Tax Planning and Multinational Behavior*

Rosanne Altshuler
Rutgers University

Lysle Boller
Penn Wharton Budget Model

Kevin A. Roberts
Stanford GSB

Juan Carlos Suárez Serrato
Stanford GSB & NBER

February 2025

Abstract

We use IRS data to study the adoption and use of hybrid tax planning structures (HTPs) by US multinational corporations (MNCs). These strategies leveraged mismatches between US and foreign tax law to legally avoid corporate taxation. We find more than 35% of US foreign profits were linked to HTPs by 2016. Difference-in-differences models show that after HTP adoption, MNCs intensify profit-shifting behaviors relative to non-adopters, leading to sharp reductions in foreign effective tax rates. Adopting MNCs also experience greater growth in real economic activity, including foreign and domestic investment and global R&D. A structural model of heterogeneous firms reveals HTP adoption patterns consistent with adopting MNCs having lower tax planning costs and lower costs of expanding R&D activities. Counterfactual analyses show that policies restricting HTP tax advantages significantly reduce foreign investment. A domestic tax cut that harmonizes global rates can offset this reduction by stimulating global R&D, increasing productivity at home and abroad.
Keywords: international taxation, profit shifting, Double Irish, Reverse Hybrid Mismatch
JEL Codes: D22, H25, H26, H32

This research was conducted as part of a Joint Statistical Research Program with the Internal Revenue Service (IRS). Any views expressed are those of the authors and not those of the IRS. The statistics reported in this paper have been reviewed and cleared for disclosure by the IRS.

*We are very grateful for comments from David Agrawal, Hunt Allcott, Alan Auerbach, Michael Best, Katarzyna Bilicka, Jeff Clemens, Sarah Clifford, Julie Cullen, Dhammika Dharmapala, Rebecca Diamond, Tim Dowd, Clare Doyle, Jesse Drucker, Naomi Feldman, Manon Francois, Roger Gordon, Mindy Herzfeld, Jim Hines, Jeffrey Hoopes, Chad Jones, Wojciech Kopczuk, Wouter Leenders, Rebecca Lester, Antoine Levy, Li Liu, Clément Malgouyres, Peter Merrill, Mathilde Muñoz, Karthik Muralidharan, Paul Oosterhuis, Mathieu Parenti, Emmanuel Saez, Navodhya Samarakoon, Shoshanna Vasserman, Daniel Xu, Danny Yagan, Gabriel Zucman, Eric Zwick, and from seminar participants at ASSA; CESifo; Columbia University; the Federal Reserve Bank of San Francisco; IIPF; the National Tax Association Annual Meetings; the NBER Public Economics Meetings; the Office of Tax Analysis of the US Treasury Department; the Oxford University Centre for Business Taxation; the Paris School of Economics; the Penn Wharton Budget Model; Rutgers University; Stanford University; the Stanford Initiative for Business, Taxation, and Society; UC Berkeley; UC San Diego; the University of Illinois at Urbana-Champaign; the University of South Carolina; and the Statistics of Income unit of the Internal Revenue Service. We are grateful to Arnold Ventures, the International Tax Policy Forum, and the NBER for their support of this project. Special thanks to Chloe Gagin, Nuria McGrath, Melanie Patrick, Ralph Rector, Michael Weber, and Jason Wenrich for assistance with data access. Maya Donovan, Clare Doyle, and Jason Harrison provided excellent research assistance. All errors remain our own.

1 Introduction

The last quarter century has seen a remarkable increase in the complexity of tax planning by multinational corporations (MNCs). Document leaks and special government reports have revealed the existence of tax planning strategies that are designed to avoid corporate income taxes in multiple jurisdictions by leveraging mismatches in tax laws across countries. Despite prominent recent international tax policy changes and multilateral projects to address tax avoidance, little is known about the importance of these tax planning strategies.[1] How prevalent are these strategies among US MNCs? Do they facilitate profit shifting and lower foreign effective tax rates (ETRs)? Does tax planning influence the real economic activity of MNCs?

This paper uses tax data from the US Internal Revenue Service (IRS) to answer these questions by analyzing the adoption and use of three complex tax planning strategies that target mismatches between US and Irish, Dutch, and Luxembourgish tax law. We combine multiple IRS tax forms to reconstruct the ownership networks of the foreign affiliates of US MNCs. This allows us to identify when a US MNC creates an ownership structure associated with our three tax planning strategies of interest. Using this information, we document the growth and prevalence of these strategies and analyze changes in MNC behavior resulting from their adoption. IRS tax return data are crucial for identifying and examining these structures, which are not disclosed in publicly-available data sources. This paper is the first to systematically uncover these structures and to study how their adoption is related to changes in both profit shifting and real economic activity.

We develop our results in four steps. First, we reconstruct MNCs' foreign ownership networks using information from key IRS tax forms. Foreign affiliates of US MNCs can be classified as either incorporated entities or pass-through (disregarded) entities; each affiliate is claimed by its parent MNC via a specific tax form that corresponds with the affiliate's entity type. A central contribution of our paper is the integration of these different tax forms, which until now have not been studied together. This integration process allows us to connect foreign affiliates not only to their ultimate US MNC parents, but also to intermediary foreign entities in instances where affiliates own each other.

Using these ownership networks, we identify US MNCs that adopt any of three "hybrid"

[1] These changes and projects include key aspects of the US Tax Cuts and Jobs Act (TCJA) of 2017, the European Anti-Tax Avoidance Directive, and the OECD's Base Erosion and Profit Shifting (BEPS) project.

tax planning (HTP) strategies. These strategies leverage mismatches between countries' tax treatment of foreign affiliates through the creation of hybrid entities, which are viewed as corporations from the perspective of one country but pass-through entities from the perspective of the other. The three HTP strategies we study—the Double Irish in Ireland, Reverse Hybrid Mismatch in the Netherlands, and Reverse Hybrid Mismatch in Luxembourg—became increasingly well known throughout the 2010s, motivating legal investigations by European countries as well as policy agendas such as Action 2 of the OECD Base Erosion and Profit Shifting (BEPS) project.[2] However, while these regulatory initiatives have led to an improved understanding of the structure and aims of HTPs, little remains known about their overall prevalence or economic impacts.

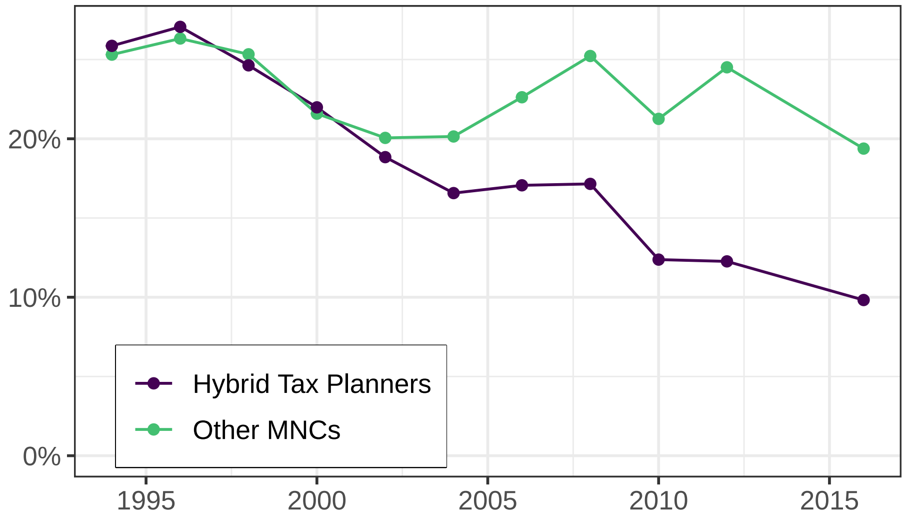
In our second step, we provide novel, systematic measures of the proliferation and drivers of hybrid tax planning. Following a 1997 regulatory change known as "Check the Box" (CTB), we document a striking increase in the adoption of these strategies. HTPs quickly became central to aggregate US MNC foreign activity: more than 35% of US foreign profits in our sample were routed through a hybrid tax planning structure in 2016, though only 18% of MNCs had adopted these structures. Consistent with anecdotal evidence, we find that hybrid tax planning was disproportionately adopted by large firms and those in industries that are particularly reliant on intellectual property (IP). However, models of *ex ante* HTP adoption based on observable MNC characteristics have low predictive power, suggesting that firms face large idiosyncratic costs and benefits of tax planning. These results underscore both the importance of addressing tax avoidance behavior as well as the challenges of targeted enforcement when avoidance is heterogeneous across firms (Bilicka, 2019; Bilicka, Devereux and Güçeri, 2024).[3]

In our third step, we consider how hybrid tax planning influences MNC behavior. Aggregate time-series comparisons of US MNCs based on HTP adoption show that tax planning is associated with substantial increases in behaviors linked to profit shifting. In the mid-1990s, the group of firms that eventually adopt an HTP and the group of never-adopting firms experienced similar trajectories with regard to their foreign ETRs and measures of domestic and foreign activity. After the 1997 CTB regulations are put in place, hybrid tax planning MNCs experience significantly larger declines in foreign ETRs; more rapid foreign and domestic growth; and sharp

[2]Use of hybrid tax planning structures by US MNCs has been previously reported by, e.g., Drucker (2010), Duhigg and Kocieniewski (2012), Kleinbard (2013), Pegg (2018), and Guardian and Reuters (2019).

[3]Throughout the paper we use tax avoidance to refer to legal strategies used to minimize tax obligations.

Figure 1: Comparison of Foreign Effective Tax Rates



Notes: Figure 1 compares the aggregate annual foreign ETR for two groups of US MNCs. The purple line shows the ETR for a group of MNCs that eventually adopt at least one of the hybrid tax structures described in Section 3. The light green line shows the ETR for MNCs that did not adopt any of these structures during the sample window. The combined sample includes most large US C corporations, as described in Section 2.

increases across several proxies for profit shifting and tax deferral, including related-party loans, intangible assets, and cash held abroad. As shown in Figure 1, the foreign ETR of adopters was roughly half that of other MNCs by 2016. By linking this substantial, persistent ETR reduction to specific tax planning strategies, we are able to provide novel insights into the means by which firms legally avoid taxes (e.g., as in Dyreng, Hanlon and Maydew, 2008).

A more thorough evaluation of the impact of tax planning is challenging because firms decide individually whether to adopt HTP structures. The motivations underlying this adoption decision are important for understanding both the real effects of tax planning as well as the most appropriate policy responses. If tax planning is primarily adopted by firms on high-growth trajectories, for example, then cross-sectional comparisons based on HTP adoption would be misleading. Firms may also establish HTP structures based on private information about the returns to foreign investment or research and development (R&D) associated with tax planning.[4]

To better understand how different forms of selection drive these patterns, we estimate staggered difference-in-differences models around the first year that a given MNC adopts an HTP. Estimates using a "stacked" difference-in-differences estimator (e.g., as in Cengiz, Dube, Lindner and Zipperer, 2019) suggest that these structures were put in place for tax avoidance purposes.

[4]This form of selection would be akin to the "selection on slopes" of Einav, Finkelstein, Ji and Mahoney (2021). We pay special attention to different sources of selection throughout our quantitative analyses.

Specifically, we show that MNCs engage in more financial transactions associated with profit shifting and the reduction of foreign ETRs following the adoption of an HTP. We also find that HTP-adopting MNCs experience larger increases in domestic and foreign capital, domestic investment, and R&D than non-adopting MNCs in the years following the adoption of an HTP. We find stable pre-trends in event study estimates for important outcomes for adopting MNCs, such as growth in domestic wages, foreign cash, R&D, and foreign ETRs. While these results provide evidence against firms selecting based on prior economic trends, they do not rule out the possibility that firms select into HTP adoption due to private expectations about the returns to adoption. We thus interpret our reduced-form findings as potentially reflecting both the effects of lower ETRs as well as selection on private information about the costs and benefits of hybrid tax planning among adopting firms.

Motivated by these empirical patterns, the fourth and final step of the paper develops and estimates a model of tax planning and MNC behavior that incorporates selection on private returns to tax planning. In the model, firms trade off heterogeneous costs of setting up hybrid tax planning structures against the potential benefits of lower foreign ETRs. The model relates the difference-in-differences estimates to key parameters, which measure how foreign ETRs impact foreign investment and how R&D investment impacts productivity. Additionally, the distributions of firms' underlying productivity, R&D adjustment costs, and tax planning costs are informed by data moments describing the concentration of profitability, R&D activity, and HTP adoption. The model identifies the importance of these different drivers of selection into HTP adoption and quantifies the degree to which investment by hybrid tax planning firms is inframarginal, in the sense that some of these firms' increased investment would have occurred in the absence of tax planning.

Through the lens of our model, the large increases in R&D and domestic investment associated with tax planning primarily reflect selection into tax planning by firms with greater potential to increase their R&D investment. In contrast, the lower ETRs associated with HTP strategies explain a large proportion of our estimated effect on foreign capital. One notable feature of our model is that, by modeling selection into tax planning, we are able to quantify the costs of tax planning to firms. We find that the setup costs of hybrid tax planning amount to 1.2% of pre-tax profits, which is 17.4% of the total benefits of HTP structures in the form of higher profits. These patterns follow from our descriptive evidence showing that firms face significant idiosyncratic costs of tax planning, and provide a new explanation for apparent under-utilization of tax havens (Gumpert, Hines and Schnitzer, 2016). We formalize these insights through counterfactual simulations corresponding to recent and proposed tax policies. In isolation, efforts to limit tax planning and raise foreign tax revenue would come at the cost of significant declines in foreign investment. In contrast, pairing such policies with reductions in domestic tax rates can offset negative effects on foreign investment by stimulating global R&D, while also reducing the setup costs associated with tax planning.

Overall, our results provide the first systematic documentation of the prevalence of hybrid tax planning strategies among US MNCs. We show that HTP-adopting MNCs represent a large fraction of domestic corporate activity and that by 2016, HTP structures accounted for about a third of all US MNC foreign profits. We estimate that adoption of these strategies is followed by large increases in financial transactions that can be used to shift profits to low-tax countries, by declines in foreign ETRs, and by relative changes in real domestic and foreign economic activity. Finally, we develop a model and conduct counterfactual policy analyses that incorporate the effects of lower ETRs along with potential selection on idiosyncratic returns to tax planning.

This paper contributes to studies that quantify the prevalence and magnitude of profit shifting, as well as the challenges that arise from attempting to do so (Hines and Rice, 1994; Dharmapala and Riedel, 2013; Clausing, 2016; Dowd, Landefeld and Moore, 2017; Bilicka, 2019; Dyreng and Hanlon, 2021; Blouin and Robinson, 2023; Dyreng, Hills and Markle, 2023; Tørsløv, Wier and Zucman, 2023). Rather than providing direct estimates of profit shifting, we document the prevalence of widely-used tax planning structures and show that MNCs use them in transactions that are likely related to profit shifting. Characterizing the structure of US MNCs' foreign activities prior to the passage of the Tax Cuts and Jobs Act of 2017 (TCJA) is an important contribution of this paper, as the response of US MNCs to the many changes and new incentives in the TCJA likely depends on these preexisting structures.[5] Chodorow-Reich, Smith, Zidar and

[5]The TCJA lowered the corporate tax rate from 35% to 21% and made significant changes to US taxation of international income. In particular, it introduced four new provisions. First, due to the transition to territorial taxation, US MNCs can now deduct dividends received from foreign affiliates from their US taxable income, thereby eliminating any repatriation tax. Second, the TCJA introduced a new tax on Global Intangible Low-Taxed Income (GILTI), defined as foreign-earned income that exceeds 10% of an MNC's tangible foreign capital investment (adjusted for depreciation). Third, a new category of income—Foreign-Derived Intangible Income (FDII)—is subject to a reduced tax rate. FDII encompasses income derived from intellectual property held in the United States that generates foreign sales. Finally, the TCJA introduced the Base Erosion and Anti-Abuse Tax (BEAT) to curb the erosion of the tax base by both US and foreign MNCs. See Dharmapala (2024) for a review of the empirical literature stuying the effects of the TCJA. We conduct a qualitative simulation of key

Zwick (2024) evaluate the effects of TCJA provisions by combining reduced-form estimates with a global investment model, but do not consider the real effects of profit shifting. Our approach complements theirs through a model that emphasizes how specific tax planning structures that accounted for over a third of the foreign profits of US MNCs influence marginal investment decisions. As we show in counterfactual simulations, the effects of realized and proposed policy changes depend on whether the foreign profits of US MNCs are sheltered in the types of structures that we study.

We also contribute to our understanding of Check the Box regulations on foreign tax rates, foreign activity, and profit shifting (Grubert and Altshuler, 2006; Mutti and Grubert, 2009; Grubert, 2012; Blouin and Krull, 2014; Albertus, 2019; Faulkender, Hankins and Petersen, 2019; Garrett, Ohrn and Suárez Serrato, 2024). We directly examine the adoption and consequences of complex tax structures facilitated by the policy. While prior research assumed that MNCs disregarded foreign affiliates following the CTB regulations, ours is the first paper to use tax information to confirm when an affiliate is disregarded and to systematically identify MNCs that use a specific set of tax planning structures.[6] Our results show that the bulk of the decrease in foreign ETRs and increase in cash held abroad over the sample period was driven by MNCs that adopted the three particular tax planning strategies we study.

Finally, our paper contributes to the literature on how profit shifting impacts real investment behavior (Grubert and Slemrod, 1998; Egger and Wamser, 2015; Suárez Serrato, 2019; De Mooij and Liu, 2020; Bilicka, Qi and Xing, 2022; Laudage Teles, Riedel and Strohmaier, 2023; Ferrari, Lafitte, Parenti and Toubal, 2024).[7] By using tax data to identify HTP structures and to demonstrate how they are used for profit shifting, we reveal substantial heterogeneity regarding the types of firms that benefited from these powerful tax planning strategies. Our findings also shed light on the mechanisms through which tax planning leads to persistent reductions in foreign ETRs and broad effects on real economic activity.

The remainder of the paper is organized as follows. Section 2 provides an overview of our

TCJA provisions in Section 6.7.

[6] In a contemporaneous paper, Samarakoon (2023) uses tax data to identify firms that use a Double Irish structure and examines how the closure of this structure impacts the repatriation of deferred earnings by MNCs. Hardeck and Wittenstein (2018) use data from the Luxembourg Leaks to identify firms with hybrid tax structures and find that hybrid tax structures reduce MNC tax rates, as measured by financial statements data.

[7] Similarly, additional work studies the effects of profit shifting on worker and executive pay (Alstadsæter, Bjørkheim, Davies and Scheuerer, 2022; Souillard, 2022) and firm value (Desai and Dharmapala, 2009; Garrett and Suárez Serrato, 2019).

data and process of identifying hybrid tax planning structures. Section 3 discusses how the Check the Box regulations facilitated HTPs and details how MNCs used the three strategies we examine to legally avoid taxes. Section 4 explores which firms adopt hybrid tax planning structures and the growth of HTPs among US MNCs over time. Section 5 estimates firm-level changes in foreign tax rates and economic activity of US MNCs following the adoption of tax planning strategies. Section 6 develops a model of international tax planning that rationalizes these empirical patterns and allows us to conduct policy counterfactuals. Section 7 concludes.

2 Data and Sample Construction

2.1 IRS Business Tax Data

Our analysis relies primarily on two IRS Statistics of Income (SOI) datasets that provide parent- and affiliate-level information disclosed in corporate tax returns, allowing us to measure the domestic and foreign activity of a large sample of public and private US corporations. These administrative datasets enable us to reconstruct the foreign ownership networks of US MNCs, linking a particular MNC to both its incorporated affiliates, known as controlled foreign corporations (CFCs), and its pass-through affiliates, known as foreign disregarded entities (FDEs).

The first dataset, commonly referred to as the SOI Corporate Sample, is an annual stratified sample of US corporations that SOI uses to produce publicly-available aggregated business income statistics.[8] The SOI Corporate Sample contains information from unaudited tax returns for approximately 100,000 US corporations annually, and has been used in the business tax literature to study the behavior of domestic firms (e.g., as in Yagan, 2015; Zwick and Mahon, 2017). Our data focus on C corporations that were sampled between 1992 and 2016. The data primarily contain information from Form 1120, the US Corporate Income Tax Return, as well as information from related forms. In our analysis, we also use information from Form 6765, which is used to claim the R&D tax credit, and Form 4562, which is used to calculate tax deductions for depreciation on capital assets.

The second dataset, which reports information related to foreign affiliates of US corporations, is used by SOI to publish aggregate statistics for international business taxes (IRS, 2022). We refer to this sample as the "SOI International Business Tax Sample." This dataset contains a subset of C corporations from the SOI Corporate Sample that file Form 5471 and/or Form 8858:

[8] Statistics are available at IRS (2017), and the sampling procedure is described in IRS (2011).

Form 5471 provides financial information and activity of CFCs, and Form 8858 provides similar information for FDEs. Unlike the SOI Corporate Sample, which is provided annually, CFC data are collected only in even years.[9] FDE data are collected for four of the years in our sample period (2006, 2008, 2012, and 2016).

We also supplement the IRS datasets with financial statements data on public companies from Compustat. Table 1 summarizes the tax forms described above along with selected outcomes that we use in our analysis, both from SOI data and from Compustat.

2.2 Sample Construction

By linking firms' Form 1120, Form 5471, and Form 8858 data, we construct a sample of 3,635 US MNCs that collectively own 43,941 CFCs and 53,141 FDEs.[10] We focus on the sample of MNCs that (1) have at least $500 million in domestic assets and (2) claim one or more CFCs with at least $50 million in foreign assets. This restriction ensures a similar inclusion criteria for all years in our sample.[11] Summary statistics for this stable sample, as well as MNC, CFC, and FDE counts, are provided in Appendix B.

One possible concern when calculating the income of foreign affiliates relates to the measurement of foreign earnings and profits (E&P). Blouin and Robinson (2023) suggest that researchers may inadvertently double count foreign earnings of MNCs. Consider a hypothetical US firm with two CFCs (A and B), where CFC A is a holding company that holds a 100% stake in CFC B and has no economic purpose other than to collect dividends from its subsidiaries. Suppose that CFC B discloses E&P of $100 million, which is issued as a dividend to CFC A. CFC A will then also report E&P of $100 million. A simple aggregation of the firm's foreign profits will result in an estimate of $200 million, even though the true figure is $100 million.

By not accounting for inter-CFC dividend payments, this simple calculation would overestimate the MNC's E&P and in turn underestimate its ETR. However, each CFC must also file attachments to Form 5471 that disclose transactions between the focal CFC and related CFCs, including any dividends that the CFCs may transfer to each other. Following the suggestion of Blouin and Robinson (2023), we first calculate an MNC's foreign earnings by obtaining pretax

[9] International Business Tax Sample data for 2014 are not made available by the IRS.

[10] We consider a firm to be an MNC if it files Form 5471 for at least one CFC.

[11] SOI expanded the sample of firms included in the International Business Tax Sample in 2004 by including smaller firms. By restricting our analysis to a uniform data sampling, we ensure our results are not driven by changes in sampling.

Table 1: Data Sources and Selected Outcomes

SOI Corporate Sample

Form	Description	Selected Outcomes
1120	Corporate Income Tax Return	Domestic Assets Domestic Wages
6765	R&D Tax Credit	Domestic R&D Expenses Domestic R&D Wages R&D Tax Credit
4562	Depreciation and Amortization	Capital Investment

SOI International Business Tax Sample

Form	Description	Selected Outcomes
5471	CFC Information Return	Country of Incorporation Foreign Assets Foreign E&P Foreign Taxes Transactions Between CFCs Transactions Between US Parent and CFCs
8858	FDE Information Return	Country of Incorporation Date Disregarded Foreign Assets Foreign E&P Pass-through Owners Tax Owner

Compustat Data

Description	Selected Outcomes
Consolidated Public MNC Data	Deferred Foreign Taxes (txdfo) Foreign Taxes (txfo) Net Income (ni) Pretax Foreign Income (pifo) R&D Expense (xrd) Revenue (sale) Total Assets (at)

E&P for each affiliated CFC using Schedules E and H from Form 5471. We then remove dividends received from related CFCs from E&P (using Schedule M from Form 5471) to limit the possibility of double-counting of foreign profits.[12] Altshuler, Boller and Suárez Serrato (2024)

[12]In their use of data from IRS Form 5471, Blouin and Robinson (2023) address measurement concerns by

examine the performance of this correction and show that it significantly reduces measurement error in IRS tax data. We discuss how this adjustment relates to our calculation of foreign ETRs in Appendix B.1.

2.3 Identifying International Corporate Ownership Structures

Both the SOI Corporate Sample and the International Business Tax Sample have been used to study domestic and international business taxation. Relatively little work, however, has utilized the wealth of information regarding FDEs.[13] Although data from Form 8858 are collected less frequently than other samples, they allow us to observe two important features of US MNC affiliate structures. First, they reveal the date when an entity was first disregarded by an MNC. Second, they allow us to reconstruct an MNC's precise tax ownership structure, linking US parents to each of their CFCs and each CFC to its related CFCs and/or FDEs. These ownership structures reveal important cross-national linkages within MNCs and, most importantly, allow us to identify MNCs that have particular foreign affiliate structures associated with hybrid tax planning, as we discuss below.

3 Hybrid Tax Planning Structures and Check the Box

This section describes the three hybrid tax planning structures we study. We first outline the "Check the Box" regulations that facilitated hybrid tax planning. We then illustrate how each structure solved key tax problems for US MNCs under the US's worldwide tax system. Further detail and institutional background are provided in Appendix C.

3.1 Check The Box Regulations

During the period we study, the United States imposed a corporate tax on the worldwide income of US corporations, with a credit for foreign taxes paid to avoid double taxation. Two particular features of this system are salient in relation to hybrid tax planning. First, taxes were not due on active foreign business income until it was repatriated to the US parent corporation. This deferral feature of the US tax code made it attractive to hold income generated abroad in tax havens.

excluding related-party dividends between affiliates. They also note that different data sources may introduce measurement distortions by double counting the equity income of affiliates, which, depending on the accounting method used, need not include related-party dividend payments.

[13] A notable exception is a recent working paper, Samarakoon (2023), that examines the impact of the closure of the Double Irish tax structure in Ireland.

Second, to prevent profit shifting, deferral was not extended to certain types of "tainted" income, regulated under Subpart F of the tax code. Earnings considered to be "Subpart F income," such as passive portfolio income and the payment of interest, dividends, and royalties from one CFC to a related CFC in another jurisdiction, were subject to immediate US corporate tax.

In 1996, the US Treasury promulgated regulations effective on January 1, 1997, that made it easier for US corporations to change the entity classification (e.g., corporate or pass-through) of domestic and foreign affiliates. This policy change became known as Check the Box, referring to the ease with which US corporations could change entity classifications. CTB was originally intended to simplify tax filing for domestic firms. However, it also enabled certain types of international tax planning strategies that leverage mismatches in tax laws across countries.

Under Check the Box, an MNC can simply check a box on a tax form to designate a foreign corporation as an FDE, disregarding it as a pass-through—an unincorporated branch of another affiliate corporation.[14] Once disregarded, the entity's transactions with its CFC owner and with other FDEs owned by the same CFC are all viewed as part of one consolidated corporation, making them transparent to the US Treasury. CTB thus facilitates tax planning by allowing US MNCs to easily create "hybrid" entities—foreign affiliates considered to be incorporated from the foreign country point of view, but pass-through from the US point of view (or vice versa, in which case they are referred to as "reverse" hybrids).

Below we discuss how tax planning structures with hybrid entities allow US MNCs to avoid US tax levied on intercompany payments such as royalties, and how these structures leverage mismatches in tax laws across countries to lower foreign tax bills.

3.2 Hybrid Tax Planning Strategies

We study three hybrid tax planning structures enabled by the Check the Box policy: the Double Irish, Reverse Hybrid Mismatch in the Netherlands, and Reverse Hybrid Mismatch in Luxembourg. To motivate these structures, consider a parent MNC that develops intellectual property that it wants to sell around the world. Any profits generated abroad are not subject to US tax

[14] Prior to 1997, we observe very few foreign disregarded entities, as the IRS used a resource-intensive system with strict rules regarding what types of entities could be declared as disregarded. After these restrictions were relaxed via CTB, usage of FDEs became widespread. Over 60,000 foreign affiliates were classified as FDEs by the end of 2016, as show in Panel A of Figure A.1. Panel B of of Figure A.1 demonstrates that by 2008, about 80% of MNCs used CTB to declare at least one FDE, and these FDE-adopting MNCs generated nearly all of foreign E&P.

until repatriated, making it advantageous for the parent to set up a holding company affiliate in a tax haven where foreign profits can enjoy indefinite tax deferral.

The US parent has two broad options to share the IP with its tax haven CFC. First, the parent could license the IP to the CFC in exchange for royalty payments. However, this structure incurs immediate Subpart F tax on the royalties from the CFC to the parent. Second, the parent can transfer the IP to the tax haven CFC, either through a transaction of existing IP or by developing the IP jointly with the CFC.[15]

Although transferring IP avoids current US tax on transactions between the parent and haven CFC, this structure creates three tax problems. First, the US parent is subject to Subpart F tax on the royalties paid to the tax haven holding company from any other CFC. Second, any outstanding foreign profits not paid to the holding company via royalties are subject to taxation in the respective jurisdictions where they remain. Finally, foreign jurisdictions may level additional withholding taxes on royalty transfers.

All of these problems could be resolved by using CTB to implement one of the three hybrid tax planning strategies we study, as illustrated below. While the description of these structures emphasizes their potential to minimize tax obligations, it is important to note that tax planning is also costly. MNCs have to pay for accounting and legal advice and to engage in transactions to form the structures. Company executives also differ in their perceived cost of adopting tax-aggressive positions. In Section 6, we present a model that incorporates these costs of tax planning into the decision to adopt an HTP.

3.2.1 The Double Irish

The first hybrid tax planning strategy we study is known as the Double Irish and involves the US parent setting up two Irish affiliates. The parent first transfers IP to a holding company CFC that is legally incorporated in Ireland, but managed and controlled in a tax haven country like Bermuda. It then "checks the box" to disregard a second Irish affiliate, which licenses the IP from the holding company in exchange for royalties. As a result, the royalty payments are

[15] A cost sharing agreement, in which the parent and tax haven CFC develop the IP jointly, allows the CFC the right to license the IP to other foreign subsidiaries in exchange for royalty payments. Notably, this system can be used to ensure that foreign profits from multiple jurisdictions ultimately end up stored in the tax haven CFC. Profits can be further accumulated in the tax haven if MNCs overprice the royalty: the absence of comparable transactions makes it challenging for tax authorities to value intellectual property and correctly price royalty payments. Further discussion of cost sharing agreements is provided in Appendix C.1. Organ, Bilicka and Güçeri (2023) study the prevalence of cost sharing agreements using IRS tax data.

contained within a single consolidated company from the perspective of the US Treasury.[16]

This structure solves the MNC's first two tax problems. First, under CTB, the royalty payments from the disregarded FDE affiliate to the CFC holding company are transparent to the US Treasury, rendering them exempt from Subpart F tax. Second, any profits retained by the CFC are not subject to Irish tax: though the US considers the holding company to be Irish, under Irish tax law it is Bermudian.

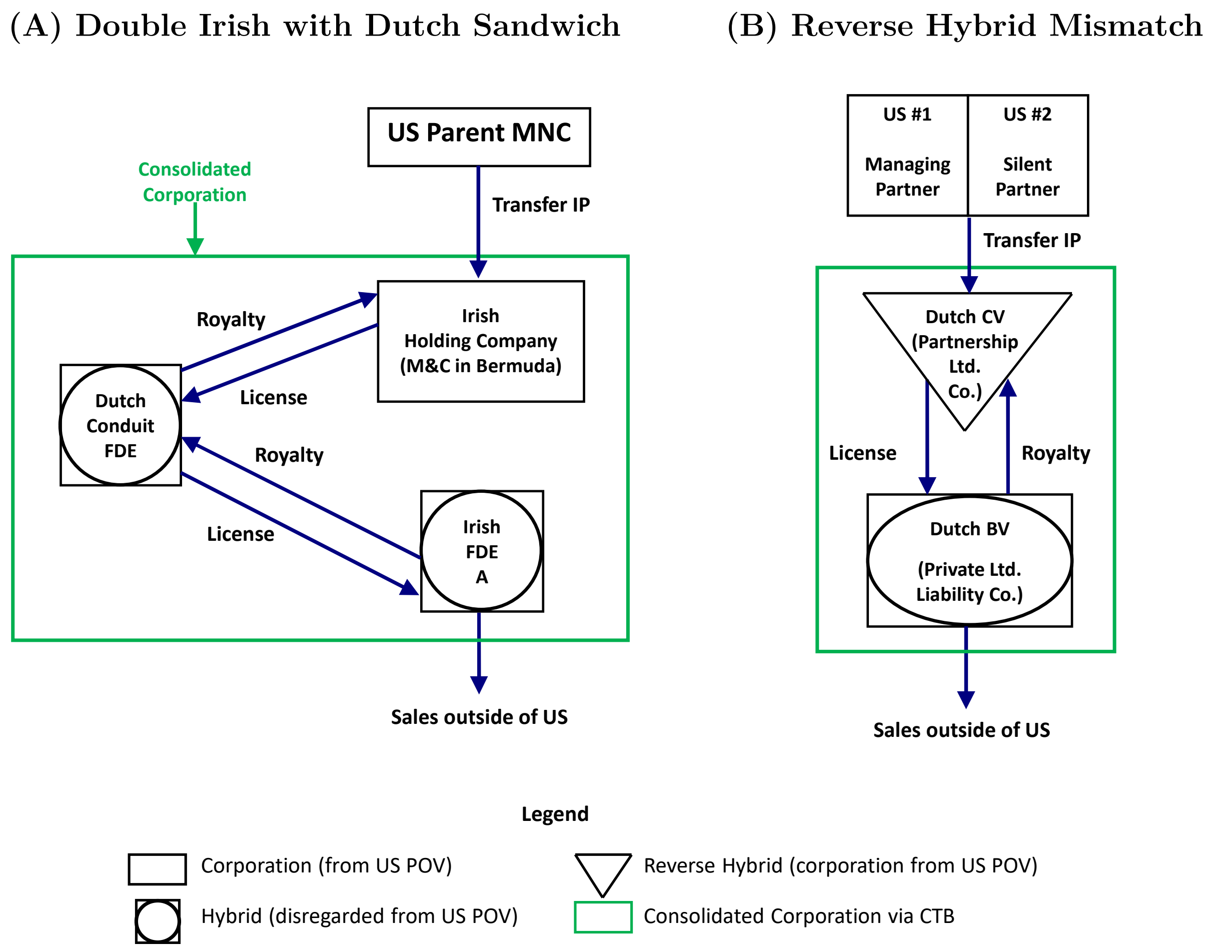
However, this simple Double Irish structure does not circumvent withholding taxes. This is because transfers from the Irish FDE to the IP-holding CFC are viewed as payments to a Bermudian company under Irish law. MNCs can solve this final tax problem by inserting a Dutch conduit—a "Dutch Sandwich"—between the original Double Irish entities. With the conduit entity in place, the parent owes no withholding tax on payments from the Irish FDE to the Dutch conduit, as no withholding taxes are due between European Union companies. Further, no withholding taxes will accrue on the royalties between the Dutch conduit and the Irish CFC because no withholding tax is imposed on these transfers under Dutch law. Finally, to avoid Subpart F taxes on these royalty payments, the US parent checks the box on the Dutch conduit, making it an FDE. Panel A of of Figure 2 provides a diagram of this "Double Irish with a Dutch Sandwich." This structure solves the three tax problems we identified above: it (1) avoids Subpart F taxes on transactions between affiliates, (2) shifts profits from high-tax foreign markets to tax haven affiliates, and (3) circumvents withholding taxes by leveraging mismatches in foreign tax law.

3.2.2 Reverse Hybrid Mismatch

The final two tax planning structures we examine use a strategy known as a Reverse Hybrid Mismatch. While we describe this structure using companies in the Netherlands, we also study a similar arrangement in Luxembourg. To set up the Reverse Hybrid Mismatch, a US MNC creates two US-based affiliates to act as managing/silent partners in a Dutch closed limited partnership called a CV (*commanditaire vennootschap* in Dutch). The partnership is a "reverse hybrid" entity: it is treated as a pass-through company by the Netherlands and as a corporation by the US. The CV holds the IP and licenses it to a Dutch private limited liability company, called a BV (*besloten vennootschap* in Dutch), which sells goods and services in foreign countries. Panel

[16]See Panel B of Figure C.1 for an illustration of the simple Double Irish.

Figure 2: Diagrams of Hybrid Tax Planning Structures



Notes: Figure 2 presents two diagrams of hybrid tax planning structures. Panel A depicts a hypothetical Double Irish with Dutch Sandwich structure and Panel B depicts a Reverse Hybrid Mismatch structure in the Netherlands, otherwise known as a CV-BV. In each of these diagrams, black rectangles represent corporations and the green rectangle depicts combined structures as perceived by the IRS. Squares with circles inside denote hybrid entities, which are corporations in the local country but disregarded for US purposes. In Panel B, the CV is shown as a triangle to denote that it is a reverse hybrid: it is a partnership for Dutch purposes but a corporation for US purposes. An analogous Reverse Hybrid Mismatch structure exists in Luxembourg, where the CV is known as an SCS and the BV is known as a SARL. Additional diagrams are presented in Figure C.1.

B of Figure 2 depicts this structure.

The Reverse Hybrid Mismatch solves the same three tax problems for the MNC. First, tax may be due in the Netherlands. By Dutch tax law, the CV is a pass-through entity, so corporate tax is not levied in the Netherlands. Second, payments from the BV to the CV can generate Subpart F tax. The (reverse hybrid) CV is a corporation from the US perspective, and if the parent "checks the box" to disregard the (hybrid) BV, the US sees the two entities as a consolidated operation. Thus, no Subpart F tax will be due on the royalties. Finally, payments from the BV to the CV could trigger Dutch withholding tax. However, during our period of analysis, a 2005 decree by the Dutch Finance Ministry exempted US-based CV-BVs from withholding tax. With this Reverse Hybrid Mismatch structure in place, profits from US-developed IP sold abroad were not subject to corporate tax in the Netherlands and enjoyed indefinite deferral from US tax. The CV-BV structure is effectively a "sink" for foreign profits.

In Luxembourg, SCS-SARL arrangements play the same Reverse Hybrid Mismatch role as CV-BV arrangements in the Netherlands. SCS and SARL are short for *société en commandite simple* and *société à responsabilité limitée*, respectively. In this case, the SCS is the reverse hybrid company and the SARL is disregarded from the US perspective.

3.2.3 Detecting Hybrid Tax Planning Structures

IRS corporate income tax return data enable us to identify for the first time specific instances of all three of these hybrid tax planning structures. First, as described previously, the Double Irish involves two Irish entities—a top-level entity that is incorporated in Ireland, but managed and controlled in another low-tax foreign country, and a lower-level Irish entity that merchandises the IP in exchange for paying a royalty. Typically, the lower-level entity is "checked" and classified as an FDE for US tax purposes. Alternatively, the MNC may "check" both entities, which are then classified as FDEs under the "tax ownership" of a separate CFC. As a result, we flag two types of CFCs that could be used in a Double Irish arrangement. First, we flag any CFC that is incorporated in Ireland and that checks the box on an Irish FDE. Second, we flag any CFC that checks the box on two separate Irish FDEs. Note that this classification method flags simple Double Irish arrangements that involve a direct link between two Irish entities, as well as more complex arrangements, such as the Double Irish with a Dutch Sandwich, that might involve intermediary affiliates through which profits are routed.

The other type of structure we consider is the Reverse Hybrid Mismatch arrangement, which we examine in the Netherlands and in Luxembourg. This arrangement involves a top-level entity that is classified as a partnership and a bottom-level entity that is classified as a private limited company in the associated country of incorporation. SOI data typically provide the acronym that is associated with the management form of foreign affiliates on Forms 5471 and 8858. To classify potential Reverse Hybrid Mismatch structures, we thus flag any CFC classified as a CV (incorporated in the Netherlands) or SCS (incorporated in Luxembourg) that checks the box on an FDE classified as a BV (Netherlands) or SARL (Luxembourg). We also flag any CFC that checks the box on a CV-BV or SCS-SARL pair of FDEs.

To define the date of adoption, we use the fact that Form 8858 reports the year in which a foreign affiliate is first disregarded. For both the Double Irish and Reverse Hybrid Mismatch arrangements, we use the first date that all flagged FDEs were disregarded to measure the year that an MNC first adopted a particular structure. With this information in hand, we now consider the types of MNCs that adopted hybrid tax planning structures.

4 Which Firms Adopt Hybrid Tax Planning Structures?

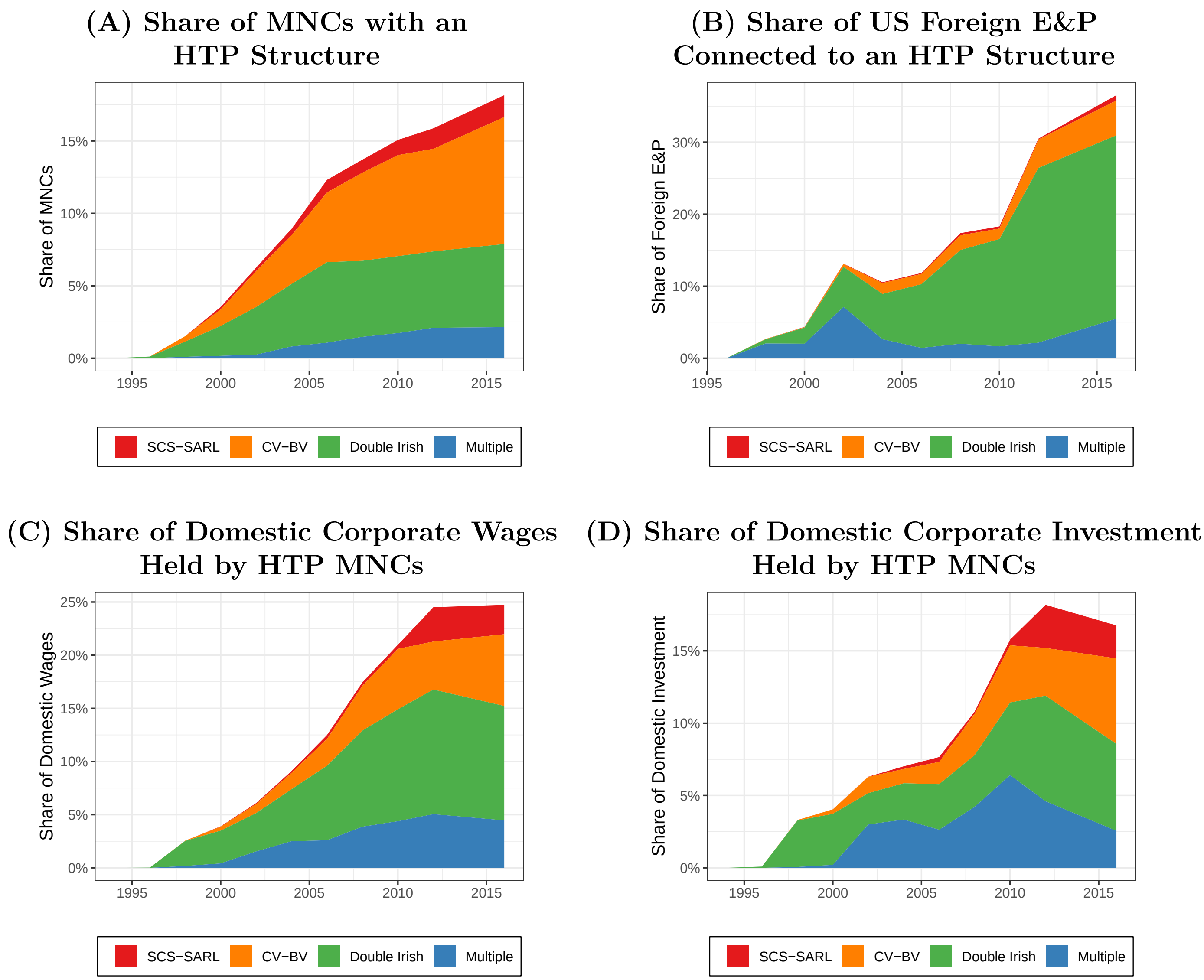
This section uses our unique hybrid tax planning data to provide new facts on the evolution and prevalence of HTP adoption by US MNCs. We then assess the extent to which observable firm characteristics are predictive of HTP adoption. While large firms and firms in IP-intensive industries are more likely to adopt an HTP, overall we find that observable characteristics have low predictive power regarding which specific firms adopt HTPs.

Figure 3 provides important descriptive facts regarding the uptake and prevalence of hybrid tax planning structures. After 1997, there was steady adoption of HTPs, with more than 18% of MNCs adopting at least one by 2016 (Panel A). Approximately 36.5% of all foreign E&P of US MNCs was routed through a hybrid tax planning structure by 2016 (Panel B). These profits are highly concentrated in the largest HTP-adopting firms: approximately 80% of HTP-connected E&P—or 29% of all US foreign E&P—is attributable to just the top 5% of hybrid tax planning MNCs in 2016.[17] In other words, the HTP-related profits of roughly 18 MNCs accounted for nearly one third of all US foreign E&P in 2016. Finally, as a share of all C corporations in the SOI Corporate Sample, which includes domestic corporations as well as MNCs, MNCs with HTP structures paid more than 20% of domestic wages (Panel C) and accounted for about 15% of domestic investment (Panel D) by 2010.

A natural question arising from these aggregate trends is what types of MNCs adopt hybrid tax planning structures. Whether or not the observable characteristics of MNCs predict HTP adoption is central to regulatory efforts that seek to address tax planning behavior. We estimate a series of simple logistic regressions that predict HTP adoption and estimate industry shares within adopting and non-adopting groups. These analyses support anecdotes that aggressive

[17]Figure A.3 plots the Lorenz cuve of foreign E&P connected to HTPs among adopting MNCs in 2016.

Figure 3: Adoption of Hybrid Tax Planning Structures



Notes: Figure 3 presents four representations of the prevalence of HTP adoption over time. Panel A shows that a growing share of US MNCs adopted HTP structures. Panel B shows the share of total US foreign E&P that is connected to an HTP. Notably, by 2016, more than 35% of all US foreign E&P was routed through an HTP. Panel C shows that HTP-adopting MNCs represented a large share domestic wages, calculated as a fraction of all domestic wages among C corporations in the IRS Statistics of Income Corporate Sample. Panel D shows similar results as Panel C, but for domestic investment. In each panel, the blue area comprises MNCs that have adopted more than one structure. Additional representations are presented in Figure A.2.

tax planning MNCs tend to be larger firms that operate in industries with large amounts of IP. We also examine a broader set of characteristics, but find that both econometric and machine learning methods struggle to accurately predict adoption of these strategies based on observables.

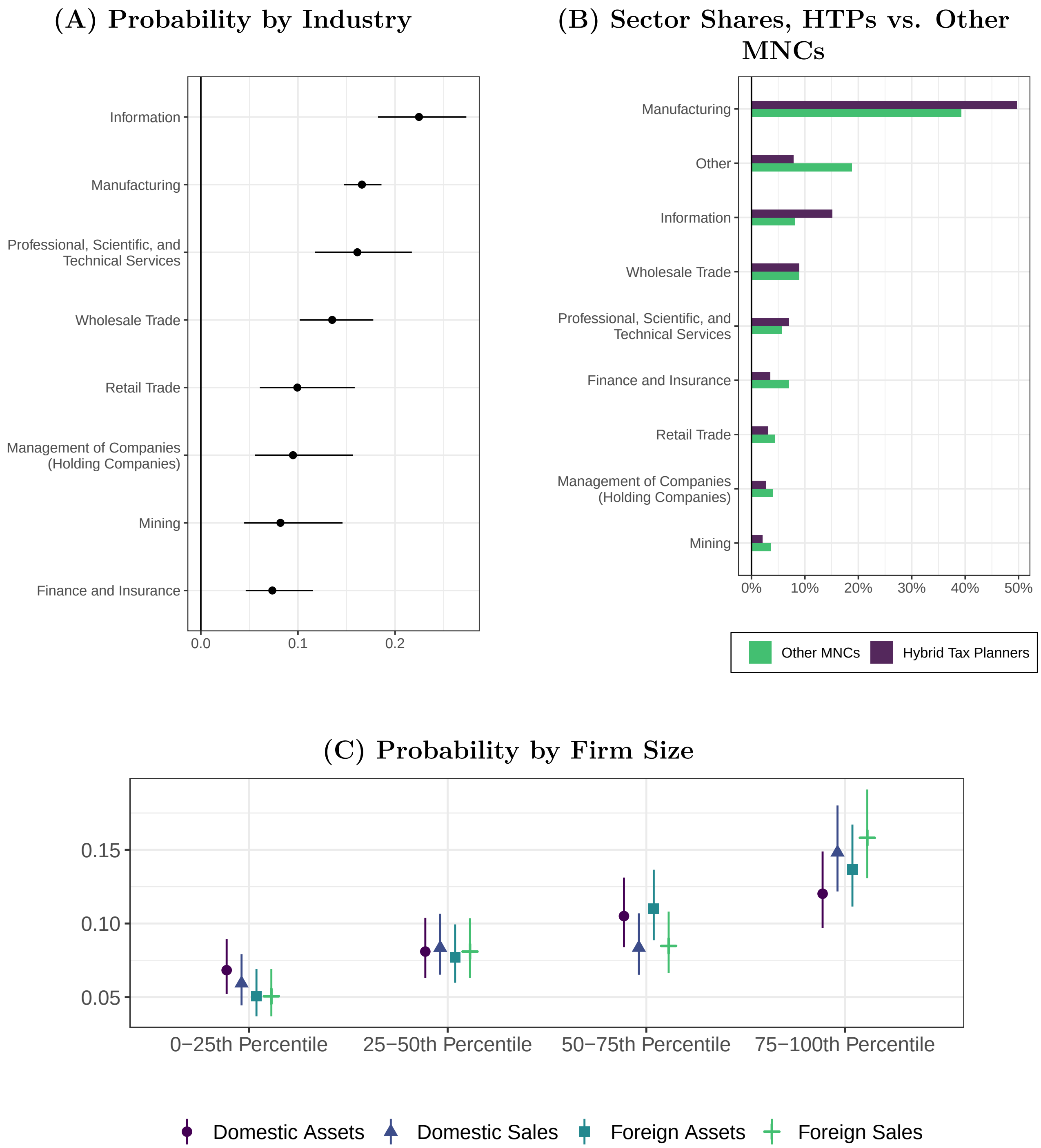
We start by analyzing industry variation in the adoption of hybrid tax planning by sector.[18] Panel A of Figure 4 reports the predicted probability of adoption by sector using estimates from a simple logit model with industry dummies. Panel B shows industry shares for MNCs that adopt HTPs and those that do not. There is considerable variation in adoption across different sectors. For example, MNCs classified under Information are more than twice as likely to adopt HTP structures compared to MNCs classified under Finance and Insurance. MNCs that adopt HTP structures disproportionately come from the Information and Manufacturing sectors.

Finally, Panel C of Figure 4 provides estimates of the predicted probability of HTP adoption according to several different measures of MNC size. Each color provides estimates computed from a separate logit model corresponding to a different measure of size (domestic assets, domestic sales, foreign assets, and foreign sales). We bin the MNCs into size quartiles. All of these measures indicate that larger MNCs tend to adopt HTP structures at higher rates.

In addition to industry and firm size, we examine whether a set of other observable characteristics is predictive of HTP adoption by conducting a jointly estimated logit regression reported in Table 2. This table provides two specifications, one with year fixed effects only and one with interactions between industry, sales quartile bins, asset quartile bins, and year fixed effects. Of the characteristics examined, only a few appear to be predictive of HTP adoption. In particular, the results suggest that geographic footprint of MNC affiliates seems to be predictive. MNCs that previously operated in the jurisdictions where we detect HTPs (Ireland, the Netherlands, and Luxembourg) are more likely to adopt them.

[18] We use IRS industry classifications that are analogous to 2-digit SIC codes. For consistency, we use the most recently observed industry classification for each MNC across all years. Analogous figures for subindustries, which are provided in Figure A.4, suggest similar patterns: adoption is stronger within subindustries that contain tech and pharmaceutical firms (e.g., data processing and chemical manufacturing). Other IP-intensive subindustries, such as publishing, also adopt HTP structures at relatively high rates.

Figure 4: Probability of HTP Adoption



Notes: Figure 4, Panel A reports the predicted probability of HTP adoption by sector according to a simple logit model. We remove industry groupings with fewer than ten MNCs in any group. Panel B reports industry shares by sector. Sectors with fewer than 10 firms in either HTP adoption group are collected into the "Other" category. In both panels, we use IRS industry classifications analogous to 2-digit SIC codes. For consistency, we use the most recently observed industry classification for each MNC across all years. Panel C reports the predicted probability of adoption by size according to four simple logit models that examine four different measures of firm size, with standard errors clustered at the MNC level. Analogous figures for Panels A and B, but using subindustries rather than industries, are presented in Figure A.4.

Table 2: Selection into Hybrid Tax Planning

	(1)	(2)
Claim Research Credit	0.105	−0.045
	(0.144)	(0.178)
Firm Age Quartile 2	0.417*	0.399+
	(0.188)	(0.212)
Firm Age Quartile 3	0.000	−0.015
	(0.209)	(0.241)
Firm Age Quartile 4	0.010	−0.041
	(0.206)	(0.238)
Avg. Statutory Foreign ETR	0.588	0.041
	(0.993)	(1.146)
Share of Foreign Sales with Unobserved Statutory Rate	0.117	0.035
	(0.320)	(0.352)
Exposure to CTB	1.608*	1.605
	(0.795)	(1.007)
Advertising to Sales Ratio	−0.147	−1.919
	(0.500)	(2.111)
Domestic Loss	−0.793***	−0.910***
	(0.184)	(0.216)
Presence in Ireland	1.371***	1.331***
	(0.199)	(0.244)
Presence in Netherlands	0.578***	0.446*
	(0.150)	(0.182)
Presence in Luxembourg	0.027	−0.077
	(0.229)	(0.265)
Num. Obs.	7,624	4,483
R2 Pseudo	0.064	0.176
Year FEs	Yes	-
Industry, Sales, Asset Quartiles x Yr FEs	-	Yes

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table 2 displays coefficients from logit regressions that predict HTP adoption based on a combination of MNC characteristics. Column (1) includes year fixed effects; Column (2) includes year-by-industry, sales, and asset quartile fixed effects, which produces a lower observation count because each bin must include both HTP adopters and non-adopters for estimation. Further details of the regression design are provided in Appendix D. Standard errors are clustered at the MNC level. +, *, **, and *** denote statistical significance at the 10, 5, 1, and 0.1% level.

We also construct a measure of exposure to CTB that captures the degree to which regulatory limitations allow MNCs to use Check the Box in any given country.[19] Both MNCs that previously operated in HTP-related countries as well as those with greater exposure to CTB may be able to shift income more easily, explaining why these measures of exposure are predictive of adoption. Finally, we find that MNCs in a domestic loss position are less likely to adopt HTP structures.[20]

Beyond the question of whether some firm characteristics are predictive of adoption, we also test how well a tax authority could leverage this information to predict the adoption of HTP structures. We evaluate this question in two ways, which we describe in more detail in Appendix D. First, using the logit models in Table 2, we observe low pseudo R-squared values of 0.064 in Column (1) and 0.176 in Column (2). This suggests that firm-level attributes do not have strong predictive power for adoption of these strategies.[21]

Second, we estimate a random forest model based on the same set of observable characteristics as in Table 2. The benefit of random forests that they allow for general nonlinearities in how these characteristics impact the likelihood of HTP adoption. We evaluate the predictive performance of this model in Appendix D.2, where we follow the literature to compute the area under the curve (AUC) for the receiver operating curve (ROC) (e.g., as in James, Witten, Hastie and Tibshirani, 2023). Figure D.2 plots this ROC and yields an AUC score of 0.655, indicating a low prediction performance associated with these observables.[22]

The results in this section demonstrate that HTPs are a first-order phenomenon when understanding the foreign operations of US MNCs. Given the importance of these MNCs for domestic economic activity, understanding the economic forces behind HTP adoption is an important question. At the same time, there remains considerable unexplained variation in HTP adoption even after controlling for a large set of firm characteristics that have been used as proxies for tax planning. The model in Section 6 builds on these insights when considering how the adoption of HTPs impacts real economic activity.

[19]We describe the construction of this measure, which relies on the fact that MNCs cannot "check the box" on *per se* corporations, in Appendix D.1.

[20]These firms may have tax credits that offset income tax levied on repatriated foreign earnings, which makes deferral relatively less attractive.

[21]Details of our logit specifications are presented in Appendix D.1. Figure D.1 plots histograms of predicted adoption scores for each specification, based on firms' realized adoption decisions, which again demonstrate low predictive success. Additional logit models based on subsets of the observables in Table 2 (Tables D.1 and D.2), as well as on characteristics of MNC auditors (Table D.3), show similar results.

[22]This conclusion is reinforced by Figure D.3, which plots a histogram for the random forest model analogous to the logit histograms in Figure D.1.

5 Hybrid Tax Planning Structures and Multinational Activity

We now formally consider the economic changes associated with HTP adoption. Figure 1 shows that HTP-adopting MNCs experienced a substantial decline in foreign effective tax rates relative to non-adopting MNCs following the enactment of CTB in 1997. This result indicates that HTP-adopting firms likely engage in profit shifting behaviors that lead to lower ETRs. Access to lower effective tax rates also suggests that firms might experience changes in real economic activity, both domestically and abroad.

Quantifying these impacts, however, is challenging. HTP adoption is a firm-level decision that is likely to generate selection bias, both due to the decision to tax plan itself as well as the timing of that decision. We approach these challenges by estimating staggered difference-in-differences models that link firm-level changes in ETRs and other MNC outcomes to the timing of HTP adoption. These models allow us to assess the importance of several potential drivers of selection. We evaluate whether selection on observables drives firm-level outcomes by implementing propensity score weighting based on the observables considered in Section 4. Pre-adoption event study coefficient estimates allow us to assess whether any post-adoption changes in firm investment or profit shifting behavior are driven by existing trends that influence the adoption decision. We interpret the resulting difference-in-differences estimates as potentially reflecting both the real effects of lower ETRs and selection on private information about the returns to HTP adoption.

We first describe this staggered difference-in-differences design and then demonstrate how it improves our understanding of the profit shifting and real investment behavior of MNCs. Our estimated effects on firm investment inform our model in Section 6, which considers how heterogeneous costs and benefits from HTP adoption impact selection into HTPs as well as the marginal investment decisions of US MNCs.

5.1 Estimating Staggered Difference-in-Differences Models

Recent literature has provided several alternative models that researchers may use to produce difference-in-differences estimates in staggered contexts. We provide estimates for three of these models.

Our main specification relies on the "stacked" design from Cengiz, Dube, Lindner and Zipperer (2019), which creates a dataset for each cohort. This dataset includes MNCs that adopt an HTP structure, as well as MNCs that do not adopt an HTP structure in the six years before and after the adoption year c. Non-adopting MNCs may therefore be repeated in the regression dataset as comparison units for different cohorts. Formally, the stacked design estimates the regression equation,

$$Y_{ict} = \alpha_{ic} + \lambda_{ct} + \sum_{\ell=-6}^{6} \mu_\ell \mathbf{1}\left\{t - c = \ell\right\} + v_{ict}, \tag{1}$$

where i indexes MNCs, c is the year in which a particular cohort first adopts a hybrid tax planning structure, and t indexes years. ℓ is an indicator for the relative number of periods after MNC i adopts a foreign tax planning structure, and α_{ic} and λ_{ct} are MNC-by-cohort and year-by-cohort fixed effects. We estimate this regression for various outcomes Y_{ict}. In all specifications, we cluster standard errors at the MNC level. We also consider simple difference-in-differences models that are similar to Equation 1 but only include a single post-treatment event-time indicator, and thus describe the average change in outcomes in the years before and after HTP adoption.

We interpret results of Equation 1 as measuring dynamic changes in firm-level outcomes of HTP-adopting MNCs as compared to those of to non-adopting MNCs. Relative to aggregate trends over time, these estimates help tie changes in firm outcomes to the timing of adoption. This approach also addresses the concern that firm outcomes are driven by concomitant shocks to firms with characteristics that are related to tax planning (e.g., larger firms, more IP-intensive firms, or firms in different industries). To do so, we estimate alternative specifications that interact year fixed effects with a set of pre-adoption covariates for MNCs to allow for time-varying heterogeneity across industries, across foreign and domestic firm sales bins, and across foreign and domestic bins for intangible assets.[23] As a robustness check, in Appendix A we also estimate effects using the stacked specification with inverse probability weights (IPW), an alternative specification proposed by Sun and Abraham (2021), and a standard two-way fixed effects (TWFE) estimator.[24]

Because tax planning is an endogenous decision by firms, we are careful to avoid interpreting our estimates of Equation 1 as the causal effect of HTP adoption. Pre-trend estimates

[23]To be precise, this implies an augmented version of Equation 1 where λ_{ct} is replaced by $\sum_{g \in G} \lambda_{gct}$, where G is a set of groups for which we include group-by-cohort-by-year fixed effects.

[24]The ability to easily incorporate propensity score weights is one notable benefit of the stacked estimator that we use as our main specification. Our IPW scores are calculated using the random forest model we introduce in Section 4. We detail the construction of these propensity scores in Appendix D.3.

help us test the validity of the parallel trends assumption underlying conventional difference-in-differences designs. In our setting, we assess pre-trends to rule out the possibility that MNCs select into tax planning based on pre-period trends in outcomes (e.g., the possibility that HTPs are disproportionately established by high-growth MNCs). However, MNCs may also select into HTP structures because (1) they have more to gain from tax planning or (2) they adopt HTPs upon realizing new IP shocks. Either form of selection would produce an upward bias of our estimates of the effects of HTP adoption on real economic activity. Section 6 develops a model of selection on gains that interprets estimates from Equation 1 as arising from both selection into tax planning and from behavioral changes related to tax planning.

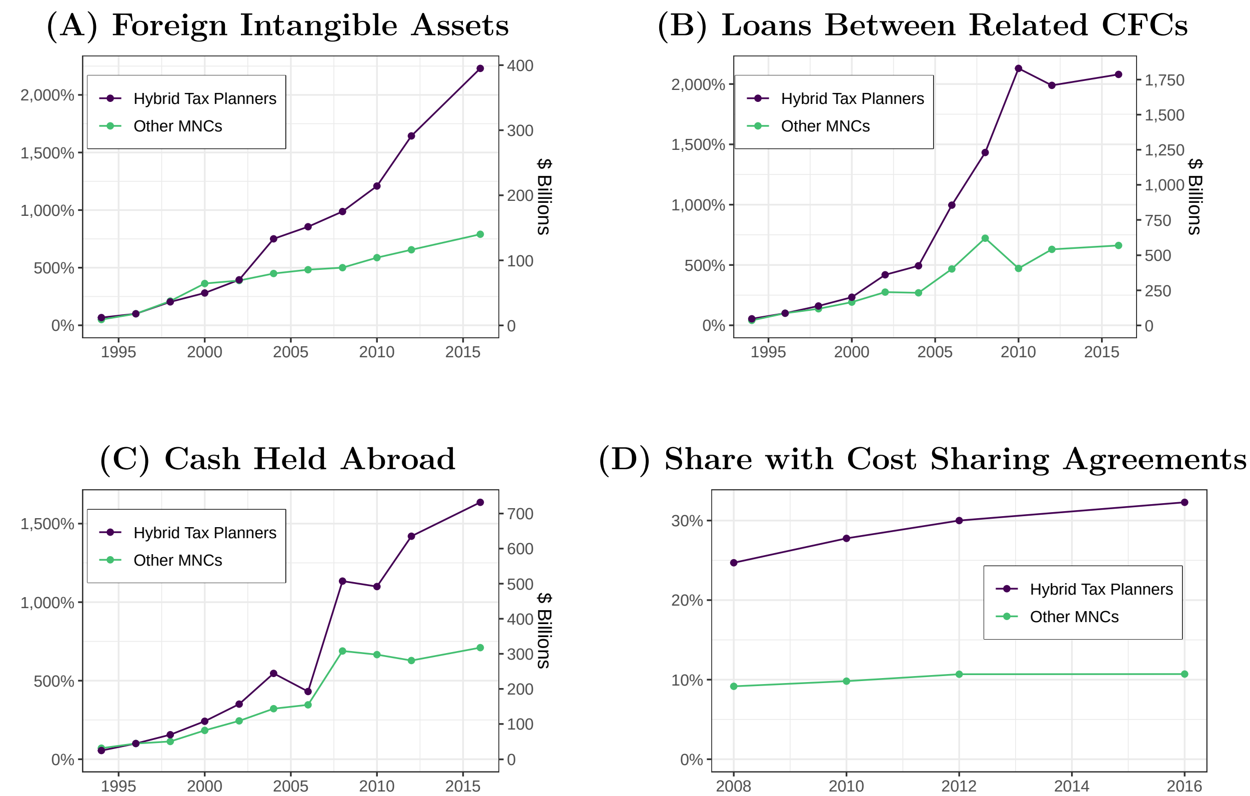
5.2 Changes in Profit Shifting Mechanisms

While the HTP structures we study have long been suspected of being used for profit shifting, lack of tax data prevented prior researchers from confirming this role in a systematic manner. We therefore start by exploring whether hybrid tax planning firms engage in the kinds of transactions that are associated with profit shifting. As in Figure 1 above, which compares average firm ETRs, Figure 5 presents aggregate comparisons between MNCs that eventually adopt HTP strategies during our sample to those that do not. Each panel plots a selected outcome as a percentage of 1996 levels. The secondary y-axis to the right of Panels A, B, and C indicates the level values for the group of hybrid tax planning firms.

In Panel A, we show that hybrid tax planning MNCs experience a much faster rise in the book value of foreign intangible assets when compared to non-HTP MNCs. This growth is consistent with the use of hybrid tax planning structures to shift income generated by intangible assets. Panel B demonstrates that HTP-adopting firms generate a much larger comparative aggregate loan balance between their related CFCs.[25] Panel C demonstrates that hybrid tax planning firms saw large increases in cash held abroad compared to non-adopters. Finally, Panel D shows that a larger share of hybrid tax planning firms used cost sharing agreements than non-adopting firms. While the fact that MNCs accumulated cash abroad during the last two decades is well known, this panel shows that the bulk of this growth occurred among the 300 firms that we observe with hybrid tax planning agreements in Ireland, the Netherlands, and/or Luxembourg. This result is

[25]These balances may be related to tax avoidance strategies known as interest stripping. As we discuss in Appendix C, these strategies can shift profits from high-tax markets to tax havens through (tax-deductible) interest payments.

Figure 5: Comparison of Aggregate Trends



Notes: Figure 5 shows the evolution of mechanisms commonly linked to profit shifting for two groups of MNCs. In each panel, the purple line shows aggregate values for a group of MNCs that eventually adopt at least one of the hybrid tax structures described in Section 3. The light green line shows aggregate values for MNCs that did not adopt any of these structures during the sample window. For comparability, aggregate values for both groups are normalized to 100% as of 1996. In Panels A - C, the right-hand axis displays dollar value in billions, relative to the aggregate 1996 dollar value for HTP-adopting MNCs. Panel A shows foreign intangible assets, Panel B shows loans between related CFCs, Panel C shows shows cash held abroad, and Panel D shows the share of MNCs in each group that were engaged in active cost sharing agreements with a CFC. Additional outcomes are shown in Figure A.5.

consistent with a transition away from undeferred royalty income.

The results in Figure 5 provide *prima facie* evidence of the specific mechanisms through which HTP strategies operate. The ability to shift profits to lower-tax countries allows MNCs to defer US income tax and avoid foreign income tax. This figure also highlights the value of using tax data, which allow us to (1) identify the adoption of specific tax planning structures, as in Figure 3; (2) link the adoption of HTP structures to specific profit shifting mechanisms, as in Figure 5; and (3) measure the associated impact on ETRs, as in Figure 1 and as discussed below.

5.2.1 Firm-Level Changes in Profit Shifting Mechanisms

We now show that the changes in firm outcomes described above are closely tied to the adoption of HTPs. Figure 6 plots estimates of Equation 1 for the outcomes shown in Figure 1 and Panels A–C of Figure 5. We report two specifications for each outcome. Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry and year-by-cohort-by-group fixed effects. Groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles. Quartiles are computed using the period prior to adoption for each cohort.

For the twelve-year window surrounding HTP adoption, this figure provides logged estimates for intangibles held abroad (Panel A), the balance of loans between CFCs (Panel B), and cash held abroad (Panel C). Across these three outcomes, we observe similar trends for adopting and non-adopting MNCs prior to the adoption of an HTP structure, followed by relative increases for HTP-adopting MNCs after the period of adoption. Consistent with these mechanisms and the result of Figure 1, Panel D shows that the post-adoption foreign ETRs of HTP-adopting MNCs gradually declined relative to those of non-adopting MNCs. Six years after adoption, MNCs experience a reduction in their foreign ETR of between three and four percentage points.[26] For all of these outcomes, we find that inclusion of size-bin-by-cohort-by-year fixed effects and industry-by-cohort-by-year fixed effects does not significantly impact the estimates.

Table 3 provides pooled estimates using a similar specification that replaces relative time dummies with pre and post dummies. The estimates in Column (1) indicate that on average, loans between CFCs increased by 40%, foreign intangible assets increased by 68%, and cash held abroad increased by 56%, relative to the pre-adoption period. We also estimate an average decline in foreign ETRs of 3.9 percentage points in the period after adoption. Column (2) shows that these estimates are stable across specifications that include interactions between bins of firm size and year fixed effects, bins of intangible assets interacted with year fixed effects, and industry-by-year fixed effects, suggesting that our results are not driven by comparisons across firms in different industries, in different domestic and foreign size categories, or that are more or less dependent on intellectual property.

[26] We calculate ETRs following the methodology described in Appendix B.1.

Figure 6: Profit Shifting Mechanisms, Deferral, and Foreign ETRs

Notes: Figure 6 provides estimates of μ_ℓ from Equation 1 for the corresponding outcome listed in each panel. Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry fixed effects and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values for each cohort.

Table 3: Profit Shifting Mechanisms, Deferral, and Foreign ETRs

	(1)	(2)	(3)	(4)	(5)
Panel A					
Foreign Intangibles	0.681***	0.735***	0.637***	0.590***	0.709***
	(0.172)	(0.177)	(0.193)	(0.171)	(0.175)
Num. Treated	248	248	208	250	229
Num. Control	1,524	1,490	1,221	1,532	1,757
Panel B					
Rltd. CFC Loans	0.401*	0.524**	0.505**	0.344+	0.491**
	(0.157)	(0.161)	(0.174)	(0.176)	(0.163)
Num. Treated	233	233	197	238	205
Num. Control	1,263	1,240	1,041	1,294	1,597
Panel C					
Foreign Cash	0.563***	0.555***	0.469**	0.539**	0.472**
	(0.133)	(0.136)	(0.149)	(0.173)	(0.144)
Num. Treated	257	257	214	257	252
Num. Control	2,054	2,000	1,518	2,023	2,037
Panel D					
Foreign ETR	-0.039**	-0.032*	-0.024	-0.037*	-0.042**
	(0.015)	(0.016)	(0.018)	(0.017)	(0.015)
Num. Treated	257	257	214	257	252
Num. Control	2,100	2,043	1,529	2,046	2,042
MNC & Year x Cohort FEs	Yes	-	-	-	-
MNC & Ind., Size x Yr x Cohort FEs	-	Yes	Yes	-	-
MNC & Ind., Size x Yr FEs	-	-	-	Yes	Yes
Inverse Prob. Weights	-	-	Yes	-	-
Model	Stacked	Stacked	Stacked	SA	TWFE

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Notes: Table 3 provides estimates of the difference-in-differences model discussed in Section 5.1 for the corresponding foreign outcome listed in each panel, where Columns (1)–(3) use a version of Equation 1 that only considers a single pre and post period. Column (1) does not include additional controls. Columns (2)–(3) include year-by-cohort-by-industry and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values. Column (3) uses inverse probability-weighted data. Column (4) estimates an alternative specification from Sun and Abraham (2021). Column (5) estimates a standard two-way fixed effects (TWFE) specification. Both columns (4) and (5) use year-by-industry and year-by-group fixed effects as defined above. Standard errors are clustered at the MNC level. +, *, **, and *** denote statistical significance at the 10, 5, 1, and 0.1% level.

5.2.2 Robustness Checks: Profit Shifting Mechanisms

Overall, the results in this section indicate that the adoption of HTP structures precedes large increases in tax avoidance behavior. This divergence between adopting and non-adopting MNCs gives important context for Figure 1, which shows that HTP-adopting MNCs experienced a much larger comparative decline in their foreign ETR during our sample period. We conduct a number of additional exercises to validate these findings.

Additional Event Study Specifications

First, to ensure that we are comparing similar firms in our regressions, we extend the estimation of Equation 1 by applying inverse probability weighting to the sample of MNCs using propensity scores generated from the random forest model discussed in Section 4. As we detail in Appendix D.3, propensity score weighting offers a convenient way to control for potential selection bias that may be introduced by a lack of balance along observable dimensions between adopting and non-adopting MNCs. We also explore the robustness of our results to using an alternative estimator from Sun and Abraham (2021), as well as a standard two-way fixed effects estimator. Table 3 shows that we obtain similar estimates of changes in firm outcomes when we expand the model in Equation 1 by including inverse probability weights (Column 3); when we use the estimator of Sun and Abraham (2021) (4); and when we use a simple TWFE estimator (5). Figures A.6, A.7, and A.8 show corresponding event studies for each of these three respective specifications.

Estimating Foreign Effective Tax Rates

We also conduct further analyses related to foreign ETR estimations. Notably, firm-level foreign ETRs can be subject to year-over-year volatility due to losses or tax credits. It is thus generally more accurate to estimate firms' aggregate foreign ETRs (i.e., by dividing total taxes over total income), rather than averaging yearly tax-income ratios. We account for this concern by conducting a simple "pooled" difference-in-differences analysis in Table 4. This table presents the average change in the foreign effective tax rate using a two-period specification, centered on the timing of firm-level HTP adoption.

As above, we calculate ETRs in SOI tax data following the methodology described in Appendix B.1. However, the estimations in Table 4 differ along four important dimensions. First, we use firm-level ETR estimates that are pooled across all pre and post periods, rather than

Table 4: Pooled Foreign ETRs

	(1)	(2)
Unweighted Foreign ETR	−0.035+	−0.032*
	(0.021)	(0.016)
Weighted Foreign ETR	−0.092**	−0.061*
	(0.034)	(0.028)
Num. Treated	155	83
Num. Control	1,101	308
Sample	SOI	Compustat
Outcomes	SOI	Compustat
Years Included	Even	All

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Notes: Table 4 estimates a difference-in-differences model using a two-period specification. Foreign effective tax rates are computed using aggregate taxes and earnings from each period to reduce measurement error relative to an annual specification. Column (1) provides estimates using measures from SOI data, as described in Section B.1. Column (2) provides estimates using measures from Compustat. Results are provided for an unweighted specification, as well as a weighted specification where firms are weighted by aggregate pre-period earnings. Firms are only included if they have positive earnings in both pre and post periods. +, *, **, and *** denote statistical significance at the 10, 5, 1, and 0.1% level.

using year-by-year foreign ETRs.[27] Second, we only include firms that have positive aggregate earnings in both periods; this reduces year-to-year volatility in the firm-level ETR. To ensure that outliers do not skew the average, we winsorize these rates so they do not exceed 100%. Third, in addition to a standard unweighted regression, we conduct a regression that weights firms by aggregate pre-period foreign income. Finally, we compute an additional average foreign ETR measure using Compustat data, following the methodology in Dyreng, Hanlon and Maydew (2008). There are advantages and disadvantages to both measures: SOI data provide a larger sample of MNCs, but contain only even years. Compustat excludes private firms, reducing its MNC coverage, but these firms are observed annually.

In Table 4, Column (1) uses SOI tax data and Column (2) uses foreign taxes and pretax income as reported in Compustat. The unweighted pooled results for both measures are broadly similar to our event study estimates in Table 3, showing declines of between 3.2 and 3.5 percentage points among firms that adopt HTP structures. Weighted results demonstrate much stronger reductions in foreign ETRs after adoption of HTP structures—between 6.1 and 9.2 percentage

[27] We use the stacked panel in this analysis in order to create distinct pre and post periods for the comparison group of firms that do not adopt HTP structures. Because each firm has a single pre-period observation and post-period observation, we cannot use the same fixed effects as our event studies above.

points, depending on the measure used. These results suggest that although firms generally experienced reductions in foreign tax rates after adopting HTP structures, these reductions were concentrated in the largest adopting firms.

5.3 Changes in Real Economic Activity

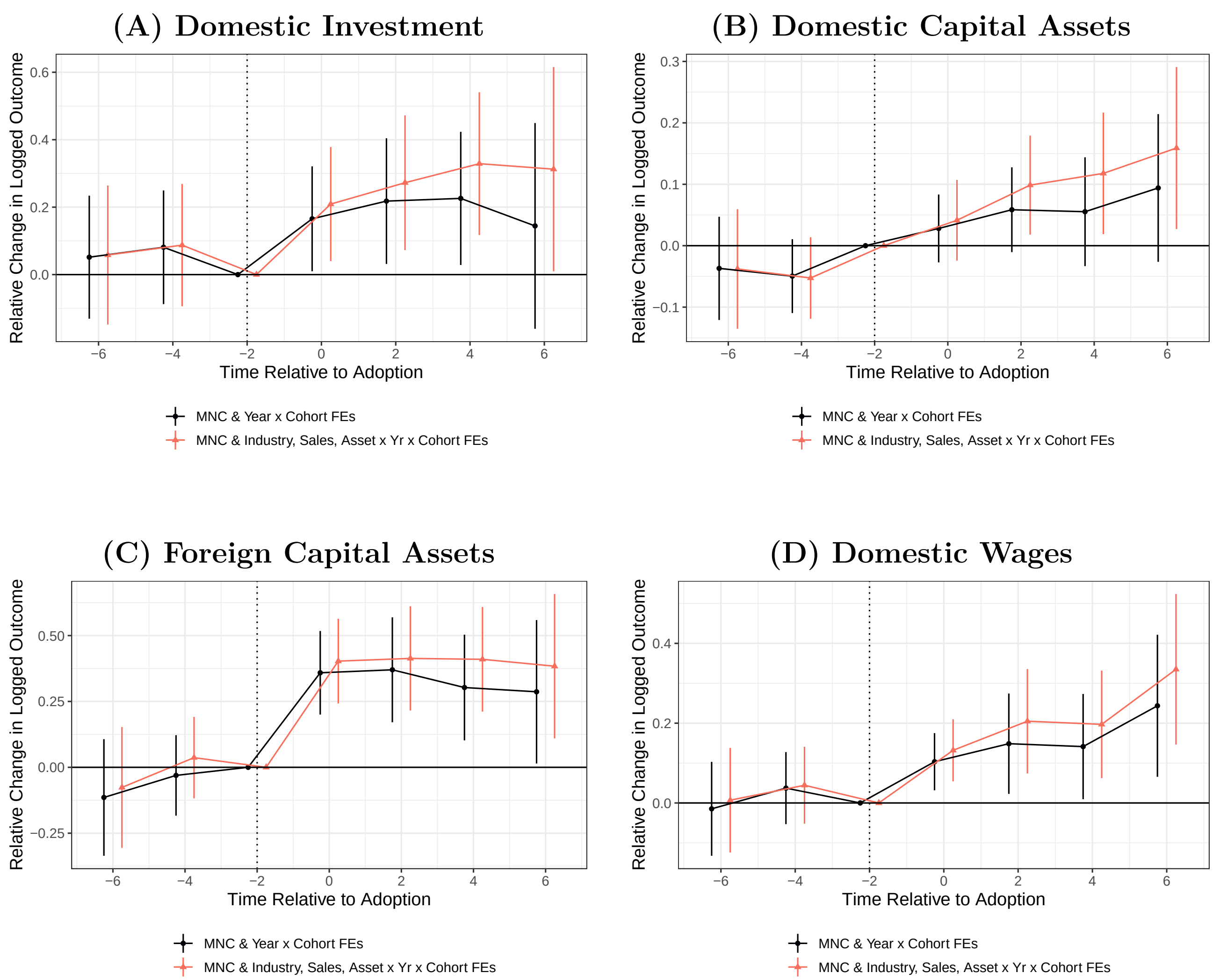
To measure changes in real activity, we estimate Equation 1 for outcomes including domestic investment, domestic capital assets, foreign capital assets, and domestic wages. Domestic wages and assets are reported on IRS Form 1120, Foreign assets are reported on IRS Form 5471, and domestic investment is measured as the sum of reported assets placed into service on Form 4562. Figure 7 presents the event study results for these outcomes. As with the profit shifting mechanisms, estimates for each of the real outcomes are not significantly different from zero in the pre-adoption period. Following the adoption of a hybrid tax planning structure, we observe significant relative increases in domestic investment (Panel A), domestic and foreign capital assets (Panels B and C), and domestic wages (Panel D).

Table 5 summarizes these estimates using a pooled specification. Column (2), which includes more granular controls, reports an increase in domestic investment of 27%, a corresponding increase in domestic capital assets of 16%, an increase in foreign capital assets of 40%, and an increase in domestic wages of 20%. While previous literature has successfully documented empirical patterns consistent with profit shifting, it has been harder to show how these profit shifting strategies relate to real economic activity. Our estimates contribute to this literature by linking significant changes in economic activity to the adoption of specific tax planning strategies.

5.3.1 R&D Activity

An important facet of MNCs' economic activity is spending on R&D, which can be significantly impacted by corporate taxes (e.g., Rao, 2016; Chen, Liu, Suárez Serrato and Xu, 2021; Akcigit, Grigsby, Nicholas and Stantcheva, 2022). Because a firm qualifies for US R&D tax credits only when its annual domestic R&D expenses exceed a moving average of its spending in past years, R&D costs as reported in IRS data generally underestimate the full extent of MNCs' R&D activities. As in Rao (2016), we examine R&D activity by merging in data from Compustat, which reflects R&D expenses from firms' consolidated financial statements. We separate this analysis from the above due to sampling attrition, as not all MNCs in the tax data are public.

Figure 7: Hybrid Tax Planning and Real Economic Activity



Notes: Figure 7 provides estimates of μ_ℓ from Equation 1 for the corresponding outcome listed in each panel. Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry fixed effects and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values for each cohort.

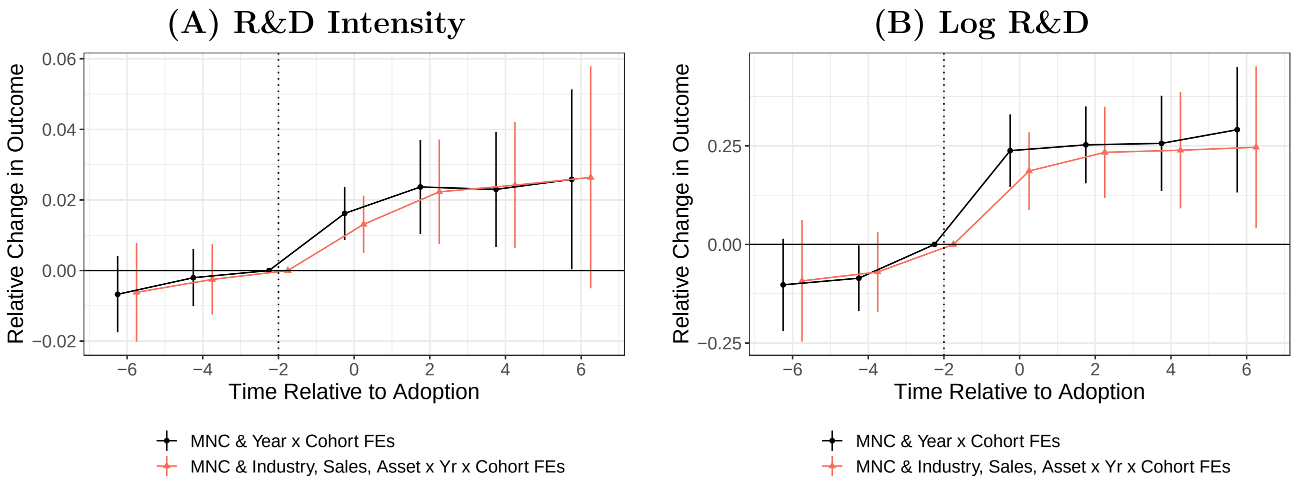
Table 5: Hybrid Tax Planning and Real Economic Activity

	(1)	(2)	(3)	(4)	(5)
Panel A					
Domestic Investment	0.170*	0.267**	0.307**	0.285**	0.206*
	(0.079)	(0.088)	(0.109)	(0.104)	(0.086)
Num. Treated	241	241	209	242	240
Num. Control	1,802	1,756	1,472	1,798	1,919
Panel B					
Domestic Capital	0.098*	0.156**	0.147**	0.076	0.105*
	(0.046)	(0.051)	(0.056)	(0.048)	(0.049)
Num. Treated	250	250	214	252	247
Num. Control	1,882	1,828	1,528	1,856	1,964
Panel C					
Foreign Capital	0.351***	0.404***	0.377***	0.340**	0.366***
	(0.101)	(0.100)	(0.106)	(0.111)	(0.105)
Num. Treated	257	257	214	257	247
Num. Control	1,906	1,852	1,492	1,866	1,978
Panel D					
Domestic Wages	0.150**	0.204***	0.182**	0.186*	0.148*
	(0.055)	(0.059)	(0.062)	(0.078)	(0.060)
Num. Treated	250	250	214	252	247
Num. Control	1,872	1,819	1,519	1,850	1,961
MNC & Year x Cohort FEs	Yes	-	-	-	-
MNC & Ind., Size x Yr x Cohort FEs	-	Yes	Yes	-	-
MNC & Ind., Size x Yr FEs	-	-	-	Yes	Yes
Inverse Prob. Weights	-	-	Yes	-	-
Model	Stacked	Stacked	Stacked	SA	TWFE

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table 5 provides estimates of the difference-in-differences model discussed in Section 5.1 for the corresponding foreign outcome listed in each panel, where Columns (1)–(3) use a version of Equation 1 that only considers a single pre and post period. Column (1) does not include additional controls. Columns (2)–(3) include year-by-cohort-by-industry and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values. Column (3) uses inverse probability-weighted data. Column (4) estimates an alternative specification from Sun and Abraham (2021). Column (5) estimates a standard two-way fixed effects (TWFE) specification. Both columns (4) and (5) use year-by-industry and year-by-group fixed effects as defined above. Standard errors are clustered at the MNC level. +, *, **, and *** denote statistical significance at the 10, 5, 1, and 0.1% level.

Figure 8: Hybrid Tax Planning and R&D Data from Compustat



Notes: Figure 8 provides estimates of μ_ℓ from Equation 1 for the corresponding R&D outcome listed in each panel. R&D Intensity (Panel A) is calculated as the ratio of annual R&D to the MNC's most recent sales value pre-adoption, and is restricted to be less than 1. Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry fixed effects and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values for each cohort. Additional robustness specifications are presented in Figure A.12.

In order to match the biannual frequency of observations in the SOI sample, we create a two-year pooled average for each Compustat variable of interest and focus the estimation on the same years available in the tax data. We study two measures of R&D using the same event study model discussed in Section 5.1 above. The first measure, R&D intensity, is computed as the ratio of R&D to revenue. We fix the denominator to the period prior to HTP adoption. A valuable feature of this measure is that it does not exclude firm-years in which zero R&D expense is reported. The second measure is the log of R&D. This measure leads to further sample attrition because of the large number of firm-years that report zero R&D expenditures.

The results of these estimations are shown in Figure 8. As with other measures of real economic activity, this figure shows that adopting firms experience a significant increase in both R&D intensity and log R&D following HTP adoption. These results are summarized in Table 6. Column (2) reports that R&D intensity increased by 0.026, which corresponds to a 48% increase relative to the average R&D intensity of 0.054 for HTP-adopting firms. Panel B shows that log R&D increased by 0.285 following adoption of an HTP. The larger estimate for R&D intensity suggests that incorporating extensive-margin responses is important in this setting and leads to larger estimates of the change in R&D activity following the adoption of an HTP structure.

Table 6: Hybrid Tax Planning and R&D Data from Compustat

	(1)	(2)	(3)	(4)	(5)
Panel A					
R&D Intensity	0.026**	0.026**	0.032**	0.033***	0.034***
	(0.008)	(0.010)	(0.010)	(0.009)	(0.009)
Num. Treated	136	124	113	124	124
Num. Control	452	385	335	380	380
Avg. R&D Intensity (All Firms)	0.051	0.051	0.047	0.051	0.051
Avg. R&D Intensity (Treated Firms)	0.054	0.054	0.054	0.054	0.054
Panel B					
Log R&D	0.319***	0.285***	0.362***	0.241***	0.268**
	(0.068)	(0.078)	(0.077)	(0.069)	(0.084)
Num. Treated	89	79	73	79	79
Num. Control	298	252	235	266	266
MNC & Year x Cohort FEs	Yes	-	-	-	-
MNC & Ind., Size x Yr x Cohort FEs	-	Yes	Yes	-	-
MNC & Ind., Size x Yr FEs	-	-	-	Yes	Yes
Inverse Prob. Weights	-	-	Yes	-	-
Model	Stacked	Stacked	Stacked	SA	TWFE

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Notes: Table 6 provides estimates of the difference-in-differences model discussed in Section 5.1 for the corresponding R&D outcome listed in each panel, where Columns (1)–(3) use a version of Equation 1 that only considers a single pre and post period. Column (1) does not include additional controls. Columns (2)–(3) include year-by-cohort-by-industry and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values. Column (3) uses inverse probability-weighted data. Column (4) estimates an alternative specification from Sun and Abraham (2021). Column (5) estimates a standard two-way fixed effects (TWFE) specification. Both columns (4) and (5) use year-by-industry and year-by-group fixed effects as defined above. +, *, **, and *** denote statistical significance at the 10, 5, 1, and 0.1% level. Additional fixed effect specifications are presented for robustness in Table A.2.

5.3.2 Robustness Checks: Real Economic Activity

The above results show that hybrid tax planning structures are not simply linked to profit shifting behaviors—HTP adoption is also connected to increases in real economic activity, both at home and abroad. As we describe in Section 5.2.2, we further validate these findings by (1) applying inverse propensity score weighting, (2) using the estimator of Sun and Abraham (2021), and (3) using a standard TWFE estimator. We display the results of these alternate estimations in

Columns (3)–(5) in Table 5. Figures A.9, A.10, and A.11 display corresponding event studies. Finally, Figure A.12 presents alternate estimations of our main stacked specification for the R&D analysis in Figure 8 and Table A.2 presents analogous alternate R&D estimations to those in Table 6. Across all alternative specifications, we continue to find that tax planning is associated with significant increases in profit shifting and real economic behavior.

5.4 Takeaways

Using detailed tax data on transactions between foreign affiliates, the results of this section show that hybrid tax planning is closely related to the kind of transactions used in profit shifting. The timing of adoption confirms that the use of these transactions increased markedly upon adoption of an HTP structure. We also show that, relative to non-adopters, hybrid tax planners see increases in economic activity both at home (domestic wages, investment, R&D) and abroad (foreign capital). The fact that we do not find differential trends prior to adoption shows that firm growth is not a significant predictor of adoption of these structures. To obtain an economic understanding of the effects of HTPs, we now consider a model where the tax benefits of HTP adoption affect MNC investment decisions and where firms decide to engage in hybrid tax planning based on heterogeneous costs and benefits.

6 A Model of International Tax Planning

This section develops a model in which MNCs provide services in different countries, engage in hybrid tax planning, and invest in R&D. In the model, tax planning can impact production and investment abroad by lowering the cost of capital. R&D investment is nonrival within the MNC and impacts production everywhere by increasing productivity across the MNC (Bilir and Morales, 2020; Dyrda, Hong and Steinberg, 2024). Thus, by lowering the cost of capital abroad, tax planning also incentivizes the MNC to increase R&D. Additionally, the model allows for the possibility that MNCs select into a hybrid tax planning strategy based on private information about their returns to R&D.

Modeling the selection behavior of MNCs allows us to characterize the real economic effects of tax planning in several ways. First, we decompose the reduced-form difference-in-differences estimates from the previous section into the behavioral changes caused by a reduction in foreign ETRs—a "treatment effect"—and a term that captures the extent to which firms adopt HTPs due to their idiosyncratic ability to engage in R&D—a "selection effect." Second, we calculate the benefits of tax planning to firms in the form of higher profits while accounting for the setup costs associated with tax planning. Lastly, we simulate how policies that alter the benefits from tax planning impact real investment and tax revenue both at home and abroad.

6.1 Model Setup

The model has two stages, which we describe in descending order. In stage 2, the MNC takes taxes as given, invests in R&D, and produces output—which is sold locally in each country—using local capital K_c.[28] In stage 1, the MNC chooses whether to set up a hybrid tax planning structure, taking into account idiosyncratic costs of tax planning, as discussed in Section 3.[29] Firm investment decisions determine how they may deduct R&D expenses from their tax bills across locations according to a function $\tau_R(K_d, K_f) \in [0, 1]$. In our baseline model, we specify τ_R such that tax deductions for R&D are apportioned across locations based on relative sales shares in each country.[30] We also consider a simplified version where MNCs fully deduct R&D expenses from their domestic tax bill, which yields closed-form expressions for optimal investment. See Appendix E for full model derivations.

Stage 2: Production

Consider two countries: d for domestic and f for foreign. The MNC sells quantities q_c of its product in each country c. The demand in each country is iso-elastic: the price for its product in each country is $p_c = I_c(q_c)^{\frac{1}{\varepsilon}}$, where $I_c > 0$ is a demand shifter (e.g., income) and $\varepsilon < -1$ is the elasticity of product demand. The MNC produces output with technology: $q_c = \phi_i K_c$, where K_c has a global price r, which we assume is not tax deductible.[31] The productivity of MNC i is captured by $\phi_i = \zeta_i \times D_i^{\gamma}$, where $0 < \gamma < \frac{1}{-(1+\varepsilon)}$, ζ_i is a fixed productivity term (e.g., existing IP), and D_i is R&D.

We assume the MNC faces a worldwide tax on corporate income from its home country d. If

[28] Our model focuses on the intensive-margin investment decision of firms across two countries, rather than the firm's choice of country in which to operate (as in, e.g., Devereux and Griffith, 2003).

[29] This model abstracts away from other behavior, such as the manipulation of transfer pricing in individual transactions (e.g., as in Hines and Rice, 1994). Such behavior can be analyzed by adding an additional stage where MNCs optimally misreport the location of their profits.

[30] This assumption mirrors the intent of cost-sharing agreements, in which costs should be apportioned based on expected benefits from IP.

[31] For simplicity, we assume the cost of capital is not tax deductible. In practice, the cost of capital may be partially tax deductible either because of a lack of expensing or from limits to the deductibility of interest expense.

the MNC sets up a hybrid tax planning structure, the MNC still pays a tax rate of t_d on domestic profits, but pays a lower tax rate of t_h by shifting foreign profits (which it defers indefinitely) to a tax haven. In this way, the HTP structure can be seen as a "do-it-yourself territorial regime," combined with a profit shifting strategy to avoid foreign country taxes. MNCs that do not tax plan instead face the foreign rate $t_f > t_h$.

The MNC solves the production and R&D investment problem:

$$\Pi(t_d, t_h, \zeta_i, b_i) \equiv \max_{K_d, K_c, D} \; (1-t_d)I_d(\phi_i K_d)^{1+\frac{1}{\varepsilon}} - rK_d + (1-t_h)I_f(\phi_i K_f)^{1+\frac{1}{\varepsilon}} - rK_f$$
$$- \tau_R(K_d, K_f) \cdot D - b_i \frac{D^2}{2}. \tag{2}$$

The term b_i is a firm-level adjustment cost of R&D investment. This term captures the fact that some firms may have a greater potential to engage in R&D projects (Chen, Liu, Suárez Serrato and Xu, 2021). Since tax planning is complementary with R&D, firms with a higher potential to engage in R&D—i.e., those with lower values of b_i—may be more likely to set up HTPs.

Equation 2 assumes that the MNC has chosen to set up a tax planning structure in Stage 1. Setting $t_h = t_d$ yields the alternative case where the MNC does not set up a hybrid tax planning structure and instead faces a worldwide income regime in which the domestic country has a higher tax rate $t_d > t_f$ and a credit for foreign taxes.

Stage 1: Tax Planning

Setting up a hybrid tax planning structure has a fixed cost c_i. This cost includes legal and accounting services related to tax planning, the cost of transactions to transfer IP and establish HTPs, as well as differences in executive attitudes toward aggressive tax planning structures.

The MNC decides to set up a hybrid tax planning structure when the profits it gains from doing so exceed the costs of setting up the structure, i.e., if

$$\Pi(t_d, t_h, \zeta_i, b_i) - c_i > \Pi(t_d, t_d, \zeta_i, b_i). \tag{3}$$

This inequality captures the four forces driving selection into HTPs. First, the likelihood that a firms adopts an HTP is increasing in the tax wedge $t_d - t_h$. Second, increased productivity ζ_i leads to an increase in the probability of adopting an HTP. Third, for firms with the same productivity ζ_i, those with better prospects for conducting R&D—i.e., lower b_i—will be more likely to adopt an HTP. Finally, firms with lower cost c_i will also be more likely to adopt an

HTP. As we will discuss in Section 6.4, the empirical moments we target allow us to characterize the importance of these distinct selection channels.

6.2 Tax Planning and Investment with Domestic R&D Deductions

We first solve the model under the assumption that R&D expenses are fully deducted from the domestic tax bill: $\tau_R = (1 - t_d)$. Because R&D deductibility does not directly influence the capital investment decisions of MNCs, this simplification yields closed-form solutions to Equation 2. Specifically, optimal K in each country is given by

$$K_c^* = (\phi_i)^{-(1+\varepsilon)} \left[\frac{1+\varepsilon}{\varepsilon} \frac{I_c}{r/(1-t_c)} \right]^{-\varepsilon}. \tag{4}$$

Higher tax rates increase the effective cost of capital $\frac{r}{(1-t_c)}$. The hybrid tax planning structure does not directly impact domestic capital through the tax rate. However, the hybrid tax planning strategy increases the relative value of foreign producing since $t_h < t_d$ and $\varepsilon < -1$, leading to increases in foreign capital.

Equations 2 and 4 imply that the MNC's decision of how much to invest in R&D, which impacts ϕ_i, solves the following problem:

$$\max_{D_i} \;\; \pi_0 \zeta_i^{-(1+\varepsilon)} D_i^{-\gamma(1+\varepsilon)} \left[(I_d(1-t_d))^{-\varepsilon} + (I_f(1-t_h))^{-\varepsilon} \right] - (1-t_d)D_i - \frac{b_i}{2} D_i^2,$$

where $\pi_0 = \frac{-r^{(1+\varepsilon)}}{\varepsilon^{-\varepsilon}(1+\varepsilon)^{(1+\varepsilon)}}$. The R&D investment decision takes into account the fact that its intellectual property is non-rival within the firm and will increase profits in both locations.

To understand how differences in productivity ζ_i and tax rates impact R&D investment, consider the simpler case where $b_i = 0$. In this case, the optimal choice of $R\&D$ is given by:

$$D_i^* = \left\{ -\frac{\gamma}{(1-t_d)} (1+\varepsilon) \pi_0 \zeta_i^{-(1+\varepsilon)} \left[(I_d(1-t_d))^{-\varepsilon} + (I_f(1-t_h))^{-\varepsilon} \right] \right\}^{\frac{1}{1+\gamma(1+\varepsilon)}}.$$

It follows from this expression that the optimal choice of R&D is increasing in firm productivity ζ_i or a reduction in foreign tax rates $(1 - t_h)$. That is, MNCs conduct more R&D if they have a larger stock of IP and/or if setting up a hybrid tax structure will increase their returns from R&D investment abroad. Together with Equation 4, this expression also implies that tax planning can indirectly impact both domestic and foreign investment by raising firms' effective productivity, as $\phi_i = \zeta_i \times D_i^\gamma$.

This simplified model shows that by obtaining lower foreign tax rates, MNCs may increase their foreign investment. Lower foreign taxes can also stimulate R&D investment, which has feedback effects on foreign and domestic investment. The model also clarifies the sources of selection into tax planning. Firms with higher values of ζ_i are more likely to benefit from tax planning. Firms with more opportunities to develop R&D (i.e., those with lower values of b_i) are also more likely to adopt these structures. Finally, firms with lower idiosyncratic costs of adoption (i.e., those with low values of c_i) will be more likely to adopt these structures.

6.2.1 Difference-in-Differences Estimates Through the Lens of the Simplified Model

The simplifying assumption that firms may fully deduct R&D expenses under the domestic tax rate allows us to derive closed-form expressions that map our difference-in-differences estimates to key model parameters. First, let β^D denote the difference-in-differences estimate of the relative change in log-R&D, which combines a behavioral increase in R&D from exposure to lower tax rates, as well as differences in R&D that are attributed to selection based on productivity ζ_i and R&D potential b_i. Formally, we can write the average relative changes in log-ϕ_i as $\Delta \ln \phi_i = \Delta \ln \zeta_i + \gamma \beta^D$, where the first term captures selection into tax planning based on ζ_i and the second captures how differences in R&D relate to differences in TFP ϕ_i.

Given optimal capital in Equation (4), difference-in-differences estimates for domestic and foreign capital can be written as:

$$\text{Domestic Capital:} \quad \beta^{K_d} = -(1+\varepsilon) \times \left(\Delta \ln \zeta_i + \gamma \beta^D\right) \tag{5}$$

$$\text{Foreign Capital:} \quad \beta^{K_f} = \beta^{K_d} - \varepsilon \ln \left(\frac{1-t_d}{1-t_h}\right). \tag{6}$$

Intuitively, we observe relative increases in domestic capital either because of differences in R&D or because of selection on ζ_i. The expression for foreign capital also reflects this mechanism through β^{K_d} but additionally allows for capital investment to be influenced by tax differentials.

Defining $\beta^{ETR} = \ln \left(\frac{1-t_d}{1-t_h}\right)$, we can then identify the parameter ε using the domestic and foreign capital effects as $-\varepsilon = \frac{\beta^{K_f} - \beta^{K_d}}{\beta^{ETR}}$. We can also recover the parameter γ by solving the expression for β^{K_d} above as follows:

$$\gamma = \left(-\frac{\beta^{K_d}}{(1+\varepsilon)} - \Delta \ln \zeta_i\right) / \beta^D.$$

These expressions allow us to calculate bounds on the selection and behavioral responses of HTP adoption. Under the assumption that $\Delta \ln \zeta_i = 0$, domestic capital increases as a result of the productivity effects of the additional (tax-driven) R&D at the rate $-(1+\varepsilon)\gamma$. At the opposite extreme, the entirety of the R&D and domestic capital changes would be due to selection.[32] In this case, the behavioral response to lower taxes would then explain $1 - \frac{\beta^{K_d}}{\beta^{K_f}}$ of the changes in foreign capital.

While these bounds may be informative, one of the benefits of the model is to obtain a more precise decomposition of the forces behind the difference-in-differences estimates while also allowing for more realistic features, namely R&D adjustment costs and apportionment-based deduction of R&D expenses. Identifying γ in this case thus requires identification of the term $\Delta \ln \zeta_i$, which we recover by comparing the ζ_i draws of firms that tax plan to those that do not.

6.3 Model Estimation

We now discuss estimation of the full model with R&D expenses deducted proportionally based on sales shares in each location. This assumption matches the intent of cost sharing agreements, but we also show model results assuming R&D is deducted domestically. Formally, we let $\tau_R(K_d, K_f) = (1 - t_d S_d - t_f S_f)$, where S_d and S_f are firm sales shares in each location such that $S_d = \frac{R_d}{R_d + R_f}$, $R_c = I_c(\phi_i K_c)^{1+\frac{1}{\varepsilon}}$, and $S_f = 1 - S_d$. Solving the model now yields the following set of first-order conditions, which we solve numerically in the course of estimation:

$$K_d = \phi^{-(1+\varepsilon)} \left(\frac{I_d}{r} \left(\frac{1+\varepsilon}{\varepsilon} \right) \left[(1 - t_d) + (t_d - t_f) \frac{D}{R_d + R_f} \cdot \frac{R_f}{R_d + R_f} \right] \right)^{-\varepsilon}, \tag{7}$$

$$K_f = \phi^{-(1+\varepsilon)} \left(\frac{I_f}{r} \left(\frac{1+\varepsilon}{\varepsilon} \right) \left[(1 - t_f) + (t_f - t_d) \frac{D}{R_d + R_f} \cdot \frac{R_d}{R_d + R_f} \right] \right)^{-\varepsilon}, \text{ and} \tag{8}$$

$$\begin{aligned} D = \frac{1}{b_i} \Bigg[& \gamma D^{\gamma(1+\frac{1}{\varepsilon})-1} \left(\frac{1+\varepsilon}{\varepsilon} \right) \zeta^{1+\frac{1}{\varepsilon}} \left((1 - t_d) I_d K_d^{1+\frac{1}{\varepsilon}} + (1 - t_f) I_f K_f^{1+\frac{1}{\varepsilon}} \right) \\ & - D \left((1 - t_d) \frac{\partial S_d}{\partial D} + (1 - t_f) \frac{\partial S_f}{\partial D} \right) \Bigg] - (1 - t_d S_d - t_f S_f). \end{aligned} \tag{9}$$

Equations 7 and 8 differ from optimal investment conditions from the basic model in the previous section via the after-tax rate $(1 - t_d)$ being augmented (in the case of domestic capital) by the term $(t_d - t_f) \frac{D}{R_d + R_f} \cdot \frac{R_d}{R_d + R_f}$. Intuitively, firm investment decisions are influenced by an incentive to shift sales, and thus R&D deductions, to the high-tax location.

To determine whether a given firm adopts an HTP, we solve the model under both t_f and t_h to determine profitability with and without hybrid tax planning. We then evaluate Equation 3 based on a given firm's idiosyncratic draw of the tax planning cost c_i.

[32] Since $\beta^D > 0$ and $\beta^{K_d} > 0$ it follows that $\gamma = 0$. We therefore have that $\Delta \ln \zeta_i = -\frac{\beta^{K_d}}{(1+\varepsilon)}$.

We calibrate the parameter vector $\vartheta \equiv (I_d, I_f, t_d, t_f, t_h, r)$. Domestic GDP is normalized as $I_d = 1$, and we assume $I_f = 0.6$ in the baseline model to roughly match the size of foreign markets faced by US MNCs, with alternative models showing robustness to larger or smaller shares of foreign GDP. Domestic tax rates are set to $t_d = 0.265$, in line with average cash ETRs over the 1998–2012 period calculated by Dyreng, Hanlon, Maydew and Thornock (2017). We set foreign rates faced by firms that do not tax plan to $t_f = 0.225$, the average average rate for other MNCs presented in Figure 1, while tax planners face $t_h = 0.133$ $(0.225 - 0.092)$ as estimated in Table 4. Finally, we set the cost of capital to $r = 0.05$.

We estimate the vector $\theta = (\varepsilon, \gamma, \mu, \Sigma)$, which includes parameters governing firm production and the joint distribution of idiosyncratic firm draws. We assume that the drivers of selection (ζ_i, b_i, c_i) have a joint log-normal distribution $\mathcal{LN}(\mu, \Sigma)$. We estimate θ using the method of simulated moments. For a given guess of θ, we simulate 10,000 firms and solve for their optimal capital use in each country, their optimal R&D, and their implied profits at home and abroad. Using these simulated firm choices, we compute the following moments: the share of firms in select sales-based size bins; the share of total profits attributed to each size bin; the share of total R&D attributed to each size bin; the share of firms that select into tax planning; the share of foreign profits attributed to tax planners; the share of total R&D attributed to tax planners in the top two size bins; and the mean log differences of foreign investment, domestic investment, and R&D between planners and non-planners. For tractability and to match the skewness in our cross-sectional moments, we select size bins that correspond to the 33rd, 66th, and 90th percentiles of firm sales. Our estimate of θ is the value that minimizes the difference between these simulated moments and their empirical counterparts.

6.4 Parameter Estimates

The discussion in Section 6.2.1 shows how the difference-in-differences estimates can help identify ε and γ. We now provide intuition for how the additional data moments can help pin down the importance of the different drivers of selection. If idiosyncratic draws of c_i fully determine selection, we should expect to see that firm size is unrelated to HTP adoption. This would be the case if we observed in the data that the share of profits of HTP firms equaled the share of HTP firms and their share of R&D. In this case, we would also find that $\Delta \ln \zeta_i = 0$. Alternatively, if HTP firms have a much larger share of profits, we would expect to find that $\Delta \ln \zeta_i > 0$. Similarly, if the share of R&D of HTP firms is larger than the share of HTP firms, this would be indicative of selection on R&D potential b_i.

While the data help identify the parameters of the distribution of (ζ_i, b_i, c_i), we have difficulty identifying all of the components of μ and Σ with reasonable precision. Instead, we focus on estimating the mean and dispersion of ζ_i, the mean and dispersion of b_i, and the dispersion in c_i. We also estimate the correlation between b_i and c_i, ρ_{bc}, which helps reconcile the magnitudes of our difference-in-differences estimates with moments describing the distribution of R&D across tax planners.[33] For a summary of how our chosen empirical moments identify model parameters, see Table A.5.

Table 7, Panel A reports the results of this estimation. We estimate a value of $\varepsilon = -2.483$. This value of the elasticity of product demand implies moderately large markups, which may be reasonable in IP-heavy industries such as technology and pharmaceutical manufacturing. We estimate a value of $\gamma = 0.612$, which we interpret as the long-run effect of R&D on productivity. Of the drivers of selection, we estimate the largest value for σ_c. This result implies that idiosyncratic differences in the costs of HTP adoption play a significant role in explaining selection into tax planning. Nonetheless, as we show below, the model also attributes a large fraction of the changes in real economic activity to selection based on b_i. We also estimate very little dispersion in ζ_i, which suggests that the estimated returns to R&D, γ, and dispersion in adjustment costs are sufficient for explaining skewness in the distribution of profitability across firms.

A key data moment that helps inform these parameter values is the fact that R&D is much more concentrated among hybrid tax planners, even more so than firm size. We estimate a negative correlation between c and b. While not a directly targeted moment, our model still implies that HTPs engage in approximately twice as much R&D as other MNCs. Thus, while heterogeneity in b, and thus the returns to tax planning, induces positive selection on R&D potential, our model estimates imply that firms with lower R&D adjustment costs may also face idiosyncratically higher setup costs to tax planning.

Figure 9 shows how the estimated model matches the data. The estimation targets the share of firms, profits, tax planning firms, and R&D at four ranges of the firm size distribution.

[33] We calibrate $\mu_c = 0$ in our baseline model, though we also show robustness to a model that estimates μ_c and calibrates $\rho_{bc} = -0.30$.

Table 7: Model Parameters and Decompositions

Panel A: Estimated Model Parameters

	(1) Elasticity of Product Demand, ε^{PD}	(2) Productivity Elasticity of R&D, γ	(3) Dispersion in s_i	(4) Dispersion in b_i	(5) Dispersion in c_i	(6) Mean of s_i	(7) Mean of b_i	(8) ρ_{bc}
Estimate	-2.483***	0.612***	0.001	2.357***	4.968**	-0.834***	0.216	-0.325**
SE	(0.304)	(0.128)	(0.005)	(0.326)	(1.942)	(0.272)	(0.794)	(0.163)

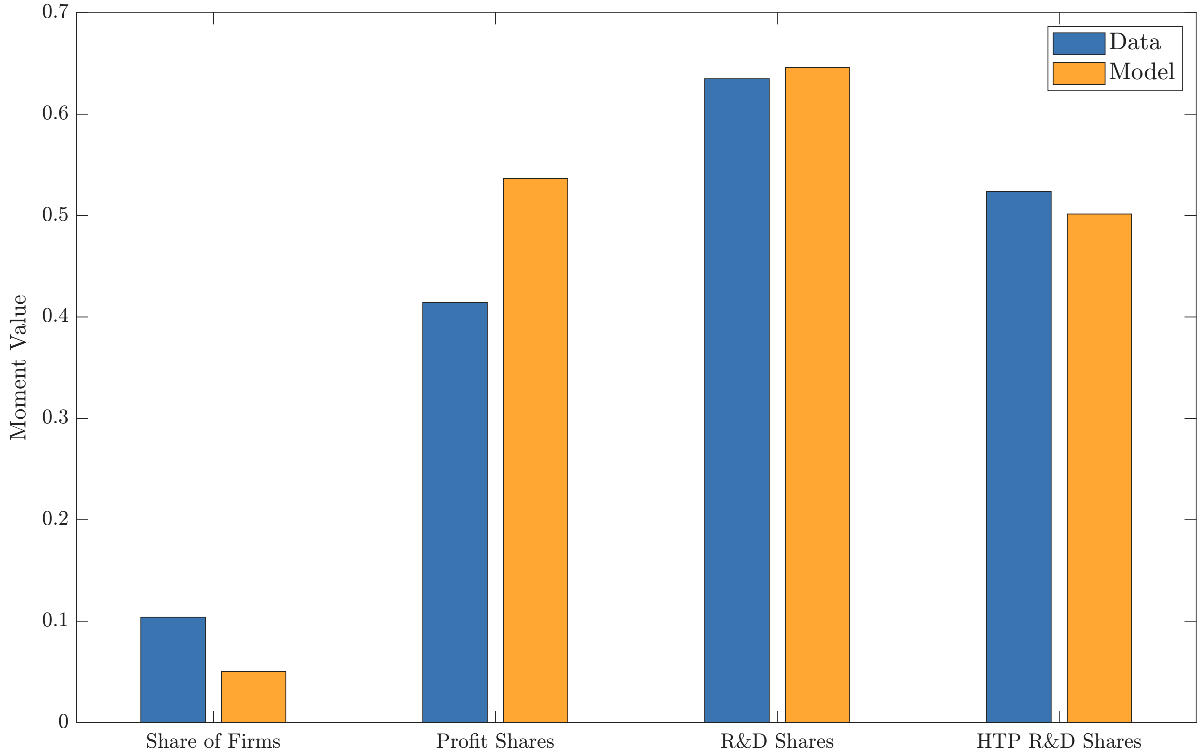
Panel B: Model Decompositions and Counterfactual Analyses (Robustness)

	(1) Baseline	(2) $\hat{W} = \text{diag}(\hat{\Sigma})^{-1}$	(3) $I_f = 0.4$	(4) $I_f = 0.8$	(5) $t_h = 9.9\%$	(6) $t_h = 16.7\%$	(7) Est. μ_c	(8) $\tau_R = (1 - t_d)$
Panel B.1: Shares of DiD Effects due to ΔETR								
$\beta^{R\&D}$	0.306	0.382	0.157	0.441	0.731	0.261	0.297	0.368
β^{K_d}	0.331	0.410	0.173	0.470	0.754	0.282	0.322	0.368
β^{K_f}	0.663	0.753	0.611	0.726	0.893	0.542	0.654	0.711
Panel B.2: Counterfactual Increase in Tax Haven Tax Rate, Percent Changes								
Foreign Tax Revenue	12.225	12.678	12.044	11.127	19.372	4.887	10.937	8.814
Global R&D	-4.261	-4.489	-1.603	-7.164	-9.437	-4.175	-4.159	-4.603
Investment Abroad	-14.889	-14.409	-10.776	-17.913	-23.219	-10.858	-13.978	-15.447
Panel B.3: Domestic Investment Elasticities								
$\varepsilon^{K_D}_{1-t_d}$	4.476	4.359	5.085	3.781	3.691	3.882	4.586	4.706
$\varepsilon^{K_D}_{1-t_d}$, R&D Fixed	2.348	2.477	2.874	1.787	1.734	1.824	2.488	2.329

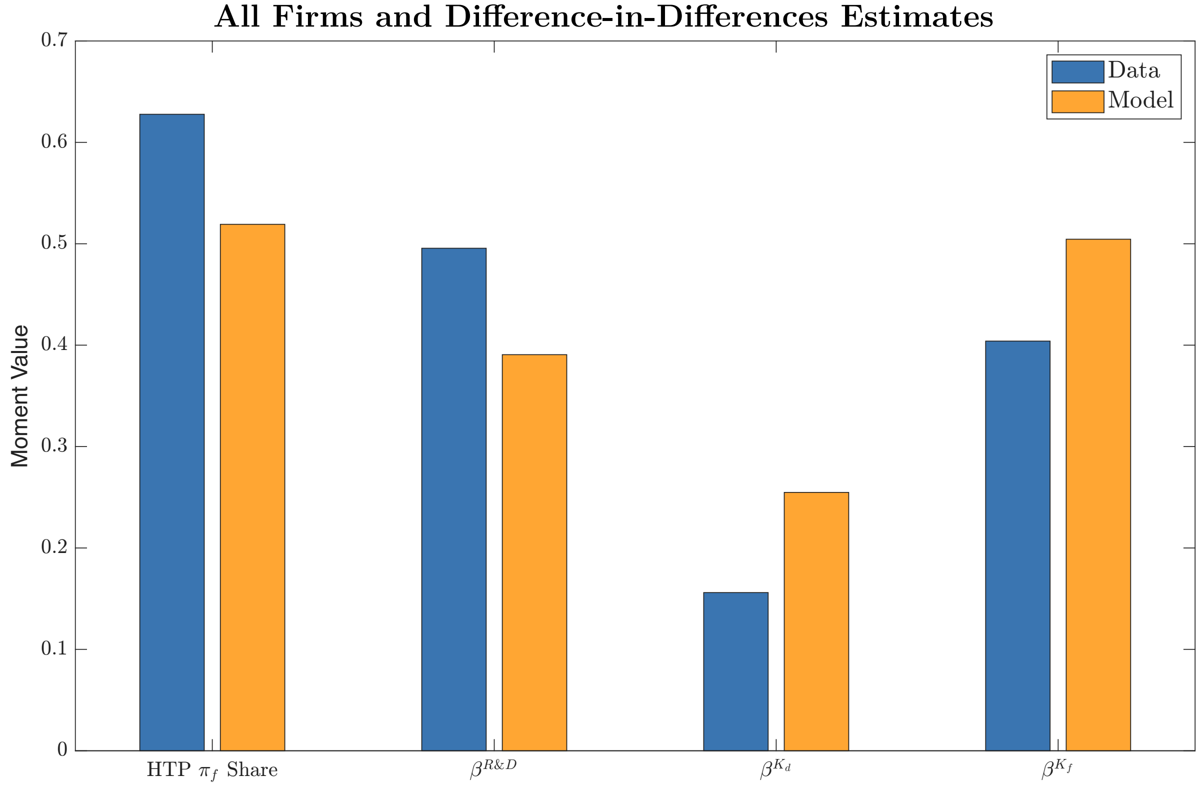
Notes: Table 7, Panel A provides estimates of model parameters based on the simulated method of moments with an identity weighting matrix. Panel B provides robustness for additional model results. Panel B.1 presents the share of our difference-in-differences estimates attributable to the change in ETR, with a detailed decomposition for our baseline model presented in Table A.4. Panel B.2 presents counterfactual changes in the specified outcomes from fully eliminating the preferential tax haven rate. Panel B.3 presents domestic investment elasticities resulting from setting $t_d = t_f$. In Panel B, Column (1) reproduces estimates from Panel A. Column (2) presents a version that uses the inverse diagonal covariance matrix to weight the SMM objective function. Columns (3) and (4) consider alternative calibrations of foreign GDP share I_f. Columns (5) and (6) calibrate the foreign tax rate under tax planning, t_h, at the 95% confidence intervals associated with our estimate from Table 4. Column (7) considers an alternative model that calibrates ρ_{bc} and estimates μ_c. Column (8) considers a simple model with full domestic R&D deductibility.

Figure 9: Comparison of Data and Model Moments

(A) Shares of Economic Activity of Hybrid Tax Planners Among Firms in the Top 10% of Sales



(B) Shares of Economic Activity of Hybrid Tax Planners Among All Firms and Difference-in-Differences Estimates



Notes: Figure 9 compares simulated moments with data moments. Panel A compares the share of economic activities among firms in the top 10% of the sales distribution. Panel B shows the aggregate share of foreign profits attributable to HTPs and difference-in-differences estimates.

Since tax planning firm are more likely to be larger, Panel A plots the model and data shares for firms in the top 10% of the sales distribution. This figure shows that the model parameters do a good job at matching the importance of firms in the top of the distribution. Panel B plots aggregate moments and difference-in-differences estimates. The model does a good job matching both the share of total foreign profits accruing to HTPs and the average magnitude of the estimates on firm outcomes for tax planners.

We estimate the structural model under a number of alternative assumptions. Table A.3 shows that, relative to our baseline estimates (Column 1), we find very similar parameter estimates while using the inverse diagonal covariance matrix to weight our GMM objective function (2); calibrating the size of foreign markets to correspond to 40% (3) or 80% (4) of domestic GDP; calibrating t_h as a standard deviation higher (5) or lower (6) than our estimated tax advantage from Table 4; estimating μ_c and calibrating $\rho_{bc} = -0.30$ (7); and considering the model from Section 6.2 where firms fully deduct R&D costs under the domestic tax rate (8).

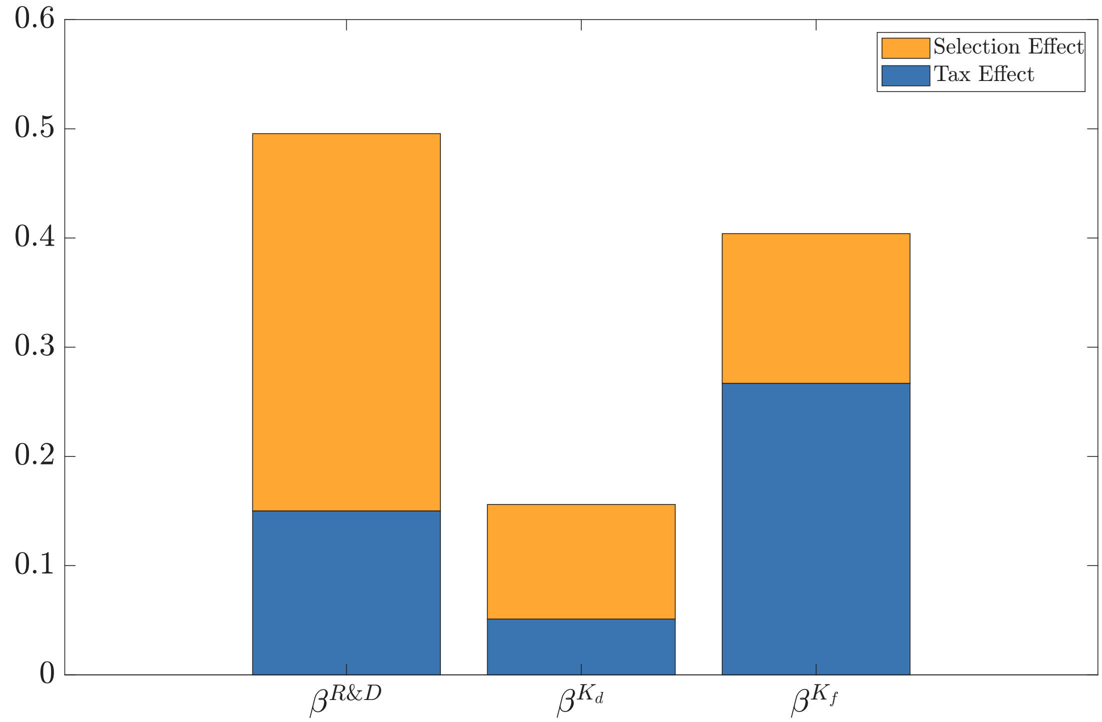
6.5 Decomposition of Difference-in-Differences Moments

Our estimates in Section 5 show that HTP adoption is associated with significant investment responses. The extent to which these patterns reflect adoption by firms with idiosyncratically high returns to R&D, as opposed to real changes in firm behavior due to lower foreign tax rates, is important for assessing the impact of policies that target tax avoidance. We now use the structural model to decompose our difference-in-differences model estimates into selection and behavioral responses.

Figure 10 performs this decomposition for log differences of each outcome. Panel B.1, Column (1) of Table 7 shows that roughly 30% of the total estimated effects of tax planning on R&D and domestic investment can be attributed to the effects of lower taxes. This implies that, relative to a naive interpretation of the difference-in-differences estimates, the domestic economy does not benefit as much from the use of HTPs by US MNCs. The rest of the columns in Panel B.1 of Table 7 show that this conclusion is robust to alternative versions of our model.

The model allows us to further quantify the role of different drivers of selection. Because we estimate little dispersion in ζ_i across firms, this selection effect is almost entirely driven by differences in the returns to R&D investment. Specifically, 99.6% of the effect on R&D is explained by tax planning firms having lower adjustment costs b_i.

Figure 10: Model Decomposition of Difference-in-Differences Estimates



Notes: Figure 10 decomposes the difference-in-differences estimates of HTP adoption on log domestic capital and log foreign capital (Column (2) of Table 5) and log R&D investment (Column (2) of Table 6) into tax and selection effects. Each column represents the full reduced-form estimate, while decompositions are calculated based on the proportion of each term's model equivalent that is attributable to tax and selection effects, respectively. We construct the log R&D effect from our estimated effect on R&D intensity combined with the sample average. Table A.4 presents the full decomposition.

In contrast to domestic outcomes, Panel B.1 of Table 7 also shows that close to two thirds of the change in foreign capital is driven by the response to lower taxes abroad. This implies that foreign investment by US MNCs would be significantly curtailed by efforts to reduce the use of HTPs.

6.6 Quantifying the Benefits and Non-Tax Costs of Tax Planning

The previous section provides evidence that the reduced foreign ETRs associated with tax planning produce meaningful real investment responses among adopting firms. These facts pose a puzzle as to why more US firms did not take advantage of tax planning opportunities, which our model addresses by introducing idiosyncratic setup costs. To better understand these patterns, we now quantify the benefits of tax planning to firms in the form of higher profits while also accounting for the costs incurred by firms to establish hybrid tax planning schemes.

We first consider the mechanical effect of tax planning associated with lower effective tax rates on foreign profits. Assuming tax planning firms do not change their investment and R&D decisions, our model shows that the lower ETRs associated with tax planning generate 11.9% higher foreign profits across all firms that tax planned. Tax planning also increases profits because lower ETRs reduce the cost of foreign capital and stimulate greater foreign investment. Holding R&D fixed, greater foreign investment and lower ETRs yield a much larger increase in foreign profits of 29.4%. Lower ETRs also stimulate R&D investment, which increases foreign profits directly via higher productivity and by increasing the returns to capital investment. Inclusive of all of these channels, we calculate that realized foreign profits for HTPs are 41.8% higher due to tax planning. The large magnitude of these benefits reflects the significant real foreign investment and R&D responses to tax planning we document in Section 6.5.

Because tax planning also induces growth in domestic capital and R&D investment, we next consider the global effects of tax planning relative to the pre-tax profits of tax planning MNCs. The mechanical effect of lower ETRs on foreign profits amounts to 1.8% of planners' pre-tax profits, while the gross increase in profits among tax planning firms is about four times larger, representing 7.2% of pre-tax profits.

The gross increase in profits from tax planning is a useful benchmark for the setup costs associated with hybrid tax planning arrangements, since firms would not establish HTP arrangements if planning costs exceeded this benefit. Our estimated benefit of 7.2% of pre-tax profits is similar to estimates based on a "shadow cost" approach whereby non-tax costs of avoidance reflect the tax savings associated with profit shifting.[34] When quantifying the realized planning costs c_i incurred by tax planners in our model, we instead find that these planning costs amount to 17.4% of the gross benefits of tax planning. This comprises 1.2% of pre-tax profits, yielding a total net benefit of tax planning of 5.9% of pre-tax profits.

Despite the large benefits associated with tax planning, the relatively low average setup costs of planning aligns with our evidence in Section 4 that planning costs are highly idiosyncratic across firms. Our model suggests that tax planning firms tend to face very low costs to tax planning, while many other firms do not tax plan due to high idiosyncratic costs. Figure A.13 visualizes these patterns through the distribution of gross and net benefits across simulated firms

[34] McClure (2023) calculates that tax avoidance costs represent 6.4% of total pre-tax income among global MNCs. Bilicka, Devereux and Güçeri (2024) quantify magnitudes by developing and estimating a model where firms face both fixed and variable costs of profit shifting strategies. Fixed costs are calculated to be 3.3% of the tax base while variable costs represent 6.9%.

that tax plan. The distribution of net benefits is more dispersed than that of gross benefits, demonstrating the importance of tax planning costs for driving heterogeneity in the returns to tax planning. It is also notable that we simulate a large mass of firms with net benefits in excess of 5% of pre-tax income, suggesting that many firms are inframarginal in their planning decisions.

6.7 Counterfactual Policy Simulations

The results in the previous two sections have meaningful implications for tax policy design. For the US, our decomposition exercise suggests that a significant fraction of the relative increase in the domestic activity of tax-planning MNCs is driven not by low tax rates but instead by selection. For foreign governments, the relatively large effect of tax advantages on foreign investment suggests that efforts to limit tax planning may come at the cost of significant declines in investment by MNCs. For both governments, the fact that many HTPs appear inframarginal with respect to planning decisions suggests that these adjustments, at least for small changes to the tax benefits of HTPs, are more likely to reflect intensive margin investment responses than extensive margin responses via the decision to tax plan.

To study the implications of our results for policymakers more formally, we use our estimated model to conduct a series of counterfactuals. First, we examine the effect of restricting the effectiveness of tax planning technology in isolation. Second, we examine a policy reform that captures key characteristics of the 2017 Tax Cuts and Jobs Act, which combined a domestic corporate rate cut with various reforms to international corporate taxation that limited benefits to tax planning. Finally, we examine a policy that harmonizes the global corporate income tax (as in, e.g., Hines, 2024), eliminating incentives for tax planning.

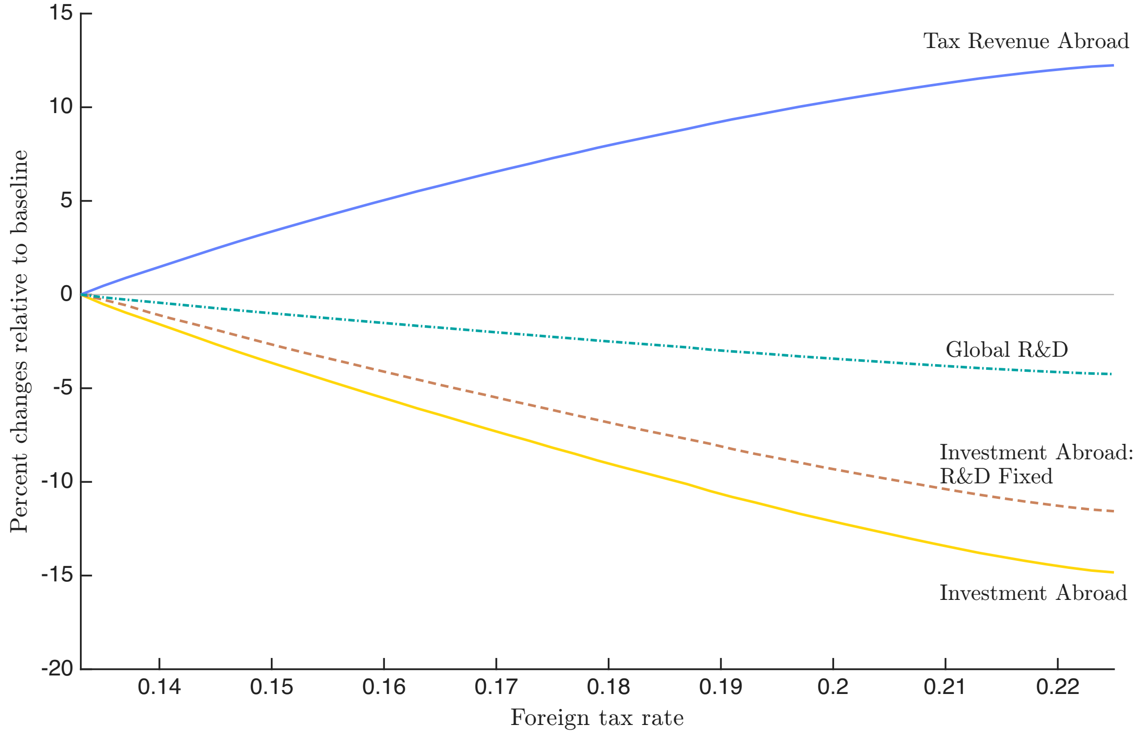
Limitations on Tax Planning in Isolation

To examine restrictions on tax planning, we first simulate the impact of reducing the tax advantage from HTPs from a 9.2pp. differential to zero. In the model, we assume that the foreign tax rate under an HTP increases from 13.3% to 22.5%.

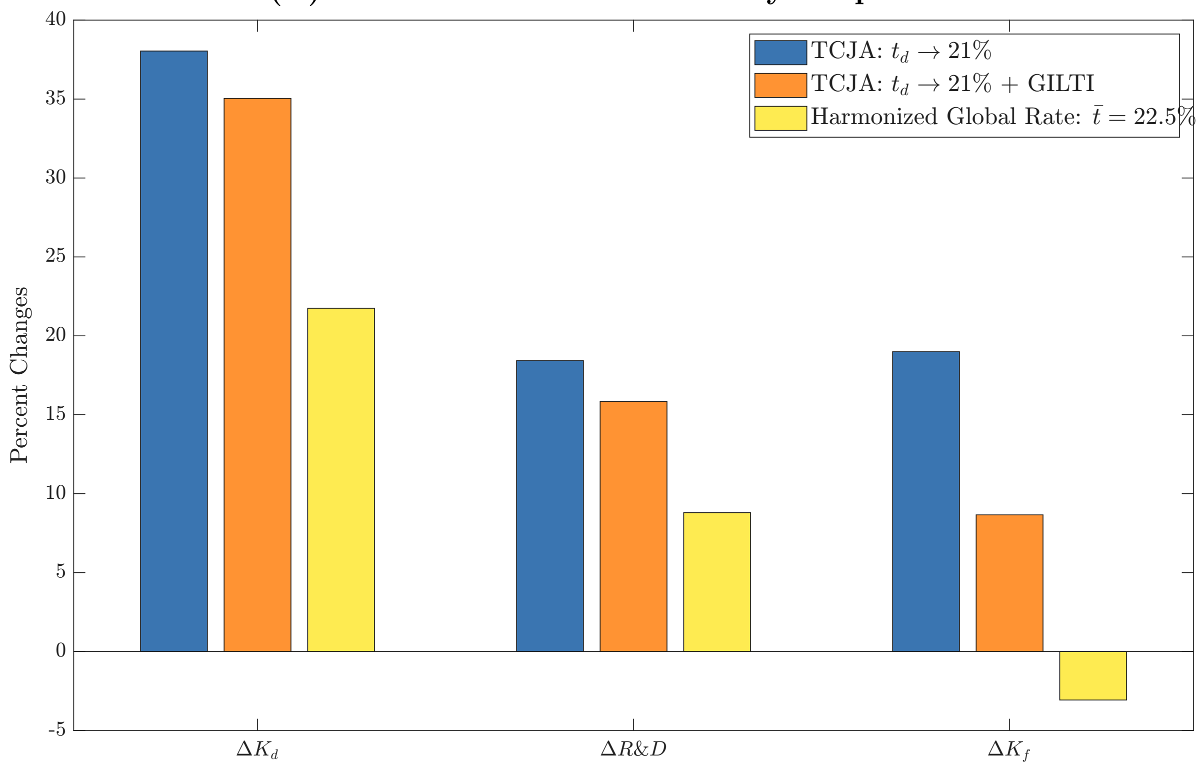
Panel A of Figure 11 plots the percentage changes in investment abroad, foreign tax revenues, and global R&D as this tax rate increases. The solid blue line shows that raising the tax rate under an HTP raises tax revenues. However, these gains come at the cost of large declines in total investment abroad, as shown by the solid red line. This result is consistent with the decomposition in Figure 10 showing that the tax advantage of HTPs explains a large share of the relative changes in foreign capital.

Figure 11: Counterfactual Simulation Results

(A) Counterfactual Increase in Tax Haven Tax Rate t_h



(B) Simulations of Recent Policy Proposals



Notes: Figure 11 presents results from counterfactual policy simulations. Panel A plots simulated percentage changes in tax revenues, foreign investment, and global R&D as the tax rate in the tax haven is increased from 13.3% to 22.5%. The dashed line shows simulated foreign investment while holding fixed R&D expenditures for HTPs under the status quo. Panel B presents percent changes in domestic investment, global R&D, and foreign investment from additional policy simulations. "TCJA: $t_d \rightarrow 21\%$" refers to a reduction in the domestic corporate tax rate from 26.5% to 21%. "TCJA: $t_d \rightarrow 21\%$ + GILTI" refers to the domestic cut plus an increase in the tax rate associated with tax havens from 13.3% to 17.9%. "Harmonized Global Rate" refers to the elimination of tax planning technology and an equalization of foreign and domestic tax rates at rate 22.5%.

Consistent with our decompositions, reducing the tax advantage of HTPs lowers global R&D, though at a much lower magnitude than for foreign investment. Still, this effect points to a meaningful reduction in US domestic investment—totaling 4.3% if HTPs are fully removed—as a result of efforts to curtail tax planning abroad.[35] An additional interesting implication of the model is that R&D responses amplify the effects of tax planning on investment. As shown by the dashed brown line, the decline in foreign investment from eliminating the tax advantage for HTPs would be about three-quarters as large if firms did not also reduce R&D expenditures.

Tax Planning and the Tax Cuts and Jobs Act of 2017

Next, we consider how our model can be used to understand the effects of the Tax Cuts and Jobs Act of 2017 on the global investment of US MNCs. We view this application as a conceptual rather than quantitative exercise, because our model abstracts from many other features of the US corporate tax code that were targeted by the TCJA (e.g., investment depreciation deductions). The model principally demonstrates how, when R&D affects global productivity, changes to domestic ETRs and changes to tax planning regulations can have offsetting or complementary effects. We use our framework to qualitatively explore two key aspects of the TCJA: a reduction in the domestic corporate tax rate and reduced incentives to engage in tax planning via the introduction of a tax on Global Intangible Low-Taxed Income (GILTI).[36]

We first consider the effects of lowering the domestic corporate tax rate from 26.5% to 21%. This reduction leads to large increases in domestic investment and global R&D expenditures of 38% and 18%, respectively. Nearly half of the change in investment is driven by greater R&D intensity. Holding R&D fixed, our model implies an elasticity of investment with respect to the after-tax rate $(1 - t_d)$ of 2.39. Inclusive of R&D responses, we find an elasticity of 4.48. Both of these elasticities are larger than the short-run elasticities estimated in prior studies on the TCJA, namely Chodorow-Reich, Smith, Zidar and Zwick (2024) and Kennedy, Dobridge, Landefeld and Mortenson (2024). Because the returns to R&D investments likely take time to be realized, we interpret our estimates as long-run elasticities. See Figure A.14 for a range of counterfactual tax

[35] We omit domestic investment from Panel A of Figure 11 because the effect is almost identical to that of R&D. The intuition for this result can be seen by applying Equation 5 and the parameters estimates in Table 7 to show that $\beta^{K_d} \approx -\gamma(1+\varepsilon)\beta^D = 0.9\beta^D$. In the full model, the presence of apportionment-based R&D deductions further attenuates these effects toward one another.

[36] See Grubert and Altshuler (2013) for an analysis of how effective tax rates for MNC investment abroad change under various reforms of the US system for taxing international income, including moving to territorial taxation with and without different versions of minimum taxes.

changes.

We next explore a simulation that combines the TCJA's domestic rate cut with a reduction in the benefits of tax planning. This exercise loosely captures the effects of the GILTI tax regime, which eliminated deferral and implemented a minimum tax on income above a specified normal return on foreign tangible capital. We simulate the reduction in the returns to tax planning such that the benefits in the form of lower foreign ETRs are halved. The investment effects of the domestic rate cut in isolation correspond to the blue bars in Panel B of Figure 11, and the combined effects of the domestic rate cut with the reduction in returns to tax planning correspond to the orange bars. While Panel A of Figure 11 demonstrates the large negative effects of increasing t_h on foreign investment, our combined simulation shows that domestic tax cuts can offset these effects substantially. This occurs because the domestic tax cut stimulates R&D investment, which in turn increases global productivity and the returns to investment abroad. Partially limiting the benefits of tax planning via GILTI produces an 8.7% increase in foreign investment when paired with TCJA's domestic tax cut ($t_d \to 21\%,\ t_h \to 17.9\%$).

Harmonized Global Corporate Income Tax

Our final simulation examines a regime of global coordination, in which domestic, foreign and haven rates are equalized to a uniform rate of 22.5%. This counterfactual represents a stronger version of recent efforts to introduce coordination between countries in the form of a global minimum tax via Pillar Two of the OECD's global tax rule. Panel B of Figure 11 presents the effect of this simulation in yellow. Because increases in foreign ETRs reduce global R&D, both the GILTI and harmonized tax provisions erode the domestic effects of a reduction in domestic corporate ETRs. Specifically, the domestic stimulus effect of the harmonized tax falls by around 17.5% relative to the isolated domestic rate cut. In contrast to a 14.9% reduction in foreign investment that results from eliminating tax haven benefits in isolation as shown in Panel A of Figure 11 ($t_h \to 22.5\%$), the combined effect of a global harmonized rate ($t_h, t_f, t_d \to 22.5\%$) reduces foreign investment by around 3%. Notably, this counterfactual also eliminates deadweight loss from tax planning, as firms no longer incur the tax planning cost c_i.

Policy Implications

Our estimated model and counterfactual simulations have a number of immediate policy implications. As the counterfactuals show, limiting foreign tax planning is not costless for foreign governments: it generates a tradeoff between higher tax revenue and lower investment by US MNCs. The model also shows that R&D generates interesting complementarities between foreign and domestic investment (as in, e.g., Desai, Foley and Hines, 2009; Chodorow-Reich, Smith, Zidar and Zwick, 2024). An implication of this complementarity is that policies aimed at reducing tax avoidance can have offsetting effects on investment. While GILTI would reduce foreign investment in isolation, the TCJA overall leads to increases in foreign investment because a reduction in the domestic tax rate also stimulates global R&D. In contrast, in the case of a harmonized global tax rate, R&D investment increases but foreign investment decreases on net. This is because a global harmonized rate limits profit shifting and increases the effective foreign tax rate. These results improve our understanding of when countries have an incentive to engage in policies such as a coordinated global minimum tax (Devereux, 2023).

7 Conclusion

Complex tax planning strategies have been a focus of media attention and have played an important role in motivating international tax reforms. Despite this focus, policymakers, practitioners, and academics lack a comprehensive understanding of the prevalence of these strategies and their role in explaining some key facts surrounding international taxation.

Using a unique integration of tax data covering the domestic and foreign operations of US MNCs, we help to fill this gap by reconstructing these MNCs' foreign affiliate ownership networks. This allows us to identify the adoption of three important tax planning strategies: the Double Irish and two forms of Reverse Hybrid Mismatch arrangement, one through the Netherlands, the other through Luxembourg. We show that these structures account for a significant fraction of the foreign profits of all US MNCs. We also link the use of these structures to financial transactions that companies could use to shift profits to low-tax (and tax haven) countries. Although only 18% of US MNCs adopt these structures, those that do obtain a significant, persistent tax advantage over other MNCs. Remarkably, this small fraction of companies generates a majority of foreign earnings by US MNCs and is responsible for the bulk of the increase in cash held abroad over the period we study. Moreover, we find that firms adopting these structures experience significant foreign and domestic growth.

Though our differences-in-differences estimates measure large change in domestic wages and R&D, our model attributes most of these changes to differential selection into tax planning. While our model accounts for selection, it also finds that foreign investment is sensitive to changes in tax planning opportunities. This result implies that the tax revenue gains associated with policies that increase tax costs abroad may come at the cost of significant declines in tangible investment.

Our findings shed new light on MNC tax planning behavior in recent decades, revealing several important lessons as policymakers continue to reshape the international tax system. The fact that a few specific tax planning structures played an outsized role in explaining aggregate trends in MNC behavior associated with profit shifting demonstrates that highly-targeted enforcement efforts may go a long way in curbing avoidance activity. Moreover, our descriptive facts point to significant heterogeneity in the aggressiveness with which firms pursue these avoidance opportunities, which suggests that targeted enforcement can also help reduce the incidence of compliance costs. As new data become available, future research should carefully consider how different firms respond to an evolving regulatory landscape, and how this heterogeneity may impact the effectiveness of recent policy attempts to curb profit shifting and tax avoidance.

References

Akcigit, Ufuk, John Grigsby, Tom Nicholas, and Stefanie Stantcheva. 2022. "Taxation and Innovation in the Twentieth Century." *The Quarterly Journal of Economics*, 137(1): 329–385.

Albertus, James F. 2019. "Does Foreign Tax Arbitrage Promote Innovation?" SSRN 2691064.

Alstadsæter, Annette, Julie Brun Bjørkheim, Ronald B. Davies, and Johannes Scheuerer. 2022. "Pennies from Haven: Wages and Profit Shifting." CESifo Working Paper 9590.

Altshuler, Rosanne, Lysle Boller, and Juan Carlos Suárez Serrato. 2024. "Turning on the Light: A New Assessment of Measurement Error in International Tax Data." *Tax Policy and the Economy, Volume 39.* University of Chicago Press.

Bilicka, Katarzyna. 2019. "Comparing UK Tax Returns of Foreign Multinationals to Matched Domestic Firms." *American Economic Review*, 109(8): 2921–53.

Bilicka, Katarzyna, Michael P. Devereux, and İrem Güçeri. 2024. "Tax Policy, Investment and Profit Shifting." NBER Working Paper 33132.

Bilicka, Katarzyna, Yaxuan Qi, and Jing Xing. 2022. "Real Responses to Anti-Tax Avoidance: Evidence from the UK Worldwide Debt Cap." *Journal of Public Economics*, 214: 104742.

Bilir, L. Kamran, and Eduardo Morales. 2020. "Innovation in the Global Firm." *Journal of Political Economy*, 128(4): 1566–1625.

Blouin, Jennifer L., and Leslie Robinson. 2023. "Accounting for the Profits of Multinational Enterprises: Double Counting and Misattribution of Foreign Affiliate Income." SSRN 3491451.

Blouin, Jennifer L, and Linda K Krull. 2014. "Does Organizational Form Affect Firms' Foreign Operations? The Role of "Check-the-Box" on Multinational Tax Planning." In *Annual Conference on Taxation and Minutes of the Annual Meeting of the National Tax Association.* Vol. 107, 1–31.

Cengiz, Doruk, Arindrajit Dube, Attila Lindner, and Ben Zipperer. 2019. "The Effect of Minimum Wages on Low-Wage Jobs." *The Quarterly Journal of Economics*, 134(3): 1405–1454.

Chen, Zhao, Zhikuo Liu, Juan Carlos Suárez Serrato, and Daniel Yi Xu. 2021. "Notching R&D Investment with Corporate Income Tax Cuts in China." *American Economic Review*, 111(7): 2065–2100.

Chodorow-Reich, Gabriel, Matthew Smith, Owen Zidar, and Eric Zwick. 2024. "Tax Policy and Investment in a Global Economy." NBER Working Paper 32180.

Clausing, Kimberly A. 2016. "The Effect of Profit Shifting on the Corporate Tax Base in the United States and Beyond." *National Tax Journal*, 69(4): 905–934.

De Mooij, Ruud, and Li Liu. 2020. "At a Cost: The Real Effects of Transfer Pricing Regulations." *IMF Economic Review*, 68: 268–306.

Desai, Mihir A., and Dhammika Dharmapala. 2009. "Corporate Tax Avoidance and Firm Value." *The Review of Economics and Statistics*, 91(3): 537–546.

Desai, Mihir A., C. Fritz Foley, and James R. Hines. 2009. "Domestic Effects of the Foreign Activities of US Multinationals." *American Economic Journal: Economic Policy*, 1(1): 181–203.

Devereux, Michael P. 2023. "International Tax Competition and Coordination with a Global Minimum Tax." *National Tax Journal*, 76(1): 145–166.

Devereux, Michael P., and Rachel Griffith. 2003. "Evaluating Tax Policy for Location Decisions." *International Tax and Public Finance*, 10: 107–126.

Dharmapala, Dhammika. 2024. "The Consequences of the 2017 Us International Tax Reform: A Survey of the Evidence." *International Tax and Public Finance*, 1–21.

Dharmapala, Dhammika, and Nadine Riedel. 2013. "Earnings Shocks and Tax-Motivated Income-Shifting: Evidence From European Multinationals." *Journal of Public Economics*, 97(Supplement C): 95 – 107.

Dowd, Tim, Paul Landefeld, and Anne Moore. 2017. "Profit Shifting of U.S. Multinationals." *Journal of Public Economics*, 148: 1–13.

Drucker, Jesse. 2010. "Google 2.4% Rate Shows How $60 Billion Is Lost to Tax Loopholes." *Bloomberg*.

Duhigg, Charles, and David Kocieniewski. 2012. "How Apple Sidesteps Billions in Taxes." *New York Times*.

Dyrda, Sebastian, Guangbin Hong, and Joseph B. Steinberg. 2024. "A Macroeconomic Perspective on Taxing Multinational Enterprises." *Journal of International Economics*, 152: 104022.

Dyreng, Scott, and Michelle Hanlon. 2021. "Tax Avoidance and Multinational Firm Behavior." In *Global Goliaths: Multinational Corporations in the 21st Century Economy.* , ed. C. Fritz Foley, James R. Hines and David Wessel. Brookings Institution Press.

Dyreng, Scott, Michelle Hanlon, and Edward L. Maydew. 2008. "Long-Run Corporate Tax Avoidance." *The Accounting Review*, 83(1): 61–82.

Dyreng, Scott, Michelle Hanlon, Edward L. Maydew, and Jacob R. Thornock. 2017. "Changes in Corporate Effective Tax Rates Over the Past Twenty-Five Years." *Journal of Financial Economics*, 124(3): 441–463.

Dyreng, Scott, Robert Hills, and Kevin Markle. 2023. "Using Financial Accounting Information to Estimate the Income Shifting of US Multinationals." SSRN 4007595.

Egger, Peter H., and Georg Wamser. 2015. "The Impact of Controlled Foreign Company Legislation on Real Investments Abroad. A Multi-Dimensional Regression Discontinuity Design." *Journal of Public Economics*, 129(Supplement C): 77 – 91.

Einav, Liran, Amy Finkelstein, Yunan Ji, and Neale Mahoney. 2021. "Voluntary Regulation: Evidence from Medicare Payment Reform." *The Quarterly Journal of Economics*, 137(1): 565–618.

Faulkender, Michael W., Kristine W. Hankins, and Mitchell A. Petersen. 2019. "Understanding the Rise in Corporate Cash: Precautionary Savings or Foreign Taxes." *The Review of Financial Studies*, 32(9): 3299–3334.

Ferrari, Alessandro, Sébastien Lafitte, Mathieu Parenti, and Farid Toubal. 2024. "Profit Shifting and International Tax Reforms." EU Tax Observatory Working Paper 11.

Garrett, Daniel G., and Juan Carlos Suárez Serrato. 2019. "How Elastic Is the Demand for Tax Havens? Evidence From the US Possessions Corporations Tax Credit." In *AEA Papers and Proceedings*. Vol. 109, 493–499, American Economic Association.

Garrett, Daniel G., Eric Ohrn, and Juan Carlos Suárez Serrato. 2024. "Effects of International Tax Provisions on Domestic Labor Markets." Working Paper.

Grubert, Harry. 2012. "Foreign Taxes and the Growing Share of Us Multinational Company Income Abroad: Profits, Not Sales, Are Being Globalized." *National Tax Journal*, 65(2): 247–281.

Grubert, Harry, and Joel Slemrod. 1998. "The Effect of Taxes on Investment and Income Shifting to Puerto Rico." *The Review of Economics and Statistics*, 80(3): 365–373.

Grubert, Harry, and Rosanne Altshuler. 2006. "The Three Parties in the Race to the Bottom: Host Governments, Home Governments and Multinational Corporations." *Florida Tax Review*, 7(3): 137–209.

Grubert, Harry, and Rosanne Altshuler. 2013. "Fixing the System: An Analysis of Alternative Proposals for the Reform of International Tax." *National Tax Journal*, 66(3): 671–712.

Guardian, and Reuters. 2019. "EU Investigates Nike's Tax Status in the Netherlands." *The Guardian.*

Gumpert, Anna, James R. Hines, and Monika Schnitzer. 2016. "Multinational Firms and Tax Havens." *The Review of Economics and Statistics*, 98(4): 713–727.

Hardeck, Inga, and Patrick U. Wittenstein. 2018. "Assessing the Tax Benefits of Hybrid Arrangements – Evidence from the Luxembourg Leaks." *National Tax Journal*, 71(2): 295–334.

Hines, James R. 2024. "Evaluating Minimum Taxation." NBER Working Paper 33140.

Hines, James R., and Eric M. Rice. 1994. "Fiscal Paradise: Foreign Tax Havens and American Business." *The Quarterly Journal of Economics*, 109(1): 149–182.

IRS. 2011. "SOI Sampling Methodology and Data Limitations." US Internal Revenue Service https://www.irs.gov/pub/irs-prior/p946--2002.pdf (Accessed: February 7, 2022).

IRS. 2017. "SOI Tax Stats – Corporation Complete Report." US Internal Revenue Service https://www.irs.gov/statistics/soi-tax-stats-corporation-complete-report (Accessed: December 1, 2017).

IRS. 2022. "SOI Tax Stats - Controlled Foreign Corporations ." US Internal Revenue Service Web Site https://www.irs.gov/statistics/soi-tax-stats-controlled-foreign-corporations (Accessed: February 7, 2022).

James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. 2023. *An Introduction to Statistical Learning with Applications in R: Second Edition.*

Kennedy, Patrick J., Christine Dobridge, Paul Landefeld, and Jacob Mortenson. 2024. "The Efficiency-Equity Tradeoff of the Corporate Income Tax: Evidence from the Tax Cuts and Jobs Act." Working Paper.

Kleinbard, Edward D. 2013. "Through a Latte, Darkly: Starbucks's Stateless Income Planning." *Tax Notes*, 1515–1535.

Laudage Teles, Sabine, Nadine Riedel, and Kristina Strohmaier. 2023. "Transfer Price Documentation Rules and Multinational Firm Behavior-Evidence from France." SSRN 4519673.

McClure, Charles G. 2023. "How Costly is Tax Avoidance? Evidence from Structural Estimation." *The Accounting Review*, 98(6): 353–380.

Mutti, John, and Harry Grubert. 2009. "The Effect of Taxes on Royalties and the Migration of Intangible Assets Abroad." In *International Trade in Services and Intangibles in the Era of Globalization.* 111–137. University of Chicago Press.

Organ, Paul R., Katarzyna Bilicka, and İrem Güçeri. 2023. "The Role of Intellectual Property in Tax Planning." Working Paper.

Pegg, David. 2018. "From Seattle to Luxembourg: How Tax Schemes Shaped Amazon." *The Guardian.*

Rao, Nirupama. 2016. "Do Tax Credits Stimulate R&D Spending? The Effect of the R&D Tax Credit in its First Decade." *Journal of Public Economics*, 140: 1–12.

Samarakoon, Navodhya. 2023. "The Effect of the Closure of the Double Irish Arrangement on the Location of U.S. Multinational Companies' Profits." SSRN 4285001.

Souillard, Baptiste. 2022. "Profit Shifting, Employee Pay, and Inequalities: Evidence From Us-Listed Companies." CESifo Working Paper 9720.

Suárez Serrato, Juan Carlos. 2019. "Unintended Consequences of Eliminating Tax Havens." NBER Working Paper 24850.

Sun, Liyang, and Sarah Abraham. 2021. "Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects." *Journal of Econometrics*, 225(2): 175–199.

Tørsløv, Thomas, Ludvig Wier, and Gabriel Zucman. 2023. "The Missing Profits of Nations." *The Review of Economic Studies*, 90(3): 1499–1534.

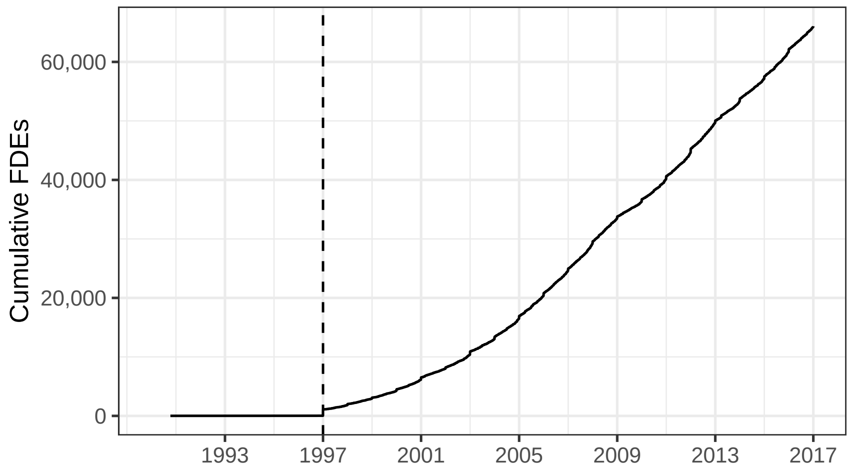
Yagan, Danny. 2015. "Capital Tax Reform and the Real Economy: The Effects of the 2003 Dividend Tax Cut." *American Economic Review*, 105(12): 3531–3563.

Zwick, Eric, and James Mahon. 2017. "Tax Policy and Heterogeneous Investment Behavior." *American Economic Review*, 107(1): 217–48.

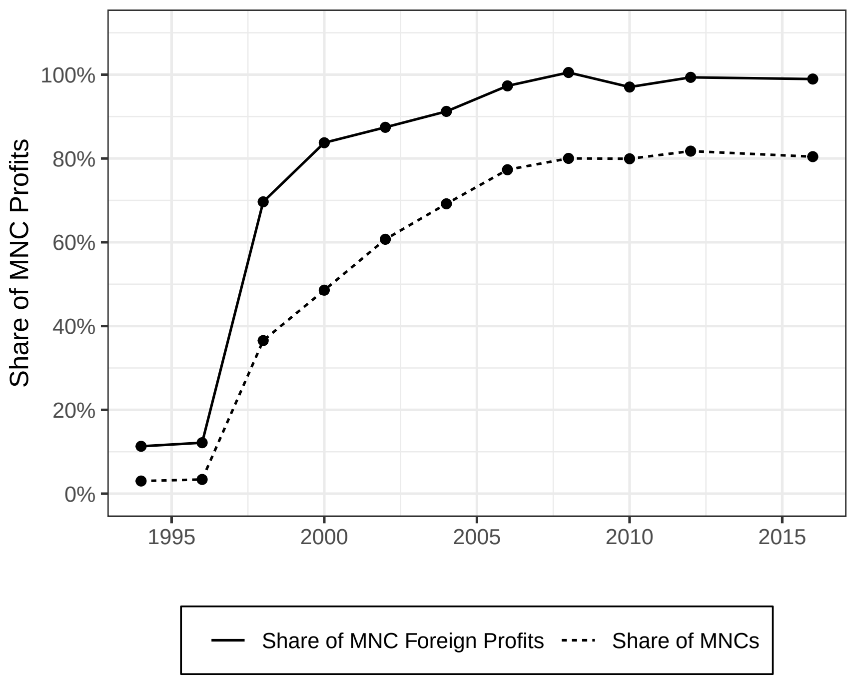
A Additional Tables and Figures

Figure A.1: Adoption of Foreign Disregarded Entities

(A) Cumulative Number of FDEs



(B) Prevalence of FDEs among US MNCs



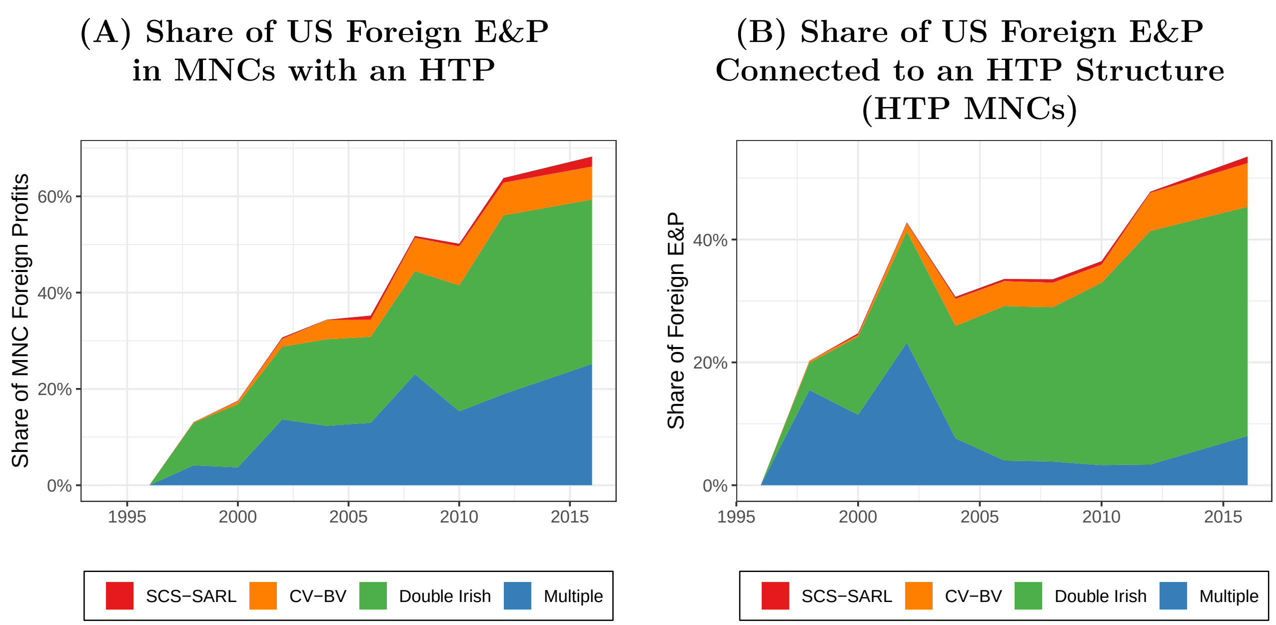
Notes: Figure A.1, Panel A plots the cumulative number of foreign disregarded entities. There were fewer than 50 FDEs prior to 1997 and this number grew rapidly following the adoption of CTB regulations. Panel B plots the fraction of US MNCs with an FDE, as well as the share of foreign profits that accrue to US MNCs with FDEs. By 2008, close to 80% of US MNCs have a FDE, and these MNCs account for close to 100% of foreign profits.

Table A.1: Disregarded Entities by Country of Incorporation

Country Name	Unadj. E&P (billions)	Num. FDEs
Ireland	224	4,844
Netherlands	136	12,236
United Kingdom	130	26,982
Switzerland	82	2,138
Cayman Islands	71	5,277
Singapore	68	3,458
Luxembourg	53	4,592
Bermuda	51	2,126
Canada	41	7,427
Australia	34	6,780

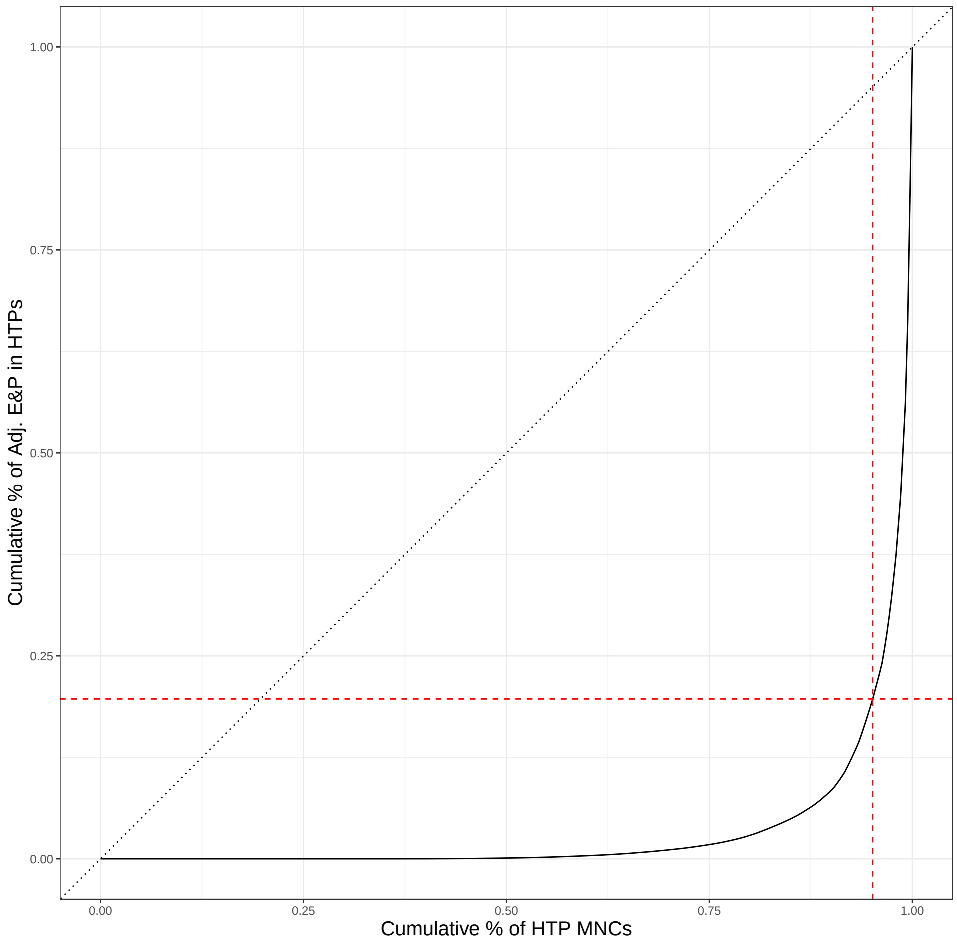
Notes: Table A.1 shows the largest ten countries according to total earnings generated by FDEs. Ireland and the Netherlands are some of the largest domiciles for these types of foreign affiliates. FDEs also generate large amounts of earnings in well-known tax havens, such as the Cayman Islands and Bermuda. Column (2) provides aggregate unadjusted E&P, generated by FDEs in the country listed in Column (1). This includes E&P for all years that we observe Form 8858 filings (2006, 2008, 2012, and 2016). Column (3) shows the number of unique entities across all years of this sample.

Figure A.2: Adoption of Hybrid Tax Planning Structures (Additional Outcomes)



Notes: Figure A.2 presents two representations of the prevalence of HTP adoption over time, in addition to those shown in Figure 3. Panel A shows that a growing share of US foreign profits were held by MNCs that adopted an HTP structure. Panel B shows the share of HTP-adopting MNCs' US foreign E&P that is connected to a hybrid tax planning structure. In each panel, the blue area comprises MNCs that have adopted more than one structure.

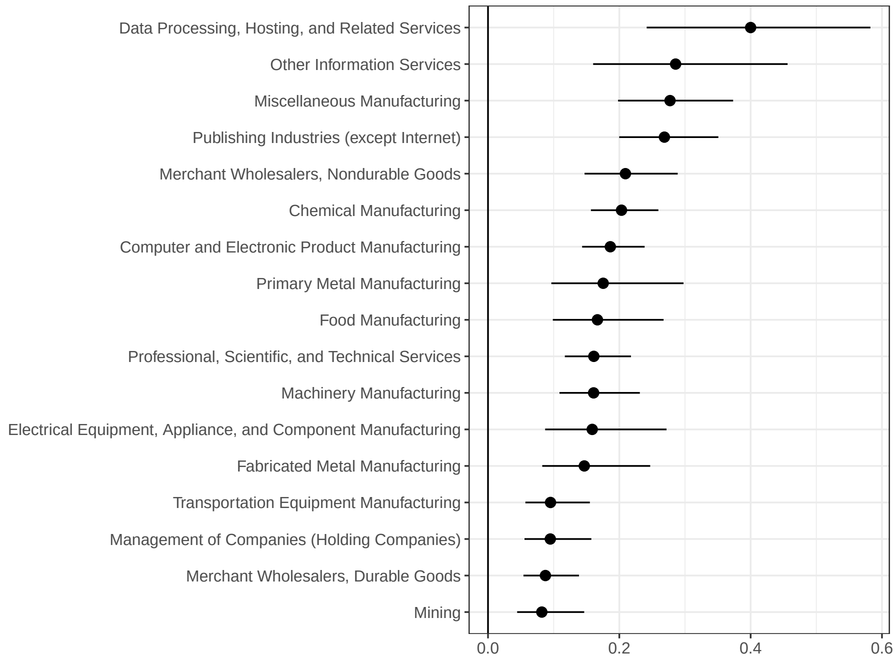
Figure A.3: Concentration of Foreign E&P in HTPs amongst HTP-Adopting MNCs in 2016



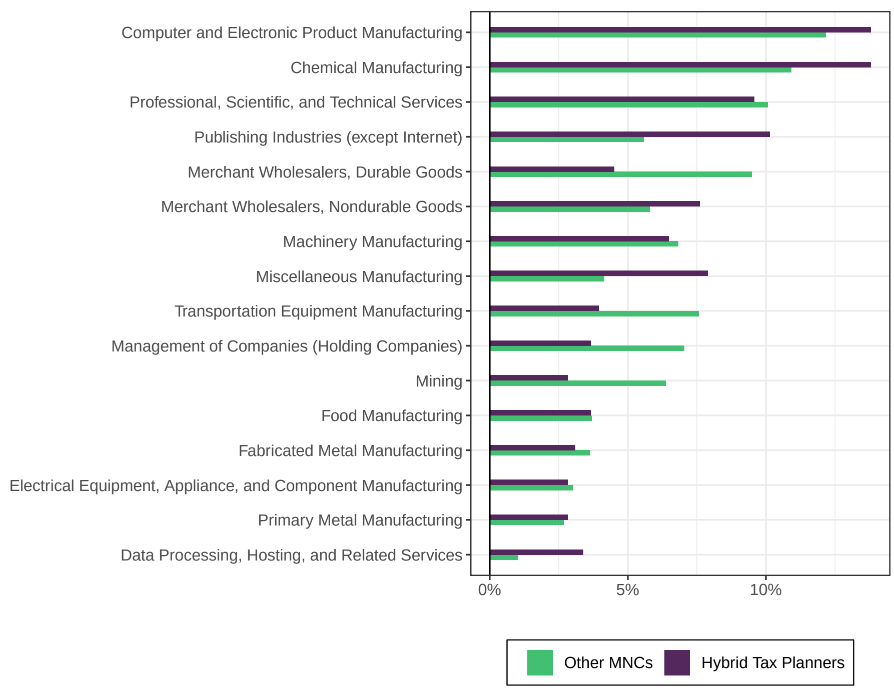
Notes: Figure A.3 presents a Lorenz curve of the distribution of foreign E&P connected to a hybrid tax planning structure amongst HTP-adopting MNCs in 2016. Panel B of Figure 3 shows that approximately 36.5% of the foreign E&P of all US MNCs was connected to hybrid tax planning structure in 2016. This Lorenz curve shows that approximately 80.32% of that HTP-connected E&P, or 29.34% of all US foreign E&P, is accounted for by the top 5% of firms that adopted a hybrid tax planning structure—roughly 18 firms. Firms with negative E&P were rounded up to 0, indicating that these estimates may underrepresent the true magnitude of concentration amongst the top 5% of HTP-adopting MNCs.

Figure A.4: Probability of HTP Adoption (Robustness)

(A) Probability by Subindustry

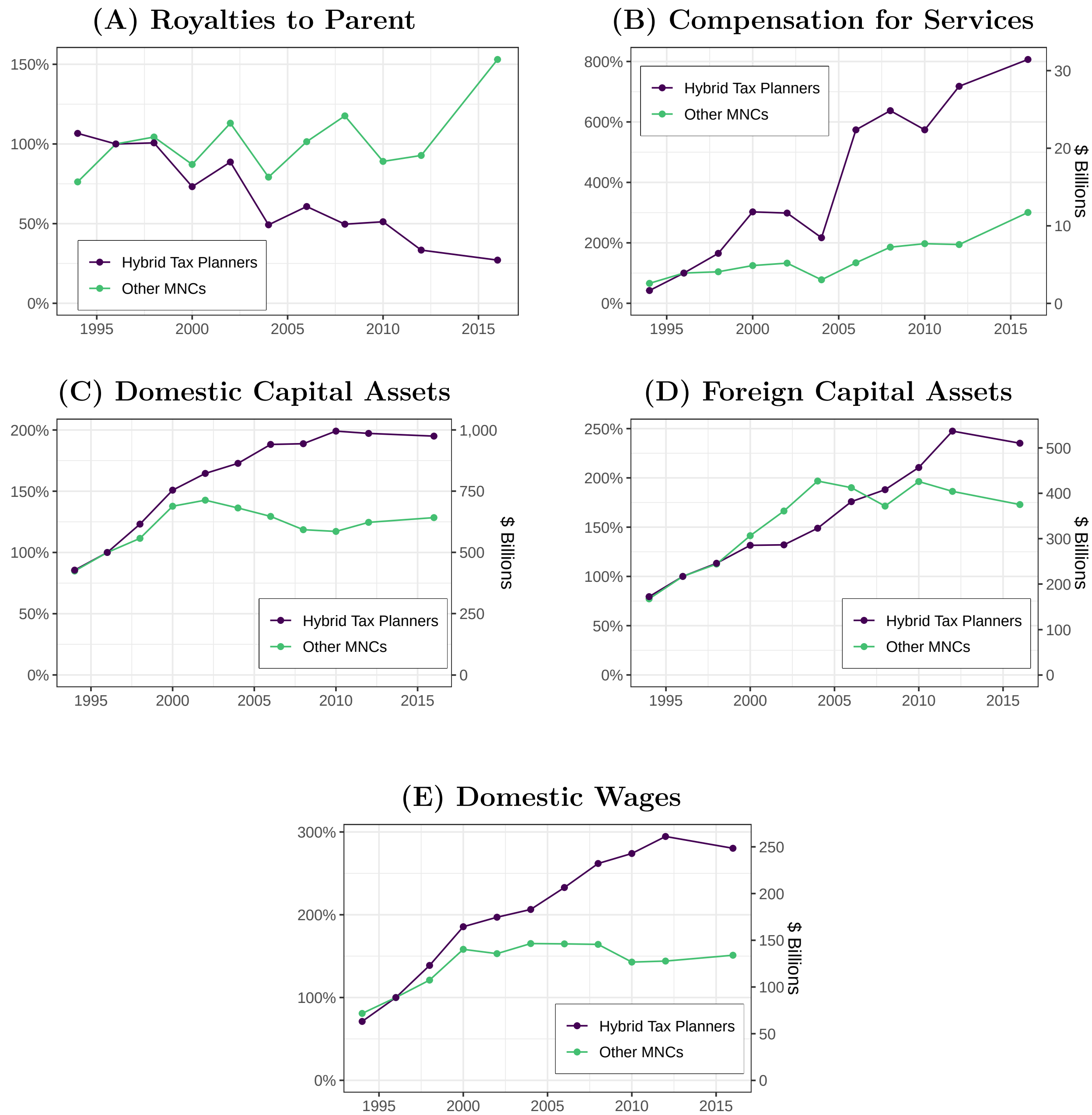


(B) Major Shares, HTPs vs. Other MNCs



Notes: Figure A.4 reports the predicted probability of adoption by major group according to a simple logit model. Panels A and B are respectively analogous to Panels A and B in Figure 4, which use sector instead of major group. We consider subindustries roughly analogous to 3-digit SIC codes and remove groupings with fewer than ten MNCs in either group.

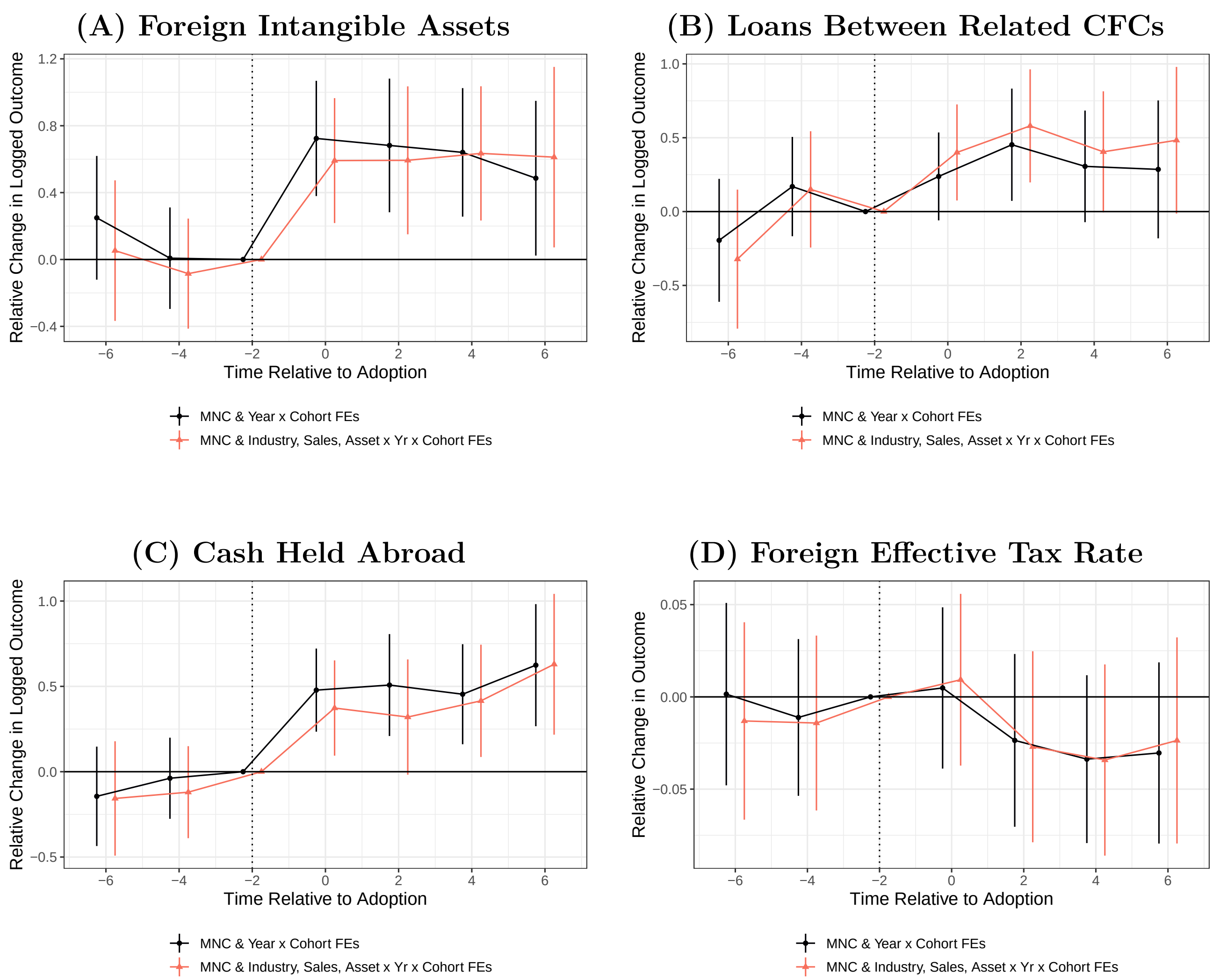
Figure A.5: Comparison of Aggregate Trends (Additional Outcomes)



Notes: Figure A.5 shows the evolution of firm outcomes for two groups of MNCs. The purple line shows aggregate values for a group of MNCs that eventually adopt at least one of the hybrid tax structures described in Section 3. The light green line shows aggregate values for MNCs that do not adopt any of these structures during the sample window. For comparability, aggregate values for both groups are normalized to 100% as of 1996. In Panels B - E, the right-hand axis displays dollar value in billions, relative to the aggregate 1996 dollar value for HTP MNCs.

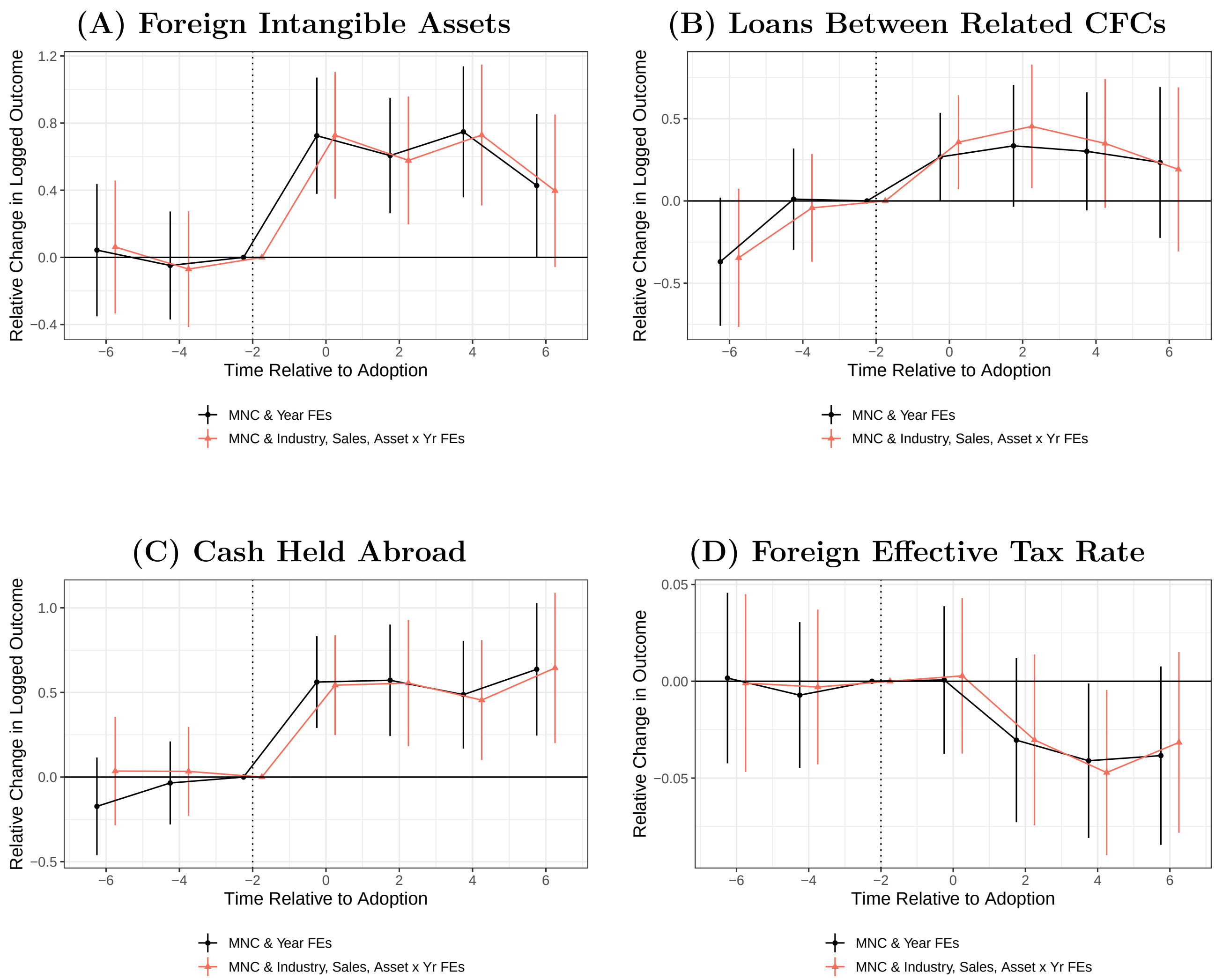
Analogous to Figure 5, Panels A and B present additional outcomes showing that HTP-adopting MNCs increased behaviors linked to profit shifting. Panel A shows royalty payments from CFCs to domestic parent entities as a share of foreign E&P; Panel B shows payments from CFCs to US parent companies for technical services. Panels C, D, and E present trends related to aggregate real economic activity of US MNCs: domestic capital assets (Panel C), foreign capital assets (Panel D), and domestic wages (Panel E). These three panels indicate that, while HTP and non-HTP MNCs had similar patterns of economic activity prior to 1997, their activities diverged over the same time period that hybrid tax planning strategies were adopted.

Figure A.6: Profit Shifting Mechanisms and Foreign ETRs (IPW)



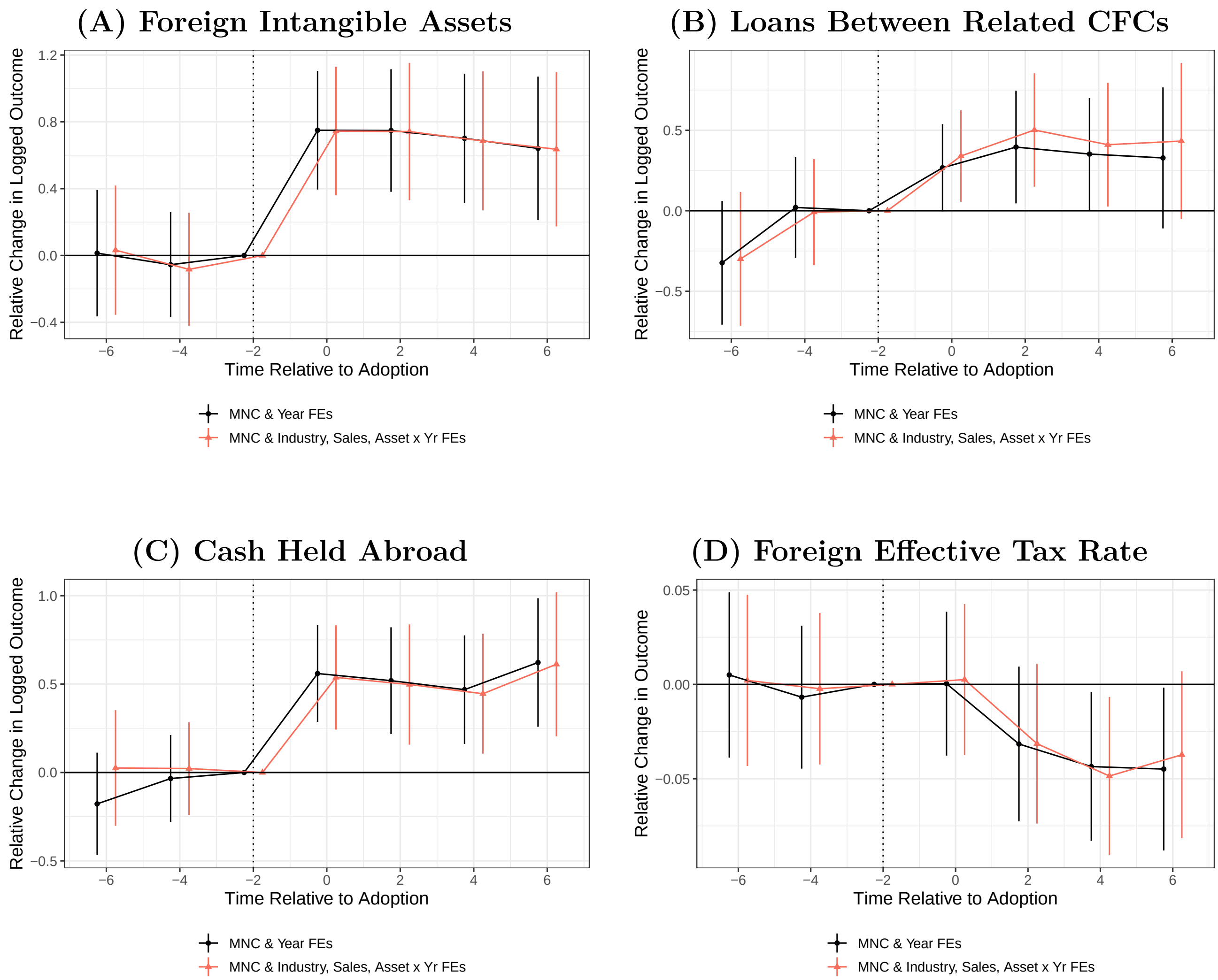
Notes: Figure A.6 provides estimates of μ_ℓ from Equation 1 for the corresponding foreign outcome listed in each panel, analogous to those in Figure 6, using inverse probability-weighted data. Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry fixed effects and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values for each cohort.

Figure A.7: Profit Shifting Mechanisms and Foreign ETRs (Sun and Abraham)



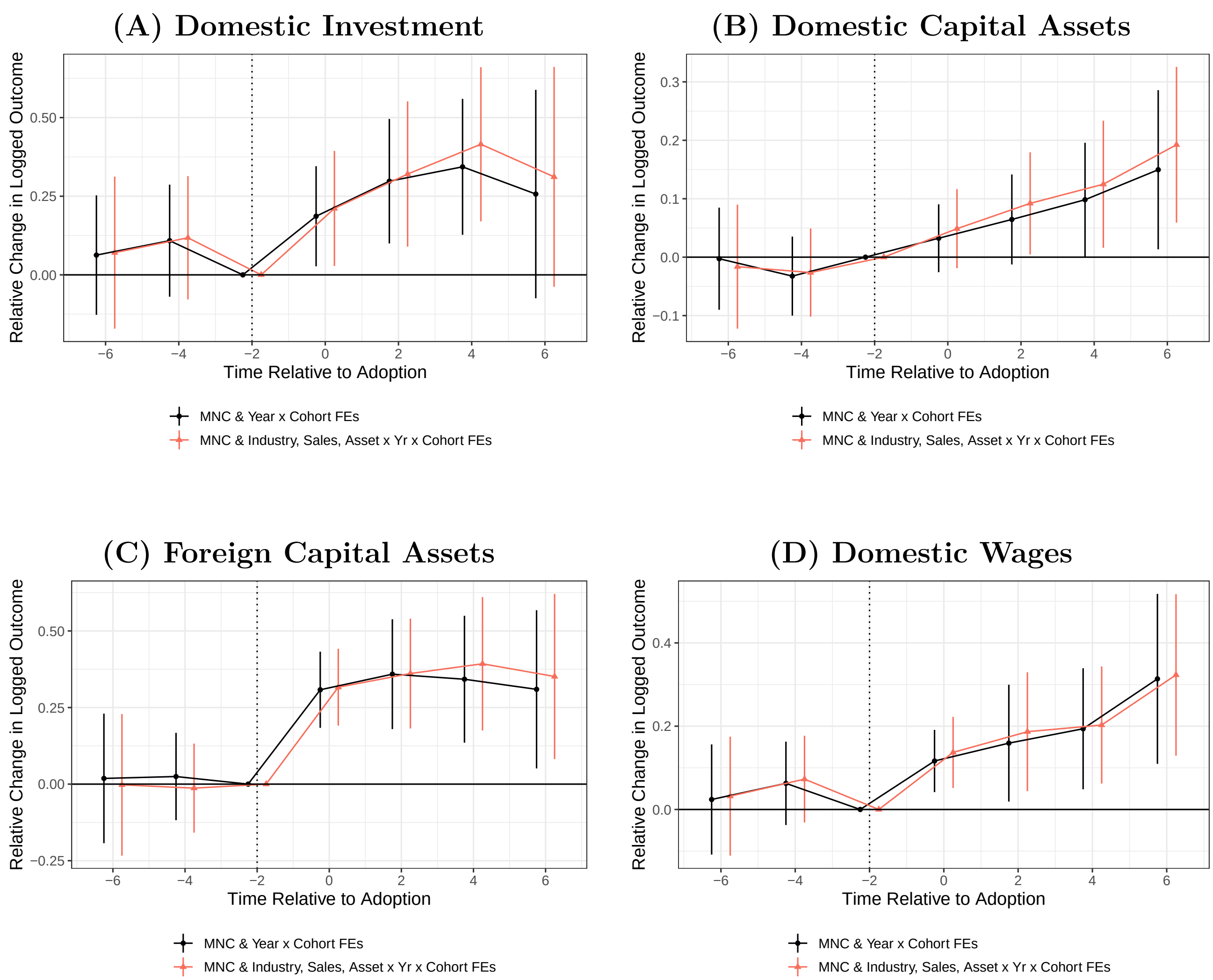
Notes: Figure A.7 provides estimates for the corresponding foreign outcome listed in each panel, analogous to those in Figure 6, from a standard two-way fixed effects regression using the staggered estimator from Sun and Abraham (2021). Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry fixed effects and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values for each cohort.

Figure A.8: Profit Shifting Mechanisms and Foreign ETRs (TWFE)



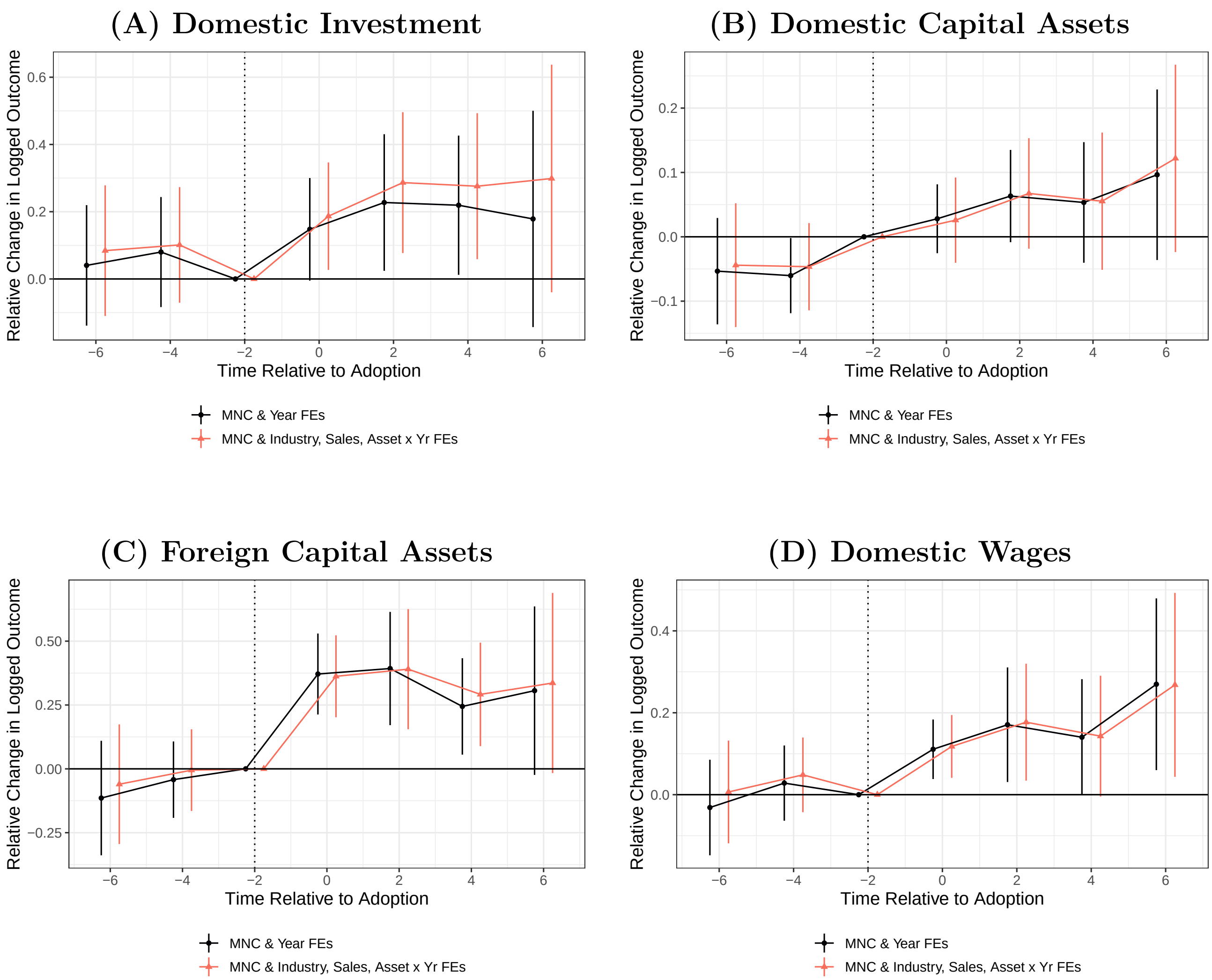
Notes: Figure A.8 provides estimates for the corresponding foreign outcome listed in each panel, analogous to those in Figure 6, from a standard two-way fixed effects regression. Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry fixed effects and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values for each cohort.

Figure A.9: Hybrid Tax Planning and Real Economic Activity (IPW)



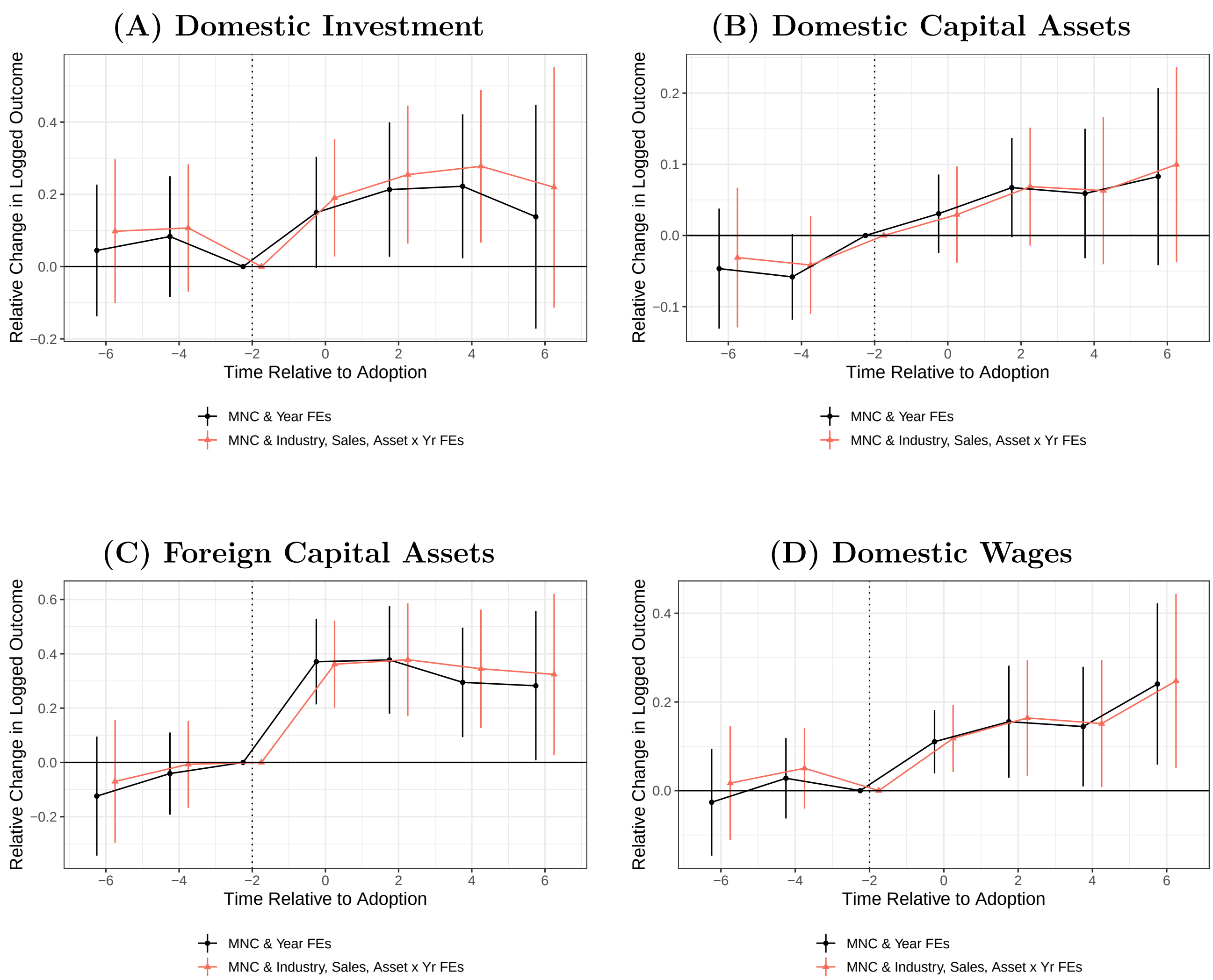
Notes: Figure A.9 provides estimates of μ_ℓ from Equation 1 for the corresponding outcome listed in each panel, analogous to those in Figure 7, using inverse probability-weighted data. Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry fixed effects and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values for each cohort.

Figure A.10: Hybrid Tax Planning and Real Economic Activity (Sun and Abraham)



Notes: Figure A.10 provides estimates for the corresponding outcome listed in each panel, analogous to those in Figure 7, from a standard two-way fixed effects regression using the staggered estimator from Sun and Abraham (2021). Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry fixed effects and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values for each cohort.

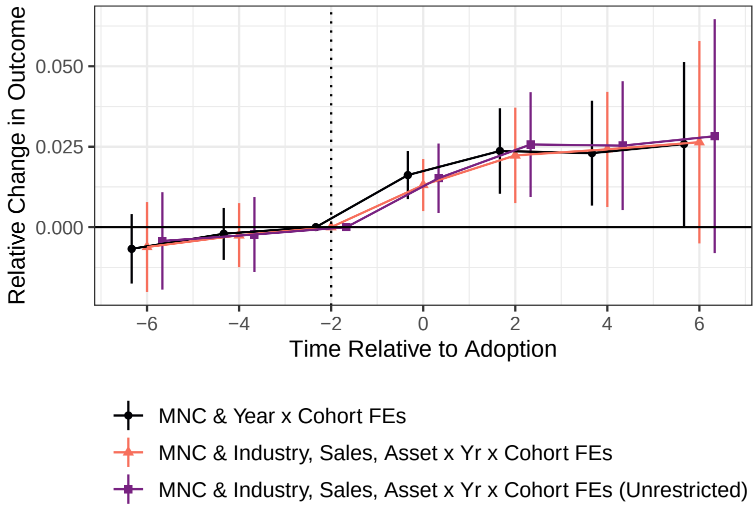
Figure A.11: Hybrid Tax Planning and Real Economic Activity (TWFE)



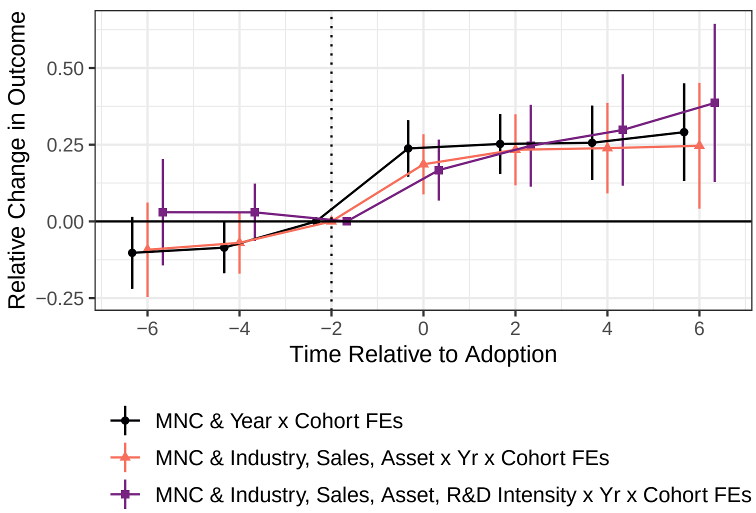
Notes: Figure A.11 provides estimates for the corresponding outcome listed in each panel, analogous to those in Figure 7, from a standard two-way fixed effects regression. Specification 1 (in black) does not include additional controls. Specification 2 (in orange) includes year-by-cohort-by-industry fixed effects and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values for each cohort.

Figure A.12: Hybrid Tax Planning and R&D Data from Compustat (Robustness)

(A) R&D Intensity



(B) Log R&D



Notes: Figure A.12 provides estimates of μ_ℓ from Equation 1 for the corresponding R&D outcome listed in each panel, using 2-year pooled average data from Compustat and dropping odd years to match the IRS SOI International Business Tax Sample. Specifications 1 and 2 (in black and orange, respectively) are identical to the results shown in Figure 8. For R&D Intensity (Panel A), Specification 3 (in purple) does not restrict R&D intensity to be less than 1. For Log R&D (Panel B), Specification 3 includes an additional R&D intensity quartile fixed effect in its year-by-cohort-by-group fixed effects, where R&D intensity is not restricted to be less than 1.

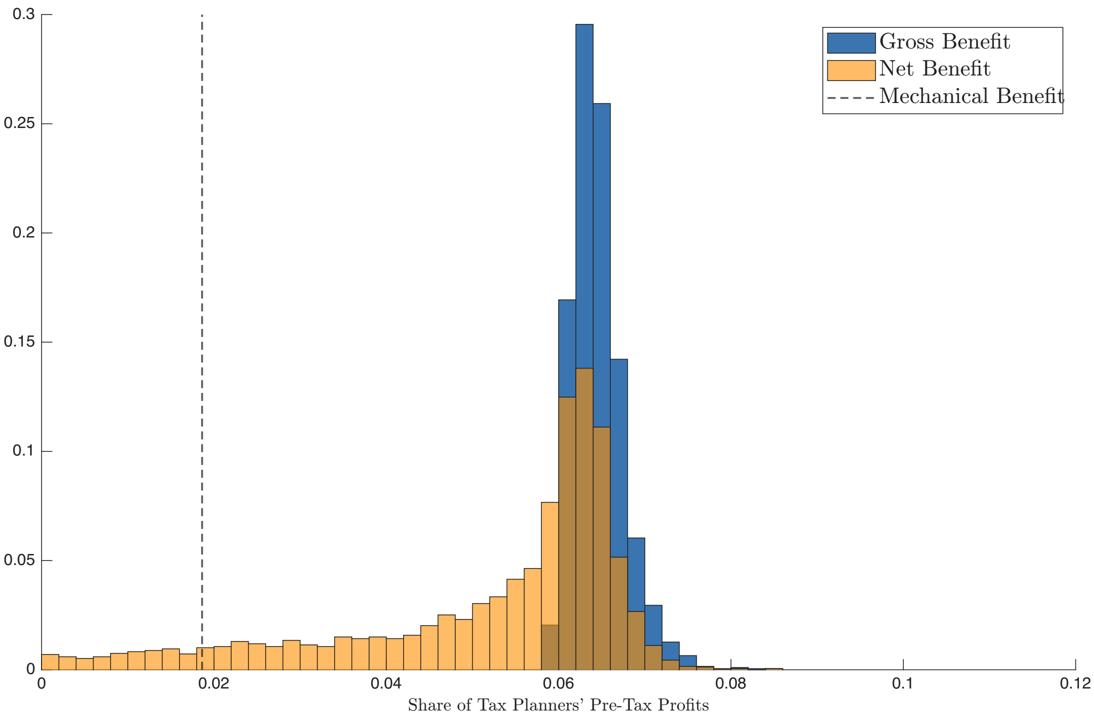
Table A.2: Hybrid Tax Planning and R&D Data from Compustat (Robustness)

	(1)	(2)	(3)	(4)
Panel A				
R&D Intensity (Unrestricted)	0.028**	0.034***	0.033**	0.034**
	(0.010)	(0.010)	(0.010)	(0.011)
Num. Treated	125	114	125	125
Num. Control	388	337	387	387
Avg. R&D Intensity (All Firms)	0.060	0.050	0.059	0.059
Avg. R&D Intensity (Treated Firms)	0.057	0.055	0.057	0.057
R&D Intensity x Yr x Cohort FEs	-	-	-	-
R&D Intensity x Yr FEs	-	-	-	-
Panel B				
Log R&D	0.277***	0.386***	0.157+	0.148
	(0.095)	(0.095)	(0.092)	(0.104)
Num. Treated	89	60	63	63
Num. Control	298	213	259	259
R&D Intensity x Yr x Cohort FEs	Yes	Yes	-	-
R&D Intensity x Yr FEs	-	-	Yes	Yes
MNC & Ind., Sales, Asset x Yr x Cohort FEs	Yes	Yes	-	-
MNC & Ind., Sales, Asset x Yr FEs	-	-	Yes	Yes
Inverse Prob. Weights	-	Yes	-	-
Model	Stacked	Stacked	SA	TWFE

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

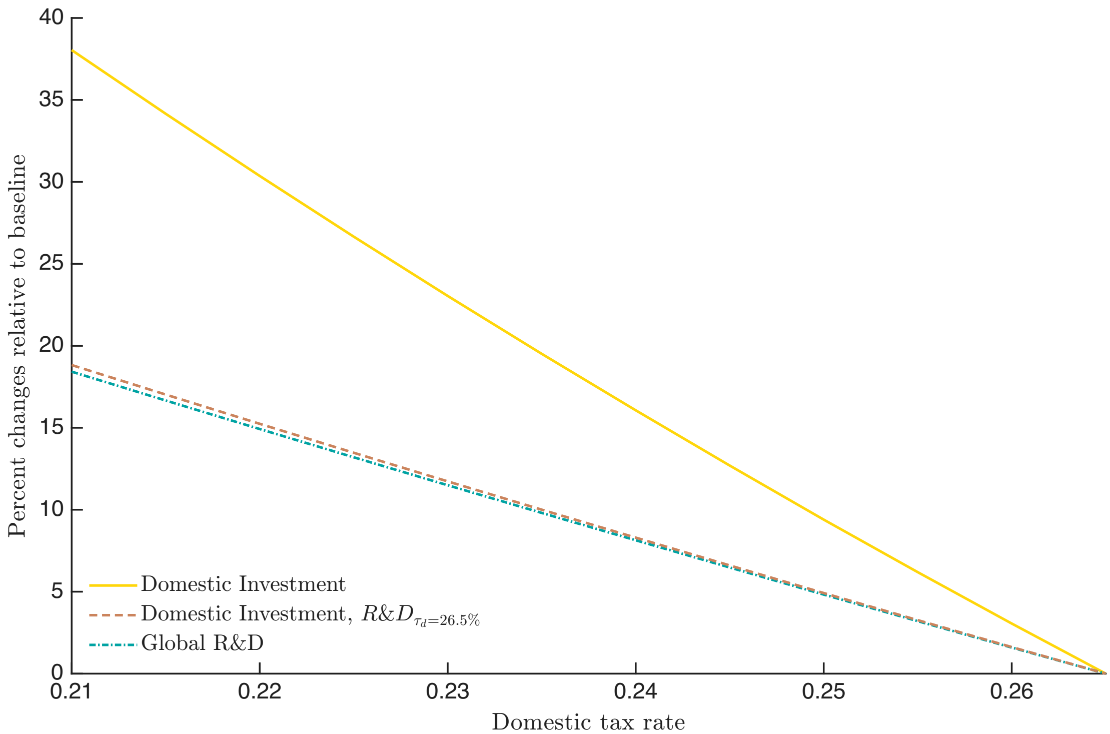
Notes: Table A.2 provides additional fixed effects specifications of the difference-in-differences model discussed in Section 5.1 for the corresponding R&D outcome listed in each panel, analogous to Table 6. Columns (1)–(3) use Equation 1 and Columns (4) and (5) a standard TWFE regression. Estimations use 2-year pooled average data from Compustat, where odd years are dropped to match the IRS SOI International Business Tax Sample. R&D Intensity (Panel A) is calculated as the ratio of annual R&D to the MNC's most recent sales value pre-adoption. All specifications include year-by-cohort-by-industry and year-by-cohort-by-group fixed effects, where groups include domestic and foreign sales quartiles and domestic and foreign intangible asset quartiles, and where quartiles are computed using pre-adoption values. Log R&D (Panel B) also includes an additional R&D intensity quartile fixed effect in its year-by-cohort-by-group fixed effects. Column (2) uses inverse probability-weighted data. Column (3) estimates an alternative specification from Sun and Abraham (2021). Column (4) estimates a standard TWFE specification.

Figure A.13: Model-Based Distribution of Benefits Across Tax Planning Firms



Notes: Figure A.13 presents histograms of the relative benefits of tax planning among the simulated firms that select into tax planning. Gross benefit refers to the difference between firm profits associated with tax planning and not planning, $\Pi_h(K_d^*, K_h^*, D^*) - \Pi_f(K_d^*, K_f^*, D^*)$, among firms that tax plan. Net benefit refers to gross benefits minus the costs of planning, c_i. The dotted line shows the mechanical benefit of lower tax rates under tax planning, holding firm investment and R&D fixed, equal to 0.0181. We normalize each term as a share of total pre-tax profits for each firm. Results are based on 10,0000 simulated firms given the parameter estimates in Table 7.

Figure A.14: Counterfactual Decrease in Domestic Tax Rate t_d



Notes: Figure A.14 plots simulated percentage changes in domestic investment and global R&D as the domestic tax rate decreases from 26.5% to 21%. The dashed brown line shows simulated domestic investment while holding fixed R&D expenditures.

Table A.3: Alternative Model Parameter Estimates

	(1) Baseline	(2) $\hat{W} = \text{diag}(\hat{\Sigma})^{-1}$	(3) $I_f = 0.4$	(4) $I_f = 0.8$	(5) $t_h = 9.9\%$	(6) $t_h = 16.7\%$	(7) Est. μ_c	(8) $\tau_R = (1 - t_d)$
Elasticity of Demand								
ε^{PD}	-2.483	-2.465	-2.507	-2.419	-2.321	-2.442	-2.507	-2.579
	(0.304)	(0.347)	(0.393)	(0.531)	(0.318)	(0.235)	(0.325)	(0.508)
R&D Productivity								
γ	0.612	0.583	0.612	0.621	0.693	0.619	0.597	0.583
	(0.128)	(0.135)	(0.168)	(0.221)	(0.168)	(0.096)	(0.124)	(0.199)
Dispersion Parameters								
σ_s	0.001	0.001	0.001	0.000	0.000	0.001	0.000	0.001
	(0.005)	(0.006)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.006)
σ_b	2.357	2.724	2.311	2.430	2.379	2.349	2.430	2.300
	(0.326)	(0.406)	(0.295)	(0.300)	(0.273)	(0.339)	(0.289)	(0.295)
σ_c	4.968	5.373	5.002	4.842	5.390	4.596	5.326	3.253
	(1.942)	(3.899)	(1.357)	(4.974)	(4.272)	(1.954)	(0.618)	(0.807)
Mean Parameters								
μ_s	-0.834	-0.713	-0.801	-0.876	-0.929	-0.901	-0.890	-0.946
	(0.272)	(0.485)	(0.149)	(0.610)	(0.289)	(0.250)	(0.288)	(0.384)
μ_b	0.216	0.226	0.214	0.215	0.250	0.214	0.207	0.182
	(0.794)	(1.083)	(1.828)	(0.751)	(0.122)	(0.721)	(0.380)	(0.130)
μ_c							0.439	
							(0.661)	
Correlation Parameter								
ρ_{bc}	-0.325	-0.320	-0.329	-0.331	-0.339	-0.329	-0.300	-0.548
	(0.163)	(0.278)	(0.142)	(0.382)	(0.285)	(0.175)		(0.098)
$g(X, \hat{\theta})$	0.215	131.265	0.188	0.262	0.297	0.211	0.203	0.185

Notes: Table A.3 provides robustness for model estimates. Column (1) reproduces estimates from Table 7. Column (2) presents a version that uses the inverse diagonal covariance matrix to weight the SMM objective function. Columns (3) and (4) consider alternative calibrations of foreign GDP share I_f. Columns (5) and (6) calibrate the foreign tax rate under tax planning, t_h, at the 95% confidence intervals associated with our estimate from Table 4. Column (7) considers an alternative model that calibrates ρ_{bc} and estimates μ_c. Column (8) considers a simple model with full domestic R&D deductibility.

Table A.4: Model Decomposition of Difference-in-Differences Estimates

	(1) DiD	(2) Model	(3) Tax Effect	(4) Selection	(5) Share due to ΔETR
$\beta^{R\&D}$	0.50	0.27	0.08	0.19	0.30
β^{K_d}	0.16	0.25	0.08	0.17	0.33
β^{K_f}	0.40	0.50	0.33	0.17	0.66
$\beta^{R\&D}_{\%\Delta}$	0.50	0.39	0.10	0.27	0.25

Notes: Table A.4 presents details of the difference-in-differences decomposition from Column (1), Panel B.1 of Table 7. Column (1) lists the estimates from Section 5.1. Column (2) lists the model-implied values of these estimates. Column (3) lists the relative change in each outcome that can be attributed to the behavioral response to the tax change. Column (4) lists the selection effect and Column (5) lists the ratio of columns (3) and (2).

Table A.5: Empirical Moments and Identification of Model Parameters

Moment	**Identifies...**
Share of firms within size bins $[-\infty, 0.1, 0.5, 3, +\infty]$	Model scale (μ_b, μ_s)
Share of firm R&D within each size bin	R&D adjustment cost distribution (μ_b, σ_b)
Share of firm profits within each size bin	Idiosyncratic productivity distribution, (μ_s, σ_s)
Share of foreign profits in HTPs within *top two* size bins	Correlation between b and c, ρ_{bc}
Share of firms that are HTPs	Planning cost dispersion, σ_c
Share of total foreign profits in HTPs	Planning cost dispersion, σ_c
Difference-in-differences effect of tax planning on R&D, $\beta_{R\&D}$	R&D productivity (together with β_{K_d} and β_{K_f}), γ
Difference-in-differences effect of tax planning on domestic investment, β_{K_d}	Elasticity of product demand (together with β_{K_f}), ε_{PD}
Difference-in-differences effect of tax planning on foreign investment, β_{K_f}	Elasticity of product demand (together with β_{K_d}), ε_{PD}

B Data

Table B.1: MNC Summary Statistics

Domestic Outcomes	All MNCs				Hybrid Tax Planners				Other MNCs			
	Mean	P25	P75	SD	Mean	P25	P75	SD	Mean	P25	P75	SD
Tangible Assets	3,024	226	1,981	9,977	4,407	341	2,894	14,023	2,659	201	1,762	8,557
Wages	583	58	447	1,636	1,125	114	928	2,440	440	49	366	1,308
Investment	267	10	141	1,619	356	17	216	1,242	243	9	125	1,704
R&D	73	0	38	343	179	0	106	644	44	0	27	184
Foreign Outcomes	All MNCs				Hybrid Tax Planners				Other MNCs			
	Mean	P25	P75	SD	Mean	P25	P75	SD	Mean	P25	P75	SD
Tangible Assets	886	16	409	3,874	1,706	56	811	6,598	668	11	313	2,692
Intangible Assets	355	0	136	1,856	898	6	462	3,467	211	0	91	1,039
Pretax E&P	279	2	105	1,607	771	12	323	3,062	148	1	74	840
Income Taxes	54	0	22	284	117	4	59	378	38	0	16	250
Cash	496	5	125	4,579	1,429	21	430	8,368	250	4	90	2,775
Foreign Affiliate Counts	All MNCs				Hybrid Tax Planners				Other MNCs			
	Mean	P25	P75	SD	Mean	P25	P75	SD	Mean	P25	P75	SD
FDE Count	38	4	34	103	86	16	81	188	23	4	24	48
CFC Count	13	2	12	41	34	4	33	86	10	2	10	26
Sample Sizes	3,635				512				3,123			

Notes: Table B.1 contains summary statistics for our stable sample as described in Section 2.2. This sample was created by identifying MNCs with coverage in both the SOI Corporate and SOI International Business Tax samples, not including MNCs that did not have at least $500 million in domestic assets as well as at least one CFC with $50 million in foreign assets. To ensure we do not disclose information about individual MNCs, the values listed for P25 and P75 are the means of ten observations surrounding a given percentile.

Table B.2: Sample Sizes

	(1) Int'l. Business Sample	(2) SOI Corp. Sample	(3) Stable Sample
MNC Count	23,222	20,029	3,635
CFC Count	333,438	322,538	43,941
FDE Count	58,690	57,685	53,141

Notes: Table B.2 shows the size of several different samples of MNCs, along with their foreign affiliates (CFCs and FDEs). We consider a firm to be an MNC if it files Form 5471 for at least one CFC. Column (1) provides sample sizes using all MNCs in the SOI International Business Tax Sample. Column (2) provides sample sizes after removing MNCs that were not C corporations. Column (3) applies a size filter that removes smaller MNCs from the sample so that the sample composition is similar in earlier and later years.

B.1 Measuring Foreign Effective Tax Rates

One possible concern when calculating foreign effective tax rates relates to the measurement of the earnings of foreign affiliates. As we discuss in Section 2.2, Blouin and Robinson (2023) suggest that aggregated IRS statistics may inadvertently double count foreign earnings. However, each CFC must also file attachments to Form 5471 that disclose transactions between the focal CFC and related CFCs, including any dividends that the CFCs may transfer to each other.

To ensure that there is no double-counting of foreign profits in our foreign ETR calculations, we subtract these related dividends. Specifically, we compute the firm-level foreign ETR as

$$ETR = \frac{\text{Foreign Taxes}}{\text{Foreign Taxes} + \text{Adjusted Foreign Earnings and Profits}},$$

where total foreign tax payments are taken from Form 5471, Schedule E.[37] To calculate adjusted foreign earnings and profits, we obtain pretax E&P for each affiliated CFC using Schedules E and H from Form 5471. Following the suggestion of Blouin and Robinson (2023), we then remove dividends received from related CFCs from E&P using Schedule M from Form 5471.

C Institutional Background: Hybrid Tax Planning

The simplest hybrid tax planning structure allows MNCs to take large deductions for interest in high-tax jurisdictions through the use of tax haven finance affiliates. Consider the following planning structure to finance a subsidiary in a high-tax country. Instead of funding the high-tax

[37] There does not appear to be any such double-counting concern related to the payment of foreign taxes. We exclude unprofitable firm-years from this calculation.

subsidiary directly, the parent injects equity into a tax haven affiliate, which lends to the high-tax subsidiary. The high-tax subsidiary then pays interest to the tax haven affiliate. This profit shifting strategy is commonly known as "interest stripping." Though the interest is deductible abroad against taxable income, it remains subject to immediate US tax under the CFC rules.

Prior to 1997, CFC rules made the use of a tax haven financing affiliate unattractive for tax purposes. Since 1997, however, the parent can check the box on the high-tax affiliate, making it a hybrid FDE. From the US point of view, the high-tax CFC is an unincorporated branch of the tax haven FDE; the interest payment is thus transparent to the US Treasury, which regards the combined tax haven/high-tax operation as one consolidated corporation. The interest payment therefore avoids Subpart F taxes and the company can defer US income tax by holding profits in the tax haven.

Panel A in Figure C.1 depicts this simple hybrid tax planning structure using a tax haven affiliate. The green box around the two entities (the tax haven CFC and the high-tax FDE) indicates that the structure is consolidated from the US point of view. This simple structure allows the parent to capitalize a foreign affiliate through a tax haven while making intercompany payments transparent, thereby avoiding any current US tax on interest.

While this structure avoids Subpart F tax and defers US income tax, the MNC would still be subject to corporate income tax in the tax haven (if it exists) and potentially to foreign withholding tax on the interest payments between affiliates.[38] Moreover, to combat interest stripping, many countries have adopted "thin-capitalization" rules that limit the tax deductibility of interest payments, reducing the attractiveness of this option.

C.1 CTB and Cost Sharing Agreements

Another form of income shifting is available to MNCs with intellectual property. This method uses cost sharing agreements (CSAs) to develop IP that can be licensed abroad. These agreements are particularly tax advantageous when combined with CTB.

Under a cost sharing agreement, the tax haven affiliate makes a "buy-in payment" that funds a part of the parent's R&D project. This gives the affiliate the right to license resulting IP to other foreign subsidiaries in exchange for royalty payments. Royalty payments are not subject to

[38] After the adoption of "look-through" rules passed as part of the Tax Increase Prevention and Reconciliation Act of 2005, MNCs could avoid Subpart F taxation on distributions of interest, rents and royalties across CFCs without relying on FDEs.

current tax under Subpart F if the parent checks the box on the affiliate making the payment.[39] The key is that with CTB, any payments for the use of the IP abroad are contained within one consolidated company from the view of the US Treasury. This structure has the same foundation as in Panel A of Figure C.1, but replaces the equity injection with a transfer of IP (via a cost sharing agreement) and uses royalty payments instead of interest to shift profits. We display this structure in Figure C.1, Panel B.

It is important to note that determining the right arm's length payment for the buy-in is usually quite difficult. Typically the IP is not fully developed at the time the buy-in payment is made, so there is uncertainty regarding future profits. While the US has rules under which buy-in payments must be adjusted if the profits associated with the IP are too high relative to payments, it is still possible for MNCs to underprice the IP. This allows US MNCs to shift income to low-tax affiliates. MNCs are then able to use hybrid tax planning structures, as discussed below, to minimize tax on the foreign profits generated from their IP.

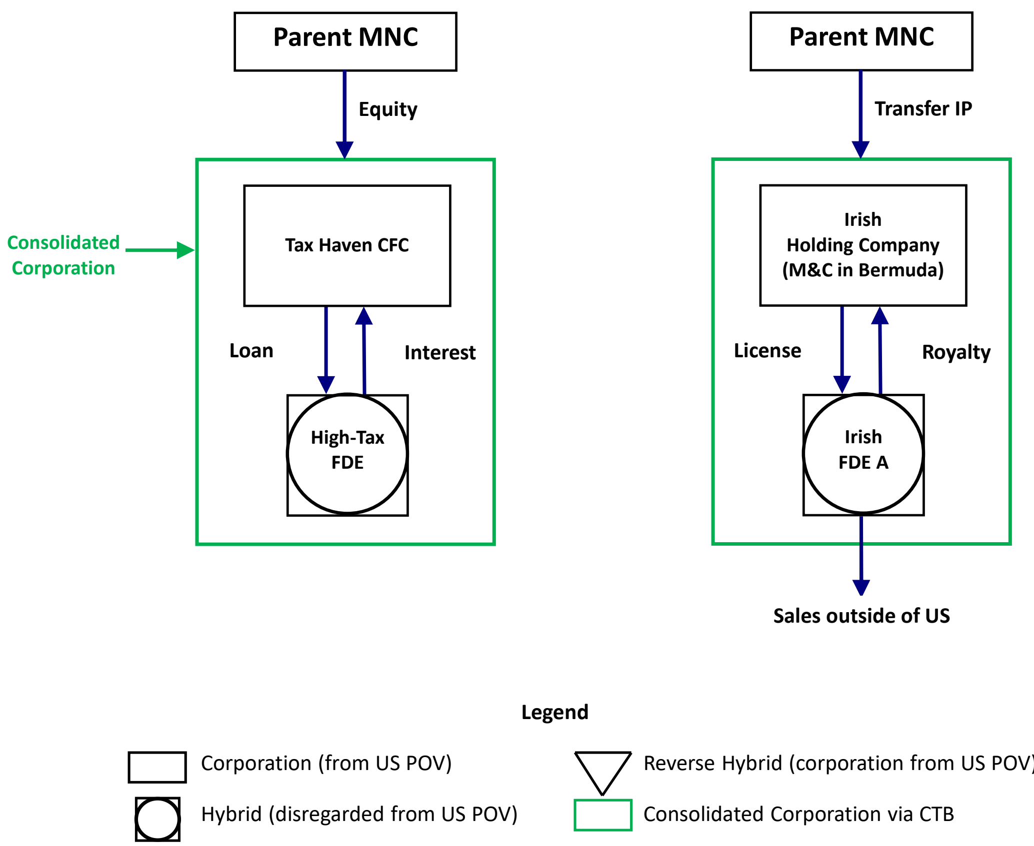
Even if IP is not underpriced, MNCs have historically attempted to strategically allocate allowable costs to generate tax savings through cost sharing agreements.

As with interest stripping, royalty payments may still be subject to corporate income taxes in a tax haven and to withholding taxes that are meant to prevent profit shifting between countries. We now describe complex tax planning strategies that aim to reduce exposure to income and withholding taxes across multiple jurisdictions, including the US.

[39]Profits could be further accumulated in a tax haven if MNCs overprice the royalty. The absence of comparable transactions makes it hard for tax authorities to value intellectual property and correctly price royalty payments.

Figure C.1: Additional Diagrams of Hybrid Tax Planning Structures

(A) Simple CTB Structure (B) Double Irish CTB with Cost Sharing



Notes: Figure C.1, Panel A depicts a hypothetical financing CTB structure. Panel B describes a Double Irish cost sharing structure with CTB. In each of these diagrams, black rectangles represent corporations and the green rectangle depicts combined structures as perceived by the IRS. Squares with circles inside denote hybrid entities, which are corporations in the local country but disregarded for US purposes. The Double Irish with Dutch Sandwich and Reverse Hybrid Mismatch tax planning structures are shown in Figure 2.

D Predicting HTP Adoption

In this appendix, we continue the discussion about predictors of HTP adoption from Section 4. We first consider additional logit specifications and then estimate a random forest model.

D.1 Logit Models

We first conduct a set of logit regressions. These models use observations from adopting MNCs in the period prior to adoption, and include all observations for never-adopters.

Table D.1 predicts HTP adoption based on whether an MNC claims a tax credit for R&D; its age (binned by quartile with the youngest firms set as the reference category); the average statutory foreign ETR that it faces (and its share of foreign sales in jurisdictions with unobserved statutory rates); a measure of its geographic exposure to Check the Box; whether it operated in in Ireland, the Netherlands, or Luxembourg prior to adoption; whether it has negative domestic earnings; and its advertising to sales ratio (a proxy for intangibles used in, e.g., Grubert and Slemrod, 1998). Though some characteristics in Table D.1 are individually significant, as we show in Table 2, they do not remain significant in a combined specification.

To compute a firm-level measure of exposure to Check the Box, we first compute a country-level measure of exposure $\gamma_c = \pi_c^p / \pi_c$, where π_c^p are aggregate foreign earnings generated by pass-through foreign affiliates (FDEs) for country c, and π_c are aggregate foreign earnings for all foreign affiliates in country c for the years that we observe FDE earnings (2006, 2008, 2012, and 2016). This measure is meant to capture differences across countries in the prevalence of *per se* corporations, which cannot be disregarded via CTB. Next, for each MNC i we compute the share of foreign sales by country s_{ic} in the period prior to adoption. Finally, for each firm, we compute the exposure measure as a weighted average of the country-level exposure measures, $\gamma_i = \sum_{c \in C_i} \gamma_c s_{ic}$ for the set of countries C_i where MNC i has positive sales in the period prior to adoption, where the weights s_{ic} are the firm-level country shares calculated in the second step. For firms that never adopt, we compute this exposure measure in every year.

Table D.2 presents logit estimates that predict HTP adoption based on four determinations of firm size: domestic sales, foreign sales, domestic assets, and foreign assets. As we discuss in Panel C of Figure 4, these measures indicate that larger MNCs tend to adopt HTP structures at higher rates.

Finally, Table D.3 provides logit estimates from a set of MNCs that also appear in Compustat to examine whether the identity of firms' auditors plays a role in adoption of hybrid tax planning structures, suggesting that the identity of a firm's auditor does not predict HTP adoption.

Table D.1: Selection into Hybrid Tax Planning (Alternative Models)

	(1)	(2)
Panel A		
Claim Research Credit	0.568***	0.215
	(0.128)	(0.170)
Num.Obs.	8,809	5,030
Panel B		
Age Quartile 2	0.499**	0.446*
	(0.178)	(0.200)
Age Quartile 3	0.205	0.071
	(0.191)	(0.221)
Age Quartile 4	0.452*	0.128
	(0.185)	(0.222)
Num.Obs.	8,809	5,030
Panel C		
Avg. Statutory Foreign ETR	0.045	-1.653
	(1.047)	(1.148)
Share of Foreign Sales with Unobserved Statutory Rate	-0.212	-0.529
	(0.344)	(0.364)
Num.Obs.	7,832	4,528
Panel D		
Exposure to CTB	2.411***	1.930*
	(0.596)	(0.873)
Num.Obs.	8,280	4,796
Panel E		
Presence in Ireland	1.460***	1.356***
	(0.183)	(0.223)
Presence in Netherlands	0.708***	0.440**
	(0.139)	(0.168)
Presence in Luxembourg	0.023	-0.105
	(0.220)	(0.249)
Num.Obs.	8,809	5,030
Panel F		
Domestic Loss	-0.861***	-0.824***
	(0.172)	(0.200)
Num.Obs.	8,809	5,030
Panel G		
Advertising to Sales Ratio	-0.007	0.561
	(0.010)	(1.714)
Num.Obs.	8,608	4,920
Year FEs	Yes	-
Industry, Sales, Asset Quartiles x Year FEs	-	Yes

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table D.1 displays coefficients from a series of logit regressions, as discussed in Section 4, that predict HTP adoption based on various MNC characteristics (Panels A-G). The model uses observations from adopting MNCs in the period prior to adoption and includes all observations from never-adopters. Column (1) includes year fixed effects; Column (2) includes year-by-industry, sales, and asset quartile fixed effects. Standard errors are clustered at the MNC level. +, *, **, and *** denote statistical significance at the 10, 5, 1, and 0.1% level.

Table D.2: HTP Uptake by Size

	Dom. Sales	For. Sales	Dom. Assets	For. Assets
Quartile 2	0.350+	0.483*	0.193	0.442*
	(0.198)	(0.207)	(0.193)	(0.210)
Quartile 3	0.350+	0.504*	0.482**	0.803***
	(0.199)	(0.207)	(0.187)	(0.198)
Quartile 4	0.949***	1.147***	0.623***	1.018***
	(0.184)	(0.193)	(0.184)	(0.195)
Num. Obs.	8,809	8,809	8,809	8,809
R2 Pseudo	0.019	0.024	0.012	0.020
Year FEs	Yes	Yes	Yes	Yes

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table D.2 displays coefficients from logit regressions, as discussed in Section 4, that predict HTP adoption based on 4 determinations of firm size: domestic sales, foreign sales, domestic assets, and foreign assets. The model uses observations from adopting MNCs in the period prior to adoption and includes all observations from never-adopters. Standard errors are clustered at the MNC level. +, *, **, and *** denote statistical significance at the 10, 5, 1, and 0.1% level.

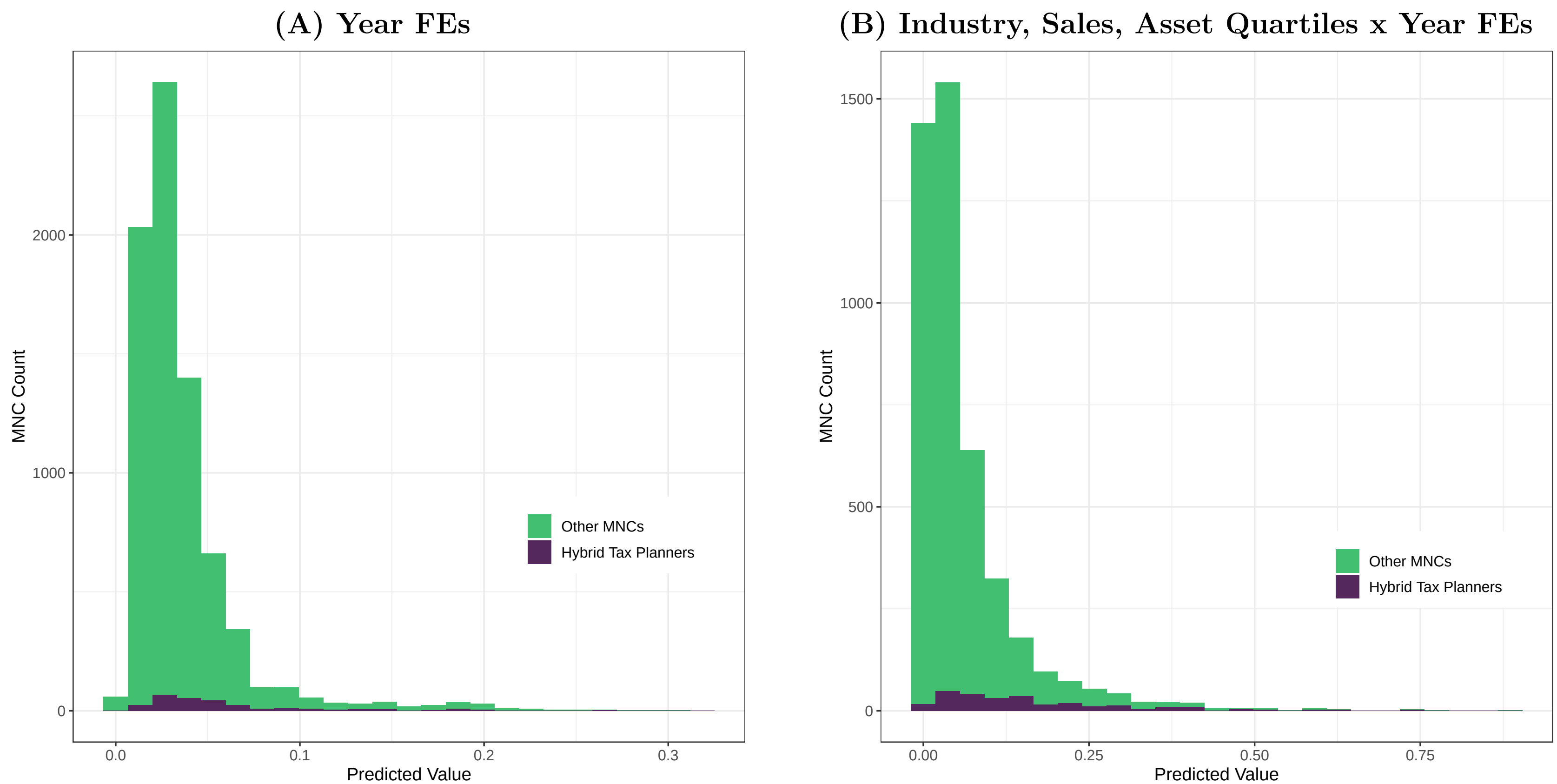
Table D.3: HTP Uptake by Auditor

	(1)	(2)	(3)	(4)
Big 4	0.805	0.378	0.342	0.044
	(1.019)	(1.082)	(0.293)	(0.348)
Medium	0.511	0.370		
	(1.054)	(1.119)		
Num.Obs.	4,610	2,491	4,610	2,491
Year FEs	Yes	-	Yes	-
Industry, Sales, Asset Quartiles x Year FEs	-	Yes	-	Yes

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table D.3 displays coefficients from logit regressions, as discussed in Section 4, that predict HTP adoption based on the identity of an MNC's auditors, determined using Compustat data. We divide the firms into three groups: MNCs with a Big 4 auditor (Ernst & Young, PWC, Deloitte, and KPMG), medium size auditors, and small auditors. Columns (1) and (2) include dummy variables for a "Big 4" auditor as well as a medium-sized auditor; Columns (3) and (4) include only the Big 4 dummy. Odd columns include year fixed effects and even columns include year-by-industry, sales, and asset quartile fixed effects. Standard errors are clustered at the MNC level. +, *, **, and *** denote statistical significance at the 10, 5, 1, and 0.1% level.

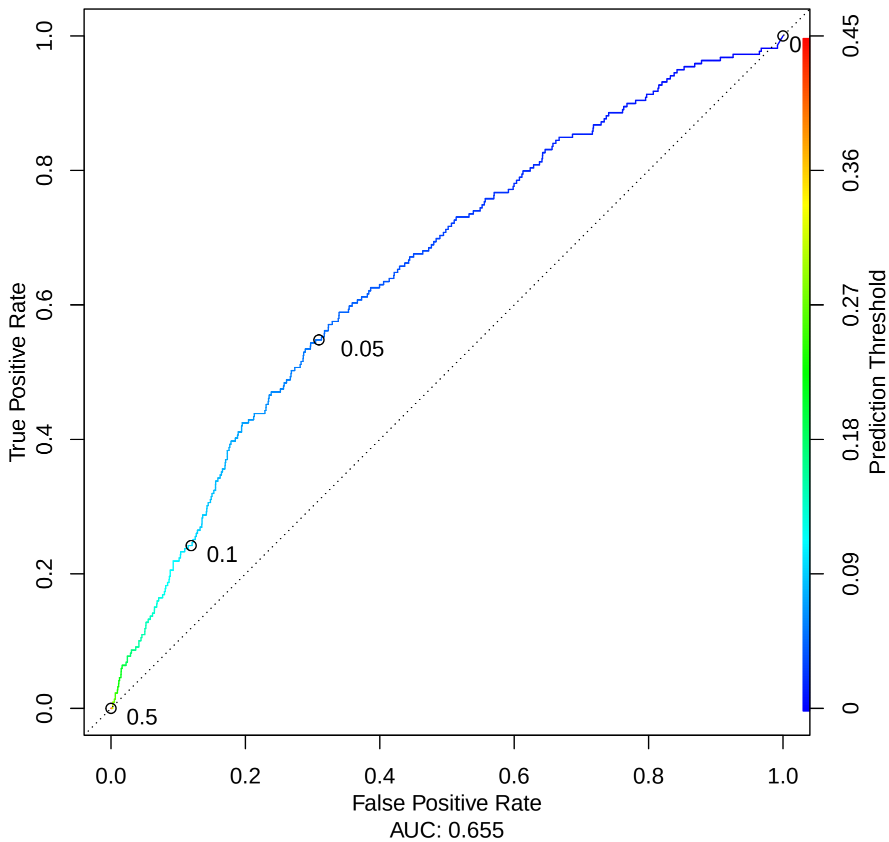
Figure D.1: Histograms of Predicted Adoption Scores (Logit Models)



Notes: Figure D.1 presents histograms of predicted HTP adoption scores, based on firms' realized adoption decisions, for two simple logit models shown in Table 2. Panel A corresponds to Column (1) of Table 2 and Panel B corresponds to Column (2). Both panels indicate that the logit models are poor predictors of actual HTP adoption.

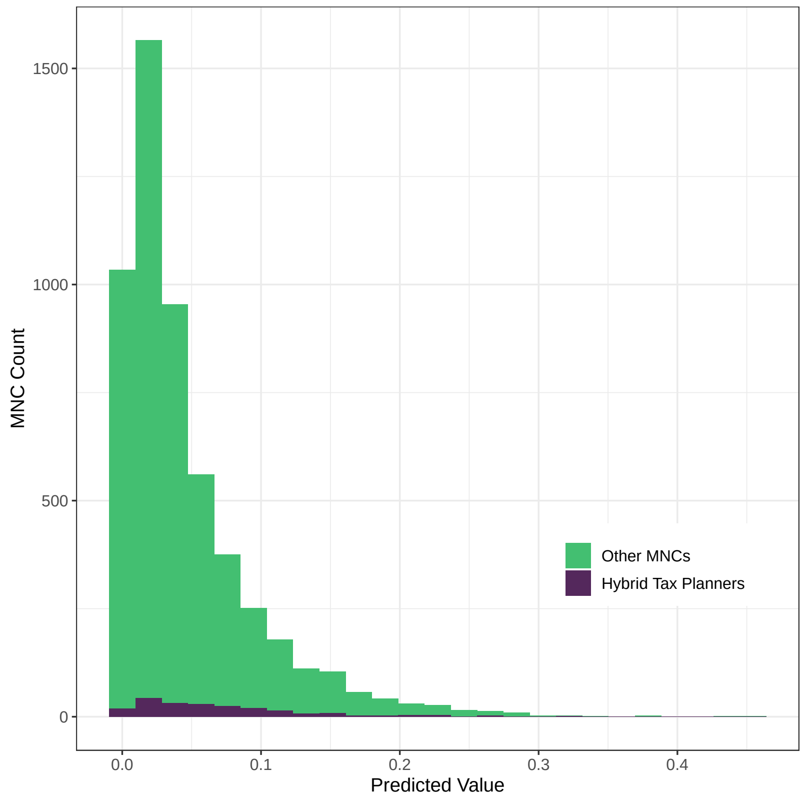
D.2 Random Forest Model

Figure D.2: ROC Curve for Random Forest Model



Notes: Figure D.2 displays the resulting receiver operating curve (ROC) for the random forest model. It yields an ROC area under the curve (AUC) score of 0.655, indicating a low prediction performance associated with these observables.

Figure D.3: Histogram of Predicted Adoption Scores (Random Forest Model)



Notes: Figure D.3 presents a histogram of predicted HTP adoption scores, based on firms' realized adoption decisions, for a random forest model. As in Figure D.1, the random forest histogram also indicates that the model is a poor predictor of actual HTP adoption.

D.3 Propensity Score Construction

We also utilize our random forest model to construct propensity scores that are used in alternative regression specifications in Section 5. Here, we discuss in greater detail how we implement inverse probability weighting (IPW) using these propensity scores.

A standard approach to inverse probability weighting in an unstaggered difference-in-differences setting estimates a single propensity score for each unit. These scores are canonically estimated using data in periods prior to HTP adoption. In staggered designs, however, control units may serve as comparisons for multiple treated cohorts, and there is not a well-defined pre period. The advantage of the stacked estimator is that it can be thought of as combining a set of unstaggered difference-in-differences datasets, one for each treated cohort.

As shown in Section 4, we find evidence for considerable variation in rates of HTP adoption by industry and by firm size, which motivates our usage of industry and firm-size fixed effects in our difference-in-differences estimates to control for time-varying heterogeneity along these dimensions. Section 4 also shows that several other observable characteristics predict MNC adoption of hybrid tax structures (see Table 2 and Table D.1). Propensity score weighting offers a convenient way to control for potential selection bias that may be introduced by a lack of balance along these observable dimensions between adopting and non-adopting MNCs.

We approach the computation of propensity scores with a similar logic to the design of the stacked estimator by computing a set of propensity scores for each treated cohort and never-treated observations that are used as cohort-level comparisons. We use the same predictor variables examined in Section 4 and Tables D.1 and 2. In contrast to the logit estimates shown in Section 4, we use a random forest model to compute propensity scores. In our context, random forest models outperform logit models from a predictive standpoint, and can flexibly account for non-linearities. They are also theoretically invariant to transformations such as the natural log, which would require dropping observations with non-positive values. This gives us a set of propensity scores for never-treated units that are used as comparison units for multiple cohorts. These scores increase comparability within cohorts across adopting and non-adopting MNCs for other observable characteristics. The score incorporates pre-adoption measures of R&D activity; firm age; average foreign statutory rates; exposure to geographies where it may have been easier to use Check the Box; prior activity in Ireland, the Netherlands, and Luxembourg; whether or not the MNC had negative domestic income; and the firm's advertising intensity relative to sales. Because the stacked estimator also explicitly duplicates never-treated units when they are used as comparisons for multiple cohorts, we can apply these sets of propensity scores directly in the stacked design in a similar way to an unstaggered propensity score weighted difference-in-differences model.

E Additional Model Derivations

We estimate a version of the model from Section 6 in which firms are able to deduct R&D expenditures from their foreign and domestic tax bills according to their sales shares. We start with a general formulation where firms deduct R&D according to a function $\tau_R(K_d, K_c)$.

$$\max_{K_d,K_c,D} \; (1-t_d)I_d(\phi_i K_d)^{1+\frac{1}{\varepsilon}} - rK_d + (1-t_c)I_c(\phi_i K_c)^{1+\frac{1}{\varepsilon}} - rK_c$$
$$- \tau_R(K_d, K_c) \cdot D - b_i \frac{D^2}{2}.$$

First-order conditions associated with investment are:

$$K_d : (1-t_d)\frac{\partial R_d}{\partial K_d} = r + D \cdot \frac{\partial \tau_R}{\partial K_d},$$
$$K_c : (1-t_c)\frac{\partial R_c}{\partial K_c} = r + D \cdot \frac{\partial \tau_R}{\partial K_c},$$

where optimal R&D is determined by

$$(1-t_d)\frac{\partial R_d}{\partial D} + (1-t_c)\frac{\partial R_c}{\partial D} = \left(\frac{\partial \tau_R}{\partial D} + b_i\right) D + \tau_R(K_d, K_c).$$

We now consider two special cases. First, that firms are able to fully deduct R&D expenses from their domestic tax bill, $\tau_R = (1-t_d)$. Second, that firms operate under cost sharing agreements whereby tax deductions for R&D expenses are apportioned to each country based on relative sales shares, $\tau_R = (1 - t_d S_d - t_f S_f)$, where S_d and S_f are domestic and foreign sales shares, respectively.

E.1 Domestic R&D Deduction

The MNC decides how much to invest in R&D, which impacts ϕ_i. The investment decision takes into account the fact that its intellectual property is non-rival within the firm and will increase profits in both locations. For an MNC i, let $\phi_i = \zeta_i \times D_i^{\gamma}$, where $\gamma < \frac{1}{-(1+\varepsilon)}$, ζ_i is the MNCs existing stock of IP, and D_i is R&D. Given the optimal foreign and domestic investment derived in Section 6, the MNC solves the R&D investment problem:

$$\max_{D_i} \quad \pi_0 \zeta_i^{-(1+\varepsilon)} D_i^{-\gamma(1+\varepsilon)} \left[(I_d(1-t_d))^{-\varepsilon} + (I_f(1-t_h))^{-\varepsilon} \right] - (1-t_d) D_i - \frac{b_i}{2} D_i^2,$$

where $\pi_0 = \frac{-r^{(1+\varepsilon)}}{\varepsilon^{-\varepsilon}(1+\varepsilon)^{(1+\varepsilon)}}$. The term b_i is a firm-level adjustment cost of R&D investment. This term captures the fact that some firms may have a greater potential to engage in R&D projects. Since tax planning is complementary with R&D, firms with a higher potential to engage in R&D—i.e., those with lower values of b_i—may be more likely to set up HTPs.

To understand how differences in productivity ζ_i and tax rates impact R&D investment, consider the simpler case where $b_i = 0$. In this case, the optimal choice of $R\&D$ is given by:

$$D_i^* = \left\{ -\frac{\gamma}{(1-t_d)} (1+\varepsilon) \pi_0 \zeta_i^{-(1+\varepsilon)} \left[(I_d(1-t_d))^{-\varepsilon} + (I_f(1-t_h))^{-\varepsilon} \right] \right\}^{\frac{1}{1+\gamma(1+\varepsilon)}}.$$

It follows from this expression that the optimal choice of R&D is increasing given firm productivity ζ_i or the relative reduction in foreign tax rates $\left(\frac{1-t_h}{1-t_d}\right)$. That is, MNCs conduct more R&D if they have a larger stock of IP and/or if setting up a hybrid tax structure will increase their returns from R&D investment abroad.[40] For this reason, MNCs with higher values of ζ_i have more to gain from establishing HTPs.

Let $\Pi(t_d, t_h, \zeta_i)$ denote the value function from conducting the optimal level of R&D using a hybrid tax planning structure. Similarly, let $\Pi(t_d, t_d, \zeta_i)$ denote the value of remaining in the worldwide tax system. For tax planners, this formulation gives the following:

$$\Pi(t_d, t_h, \zeta_i) \quad = \quad \pi_1 \left\{ \zeta_i^{-(1+\varepsilon)} \left[(I_d(1-t_d))^{-\varepsilon} + (I_f(1-t_h))^{-\varepsilon} \right] \right\}^{\frac{1}{1+\gamma(1+\varepsilon)}} - (1-t_d) D_i^*,$$

where $\pi_1 = \left[-\frac{\gamma}{(1-t_d)} (1+\varepsilon) \right]^{\frac{-\gamma(1+\varepsilon)}{1+\gamma(1+\varepsilon)}} \pi_0^{\frac{1}{1+\gamma(1+\varepsilon)}}$.

[40]Taking logs and differentiating shows that $\frac{\partial \ln D_i^*}{\partial \ln \zeta_i} = \frac{-(1+\varepsilon)}{1+\gamma(1+\varepsilon)} > 0$ and $\frac{\partial \ln D_i^*}{\partial \ln\left(\frac{1-t_h}{1-t_d}\right)} = \frac{-\varepsilon}{1+\gamma(1+\varepsilon)} > 0$. These elasticities are attenuated when $b_i > 0$.

E.2 R&D Deductibility with Apportionment Shares

With apportionment-based R&D expenditure deductions, MNCs solve the following joint optimization problem:

$$\max_{K_d,K_c,D} \; (1-t_d)I_d(\phi_i K_d)^{1+\frac{1}{\varepsilon}} - rK_d + (1-t_c)I_c(\phi_i K_c)^{1+\frac{1}{\varepsilon}} - rK_c$$
$$- D\left(1 - t_d S_d - t_f S_f\right) - b_i \frac{D^2}{2},$$

where $S_d = \frac{R_d}{R_d+R_c}$, $S_c = 1 - S_d$, and $R_c = I_c(\phi_i K_c)^{1+\frac{1}{\varepsilon}}$. We first consider the partial derivative of the sales shares with respect to $\{K_d, K_c\}$:

$$\frac{\partial S_d}{\partial K_d} = \frac{R_c}{(R_d+R_c)^2}\frac{\partial R_d}{\partial K_d},$$
$$\frac{\partial S_c}{\partial K_c} = \frac{R_d}{(R_d+R_c)^2}\frac{\partial R_c}{\partial K_c},$$

To derive partials with respect to D, we consider:

$$\frac{\partial R_d}{\partial D} = \gamma\left(1+\frac{1}{\varepsilon}\right) I_d(\zeta_i K_d)^{1+\frac{1}{\varepsilon}} D^{\gamma(1+\frac{1}{\varepsilon})-1},$$
$$\frac{\partial R_c}{\partial D} = \gamma\left(1+\frac{1}{\varepsilon}\right) I_c(\zeta_i K_c)^{1+\frac{1}{\varepsilon}} D^{\gamma(1+\frac{1}{\varepsilon})-1},$$

Defining $\pi_D = \gamma\left(1+\frac{1}{\varepsilon}\right)\zeta^{1+\frac{1}{\varepsilon}} D^{\gamma(1+\frac{1}{\varepsilon})-1}$, we have

$$\frac{\partial S_d}{\partial D} = \frac{\frac{\partial R_d}{\partial D}(R_d+R_c) - R_d\left(\frac{\partial R_d}{\partial D}+\frac{\partial R_c}{\partial D}\right)}{(R_d+R_c)^2},$$
$$= \frac{R_f}{(R_d+R_c)^2}\frac{\partial R_d}{\partial D} - \frac{R_d}{(R_d+R_c)^2}\frac{\partial R_c}{\partial D},$$
$$= \pi_D\left[\frac{R_f}{(R_d+R_c)^2} I_d K_d^{1+\frac{1}{\varepsilon}} - \frac{R_d}{(R_d+R_c)^2} I_c K_c^{1+\frac{1}{\varepsilon}}\right].$$
$$\frac{\partial S_c}{\partial D} = \pi_D\left[\frac{R_d}{(R_d+R_c)^2} I_c K_c^{1+\frac{1}{\varepsilon}} - \frac{R_c}{(R_d+R_c)^2} I_d K_d^{1+\frac{1}{\varepsilon}}\right].$$

With these objects in hand, we now turn to our optimality conditions. The first-order condition for capital investment in the home country is given by:

$$\begin{aligned}(1-t_d)\frac{\partial R_d}{\partial K_d} - D\left[(t_c - t_d)\frac{\partial S_d}{\partial K_d}\right] &= r,\\ \left[(1-t_d) - D(t_c - t_d)\frac{R_c}{(R_d+R_c)^2}\right]\frac{\partial R_d}{\partial K_d} &= r,\\ \left[(1-t_d) - D(t_c - t_d)\frac{R_c}{(R_d+R_c)^2}\right] I_d\left(1+\frac{1}{\varepsilon}\right)\phi_i^{1+\frac{1}{\varepsilon}} K_d^{\frac{1}{\varepsilon}} &= r,\end{aligned}$$

Equivalently, the first-order condition for foreign investment is:

$$\left[(1-t_c) - D(t_d - t_c)\frac{R_d}{(R_d+R_c)^2}\right] I_c\left(1+\frac{1}{\varepsilon}\right)\phi_i^{1+\frac{1}{\varepsilon}} K_c^{\frac{1}{\varepsilon}} = r.$$

For computational implementation, it is convenient to recast these expressions as root-finding conditions:

$$0 = \phi_i^{-(1+\varepsilon)}\left(\frac{I_d}{r}\left(\frac{1+\varepsilon}{\varepsilon}\right)\left[(1-t_d) + (t_d - t_c)\frac{D}{R_d+R_c}\cdot\frac{R_c}{R_d+R_c}\right]\right)^{-\varepsilon} - K_d, \tag{E.1}$$

$$0 = \phi_i^{-(1+\varepsilon)}\left(\frac{I_c}{r}\left(\frac{1+\varepsilon}{\varepsilon}\right)\left[(1-t_c) + (t_c - t_d)\frac{D}{R_d+R_c}\cdot\frac{R_d}{R_d+R_c}\right]\right)^{-\varepsilon} - K_c. \tag{E.2}$$

The first-order condition for R&D expenditures D is then:

$$\begin{aligned}b_i D = (1-t_d)\frac{\partial R_d}{\partial D} + (1-t_f)\frac{\partial R_f}{\partial D}\\ - (1-t_d)S_d - D(1-t_d)\frac{\partial S_d}{\partial D}\\ - (1-t_f)S_c - D(1-t_f)\frac{\partial S_c f}{\partial D}.\end{aligned}$$

Rearranging yields the root-finding problem:

$$\begin{aligned}0 = \frac{1}{b_i}\Bigg[&\pi_D\left((1-t_d)I_d K_d^{1+\frac{1}{\varepsilon}} + (1-t_c)I_c K_c^{1+\frac{1}{\varepsilon}}\right)\\ &- D\left((1-t_d)\frac{\partial S_d}{\partial D} + (1-t_c)\frac{\partial S_c}{\partial D}\right)\Bigg] - (1 - t_d S_d - t_c S_c) - D.\end{aligned} \tag{E.3}$$

Estimating the full model requires finding the solution set $\{K_d^*, K_c^*, D^*\}$ that satisfies equations E.1, E.2, and E.3 for a given set of parameters. We use Broyden's Method to find this solution for each simulated firm under both t_f and t_h within our estimation routine.

Given profits $\Pi_h(K_d^*, K_h^*, D^*)$ and $\Pi_f(K_d^*, K_f^*, D^*)$ associated with tax planning and not planning, respectively, and planning costs c_i, each firm then adopts a hybrid planning structure if

$$\Pi_h(K_d^*, K_h^*, D^*) - c_i > \Pi_f(K_d^*, K_f^*, D^*).$$