings$	0.3859	0.4576*	-0.0717
	(0.3366)	(0.2607)	(0.1947)
$I[NoNexus] \times IPBoxSavings$	0.0070	-0.0563	0.0633
	(0.4194)	(0.3368)	(0.3207)
$IPBoxSavings \times I[OwnPatent]_{t-1}$	-0.6121*	-0.5222	-0.0899
	(0.3078)	(0.3080)	(0.1082)
$I[LimitedNexus] \times IPBoxSavings$	0.3039	0.3242	-0.0203
$\times I[OwnPatent]_{t-1}$	(0.5574)	(0.5059)	(0.1493)
$I[NoNexus] \times IPBoxSavings$	0.7979**	0.4973	0.3006*
$\times I[OwnPatent]_{t-1}$	(0.3730)	(0.3656)	(0.1529)
$IPBoxSavings \times I[OwnPatent]_{t-1}$	-1.7594***	-2.0665***	0.3071
$\times I[HighCites]_{t-1}$	(0.5860)	(0.5927)	(0.2119)
$I[LimitedNexus] \times IPBoxSavings$	1.2900	1.6373*	-0.3473*
$\times I[OwnPatent]_{t-1} \times I[HighCites]_{t-1}$	(0.7981)	(0.9339)	(0.1952)
$I[NoNexus] \times IPBoxSavings$	1.7983**	2.0044**	-0.2061
$\times I[OwnPatent]_{t-1} \times I[HighCites]_{t-1}$	(0.7427)	(0.8803)	(0.3644)
	⋱	⋱	⋱
Marginal Change in Predicted Pr(Acquired = 1):[a]			
Patent-less firms; Acquired IP disallowed	-3.062**	-5.256***	1.713
Patent-less firms; Limited nexus	-0.59	-0.978	0.254
Patent-less firms; No nexus	-3.018	-5.782*	3.001
$I[HighCites]_{t-1} = 0$; *Acquired IP disallowed*	-2.459***	-3.145**	-0.058
$I[HighCites]_{t-1} = 0$; *Limited nexus*	-0.903	-0.878	-0.991
$I[HighCites]_{t-1} = 0$; *No nexus*	-0.644	-1.866	3.636
$I[HighCites]_{t-1} = 1$; *Acquired IP disallowed*	-4.14***	-5.076***	4.466
$I[HighCites]_{t-1} = 1$; *Limited nexus*	-1.264	-1.179	-2.043
$I[HighCites]_{t-1} = 1$; *No nexus*	-0.358	-1.137	6.805
Observations	1,242,265	1,242,265	1,242,265
R-squared	0.0035	0.0029	0.0011

Significance levels are designated as *** p<0.01, ** p<0.05, and * p<0.1. Standard errors (in parentheses) are clustered at the country and year levels.
All specifications include a full set of time-varying firm- and country-level controls along with country, year, and industry fixed effects. Complete results are reported in Appendix Table A.1.
[a] Marginal changes in $Pr(Acquired = 1)$ are computed as the effect of a 1 unit (100 percentage point) change in $IPBoxSavings$, summing coefficients over relevant interaction terms and scaling by the unconditional mean probability of acquisition among low-citation versus high-citation patent-owning firms, as appropriate.

A Appendix

A.1 Likelihood of Becoming an Acquirer

In most respects, the introduction of preferential taxation of IP-related income should impact M&A activity similarly whether viewed from the perspective of target firms or acquirers. We model the probability that firm i becomes an acquirer in year t accordingly, with the main distinction from the model for targets being that we constrain IP box effects to be independent of the potential acquirer's patent holdings. This restriction reflects the reality that nexus requirements should exert no differential effect on patent-owning acquirers (i.e. acquisitions do not affect the IP box eligibility of the acquirer's own pre-existing IP), nor should patent ownership by the acquiring firm have a first-order effect on the after-tax value of synergistic gains via the net income expansion or tax planning channels.[36] Naturally, we cannot condition on targets' patent ownership as this is undefined for firms that do not make acquisitions. Identification hence rests on a narrower panel DiD approach, and the modified model from the perspective of potential acquiring firm i becomes:

$$\begin{aligned} Pr(Acquirer_{ijct} = 1) = \alpha + \vec{\beta} \cdot \mathbf{I\vec{P}Box_{ct}} + \gamma \cdot Patent_{ijct-1} + \vec{\theta} \cdot \mathbf{\vec{Tax}_{ct}} \\ + \vec{\psi} \cdot \mathbf{\vec{W}_{ct}} + \vec{\rho} \cdot \mathbf{\vec{X}_{ijct-1}} + \mu_j + \eta_c + \zeta_t + \varepsilon_{ijct} \end{aligned} \tag{A.1}$$

All of the independent variables are as described in the paper, except that each should be viewed as reflecting the firm and country characteristics of potential acquirers instead of targets. In practice, we strive to estimate equation (A.1) using an identical sample of firms as for our set of potential targets in Section 5, such that the only distinctions between analyses are in terms of the outcomes of interest and the treatment of patent

[36] Implicitly, this reflects the presumption that M&A transactions are driven primarily by opportunities to extract greater after-tax returns from the set of assets held by the *target* rather than through gains attributable to the acquirer's pre-existing assets. This asymmetry presumably plays a dominant role in determining which entity becomes the acquirer in the transaction.

ownership. Figure A.1 maps the share of firms ever to make an acquisition during our sample period across the EU.

Tables A.2 and A.3 (for the full set of coefficients) present ordinary least squares regression results corresponding to estimation of equation (A.1). The question of interest, once again, is whether the adoption of an IP box regime—specifically, the choice of preferential tax rate relative to the ordinary corporate rate and the presence of eventual nexus requirements—affect the business decision of a firm to engage in an M&A deal, except that we now consider this from the perspective of a potential acquirer. Our dependent variable is therefore set to 100 if a firm is an acquirer in an M&A transaction and zero otherwise, and we consider separate outcomes for the set of all deals versus international and domestic deals only.[37]

Looking first at the "All Deals" column (column 1) of Table A.2, when $I[LimitedNexus]$ and $I[NoNexus]$ are both zero (i.e. acquired IP is ineligible for preferential tax treatment), we see that, as in Section 5.1, $IPBoxSavings$ has a negative impact on M&A deals in general, which manifests itself here as a decrease in the likelihood of becoming an acquirer. Introducing an IP box with a nexus requirement creates an incentive for firms to develop profitable IP assets internally, as this is the only way to profit from the reduced tax rate on IP in such countries. Consequently, forms of business investment other than greenfield or brownfield investment, including M&A transactions or purchases of IP assets (e.g., in the spirit of Serrano (2006)), become relatively less attractive overall.

In terms of economic magnitude, the coefficient on $IPBoxSavings$ implies that a 1 percentage point increase in IP box regime generosity is associated with an overall reduction in the probability of making an acquisition of approximately 3.6 percent (p-value = 0.001. We find a similar effect for both international and domestic deals, as well as when we base our identification on an IP box dummy rather than the extent of the tax

[37]Notably, our model delivers considerably greater predictive fit when we focus on predicting the probability of becoming an acquirer rather than a target. This likely reflects in part the higher frequency of such events in our sample, which is itself a likely consequence of better coverage of financial statement information in Orbis for larger firms.

savings (unreported). When we further differentiate among countries extending preferential treatment to acquired IP, the negative effect of $IPBoxSavings$ on the likelihood of becoming an acquirer dissipates, but only in the most permissive regimes as indicated by the positive coefficient on the interaction, $I[NoNexus] \times IPBoxSavings$.

Contrasting the results for international and domestic deals in Table A.2, we see that the negative effect attributable to nexus requirements does not dissipate entirely for international deals. In the case of international deals, it is not sufficient to acquire a foreign target in order to profit from the introduction of an IP box with a permissive regime allowing for acquired IP. As a further step, the acquirer needs to engage in post-deal restructuring to locate acquired IP in the country of residency of the acquirer, where the IP box applies. The insignificant coefficient on the interaction term $I[NoNexus] \times IPBoxSavings$ in column 2 suggests that such a restructuring for the purposes of exploiting an IP box may be too costly from the acquirer's perspective, especially given the (continued) existence of alternative opportunities for strategic income reallocation involving tax havens or other low-tax jurisdictions.

In the case of the most permissive regimes allowing for acquired IP ($I[NoNexus] = 1$), the results involving domestic deals are markedly different from those for cross-border transactions. A one-percentage point increase in $IPBoxSavings$ is associated with a precisely-estimated 7.2 percent increase in the probability that a firm makes a domestic acquisition, consistent with a strong effect operating through the net income expansion channel. Given that the tax-planning channel is not likely to play a dominant role in the likelihood of being an acquirer across deal types (for reasons described above), we interpret these differences as consistent with differences in expected productivity improvements. Numerous empirical studies document that domestic M&A is followed by substantial productivity improvements, while there is comparatively little evidence of productivity improvements in international M&A (Wang and Wang, 2015). This may be attributable to the lower integration risk in domestic deals than in international deals.

Moreover, we generally expect the acquirer to confer larger gains in after-tax profitability on the target's original operations than vice versa, but these gains are only eligible for preferential taxation in the case of a domestic deal in regimes without nexus requirements (i.e. where the target is also in the IP box country).

Comparable results for our event study analysis of the probability of becoming an acquirer generally suffer from weaker statistical precision and wider confidence intervals, as shown in Figure A.2. Nevertheless, these results largely mirror those from our general DiD analysis while presenting a more muted picture of period-specific reactions overall, such that anticipation effects do not appear important. Panels (a) and (b) suggest that nexus requirements only have a significant negative effect on international deals in the year of IP box adoption. Thereafter, the effect on international deals remains negative but not significantly different from zero. In the case of domestic deals—where would-be acquirers and targets are equally eligible to benefit from preferential taxation—the effect of IP box adoption coupled with strict nexus requirements is largely flat, before spiking upwards 3-plus years out. Without the ability to condition on the *target's* patent ownership, nexus requirements may only bind infrequently from the perspective of a potential acquirer (i.e. only for the subset of deals that would involve IP-owning targets) and may constitute less of a hardship when the acquirer already has operations in the same country as the target. In countries with no nexus requirements (panels (e) and (f)), the general patterns from panels (a) and (b) are reversed in the sense that international deals appear largely unaffected by the adoption of IP box provisions, whereas the probability that a firm acquires a domestic target increases significantly in the year of IP box adoption and remains elevated thereafter. (Viewed differently, the net effect of competing incentive effects shift the probability of becoming an acquirer up by a comparable amount for international and domestic deals.)

As discussed above, we generally expect tax planning motives to play a lesser role in terms of the effect of IP box adoption on the probability of becoming an acquirer. Hence,

the appearance of significant positive effects of IP box adoption on the probability of making domestic acquisitions without a corresponding positive effect for international deals in countries without nexus requirements is instead evidence of differences in the importance of the net income expansion channel. If synergistic gains from M&A transactions are primarily attributable to the assets held by the target, domestic transactions where both the acquirer and target are eligible for preferential taxation of IP income should drive larger increases in deal attractiveness than international transactions, where only the acquirer's original IP assets are eligible. This argument may likewise explain the *relatively* larger incentive effects attributable to the net income expansion channel among patent-owning firms for international deals as compared to domestic deals, as shown in panels (e) and (f) of Figure 4 for the probability of becoming a target. In that context, as long as there are no nexus requirements, the target's assets are eligible for preferential taxation regardless of the type of M&A transaction, such that domestic and foreign acquirers might have more similar opportunities for expanding net income via the target.

Figure A.1. Share of Acquiring Firms by Acquirer Country: 1994-2014

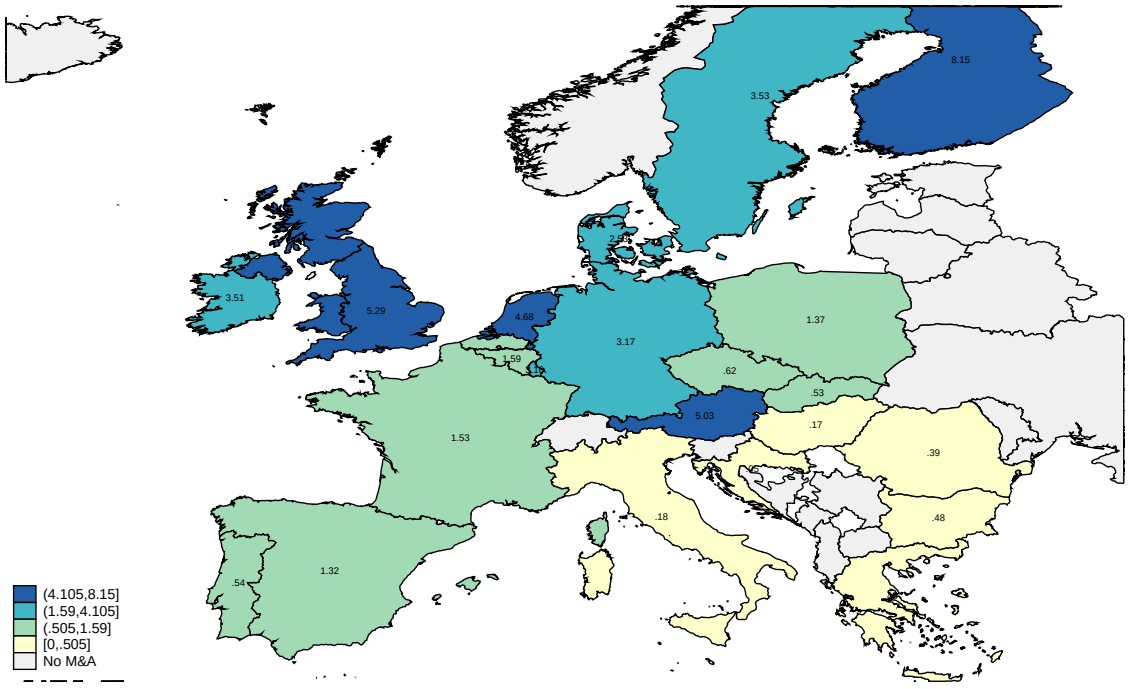
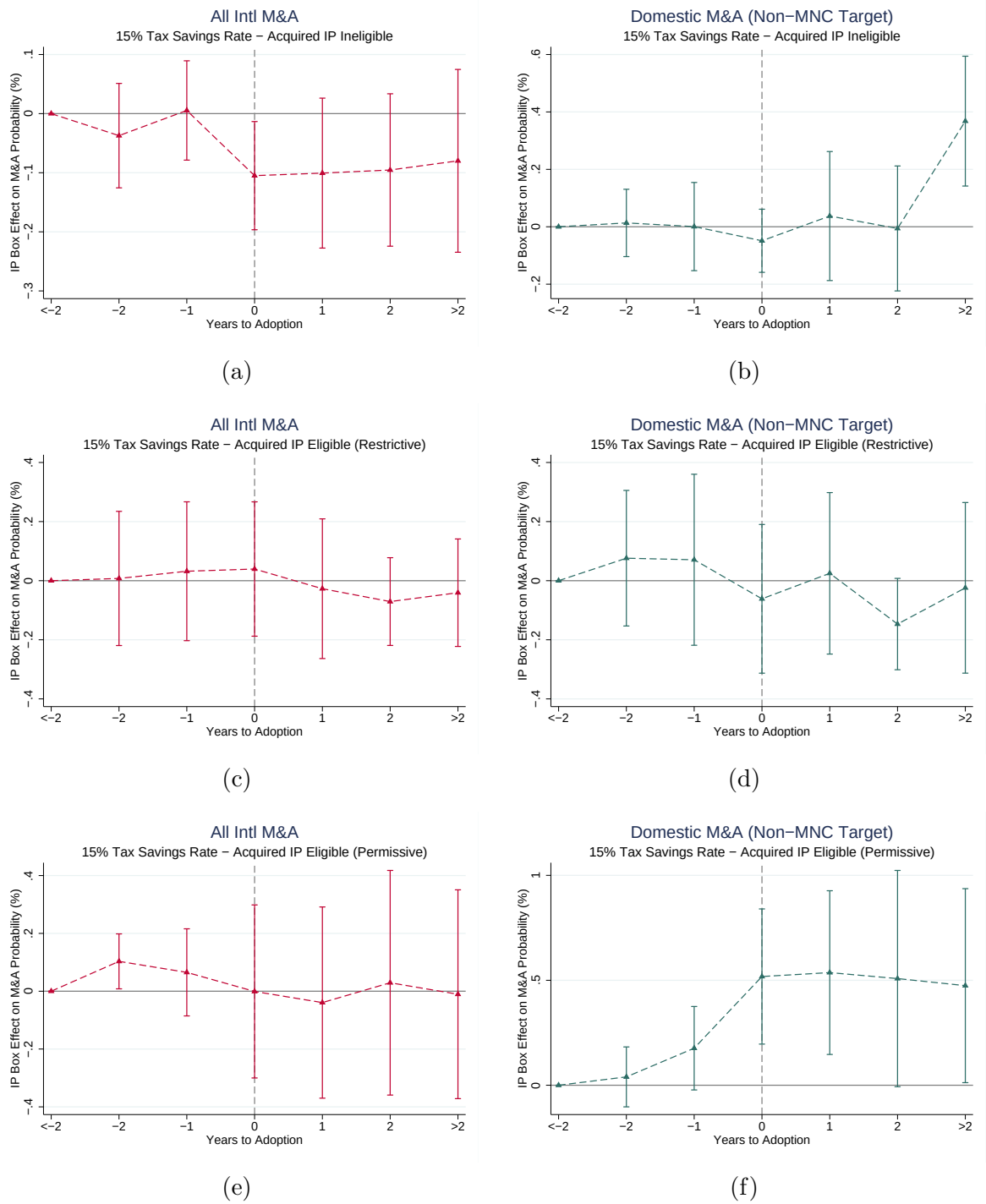


Figure A.2. IP Box Effects on the Likelihood of Acquirer Acquisition: Event Study Estimates



For each IP box country, we define period $t = 0$ as the year of regime adoption, and we construct a full set of binary indicator variables flagging periods $t = -3$ (including earlier years) through $t = 3$ (including later years). Each of these indicators is then interacted with the IP box tax savings rate and nexus requirement indicators. The IP box effects in period $t = -3$ are constraint to be zero. We report estimated effects assuming $IPBoxSavings = 0.15$ (the sample median). Whisker bars represent 95% confidence intervals.

Table A.1. IP Box Effects on the Likelihood of Target Acquisition

$Y = Pr(Acquired = 1), Y \in \{0, 100\}$	All Deals (1)	Deal Type International (2)	Domestic (3)
$IPBoxSavings$	-0.4729**	-0.5703***	0.0975
	(0.2130)	(0.1660)	(0.1789)
$I[LimitedNexus] \times IPBoxSavings$	0.3777	0.4603*	-0.0826
	(0.3111)	(0.2458)	(0.1843)
$I[NoNexus] \times IPBoxSavings$	0.0116	-0.0385	0.0501
	(0.4141)	(0.3059)	(0.3194)
$IPBoxSavings \times I[OwnPatent]_{t-1}$	-0.6374**	-0.5589*	-0.0784
	(0.2933)	(0.2921)	(0.0874)
$I[LimitedNexus] \times IPBoxSavings$	0.3007	0.3227	-0.0220
$\times I[OwnPatent]_{t-1}$	(0.4756)	(0.4742)	(0.1401)
$I[NoNexus] \times IPBoxSavings$	0.7978**	0.5110	0.2868**
$\times I[OwnPatent]_{t-1}$	(0.3455)	(0.3368)	(0.1330)
$I[OwnPatent]_{t-1}$	0.0099	-0.0285	0.0384
	(0.2973)	(0.2915)	(0.0727)
$CIT \times I[OwnPatent]_{t-1}$	0.2666	0.3885	-0.1219
	(0.9857)	(0.9991)	(0.2298)
$\bar{ETR}_{-3}$	0.0251	0.0113	0.0138
	(0.0239)	(0.0170)	(0.0113)
CIT	0.7298	0.2753	0.4545**
	(0.5913)	(0.5165)	(0.1826)
$I[MNC]$	0.0473*	0.0387*	0.0086
	(0.0267)	(0.0196)	(0.0087)
$I[HavenSubs]$	-0.3288**	-0.1772*	-0.1516***
	(0.1338)	(0.0993)	(0.0507)
$\bar{ROA}_{-3}$	0.0936	0.0834	0.0102
	(0.0867)	(0.0748)	(0.0139)
$\log(\bar{Assets})_{-3}$	0.0986***	0.0809***	0.0176***
	(0.0182)	(0.0139)	(0.0053)
$\bar{Intan}_{-3}$	0.1174	0.1438*	-0.0265
	(0.0716)	(0.0821)	(0.0219)
$\bar{Cash}_{-3}$	0.0000***	0.0000***	0.0000**
	(0.0000)	(0.0000)	(0.0000)
$I[HighGrowth]_{t-1}$	0.0141	0.0165*	-0.0024
	(0.0109)	(0.0090)	(0.0042)
$CapitalSpend_{-3}$	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)
$Listed_{t-1}$	0.0771	-0.1841	0.2612**

Continued on next page

	(0.2089)	(0.1541)	(0.1003)
$\bar{Leverage}_{-3}$	0.0009	-0.0029	0.0038
	(0.0057)	(0.0053)	(0.0027)
$\bar{Tangibility}_{-3}$	-0.0134	-0.0074	-0.0059
	(0.0121)	(0.0081)	(0.0046)
$HavenSubsShare$	0.3333	0.1810	0.1523**
	(0.1960)	(0.1482)	(0.0684)
$I[HighRoyaltyTax]$	0.1309	0.1800*	-0.0491
	(0.1390)	(0.0881)	(0.0641)
$MarketCap$	0.0001	0.0001	-0.0000
	(0.0005)	(0.0003)	(0.0003)
$\Delta MarketCap$	0.0098	0.0133**	-0.0034
	(0.0082)	(0.0051)	(0.0039)
$\log(LaborForce)$	-0.8776*	-0.9277**	0.0501
	(0.4397)	(0.3457)	(0.1845)
$Unemp$	0.3070	0.2370	0.0700
	(0.7401)	(0.4317)	(0.3709)
$Exports$	-0.5332	-0.5137	-0.0195
	(0.4549)	(0.3518)	(0.1845)
$\log(GDP)$	-0.1116	-0.1626	0.0511
	(0.4658)	(0.3097)	(0.2156)
CPI	-0.3646	-0.0196	-0.3450
	(0.4885)	(0.4426)	(0.2585)
$REER$	0.0536	-0.0157	0.0693
	(0.5941)	(0.4607)	(0.1601)
EFI	-0.1811**	-0.1142*	-0.0669*
	(0.0754)	(0.0647)	(0.0364)
$R\&DStateAid$	-0.7056	0.0444	-0.7501*
	(0.8691)	(0.6509)	(0.3732)
Observations	1,242,568	1,242,568	1,242,568
R-squared	0.0035	0.0028	0.0011

Significance levels are designated as *** p<0.01, ** p<0.05, and * p<0.1. Standard errors (in parentheses) are clustered at the country and year levels.
All specifications include a full set of country, year, and industry fixed effects.

Table A.2. IP Box Effects on the Likelihood of Acquirer Acquisition

$Y = Pr(Acquirer = 1), Y \in \{0, 100\}$	All Deals (1)	Deal Type International (2)	Domestic (3)
LPM Coefficient Estimates			
$IPBoxSavings$	-1.8386***	-0.9424***	-0.8962**
	(0.5704)	(0.3105)	(0.3969)
$I[LimitedNexus] \times IPBoxSavings$	1.1097	0.6830	0.4267
	(0.8941)	(0.4398)	(0.5378)
$I[NoNexus] \times IPBoxSavings$	3.2309*	-0.0246	3.2555***
	(1.7317)	(0.8160)	(1.1452)
	⋱	⋱	⋱
Unconditional Pr(Acquirer = 1) (Percent):			
All firms	0.508	0.181	0.328
Marginal Change in Predicted Pr(Acquirer = 1):[a]			
Acquired IP disallowed	-3.616***	-5.214***	-2.734**
Limited nexus	-1.434	-1.435	-1.432
No nexus	2.738	-5.35	7.199**
Observations	1,242,120	1,242,120	1,242,120
R-squared	0.1484	0.0765	0.0770

Significance levels are designated as *** p<0.01, ** p<0.05, and * p<0.1. Standard errors (in parentheses) are clustered at the country level.

All specifications include a full set of time-varying firm- and country-level controls along with country, year, and industry fixed effects. Complete results are reported in Appendix Table A.1.

[a] Marginal changes in $Pr(Acquirer = 1$ are computed as the effect of a 1 unit (100 percentage point) change in $IPBoxSavings$, summing coefficients over relevant interaction terms and scaling by the unconditional mean probability of acquisition across all firms.

E.g. $\left\{ \frac{\partial Pr(Acquirer=1)}{\partial IPBoxSavings} \cdot \frac{1}{Y} \right\}_{|I[LimitedNexus]=0, I[NoNexus]=0} = -\frac{1.8386}{0.508} = -3.616.$

Table A.3. IP Box Effects on the Likelihood of Acquirer Acquisition

$Y = Pr(Acquirer = 1), Y \in \{0, 100\}$	All Deals (1)	Deal Type International (2)	Domestic (3)
$IPBoxSavings$	-1.8386***	-0.9424***	-0.8962**
	(0.5704)	(0.3105)	(0.3969)
$I[LimitedNexus] \times IPBoxSavings$	1.1097	0.6830	0.4267
	(0.8941)	(0.4398)	(0.5378)
$I[NoNexus] \times IPBoxSavings$	3.2309*	-0.0246	3.2555***
	(1.7317)	(0.8160)	(1.1452)
$I[OwnPatent]_{t-1}$	0.1417	0.1111***	0.0306
	(0.0928)	(0.0371)	(0.0738)
$E\bar{T}R_{-3}$	0.0917	0.0545	0.0372
	(0.1021)	(0.0480)	(0.0654)
CIT	2.5497	1.4329	1.1169
	(2.8294)	(1.2178)	(1.6437)
$I[MNC]$	0.5004**	0.2451***	0.2553**
	(0.1944)	(0.0836)	(0.1163)
$I[HavenSubs]$	11.8842***	6.3212***	5.5629***
	(2.0387)	(1.1235)	(1.0184)
$R\bar{O}A_{-3}$	0.1297	0.0704	0.0592
	(0.1482)	(0.0670)	(0.0859)
$\log(As\bar{s}ets)_{-3}$	0.2983***	0.0990***	0.1993***
	(0.0833)	(0.0307)	(0.0540)
$In\bar{t}an_{-3}$	1.6867*	0.7786*	0.9080*
	(0.9650)	(0.4407)	(0.5264)
$C\bar{a}sh_{-3}$	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)
$I[HighGrowth]_{t-1}$	0.1593***	0.0585**	0.1007**
	(0.0548)	(0.0210)	(0.0360)
$CapitalSpend_{-3}$	0.0006	0.0003	0.0003
	(0.0007)	(0.0003)	(0.0004)
$Listed_{t-1}$	16.4156***	6.2568***	10.1588***
	(2.9230)	(1.0926)	(1.8816)
$Lev\bar{e}rage_{-3}$	-0.0551	-0.0330	-0.0222
	(0.0505)	(0.0234)	(0.0281)
$Tang\bar{i}bility_{-3}$	0.0277	0.0105	0.0172
	(0.0184)	(0.0071)	(0.0121)
$HavenSubsShare$	-15.0820***	-7.9646***	-7.1175***
	(2.6077)	(1.3990)	(1.4030)
$I[HighRoyaltyTax]$	0.5553*	0.3156**	0.2397

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	(0.2839)	(0.1506)	(0.1810)
$MarketCap$	-0.0013	0.0013**	-0.0027***
	(0.0012)	(0.0006)	(0.0008)
$\Delta MarketCap$	0.0086	0.0072	0.0014
	(0.0176)	(0.0081)	(0.0155)
$\log(LaborForce)$	-2.0530	-1.2162**	-0.8367
	(1.2667)	(0.5511)	(0.9444)
$Unemp$	2.3060	-0.3322	2.6382*
	(1.5831)	(0.4763)	(1.3506)
$Exports$	-1.4983	-0.7106	-0.7877
	(1.0639)	(0.4465)	(0.8828)
$\log(GDP)$	0.4779	-0.2622	0.7401
	(0.6434)	(0.2185)	(0.5248)
CPI	3.0916	1.0389	2.0527
	(2.2673)	(0.7924)	(1.6342)
$REER$	2.2106***	0.8424***	1.3682**
	(0.6968)	(0.2120)	(0.5338)
EFI	0.1965	0.0801	0.1164
	(0.1818)	(0.0548)	(0.1437)
Constant	16.1210	17.8341*	-1.7131
	(21.6091)	(10.1556)	(14.5366)
Observations	1,242,120	1,242,120	1,242,120
R-squared	0.1484	0.0765	0.0770

Significance levels are designated as *** p<0.01, ** p<0.05, and * p<0.1. Standard errors (in parentheses) are clustered at the country level.
All specifications include a full set of country, year, and industry fixed effects.