At A Cost: the Real Effects of Transfer Pricing Regulations

Ruud De Mooij Li Liu*

29th December 2017

Abstract

Unilateral implementation of anti-profit shifting rules may have negative impact on real investment and domestic revenue if multinational firms (MNCs) respond by reducing their presence in the local economy. This paper uses unique panel data on domestic and multinational companies in 27 countries during 2006-2014 to find that MNC affiliates reduce their investment by over 11 percent following the introduction of transfer pricing regulations. There is no significant reduction in total investment by the MNC group, suggesting that these investments are most likely shifted to affiliates in other countries. The impact of transfer pricing regulations corresponds to an increase in the "TPR-adjusted" corporate tax rate by almost one quarter.

Keywords: profit shifting, foreign direct investment, corporate tax policy, multinational firms
JEL Classification: H25, H87, F23

*De Mooij: International Monetary Fund (rdeMooij@imf.org). Liu: International Monetary Fund and Oxford University Centre for Business Taxation (lliu@imf.org). The views expressed are the authors' and do not necessarily represent the views of the IMF, its Executive Board, or IMF management. We thank Adrian Peralta Alva, Michael Devereux, Dhammika Dharmapala, Mihir Desai, Harry Grubert†, Shafik Hebous, Jim Hines, Niels Johannesen, Michael Keen, Laura Jaramillo Mayor, Tim Schmidt-Eisenlohr, Juan Carlos Serrato, Nicholas Sly, and conference and seminar participants at the IMF, Oxford University Centre for Business Taxation 2017 Symposium, National Tax Association 2017 Conference and AEA 2018 Annual Meeting for helpful comments. We are grateful to Devan Mescall for providing the dataset on transfer pricing regulations and to John Russell Damstra for providing excellent research assistance. Any remaining errors are our own.

1 Introduction

Tax-motivated profit shifting within multinational corporations (MNCs) has been on top of the international tax policy agenda since the global financial crisis – most notably due to the G20/OECD initiative on base erosion and profit shifting (OECD 2015). Profit shifting means that MNCs shift income from affiliates in high-tax jurisdictions to those in low-tax jurisdictions to reduce their overall tax liability. There is ample empirical evidence demonstrating that extensive profit shifting is taking place. For example, it is found that German affiliates of MNCs have paid on average 27 percent less in taxes than comparable domestic German firms (Finke, 2013). In the UK, taxable profits as a share of total assets reported by subsidiaries of foreign MNCs are on average 12.8 percentage points lower than those of comparable domestic standalone companies (Habu, 2017).[1]

A common way for MNCs to shift profits is through the manipulation of transfer prices, that is, the prices charged for transactions between related parties. These transfer prices are necessary to determine the allocation of profits between affiliates of a MNC group. Tax laws generally prescribe that these prices should be arm's length, reflecting market prices that unrelated parties would have used for similar transactions. However, due to information asymmetries vis-à-vis the tax administration, MNCs can often charge artificially low or high prices for sales between related parties in high-tax and low-tax jurisdictions, thereby shifting profits and reducing their overall tax liabilities.

Many governments limit the extent of transfer mispricing by implementing transfer pricing regulations (TPRs). These generally describe the methods allowed to determine arm's-length prices, prescribe documentation requirements, set penalties in case of non-compliance, and determine the probability of a transfer price adjustment. TPRs can raise the effective tax burden on MNCs, thus protecting domestic revenue and leveling the playing field vis-a-vis domestic companies (OECD, 2013; Fuest et al., 2013).[2]

[1] Dharmapala (2014) and Hines (2014) provide comprehensive discussions on the extent of profit shifting by multinationals. Heckemeyer and Overesch (2013) provide a quantitative review of 25 empirical studies on profit-shifting behavior of multinationals. A more recent survey article by Beer et al. (2018) finds a consensus semi-elasticity of reported profitability by MNCs with respect to the international tax differentials of around 1.2. Regarding the scale of revenue loss from international tax avoidance, recent estimates suggest an annual loss in government revenue by between $100 and 650 billion globally, with disproportionately larger losses found for developing countries (UNCTAD, 2015; OECD, 2015; Crivelli et al., 2016).

[2] From the perspective of the MNC, TPR may also increase tax uncertainty (Mescall and Klassen 2014;

However, TPR may have unintended consequences by affecting MNC investment. In particular, if MNC investment would decline in response to the introduction or strengthening of TPR, this could offset its benefits, especially if multinational investments yield positive productivity spillovers to local firms (Andrews et al., 2015). The exact relationship between TPR and investment has received little attention in the literature, both in theory and in empirical research. Indeed, there is currently no direct empirical evidence regarding the investment effect of TPR.[3]

To fill this gap in the literature, this paper studies the effect of TPR on investment in fixed assets by affiliates of MNCs in their host country. Our analysis employs a micro-level dataset that provides rich information on MNC and domestic affiliates (and their parent companies). The main dataset comprises 27 countries and is merged with detailed information on the characteristics of TPRs, including their introduction date, among these countries during 2006-2014. Our main analysis employs a standard DD approach and includes a full set of country-year fixed effects, industry-year fixed effects, and country-industry fixed effects to control for potential confounding effects of the legislation. The identifying variation comes from the differential change in investment by a MNC affiliate relative to investment by a purely domestic affiliate in response to the introduction of TPR in the local economy. In addition, we use a panel regression, similar to the estimation approach used in Overesch (2009), Lohse and Riedel (2013) and Buettner and Wamser (2013), to estimate the extent of changes in the tax sensitivity of multinational investment due to TPRs. This in turn allows us to back out the percentage reduction in the so-called "TPR-adjusted" corporate tax rate and cost of capital following the introduction of TPRs.

To guide the empirical analysis, we develop a simple model describing the impact of TPR on the scale of multinational investment. The key channel in the model is that TPR makes it costlier for the MNC to manipulate transfer prices and, thereby, to shift profits into the low-tax country. This reduces the optimal supply of intermediate inputs and, thereby, reduces

IMF and OECD 2016). This is discussed in Section 2.

[3]Recent studies have assessed the impact of TPR on reported profitability by MNC affiliates and provide mixed evidence: some find that they lead to an increase in the MNCs' reported operating profits, while others find no significant effect (Lohse and Riedel, 2013; Saunders-Scott, 2013). Some studies have also looked at the effect of thin capitalization rules (TCRs) – another form of anti-avoidance policy – on investment (Buettner and Wamser, 2013).

the return on investment in the foreign affiliate. Indeed, the cost of capital rises and fewer investments in the affiliate are undertaken. The model suggests that the negative effect of TPR on investment depends on the absolute difference in statutory corporate income tax rates between the home country of the MNC and the host country of the affiliate.

The results from the DD regressions point to strong evidence for a negative impact of TPR on MNC investment: investment in foreign affiliates is around 11 percent lower following the introduction of TPR, compared to investment in similar firms that are wholly domestic. The dampening effect of the TPR on investment is decreasing in the share of intangible assets of firms. The results from the first-difference panel regression suggest that the effect of TPRs corresponds to an increase in the "TPR-adjusted" corporate tax rate of 23 percent and an increase in the "TPR-adjusted" cost of capital by 15 percent. We also find that lower investment in the affiliate does not lead to a similar reduction in total investment by the MNC group. We interpret this as evidence of relocation: the multinational diverts its investment away from the country that introduces the TPR toward other countries. Unilateral implementation of TPR therefore causes investment spillover effects on other countries.

This paper contributes to a growing literature that exploits cross-sectional variation to study the effects of anti-avoidance legislations on key aspects of firm behavior, including reported profits (Saunders-Scott, 2013, 2015; Beer and Loeprick, 2015; Marques and Pinho, 2016; Nicolay et al., 2016), transfer prices (Clausing, 2003; Bernard et al., 2006; Davies et al., 2018; Vicard, 2015; Cristea and Nguyen, 2016; Flaaen, 2016; Liu et al., 2017), and capital structure (Buettner et al., 2012; Buettner and Wamser, 2013; Blouin et al., 2014; Merlo and Wamser, 2015; De Mooij and Hebous, 2017). Our analysis complements these studies by looking at the impact of anti-avoidance legislation on MNC investment, which to date has been explored only in the context of thin capitalization rules (Buettner et al., 2014). Our paper also directly relates to studies of profit-shifting opportunities on MNC investment (Hines and Rice, 1994; Grubert and Slemrod, 1998; Desai et al., 2006; Overesch, 2009), and the larger literature on taxation and business investment (Cummins et al., 1994; Caballero et al., 1995; House and Shapiro, 2008; Bond and Xing, 2015; Yagan, 2015; Zwick and Mahon, 2017), by offering a new perspective on the effect of anti-avoidance legislations

on MNC investment.

The results in the paper are important for the current policy debate on base erosion and profit shifting and anti-avoidance legislation. For instance, the negative investment effects from TPR can make some governments reluctant to introduce them unilaterally or may encourage them to make these regulations less stringent. As these reflect spillover effects to other countries, binding international coordination can be beneficial to avoid policies becoming inefficiently lenient from a global perspective.[4]

The rest of the paper is structured as follows. Section 2 provides an overview of TPR across countries. Section 3 develops a simple model to illustrate how TPR can affect MNC investment into an affiliate. Section 4 describes the data and sample selection used for the empirical analysis. Section 5 explains the research designs and Section 6 reports the main results. Section 7 elaborates on the results for total investment by the MNC group, based on consolidated accounts. Finally, Section 8 concludes.

2 Institutional Background

The current system of international taxation is largely based on separate accounting, i.e. the unconsolidated account of a multinational affiliate that terminates at the border. To determine the income in each affiliate of a group, the multinational must use transfer prices for transactions between related parties. In principle, the setting of transfer prices should follow the arm's-length principle, meaning that prices of goods and services sold between related parties should mimic the prices that would be used in transactions between unrelated parties.[5] However, given the nature of related-party transactions, there can exist a wide range of arm's-length prices for the same transaction, especially when a comparable transaction does not exist for unrelated parties. Also, it can be very costly for tax authorities to verify whether a transfer price used by a MNC is indeed arm's-length. Consequently, MNCs have

[4]Restricting the opportunities for countries to set their own anti-avoidance regulations can, however, reinforce tax competition among countries in the use of corporate tax rates (Keen, 2001; Janeba and Smart, 2003; Bucovetsky and Haufler, 2007).

[5]The arm's length principle is established in Article 9 of the OECD and the UN Model Tax Conventions, and is the framework for the extensive network of bilateral income tax treaties between countries. The OECD and UN also have developed Transfer Pricing Guidelines, to support countries' implementation of the principle.

some discretion to under-price exports sold from an affiliate a high tax country to an affiliate in a low tax country (or over-price imports), thereby shifting profits and reducing their global tax burden.

There is ample empirical evidence for the presence of tax-motivated transfer mispricing. Most of these studies estimate how the price wedge between the arm's-length price observed for unrelated transactions and the transfer price used for related party transactions varies with the statutory CIT rates in the destination country relative to the home country. Studies for the US, UK and France typically find evidence for significant responses of the price wedge to the tax rate differential, as supportive evidence for tax-motivated transfer mispricing by MNCs (Clausing, 2003; Bernard et al., 2006; Davies et al., 2018; Vicard, 2015; Cristea and Nguyen, 2016; Flaaen, 2016; Liu et al., 2017).

To limit transfer mispricing, several countries have implemented TPRs. These offer guidance in the implementation of the arm's length principle and often include various specific requirements. For instance, they limit the methods that can be used for establishing an arm's length price; specify requirements for the documentation needed to support the transfer prices used by a MNC; and set transfer-pricing specific penalties if mispricing is detected or adequate documentation not provided. The scope and design of these regulations vary between countries and across time. Stricter regulations could increase the cost of transfer mispricing and, indeed, are found to be effective in curbing the extent of profit shifting in advanced economies. For example, Lohse and Riedel (2013) show that the introduction and tightening of transfer pricing rules raises (lowers) reported operating profits of high-tax (low-tax) affiliates and reduces the sensitivity of affiliates' pre- tax profits to corporate tax rates.

Our empirical analysis focuses on the impact of TPRs on investment. It uses two policy variables to capture TPRs. First, we use a discrete variable TPR_{kt} to reflect the introduction of transfer pricing regulation. This dummy variable takes the value of 1 in the years after country k introduced some TPR in year t to capture the effect of TPR implementation, and is zero otherwise. This information is derived from Deloitte's annual *Transfer Pricing Strategic Matrix* and is summarized in Mescall and Klassen (2014). Panel A in Figure 1 provides an overview of the number of countries with TPR in each year between 1928 and 2015: Sweden

was the first country that introduced some form of TPR in 1928. A more modern version of TPR was first implemented in the early 1980s in Australia. Since then it has been gradually adopted in other countries across the world. Today, almost 70 countries have TPRs in place. Since 1995, many OECD countries base their TPR on the OECD Transfer Pricing Guidelines. Our analysis concentrates on the countries that have introduced TPR between 2006 and 2015, among which six are European countries.

TPRs can vary in several dimensions. This can determine their overall strictness and, therefore, their implications for the behavior of MNCs. To capture the strictness of TPR, we use a second variable, namely an index of TPR strictness developed by Mescall and Klassen (2014). The index is based on 15 detailed features in the regulation and its enforcement (see also Saunders-Scott (2013)).[6] Mescall and Klassen (2014) use these features to explain the variation in the perception of 76 transfer pricing experts regarding the transfer pricing risk in 27 different countries, as revealed in a survey conducted in 2010.[7] From the regression equation, one can simulate the systematic impact of each TPR feature on the perceived transfer pricing risk, including for countries not captured in the Mescall and Klassen study and for years before and after 2010. Thus, a panel can be constructed of a transfer-pricing risk variable, labeled *tprisk*. This variable measures the overall strictness of the transfer pricing rule and ranges between 1.26 and 5.17 in our sample countries, with the higher value reflecting more stringent TPR. Alternatively, the *tprisk* variable can be interpreted as a

[6]These detailed TPR features include 12 regulatory variables on: (1) whether the government allows advance pricing agreement, (2) whether benchmark data are available to taxpayer, (3)whether the government requires contemporaneous documentation, (4) whether cost-contribution arrangement is allowed, (5) whether commissionaire arrangement is allowed, (6) whether foreign comparables are allowed to estimate transfer prices, (7) whether related party setoffs (bundling of transactions) are allowed, (8) whether the taxpayer is required to pay the tax assessment before going to competent authority, (9) whether the government identifies an order of transfer pricing methods to use, (10) whether the government requires disclosure on the tax return concerning related party transactions, (11) whether the government allows a self-initiated adjustment, (12) whether transfer pricing documentation is required. It also contains 3 enforcement variables on: (13) whether the government has discretion over penalty reduction, (14) whether the government uses proprietary tax data to calculate a "revised" transfer price, and (15) the assessed degree of transfer pricing enforcement as a percentage based on transfer pricing experts' 1 to 5 assessment of enforcement strictness, where a score of 1.0 (5 out of 5) is most strict and 0.2 (1 out of 5) is least strict.

[7]Specifically, the perceived transfer pricing risk depends on these TPR features in the following way: $tprisk = 1.27^{***} + 0.262^{**}SecretComparables - 0.437^{***}APA + 0.614^{***}NoForeignComps + 0.102NoSetoffs + 0.319^{**}NoCCA + 0.062PayTaxFirst - 0.326^{***}BenchmarkData + 0.008SelfInitiatedAdj + 0.321^{**}NoCommissionaire + 0.075RelatedParty + 0.39^{***}ContemporaryDoc + 0.035TPDoc + 0.296Priority + 0.533^{***}PenaltyUncertainty + 2.46^{***}TPEnforceSvy + 0.011^{***}AgeofRules$, where ***,**,* denote significance level at the 1%, 5%, and 10%, respectively.

measure of tax uncertainty, induced by TPR—an interpretation that more closely resembles that of Mescall and Klassen. Hence, this variable can also shed light on the impact of increased tax uncertainty on MNC investment. Panel B of Figure 1 shows the variation in *tprisk* both across countries and over time in our dataset, reflected by the median, the 25th and 75th percentiles, and the minimum and maximum value. We see that the dispersion across countries has become smaller in recent years, while the median has remained at a similar level.

3 Theory

This section develops a simple model to illustrate the impact of TPR on multinational investment in a foreign subsidiary. Assume that a multinational parent resides in home country h. It decides on how much capital (k) to invest in its foreign subsidiary in country s. For simplicity, it is assumed that the investment is financed by equity at a cost r, which is exogenously determined on the world capital market. Next to capital, the parent also supplies the subsidiary with intermediate inputs (x) used in production –which can also be thought of as firm-specific knowledge. The subsidiary generates output through production technology $f(k, x)$, which features decreasing returns in each of the two inputs, capital and intermediates (i.e. $f_k, f_x > 0, f_{kk}, f_{xx} < 0$). Marginal factor productivity of each factor rises in the other input ($f_{kx} > 0$).

The parent can buy the intermediate input at the local market at price p (or, alternatively, produce it and then sell at a fixed price p). However, when it supplies x to its subsidiary, the parent can charge a transfer price (p^T) that deviates from the arm's-length market price. This can be desirable for the firm to shift profit between the parent and the subsidiary. Indeed, if the tax rate charged by the country where the subsidiary is located (τ^s) is lower than the tax rate charged by the country of the parent (τ^h) and the repatriation of income is exempt in the parent country, it will be attractive to shift income from the parent to subsidiary. In deviating the transfer price from the market price, however, the parent faces an expected cost (c), e.g. due to a penalty when caught or because of costs associated with a transfer pricing dispute. The expected costs per unit of intermediate input traded are

assumed to rise quadratically in the price deviation, i.e. $c = \beta(p^T - p)^2$. The parameter β can be influenced by the government through anti-avoidance rules, such as TPR, e.g. by determining the probability of an adjustment in the transfer price or the penalty in case of detected mispricing. Hence, stricter the TPR rules are reflected in a higher β.

Based on these assumptions, the subsidiary earns the following income:

$$(1 - \tau^s)[f(k, x) - p^T x], \tag{1}$$

which is taxed in the host country of the subsidiary. The income is assumed to be exempt in the parent country when distributed. The earnings of the parent company are as follows:

$$(1 - \tau^h)(p^T - p)x + (1 - \tau^s)[f(k, x) - p^T x] - rk - \beta[p^T - p]^2 x, \tag{2}$$

i.e. it earns direct income from the sale of the intermediate input, which is taxable at rate τ^h, receives the profit from the subsidiary, which is taxable at rate τ^s, and incurs the cost of financing k and the expected cost of deviating the transfer price from its arm's-length price.

The parent maximizes its profits with respect to three choice variables: k, x and p^T. The first-order conditions of this maximization problem read as follows:

$$(1 - \tau^s) f_k = r, \tag{3}$$

$$f_x = p + \frac{(\tau^h - \tau^s)(p^T - p) + \beta(p^T - p)^2}{(1 - \tau^s)}, \tag{4}$$

$$p^T = p - \frac{(\tau^h - \tau^s)}{2\beta}, \tag{5}$$

Eq.(3) show the usual optimality condition for investment, indicating that a higher tax rate in the host country of the subsidiary will increase the cost of capital and, therefore, require a higher marginal product for investment to be undertaken. Under decreasing returns, this will reduce investment. Eq. (4) shows that the parent will supply intermediate inputs to the subsidiary up to the point where its marginal product equals the marginal cost. If the tax rates in the parent and subsidiary countries are the same, or if the parent charges the arm's-length market price for the intermediate inputs, then Eq. (4) shows that the marginal cost exactly equals p. Otherwise, the marginal costs of using intermediate inputs in the

subsidiary may differ from p, depending on the tax differential and the cost of shifting. Eq. (5) determines the optimal transfer price. If the tax rate in the subsidiary country is lower than the tax rate in the parent country, Eq. (5) shows that the optimal transfer price used by the parent will be lower than the arm's-length price. This is because the lower transfer price will increase the income earned by the subsidiary and decrease direct income earned by the parent. This reduces the overall tax liability of the multinational. The extent to which the transfer price is reduced depends on the parameter β, i.e. the cost parameter that can be influenced by TPR.

Combining Eq. (4) and (5), we can obtain an expression of the optimal supply of intermediate inputs:

$$f_x = p - \frac{(\tau^h - \tau^s)^2}{4\beta(1-\tau^s)}, \tag{6}$$

Hence, Eq. 6 suggests that any tax rate differential between the parent and the subsidiary will lead to a lower required marginal return to x, i.e. $\partial f_x/\partial(\tau^h - \tau^s) < 0$. Only if the tax difference is zero will f_x be independent of tax parameters. Due to decreasing returns, this implies a higher supply of intermediate inputs i.e. $\partial x/\partial(\tau^h - \tau^s) > 0$; and since $f_{kx} > 0$, it will also imply a higher marginal product of capital and, therefore, an increase in investment.

As long as tax rates differ ($\tau^h \neq \tau^s$), Eq. (6) also shows that TPR will influence the supply of intermediate inputs. This is reflected by the impact of a change in β, i.e. $\partial f_x/\partial\beta = (\tau^h - \tau^s)^2/(4(1-\tau^s)\beta^2) > 0$ so that $\partial x/\partial\beta < 0$, i.e. stricter TPR will reduce the supply of intermediate inputs to the subsidiary. Since $f_{kx} > 0$, this implies that stricture TPR also reduces the marginal product of capital f_k and, therefore, investment $\partial k/\partial\beta < 0$. This effect will only occur if the subsidiary is located in a different country than the parent and the tax rates in these countries differs. Indeed, the size of the effect rises in the tax differential between the two countries. If the parent and the subsidiary reside in the same country (or if tax rates between countries are the same), however, Eq. (6) shows that an increase in β will have no implications for the optimal supply of x and, therefore, for optimal investment k. We use this difference in our empirical strategy to identify the effect of TPR on multinational investments, using wholly domestic firms as a control group. This constitutes our main hypothesis in this paper: *stricter TPR will reduce investment by mul-*

tinational parents in their foreign subsidiaries, but not by purely single national parents in their domestic subsidiaries.

4 Data

The primary dataset for the empirical analysis is an unbalanced panel of 101,079 unique companies in 27 countries for the years 2006 to 2014. It is constructed using unconsolidated financial statements of affiliates that are part of a multinational or purely national company group in the ORBIS database provided by Bureau van Dijk. A company is defined as a MNC affiliate if its ultimate parent company is in a different country and owns at least 50% of its shares. A company is defined as a domestic affiliate if (1) its ultimate parent company (owning at least 50% of its shares) is in the same country and (2) all other affiliates of the company group are in the same country of the parent company. The comparison is thus between MNC affiliates and affiliates of purely domestic company groups, excluding all independent, stand-alone companies that may be less comparable to MNCs. Figure 2 shows the distribution of multinational and domestic affiliates across industry sectors in the main dataset.

The main sample for regression analysis includes all non-financial, non-utility multinational affiliates with non-missing (and non-zero) sales, total assets and fixed asset values. We discard any companies with missing industry information, with less than three consecutive observations, and in countries with less than 1,000 observations. We further eliminate MNC affiliates that locate in the same country as their parent company. Table 1 shows the country distribution of affiliates in the main regression sample, distinguished by MNC affiliates and domestic affiliates.

Firm-level Data The main variables for the analysis are investment in fixed capital assets, sales, cash flow, and earnings before interest and tax (EBIT). We compute **investment spending** (I_t) as the change in fixed tangible assets plus depreciation, i.e. $I_t = K_t - K_{t-1} + depreciation$, where **capital stock** (K_t) is the reported book value of fixed tangible asset in year t. **Investment rate** (I_t/K_{t-1}), is defined as the ratio between current-year gross

investment spending and beginning-of-year capital stock. In some regressions we conduct separate analyses for intensive and extensive margin responses. The intensive margin variable is the logarithm of investment spending. The extensive margin variable is an indicator for positive investment. **Sales** equal operating revenue. **Sales growth rate** equals the ratio between current-year and previous-year operating revenue minus 1. **Cash flow rate** is current-year cash flow divided by lagged capital stock. **Profit margin** is calculated as EBIT divided by sales. All ratio variables are winsorized at top and bottom 1 percentile to minimize influence of outliers.

Country-level Variables As discussed in Section 2, our main variables of interest are the discrete binary indicator on the existence of some transfer pricing regulation (TPR), and the measure of the overall transfer-pricing strictness (*tprisk*). These two policy variables are constructed based on information provided in Mescall and Klassen (2014), which are available between the years 2006 and 2013. We expand their coverage for one more year to 2014 by using country-specific detailed TPR characteristics in Deloitte's *Transfer Pricing Strategic Matrix, 2014*. Data on country-level macroeconomic characteristics, including GDP per capita, the growth rate of GDP per capita, population, and unemployment rate, that capture the aggregate market size and demand characteristics in the host country are from the IMF's World Economic Outlook database. The user cost of capital is computed as $r_{real} + \frac{1-A}{1-CIT}$, where r_{real} is the real interest rate and the second term reflects varying tax rules and corporate income tax (CIT) rates in different countries and over time. Data on the statutory CIT rates and the net present value of depreciation allowances (A) are provided by the Oxford University Centre for Business Taxation.[8] The tax differential, which proxies for the net tax savings from transfer mispricing, is the absolute difference between the host country and parent country statutory CIT rate. Table 2 presents the summary statistics of the key variables that are used in the regression analysis.

Alternative regression sample In addition to the main regression sample that includes both multinational and domestic affiliates, we use alternative data in some of the analysis.

[8]The calculation assumes a common real interest rate of 7.5 percent for all countries throughout the sample period.

First, the analysis on the tax sensitivity of FDI in Section 6.4 uses a smaller dataset that excludes domestic affiliates from the sample to focus on the tax sensitivity of multinational investment. Second, the analysis on the potential spillover effect of TPRs in Section 7 uses a sample of consolidated accounts in ORBIS. It includes companies that are parent of multinational or domestic company group to eliminate double counting, as regional headquarters are also required to file consolidated accounts. The sample for this analysis includes 17,638 observations corresponding to about 2,024 distinct non-financial, non-utility parent companies in more than 60 countries in the period from 2006 to 2015. Investment in the consolidated accounts reflect total investment of the company group. Finally, Section 6.2 uses a matched sample of multinational and domestic affiliates based on their average turnover, turnover growth rate, number of workers, and total assets during the sample period.

5 Empirical Specifications

This section describes two empirical strategies we use to identify the effect of TPRs on multinational investment: a difference-in-difference (DD) approach and a more traditional panel regression. Both approaches exploit the plausibly exogenous time-series variation in the effective cost of capital following the introduction of transfer pricing regulations in countries. The DD approach estimates the differential changes in investment by MNCs compared to that by domestic affiliates. The panel regression estimates the difference in the tax sensitivity of multinational investment before and after the introduction of TPRs.

5.1 Difference-in-Difference Specification

Our main empirical strategy is the standard DD approach. Intuitively, if the adoption of TPR raises the effective cost of capital only for multinationals, we would expect a subsequent reduction in their investment relative to the investment by otherwise similar affiliates that are part of purely domestic company groups. Formally, we test the investment response using the following specification:

$$Investment_{ikt} = a_i + d_t + \beta_{TPR} MNC_i \times TPR_{kt} + \beta_{\mathbf{x}} \mathbf{x}_{ikt} + \beta_{\mathbf{z}} \mathbf{z}_{kt} + \varepsilon_{ikt}, \qquad (7)$$

where i indexes firms, k indexes the host country, and t indexes time. We control explicitly in this specification for changes in investment due to other non-tax factors by using a control group of affiliates from purely domestic companies in the same host country. The latter are exposed to the same aggregate shocks as those experienced by the multinationals. The dependent variable $Investment_{ikt}$ denotes current-year investment spending I_t divided by lagged capital stock K_{t-1}. The key variable of interest is the interaction term between two dummy variables: an indicator that takes the value of 1 if firm i is part of a multinational group and zero otherwise (MNC_i); and an indicator that takes the value of 1 for all the years following the introduction of TPR in country k, and zero otherwise (TPR_{kt}). The coefficient β_{TPR} represents the DD estimate of the effect of TPR on investment by MNC affiliates, and is expected to be negative following our theoretical prediction of Section 3. Note that this approach assumes away any general equilibrium effects which would affect only investment by domestic groups or all investment alike. For instance, should a reduction of multinational investment lead to an immediate expansion of domestic investment, then β_{TPR} would underestimate the effect of the TPR on multinational investment. It is difficult, however, to determine the overall sign and size of these possible general equilibrium effects.

Throughout the various specifications based on Eq. (7), a full set of firm fixed effects (a_i) is always included to control for unobserved heterogeneity in firm-level productivity and parent-company characteristics. Firm fixed effects subsume host-country fixed effects (given that affiliates do not change their location), controlling for time-invariant differences across host countries that may affect the location choice of multinationals. These considerations could include, for example, perceived average quality of governance during the sample period, common language and/or former colonial ties with the home country, and geographical distance between the home and host country. We also include a full set of time dummies (d_t) to capture the effect of aggregate macroeconomic shocks, including the effect of the great recession, that are common to both multinational and domestic companies. X_{ikt} denotes a vector of firm-level non-tax determinants of investment, including proxies for firm size, its growth prospect, the degree of financial constraints and profitability. Finally, ε_{ikt} is the error term.

We include in most DD specifications the statutory corporate tax rate in the host country

(or alternatively, a set of country-year fixed effects), to control for potential confounding effects of concurrent tax reforms on business investment. We also include a set of time-varying country characteristics (Z_{kt}) in the host countries, including GDP per capita, population, and unemployment rate to capture the effect of time-varying local productivity, market size and demand characteristics on investment. Our preferred specification includes a full set of industry-year fixed effects, country-year fixed effects, and country-industry fixed effects. Taking the full set of fixed effects is crucial for insulating the causal effect of TPR on investment. Specifically, the two-way industry-year fixed effects control for the average investment in a given industry-year across all countries, taking out all the industry-specific shocks to business investments in each year. This fixed effect is important to control for any difference in the industry composition of MNCs compared to domestic companies. The second fixed effect, for country-year pairs, controls for macroeconomic shocks to investment that are common to all firms in each country-year pair. Finally, country-industry fixed effects control for all shocks to the supply or demand of fixed capital that are industry and country specific throughout the sample period. The coefficient of interest β_{TPR} hence insulates the effect of TPR on MNC investment from all of the industry and country specific factors that could potentially confound the investment effects of the policy change.

Identification Our DD strategy rests critically on the assumption that, prior to the introduction of TPRs, there are no differential changes in investment by MNCs relative to domestic companies, conditional on changes in non-TPR factors that are already empirically controlled for. We perform placebo tests to check the validity of the identification assumption by examining whether there was a differential change in MNC investment in any of the pre-legislation years. Specifically, we estimate the model:

$$\begin{aligned} Investment_{ikt} = a_i + d_t + \sum_{l=-5}^{-1} \beta_l MNC_i \times TPR_{kt} \times Pre-TPR_l \\ + \sum_{Post-TPR_n} \beta_n MNC_i \times TPR_{kt} \times Post-TPR_n + \beta_{\mathbf{x}} \mathbf{x}_{ikt} + \beta_{\mathbf{z}} \mathbf{z}_{kt} + \varepsilon_{ikt}, \end{aligned} \tag{8}$$

where $Pre-TPR_l$ is a dummy variable that takes the value of 1 for the l_{th} year before the introduction of the TPR, and zero otherwise, and $Post-TPR_n$ is a dummy variable that

takes the value of 1 for the n_{th} year after the introduction of the TPR, and zero otherwise. Without loss of generality for our test, we normalize $\beta_0 = 0$. In this specification, the assumption of parallel trends between the treated and control group corresponds to the hypothesis that all pre-TPR β_ls are equal to each other, i.e. there is no significant change in the difference between investment by multinational and domestic affiliates in any of the pre-TPR years, even if the investment levels between the two groups could be different. Table 3 presents the full set of regression results. We test the null hypothesis that there is no difference in the pre-TPR effects, that is, all pre-reform β_l coefficients are equal to each other. We run this test and obtain a $p-$value of 0.23; our parallel trends assumption therefore passes the placebo test.

5.2 Panel Regression Specification

Our second regression follows a more structural approach to identify the impact of the introduction of TPR on MNC investment. One interpretation of the theoretical results of Section 3 is that transfer mispricing opportunities reduce the cost of capital on MNC investment; and hence tightening of TPR increases the cost of capital on their investment. In principle, the model should allow us to quantify the effect of TPR on the cost of capital, by comparing the magnitude of cost of capital with and without TPR. Unfortunately, this exercise is infeasible since we cannot observe the exact magnitude of the change in β in Eq. (2) which would reflect the impact of TPR. We can, however, infer this impact indirectly by estimating the tax-sensitivity of MNC investment with and without TPR. This can be done either by using a direct measure for the cost of capital, or by using the statutory CIT rate as a proxy for the tax impact on investment.

To illustrate this idea, suppose that β_{tax} is the semi-elasticity of MNC investment (I) with respect to the corporate tax rate (CIT) in the absence of TPR (i.e. $\beta_{tax} = \frac{\partial lnI}{\partial CIT}$). After the introduction of TPR, the semi-elasticity changes into $\gamma_{tax} = \beta_{tax} + \beta_{tax}^{TPR}$, where β_{tax}^{TPR} measures the change in the semi-elasticity as a result of the introduction of TPR. Using our sample, we can directly estimate β_{tax} and β_{tax}^{TPR} by estimating the following equation:

$$Investment_{ikt} = a_i + d_t + \beta_{tax} CIT_{kt} + \beta_{tax}^{TPR} \times CIT_{kt} \times TPR_{kt} + \beta_{\mathbf{x}} \mathbf{x}_{ikt} + \varepsilon_{ikt}. \quad (9)$$

The change in the semi-elasticity in response to the introduction of TPR would reflect the change in the effective rate of CIT. This is because with TPR, we have $lnI = \beta_{tax} \times (1 + \frac{\beta_{tax}^{TPR}}{\beta_{tax}} \times CIT_t$. Instead of interpreting this as a change in the semi-elasticity, one can also argue that this reflects a change in the effective rate of CIT, namely it increases with the fraction $\frac{\beta_{tax}^{TPR}}{\beta_{tax}}$. Indeed, each percentage point change in the CIT rate in the absence of TPR (i.e. $\beta_{tax}^{TPR} = 0$) will have an equivalent effect in the presence of TPR of $(1 + \frac{\beta_{tax}^{TPR}}{\beta_{tax}} \times CIT_t)$. We can call this the "TPR-adjusted" corporate tax rate. A similar exercise can be performed, using the cost of capital instead of CIT rates (although the cost of capital is measured with noise), which we can call the "TPR-adjusted" cost of capital. The empirical analysis will measure these adjustments to infer the corresponding tax adjustment due to the introduction of TPR.

6 Results

This section first provides direct evidence on the reduction in MNC investment response to the introduction of TPR, based on the DD regression approach. It then presents robustness checks and discusses some heterogeneity in responses across firms. Finally, we estimate the "TPR-adjusted" semi-elasticity of multinational investment.

6.1 Baseline Results

Table 4 presents the main DD regression results based on Eq. (7). Each regression in Table 4 includes a full set of firm fixed effects and year fixed effects. We report standard errors clustered at the firm level. Column (1) leaves out any country-level control variables. The DD coefficient is negative and significant at the 1 percent level, indicating that, on average, the introduction of TPR dampens MNC investment. The coefficient estimates on firm-level non-tax determinants of investment have the expected signs and are highly significant. For example, the negative coefficients on cash flow and profitability suggest that firms that are less financially constrained invest more in fixed capital assets. The positive coefficient on sales growth implies a positive link between firm-level investment and its growth prospect.

Column (2) of Table 4 checks the robustness of the baseline finding by including the host

country-level statutory CIT rate, population, unemployment rate, exchange rate, real GDP per capita, and GDP growth rate. This is to ensure that the DD estimate is not confounded with contemporaneous macroeconomic changes in the host country that may affect MNC investment. Inclusion of these country-level characteristics slightly reduces the magnitude of the DD coefficient from -0.049 to -0.041. However, the difference in the DD coefficient estimates is not statistically significant.

The next four columns of Table 4 check the robustness of the baseline finding by subsequently adding two-way country-year fixed effects in Column (3), two-way industry-year fixed effects in Column (4), two-way country-industry fixed effects in Column (5), and two-way home country-industry fixed effects in Column (6). In our preferred specification in Column (6), the DD estimate is around -0.041 and significant at the 1 percent level, suggesting that on average the implementation of TPR reduces investment rate by multinationals by around 4.1 percentage point. Given that the average gross investment per dollar of fixed asset is around 35.9 cents for multinational affiliates in the sample, this corresponds to 11.4 percent reduction in their investment.

Finally, Column (7) of Table 4 includes a triple interaction term between $MNC_i \times TPR_{kt}$ and the $tprisk_{kt}$ variable that measures the strictness of TPR. Intuitively, stricter TPR would increase the effective cost of capital faced by multinationals, thereby dampening their investment by more. The negative coefficient estimate on the triple interaction term suggests that this is indeed the case, with a coefficient of -0.072 that is significant at the 1 percent level.

6.2 Robustness Checks

Table 5 presents regressions from alternative specifications and samples to test the robustness of the findings in Table 4. Column (1) excludes affiliates with parent countries with worldwide taxation, which could mute the incentive for profit shifting compared to territorial taxation. Column (2) clusters the standard errors at the host country level. This is to address the concern that in tax reform studies, the standard errors can be understated by assuming independence across firms within the same tax jurisdiction (Bertrand et al., 2004). In both columns, the result on the TPR variable remains unchanged. Column (3) uses an investment

rate winsorized at the top and bottom 2.5 percentile as the dependent variable, to ensure that the identified effect of TPR is not driven by any outliers in investment. The DD estimate is smaller at around 0.02, but remains statistically significant at the 1 percent level. Moreoever, it is not statistically different from the DD estimate reported in Column (6) of Table 4 that uses the investment rate winsorized at the top and bottom 1 percentile as the dependent variable.

Column (4) implements a matching DD strategy (Heckman et al. (1997)) to address the concern that companies in the treated and control groups may not have similar observable characteristics, and that these differences may explain different trends in investment over time. The regression in Column (4) replicates the DD analysis on a subsample of matched firms from a Mahalanobis distance matching procedure based on average firm-level turnover, turnover growth, employment and total assets. The resulting estimate remains positive and significant at the 1 percent level for the matched sample, and the size of the coefficient remains similar.

The last two columns of Table 5 check the robustness of the findings by conducting separate analyses for intensive and extensive margin responses. Column (5) uses a discrete dummy indicator for positive investment as the dependent variable. The linear probability regression captures the extensive margin investment responses to TPRs. The coefficient is small and insignificant, suggesting that TPRs have negligible impacts on firm's likelihood to invest in years after their introduction. Column (6) examines the intensive margin response using the logarithm of investment as the dependent variable, thus excluding observations with negative investment. The DD coefficient is positive and highly significant, suggesting that investment reduction due to TPR is concentrated in MNCs with positive investment prior to the policy change.

6.3 Evidence on Heterogeneous Investment Responses

Table 6 explores heterogeneity in investment responses across firms. First, it looks at the variation in the size of tax differentials. Second, it explores variation in the intensity of intangible assets.

The size of tax differential. Eq. (6) suggests that the tax differential matters for the impact of TPRs on investment.[9] To explore this, we divide the sample into quartiles based on the tax differential, and then interact the main policy term in Eq. (7) with the quartile indicators:

$$Investment_{ikt} = a_i + d_t + \sum_{j=1}^{4} \beta_j MNC_i \times TPR_{kt} \times \{\mathbf{I}|TaxDiff \in Quartile_j\} + \beta_{\mathbf{x}}\mathbf{x}_{ikt} + \varepsilon_{ikt}, \quad (10)$$

Column (1) of Table 6 presents the coefficients obtained from this regression. Interestingly, the results suggest that introduction of TPRs mainly affect investment by affiliates in the 2^{nd} quartile of the tax differential, and to a lesser extent also in the 3^{rd} and 4^{th} quartile. At the bottom quartile of tax differential, the response is insignificant. This may be due to fixed costs associated with changing investment. However, the result needs to be interpreted with caution as the DD coefficient estimate for the first quartile is also negative albeit estimated with imprecision.

The intensity of intangible assets. For firms investing heavily in intangible assets, it can be more difficult to find comparable prices to comply with the arm's length principle. For them, TPR may have little impact. We test the effect of intangible asset intensity on the relationship between TPR and investment in the following specification:

$$Investment_{ikt} = a_i + d_t + \beta_{TPR} MNC_i \times TPR_{kt} + \beta_{Intang} MNC_i \times TPR_{kt} \times IntangShare_i + \beta_{\mathbf{x}}\mathbf{x}_{ikt} + \varepsilon_{ikt}, \quad (11)$$

where $IntangShare_i$ is the average level of intangible fixed assets relative to total assets for firm i during the sample period. In this specification, β_{TPR} captures the impact of transfer pricing regulation on investment for firms with no intangible assets, whereas β_{Intang} captures the changing impact of transfer pricing regulation on investment across firms of different intangible asset intensity.

Table 6 Column (2) reports a negative coefficient estimate on the main interaction term $MNC_i \times TPR_{kt}$. The coefficient on the three-way interaction term is small and positive,

[9] This tax differential variable thus captures the tax incentive for profit shifting between affiliates and parent companies. Parent companies are typically large relative to the size of the group and have been shown to play a prominent role in the profit shifting strategies of multinational firms (Lohse and Riedel, 2013).

which combined with, suggests that the negative effect of TPR on multinational investment decreases in the firm's intensity of intangible assets.

6.4 TPR-adjusted tax elasticity

As discussed in Section 5.2, TPR may increase the "effective", or "TPR-adjusted" CIT rate. This can be inferred by comparing the pre- and post-TPR estimates of the semi-elasticity of multinational investment.

Table 7 summaries the regression results based on Eq.(9) using a smaller sample that only includes multinational affiliates. Column (1) suggests that without TPR, a one percentage point lower statutory CIT rate in the host country increases the investment (as a share of total assets) by multinationals by 0.83 percentage point. In the presence of TPR, the sensitivity of investment to CIT increases by 0.36 percent point to 1.19 (in absolute term). This finding persists when replacing the CIT variable with a measure of the cost of capital (COC) in Column (2), although the COC coefficient is estimated with imprecision in the absence of TPR.

To directly measure the semi-elasticity of multinational investment, Column (3) uses the logarithm of fixed tangible assets as the dependent variable. In this specification, the coefficient on CIT can be directly interpreted as the semi-elasticity of MNC investment. The specification is based on the Cobb-Douglas production function (in logarithm) and controls for the size of output (proxied by *log* Sales) and employment (proxied by *log* Number of workers). The results suggest that the estimated semi-elasticity of fixed capital asset is slightly larger than one in the absence of TPR and highly significant. Hence, a 1 percentage-point increase in the CIT rate will reduce MNC investment by approximately 1 percent. The tax effect increases by 0.24 in the presence of TPR to an overall semi-elasticity of 1.26. Following our interpretation in Section 5.2, the introduction of TPR corresponds to a "TPR-adjusted" CIT rate that is 23 percent larger than without TPR. Column (4) replaces the CIT rate with a measure of the cost of capital. The results are qualitatively unchanged, and imply that the "TPR-adjusted" cost of capital is 15 percent larger than the cost of capital without TPR.

7 The Effect of Transfer-Pricing Regulation on Total MNC Investment

The reduction in fixed capital investment by MNC affiliates identified in Section 6 may have two alternative interpretations: (i) a reduction in total investment due to a higher cost of capital for the entire MNC company group; or (ii) a reallocation of investment to other affiliates of the same MNC group. Both types of investment response reduce welfare in the host country that has implemented TPR. However, the two have very different welfare implication for the rest of the world. Indeed, reduced investment by the MNC group would reduce global welfare, while a reallocation of investments across countries would imply higher welfare in countries that benefit from the inflow of investment. Of course, cross-country spillovers of this kind can intensify tax competition among national governments and ultimately lead to too lenient TPR in all countries, if there is no international cooperation.

To identify the impact of TPR on total investment of the MNC group, we use a similar DD empirical strategy based on equation (7). All the key variables are as previously defined but are now based on consolidated accounts of the parent company. In particular, $Investment_{ikt}$ now reflects the amount of worldwide investment by the MNC group with parent company i in country k. TPR_{kt} is a discrete dummy variable that takes the value of one if there is some transfer pricing regulation in the parent country k, and zero otherwise. It is important to note that the TPR_{kt} variable defined in this way only captures the effect of TPR in the parent country, ignoring the effect of TPRs in any other countries where affiliates of the same MNC group operate.[10] This implies that there can be measurement error in the TPR_{kt} variable to determine the impact of TPRs on the multinational group's investment.

Table 8 summarizes the results, where the DD coefficient captures the impact of parent-country TPR on total investment by the MNC group. Column (1) reports the baseline regression results based on equation (7) with no country-level controls. Contrary to our expectation, the DD coefficient is positive and significant at the 1 percent level, and remains significant with inclusion of country-level characteristics in Column (2). However, the DD

[10]There is limited time variation in the TPR_{kt} variable that aims to capture the impact of transfer regulations both at the parent and affiliate countries, as its value depends on the first country that introduces the transfer pricing regulation faced by any affiliate in the group within the sample period.

coefficient is no longer significant with the inclusion of country-year fixed effects in Column (3), suggesting that the significance of the DD coefficient may reflect other country-specific common trends in MNC investment that are unrelated to the introduction of TPR. The DD coefficient remains insignificant when further including industry-year fixed effects and industry-country fixed effects in Column (4). Column (5) further interacts the discrete interaction term with the top statutory CIT rate in the parent country, and the basic finding remains unchanged.[11] Overall, the absence of a clear effect of TPR on MNC consolidated investment suggests that the negative effect of TPRs on investment in foreign affiliates is due to a relocation effect of investment.

8 Conclusions

Despite the increased global interest in transfer pricing regulations to mitigate tax avoidance by multinational companies–most notably due to the G20/OECD project on base erosion and profit shifting–there is no empirical evidence on their real implications and, therefore, their impact on global welfare. This paper fills this gap by estimating the effect of transfer pricing regulations on multinational investment. We use a quasi-experimental research design, exploiting a large micro data set of unconsolidated accounts of both multinational affiliates and affiliates of purely national corporations. Guided by a simple theoretical model, we argue that transfer pricing regulation should only affect the cost of capital of the multinational affiliates. The affiliates of purely national corporations can thus be used as a control group to identify the impact on multinational investment. Our data comprises the period between 2006 and 2014, during which several of the 27 countries in the sample introduced transfer pricing regulations. The estimates suggest that, on average, the introduction of transfer pricing regulations reduced investment in multinational affiliates by 11 percent. The reduction in investment rises in the strictness of the transfer pricing regulation; it is also larger for firms that are less intensive in the use of intangible assets; and it becomes smaller if the tax differential with other countries becomes very small. Regressions based

[11] The basic finding also remains unchanged when interacting the discrete interaction term with the *tprisk* variable.

on consolidated statements indicate that aggregate multinational investment is not affected by transfer pricing regulations, which suggests that the investment decline in multinational affiliates is due to relocation effects toward affiliates in other countries, i.e. there are spillover effects of transfer pricing regulations to other countries.

Our results have important policy implications. For example, unilateral introduction of transfer pricing regulation will significantly distort the international allocation of capital and, therefore, will induce global welfare losses that are of a similar kind as those induced by differences in corporate tax rates. International coordination in the implementation of transfer pricing regulation is therefore desirable. Inclusion of all countries is important, as otherwise countries will have an incentive to opt out in order to attract capital from abroad.

The analysis of these and other real effects of anti-avoidance regulation is critical to assess their implications for global efficiency and welfare. More research is needed to understand these real effects, including of other forms of anti-avoidance regulation such as rules that restrict interest deductibility, provisions against treaty abuse, and more general anti-avoidance rules. Also the interaction between these anti-tax avoidance rules and other tax policy parameters, for example the impact they have on tax competition using corporate tax rates, is critical to infer the global welfare effects of their introduction. These issues are left for further research.

References

Andrews, D., C. Criscuolo, and P. Gal, *Frontier Firms, Technology Diffusion and Public Policy*, OECD Publishing, 2015.

Beer, Sebastian and Jan Loeprick, "Profit shifting: drivers of transfer (mis)pricing and the potential of countermeasures," *International Tax and Public Finance*, 2015, *22* (3), 426–451.

_ , Ruud A. De Mooij, and Li Liu, "International Corporate Tax Avoidance: A review of the channels, effect sizes and blindspots," IMF Working Paper 2018/xx, International Monetary Fund 2018.

Bernard, Andrew B., J. Bradford Jensen, and Peter K. Schott, "Transfer Pricing by U.S.-Based Multinational Firms," Working Paper 12493, National Bureau of Economic Research August 2006.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan, "How Much Should We Trust Differences-In-Differences Estimates?," *The Quarterly Journal of Economics*, 2004, *119* (1), 249–275.

Blouin, Jennifer, Harry Huizinga, Luc Laeven, and Gaëtan J.A. Nicodème, "Thin Capitalization Rules and Multinational Firm Capital Structure," CESifo Working Paper Series 4695, CESifo Group Munich 2014.

Bond, Stephen and Jing Xing, "Corporate Taxation and Capital Accumulation: Evidence from sectoral panel data for 14 OECD countries," *Journal of Public Economics*, 2015, *130*, 15 – 31.

Bucovetsky, Sam and Andreas Haufler, "Preferential Tax Regimes With Asymmetric Countries," *National Tax Journal*, December 2007, *60* (4), 789–795.

Buettner, Thiess and Georg Wamser, "Internal Debt and Multinational Profit Shifting: Empirical Evidence From Firm-Level Panel Data," *National Tax Journal*, March 2013, *66* (1), 63–95.

_ , Michael Overesch, and Georg Wamser, "Anti Profit-Shifting Rules and Foreign Direct Investment," Technical Report 2014.

_ , _ , Ulrich Schreiber, and Georg Wamser, "The Impact of Thin-Capitalization Rules on the Capital Structure of Multinational Firms," *Journal of Public Economics*, 2012, *96* (11–12), 930 – 938.

Caballero, Ricardo J., Eduardo M. R. A. Engel, and John C. Haltiwanger, "Plant-Level Adjustment and Aggregate Investment Dynamics," *Brookings Papers on Economic Activity*, 1995, *26* (2), 1–54.

Clausing, Kimberly A., "Tax-Motivated Transfer Pricing and US intrafirm trade prices," *Journal of Public Economics*, September 2003, *87* (9-10), 2207–2223.

Cristea, Anca D. and Daniel X. Nguyen, "Transfer Pricing by Multinational Firms: New Evidence from Foreign Firm Ownerships," *American Economic Journal: Economic Policy*, August 2016, *8* (3), 170–202.

Crivelli, Ernesto, Ruud de Mooij, and Michael Keen, "Base Erosion, Profit Shifting and Developing Countries," *FinanzArchiv: Public Finance Analysis*, 2016, *72* (3), 268–301.

Cummins, Jason G., Kevin A. Hassett, R. Glenn Hubbard, Robert E. Hall, and Ricardo J. Caballero, "A Reconsideration of Investment Behavior Using Tax Reforms as Natural Experiments," *Brookings Papers on Economic Activity*, 1994, *1994* (2), pp. 1–74.

Davies, Ronald B., Julien Martin, Mathieu Parenti, and Farid Toubal, "Knocking on Tax Haven's Door: Multinational Firms and Transfer Pricing," *Review of Economics and Statistics, forthcoming*, 2018.

De Mooij, Ruud A. and Shafik Hebous, "Curbing Corporate Debt Bias: Do Limitations to Interest Deductibility Work?," IMF Working Paper 2017/22, International Monetary Fund 2017.

Desai, Mihir A., C. Fritz Foley, and James R. Hines, "The demand for tax haven operations," *Journal of Public Economics*, 2006, *90* (3), 513 – 531.

Dharmapala, Dhammika, "What Do We Know about Base Erosion and Profit Shifting? A Review of the Empirical Literature," *Fiscal Studies*, 2014, *35* (4), 421–48.

Finke, Katharina, "Tax Avoidance of German Multinationals And Implications for Tax Revenue," memo, ZEW - Center for European Economic Research 2013.

Flaaen, Aaron, "The Role of Transfer Prices in Prot-Shifting by U.S. Multinational Firms: Evidence from the 2004 Homeland Investment Act," mimeo, Federal Reserve Board. 2016.

Fuest, Clemens, Christoph Spengel, Katharina Finke, Jost Heckemeyer, and Hannah Nusser, "Profit shifting and 'aggressive' tax planning by multinational firms: Issues and options for reform," Technical Report 2013.

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

Habu, Katarzyna, "How aggressive are foreign multinational companies in avoiding corporation tax?," Working Paper 1713, Oxford University Centre for Business Taxation 2017.

Heckemeyer, Jost and Michael Overesch, "Multinationals' profit response to tax differentials: Effect size and shifting channels," ZEW Discussion Papers 13-045, ZEW - Center for European Economic Research 2013.

Heckman, James J, Hidehiko Ichimura, and Petra E Todd, "Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme," *Review of Economic Studies*, October 1997, *64* (4), 605–54.

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

Hines, James R., "How Serious is the Problem of Base Erosion and Profit Shifting?," *Canadian Tax Journal*, 2014, *62* (2), 443–53.

House, Christopher L. and Matthew D. Shapiro, "Temporary Investment Tax Incentives: Theory with Evidence from Bonus Depreciation," *American Economic Review*, June 2008, *98* (3), 737–68.

Janeba, Eckhard and Michael Smart, "Is Targeted Tax Competition Less Harmful Than Its Remedies?," *International Tax and Public Finance*, May 2003, *10* (3), 259–280.

Keen, Michael, "Preferential Regimes Can Make Tax Competition Less Harmful," *National Tax Journal*, 2001, *54* (4), 757–762.

Liu, Li, Tim Schmidt-Eisenlohr, and Dongxian Guo, "Transfer Pricing and Tax Avoidance: Evidence from Linked Tax-Trade Statistics in the UK," Working Paper 1715, Oxford University Centre for Business Taxation 2017.

Lohse, Theresa and Nadine Riedel, "Do Transfer Pricing Laws Limit International Income Shifting? Evidence from European Multinationals," Technical Report 2013.

Marques, Mário and Carlos Pinho, "Is transfer pricing strictness deterring profit shifting within multinationals? Empirical evidence from Europe," *Accounting and Business Research*, 2016, *46* (7), 703–730.

Merlo, Valeria and Georg Wamser, "Debt Shifting and Thin-capitalization Rules," *CESifo DICE Report*, 01 2015, *12* (4), 27–31.

Mescall, Devan and Kenneth J. Klassen, "How do tax and accounting policies affect cross-border mergers and acquisitions?," Working Paper Series, University of Saskatchewan 2014.

Nicolay, Katharina, Hannah Nusser, and Olena Pfeiffer, "On the Interdependency of Profit-shifting Channels and the Effectiveness of Anti-Avoidance Legislation," Technical Report 2016.

OECD, *Action Plan on Base Erosion and Profit Shifting*, OECD Publishing, 2013.

_ , *Measuring and Monitoring BEPS, Action 11 - 2015 Final Report*, OECD Publishing, 2015.

Overesch, Michael, "The Effects of Multinationals' Profit Shifting Activities on Real Investments," *National Tax Journal*, 2009, *62* (1), 5–23.

Saunders-Scott, Molly J., "How does transfer-pricing enforcement affect reported profits?," Technical Report, University of Michigan 2013.

_ , "Substitution Across Methods of Profit Shifting," *National Tax Journal*, December 2015, *68* (4), 1099–1120.

UNCTAD, *Reforming International Investment Governance, World Investment Report*, United Nations Publications, 2015.

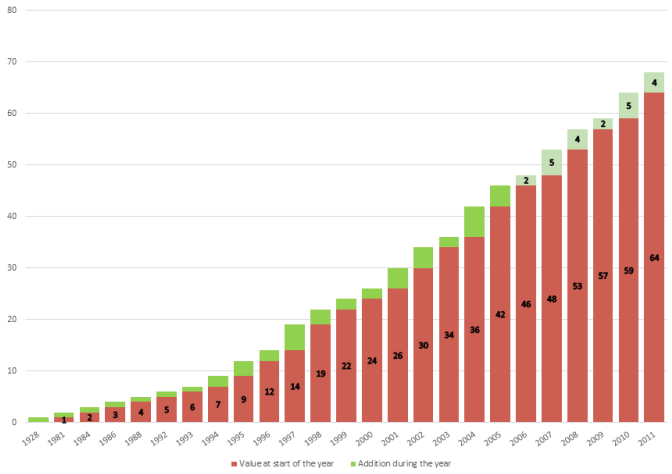
Vicard, Vincent, "Profit Shifting Through Transfer Pricing: Evidence from French Firm Level Trade Data," Working Paper 555, Banque de France 2015.

Yagan, Danny, "Capital Tax Reform and the Real Economy: The Effects of the 2003 Dividend Tax Cut," *American Economic Review*, 2015, *105* (12), 3531–63.

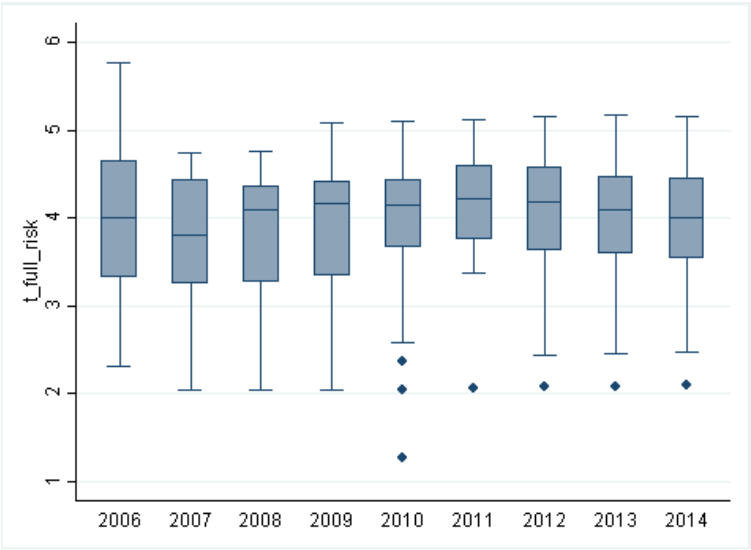
Zwick, Eric and James Mahon, "Tax Policy and Heterogeneous Investment Behavior," *American Economic Review*, January 2017, *107* (1), 217–48.

Figure 1. Transfer Pricing Regulations (TPRs)

A. Number of Countries with TPRs

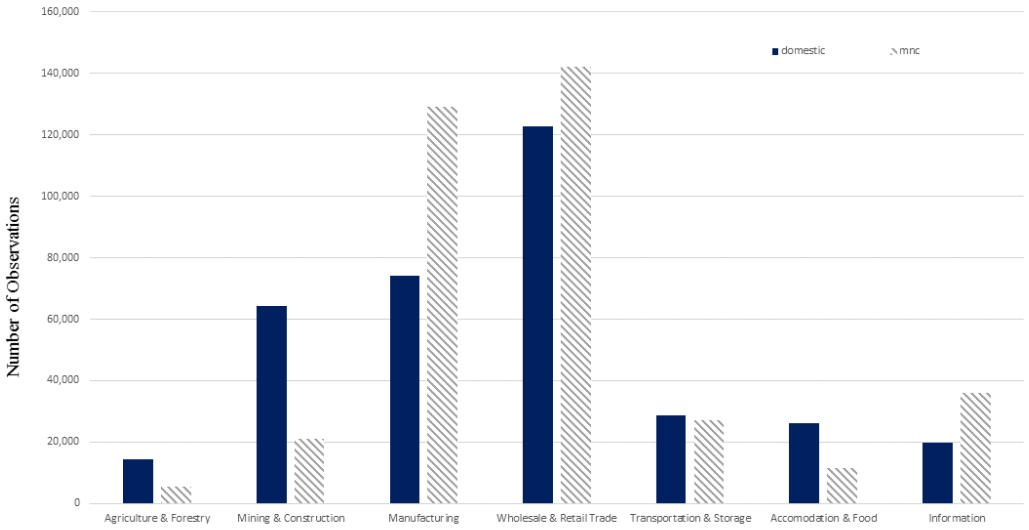


B. Variation in the Strictness of TPRs



Notes: Panel A plots the number of countries with newly-introduced TPRs (top green bar) and the number of countries with existing TPRs (bottom red bar) during 1928-2011. Panel B exhibits cross-sectional variation in the overall strictness of the TPRs (*tprisk*) during 2006-2014, showing the median, the 25^{th} and 75^{th} percentiles, and the minimum and maximum value of *tprisk* in a box plot.

Figure 2. Industry Distribution



Notes: This figure shows the distribution of industries by ownership types for companies in the main estimation sample in the time period 2006 to 2014.

Table 1. Country Statistics

Number of Companies in:	Total	MNC	Domestic Company Group
Austria	5,643	4,565	1,078
Belgium	37,417	25,695	11,722
Bosnia & Herzegovina	2,035	1,678	357
Bulgaria	13,391	3,740	9,651
Czech Republic	29,200	18,661	10,539
Denmark	3,497	2,596	901
Estonia	5,898	3,902	1,996
Finland	19,545	8,533	11,012
France	144,662	70,158	74,504
Germany	27,752	19,588	8,164
Greece	8,189	4,890	3,299
Hungary	15,798	15,446	352
Japan	2,637	2,351	286
Korea, Republic of	14,320	10,354	3,966
Luxembourg	854	639	215
Netherlands	1,727	1,168	559
New Zealand	982	941	41
Norway	37,711	11,452	26,259
Poland	30,565	20,696	9,869
Portugal	29,993	14,020	15,973
Romania	17,922	13,489	4,433
Slovak Republic	10,991	8,475	2,516
Slovenia	4,949	3,964	985
Spain	100,403	39,720	60,683
Sweden	91,067	20,446	70,621
Ukraine	2,249	654	1,595
United Kingdom	63,053	44,894	18,159

Notes: This table lists the number of companies by ownership types in the main estimation sample between 2006 and 2014.

Table 2. Summary Statistics

Variables:	**Mean**	**Std Dev**	**Median**	**P10**	**P90**
Firm-level variables:					
Investment spending ($1,000)	1,725.43	30,589.58	70.73	-47.04	2,266.74
Fixed asset ($1,000)	11,527.90	133,200.00	689.49	26.79	14,167.16
Investment rate (I_t/K_{t-1})	0.45	1.07	0.15	-0.06	1.06
Operating revenue ($1,000)	54,055	440,600	6,812	681	83,028
Cash flow rate	2.12	7.08	0.39	-0.25	5.23
Profitability	0.08	0.16	0.06	-0.03	0.23
Sales Growth Rate	0.06	0.30	0.03	-0.26	0.41
Country-level variables:					
CIT rate (%)	27.34	5.79	28.00	19.00	33.33
Tax differential (in absolute %)	4.79	6.22	1.67	0	14.50
Cost of Capital	0.07	0.01	0.07	0.06	0.08
Population (million)	35.01	25.98	38.14	5.40	63.38
Unemployment rate (%)	9.34	4.88	8.10	5.33	16.18
Exchange rate (rel to USD)	29.21	154.93	0.75	0.68	7.65
GDP per capita (constant USD)	40,578.83	20,855.08	42,249.06	12,976.81	60,944.47
GDP growth rate (%)	1.02	2.92	1.26	-2.94	4.18

Notes: this table provides the summary statistics of the key variables in the main estimation sample for regression analysis.

Table 3. Test of Common Trends between Treated and Control Groups

Year	$\hat{\beta}$	Std. Error
Pre TPR Year 5	0.147	0.199
Pre TPR Year 4	0.191	0.142
Pre TPR Year 3	0.145	0.129
Pre TPR Year 2	-0.044	0.034
Pre TPR Year 1	0.008	0.026
Post TPR Year 1	-0.049**	0.023
Post TPR Year 2	0.001	0.015
Post TPR Year 3	-0.036***	0.013
Post TPR Year 4 and more	-0.015**	0.006
Joint test with H_0 that all pre-reform β_l coefficients are equal to each other: $p-$value = 0.228		

Notes: this table presents regression results of a common trend test between treated and control groups in the pre-TPR years. We estimate the equation: $Investment_{ikt} = a_i + d_t + \sum_{l=-5}^{-1} \beta_l MNC_i \times TPR_{kt} \times PreTPR_l + \sum_{PostTPR_n} \beta_n MNC_i \times TPR_{kt} \times PostTPR_n + \beta_{\mathbf{x}} \mathbf{x}_{ikt} + \beta_{\mathbf{z}} \mathbf{z}_{kt} + \varepsilon_{ikt}$, where $PreTPR_l$ is a dummy variable that takes the value of 1 for the l_{th} year before the introduction of the TPR, and zero otherwise, and $PostTPR_n$ is a dummy variable that takes the value of 1 for the n_{th} year post the introduction of the TPR, and zero otherwise. We normalize $\beta_0 = 0$ in the year of TPR introduction. In this estimation, the null hypothesis that there is no difference in pre-reform trends is equivalent to the null hypothesis that all pre-reform β_l coefficients are equal to each other. The last row reports the $p-$value for this joint test.

Table 4. Investment Responses to TPR: Baseline Results

Dependent variable:	Investment per $ fixed asset						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$MNC_i \times TPR_{kt}$	-0.049***	-0.041***	-0.024***	-0.025***	-0.025***	-0.041***	
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.012)	
$MNC_i \times TPR_{kt} \times tprisk_{kt}$							-0.072***
							(0.025)
$log(Sales_{t-1})$	-0.165***	-0.167***	-0.159***	-0.160***	-0.160***	-0.161***	-0.178***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.010)
Cash flow per $ fixed asset	0.038***	0.038***	0.038***	0.038***	0.038***	0.037***	0.041***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Profitability_{t-1}$	0.095***	0.088***	0.081***	0.081***	0.081***	0.083***	0.087***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.020)	(0.027)
$Sales\ growth\ rate_{t-1}$	0.043***	0.041***	0.039***	0.039***	0.039***	0.040***	0.021**
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.009)
Firm FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y
Country-Year FE	N	N	Y	Y	Y	Y	Y
Industry-Year FE	N	N	N	Y	Y	Y	Y
Country-Industry FE	N	N	N	N	Y	Y	Y
Home Country-Industry FE	N	N	N	N	N	Y	Y
R^2	0.274	0.275	0.277	0.278	0.278	0.277	0.314
N	486,756	486,756	486,754	486,754	486,754	439,507	289,310

Notes: This table reports difference-in-difference estimates of the effect of the transfer pricing regulation on investment by multinational affiliates. All columns display the DD coefficient on the $MNC_i \times TPR_{kt}$ variable, from a regression of investment on this interaction, affiliate fixed effects, year fixed effects and additional controls. Investment is gross investment scaled by book value of fixed capital asset in (end of) previous year. Affiliate-Level controls include lagged turnover, lagged turnover growth rate, cash flow scaled by lagged asset, and lagged profit margin. All firm-level ratio variables are winsorized at top and bottom 1 percentile to remove the influence of outliers. Additional country-level controls in Column (2) include statutory corporate tax rate, GDP per capita, population size, unemployment rate, GDP growth rate, and exchange rate in the host country. Heteroskedasticity-robust standard errors are clustered at firm level. ***, **, * denotes significance at the 1%, 5% and 10% levels, respectively.

Table 5. Investment Responses to TPR: Robustness Checks

Dependent variable:	Investment per $ fixed asset, $P99^{th}$ excl. worldwide parent country	$P99^{th}$ std err. clustering by host country	$P97.5^{th}$	$P99^{th}$ matched sample	$I > 0$	$logI$
	(1)	(2)	(3)	(4)	(5)	(6)
$MNC_i \times TPR_{kt}$	-0.041***	-0.041***	-0.018***	-0.036***	0.002	-0.037**
	(0.012)	(0.010)	(0.006)	(0.013)	(0.004)	(0.016)
$log(Sales_{t-1})$	-0.162***	-0.161***	-0.092***	-0.188***	-0.055***	0.164***
	(0.007)	(0.025)	(0.003)	(0.009)	(0.002)	(0.011)
Cash flow per $ fixed asset	0.037***	0.037***	0.018***	0.035***	0.005***	0.005***
	(0.001)	(0.002)	(0.000)	(0.001)	(0.000)	(0.001)
$Profitability_{t-1}$	0.083***	0.083*	0.078***	0.109***	0.104***	0.159***
	(0.020)	(0.042)	(0.009)	(0.026)	(0.007)	(0.031)
Sales growth $rate_{t-1}$	0.039***	0.040***	0.024***	0.047***	-0.020***	0.040***
	(0.007)	(0.006)	(0.003)	(0.008)	(0.003)	(0.010)
Firm FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Country-Year FE	Y	Y	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y	Y	Y
Country-Industry FE	Y	Y	Y	Y	Y	Y
Home Country-Industry FE	Y	Y	Y	Y	Y	Y
R^2	0.28	0.28	0.32	0.282	0.35	0.83
N	438,035	439,507	439,507	308,152	439,507	337,110

Notes: this table reports difference-in-difference estimates of the effect of the transfer pricing regulation on investment by multinational affiliates. All columns display the DD coefficient on the $MNC_i \times TPR_{kt}$ variable, from a regression of investment on this interaction, affiliate fixed effects, year fixed effects and additional controls. The dependent variable in Columns (1)-(4) is gross investment scaled by book value of fixed capital asset in (end of) previous year. The dependent variable in Columns (5) is a dummy indicator that takes the value of 1 for positive investment, and 0 otherwise. The dependent variable in Columns (6) is the level of investment in logarithm. Affiliate-Level controls include lagged turnover, lagged turnover growth rate, cash flow scaled by lagged asset, and lagged profit margin. All other variables are as previously defined. Heteroskedasticity-robust standard errors are clustered at firm level. ***, **, * denotes significance at the 1%, 5% and 10% levels, respectively.

Table 6. Heterogeneous Investment Responses

Firm Characteristic: Dept Var: Investment per $ fixed asset	Tax Differential Quartile (1)	Share of Intangible Assets (2)
$MNC_i \times TPR_{kt} \times Quartile_{TaxDiff,1}$	-0.022	
	(0.021)	
$MNC_i \times TPR_{kt} \times Quartile_{TaxDiff,2}$	-0.052***	
	(0.015)	
$MNC_i \times TPR_{kt} \times Quartile_{TaxDiff,3}$	-0.015*	
	(0.009)	
$MNC_i \times TPR_{kt} \times Quartile_{TaxDiff,4}$	-0.015*	
	(0.009)	
$MNC_i \times TPR_{kt}$		-0.032***
		(0.008)
$MNC_i \times TPR_{kt} \times IntangShare_i$		0.002***
		(0.000)
$log(Sales_{t-1})$	-0.160***	-0.160***
	(0.007)	(0.007)
Cash flow per $ fixed asset	0.038***	0.038***
	(0.001)	(0.001)
$Profitability_{t-1}$	0.081***	0.082***
	(0.018)	(0.018)
$Sales\ growth\ rate_{t-1}$	0.039***	0.039***
	(0.007)	(0.007)
Firm FE	Y	Y
Year FE	Y	Y
Country-Year FE	Y	Y
Industry-Year FE	Y	Y
Country-Industry FE	Y	Y
R^2	0.278	0.278
N	486,754	486,754

Notes: This table presents regression results on the heterogeneous effect of TPR on investment. Column (1) reports the effect of TPR across the tax differential quartiles. The dummy variable $Quartile_{TaxDiff,j}$ takes the value of 1 if the absolute difference between the home and parent country tax rate lies in the j^th quartile, and zero otherwise. Column (2) reports the effect of TPR across varying shares of intangible assets. The intangible asset share variable is calculated for each firm the average intangible fixed assets relative to its total assets over the sample period. ***, **, * denotes significance at 1%, 5%, and 10% level, respectively.

Table 7. Estimated Effects of TPRs on the Tax Elasticity of FDI

Dependent variable:	Investment per $ fixed asset		log (Fixed Tangible Assets)	
	(1)	(2)	(3)	(4)
CIT_{kt}	-0.834***		-1.023***	
	(0.198)		(0.141)	
$CIT_{kt} \times TPR_{kt}$	-0.356***		-0.238***	
	(0.073)		(0.060)	
COC_{kt}		-0.462		-8.594***
		(1.412)		(1.211)
$COC_{kt} \times TPR_{kt}$		-1.736***		-1.260***
		(0.425)		(0.306)
Sales (in logs)	-0.198***	-0.196***	0.141***	0.138***
	(0.009)	(0.010)	(0.008)	(0.008)
Number of workers (in logs)			0.532***	0.539***
			(0.012)	(0.013)
Cash flow per $ fixed asset	0.032***	0.032***		
	(0.001)	(0.001)		
$Profitability_{t-1}$	0.135***	0.134***		
	(0.028)	(0.028)		
$Sales\ growth\ rate_{t-1}$	0.051***	0.051***		
	(0.009)	(0.009)		
Additional Host Country Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y
Country-Industry FE	Y	Y	Y	Y
R^2	0.284	0.285	0.958	0.958
N	248,008	243,709	252,295	247,586

Notes: This table reports . All columns display the estimated coefficient on the tax variable, from a regression of investment on the tax variable, firm fixed effects, year fixed effects and additional controls. Investment is gross investment scaled by book value of fixed capital asset in (end of) previous year in Columns (1)-(2), and logarithm of tangible fixed asset in Columns (3)-(4). Affiliate-Level controls include lagged turnover, lagged turnover growth rate, cash flow scaled by lagged asset, and lagged profit margin in Columns (1)-(2), and logarithms of turnover and number of employees in Columns (3)-(4). All firm-level ratio variables are winsorized at top and bottom 0.01th percentile to remove the influence of outliers. Host country-level controls include GDP per capita and GDP growth rate. Heteroskedasticity-robust standard errors are clustered at firm level. ***, **, * denotes significance at the 1%, 5% and 10% levels, respectively.

Table 8. Total Investment Responses to Transfer-Pricing Regulations

Dependent variable: Investment per $ fixed asset	(1)	(2)	(3)	(4)	(5)
$MNC_i \times TPR_{kt}$	0.056***	0.049**	0.029	0.031	
	(0.019)	(0.019)	(0.024)	(0.024)	
$MNC_i \times TPR_{kt} \times CIT_{kt}$					0.125
					(0.095)
$log(Sales_{t-1})$	-0.070***	-0.085***	-0.065***	-0.065***	-0.083***
	(0.019)	(0.021)	(0.020)	(0.020)	(0.021)
Cash flow per $ fixed asset	-0.006	0.010	-0.008	-0.009	0.009
	(0.015)	(0.016)	(0.015)	(0.015)	(0.017)
$Profitability_{t-1}$	0.002	0.005	0.001	0.002	0.006
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
$Sales\ growth\ rate_{t-1}$	-0.012	-0.017	-0.010	-0.010	-0.013
	(0.021)	(0.021)	(0.022)	(0.022)	(0.023)
Firm FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Country-Year FE	N	N	Y	Y	Y
Industry-Year FE	N	N	N	Y	Y
Country-Industry FE	N	N	N	Y	Y
R^2	0.211	0.220	0.240	0.246	0.255
N	12,899	12,023	12,748	12,748	11,991

Notes: This table reports difference-in-difference estimates of the effect of the transfer pricing regulation on worldwide investment by MNC group. All columns display the DD coefficient on the $MNC_i \times TPR_{kt}$ variable, from a regression of investment on this interaction, MNC group fixed effects, year fixed effects and additional controls. Investment is gross investment scaled by book value of fixed capital asset in (end of) previous year. Affiliate-Level controls include lagged turnover, lagged turnover growth rate, cash flow scaled by lagged asset, and lagged profit margin. All firm-level ratio variables are winsorized at top and bottom 1 percentile to remove the influence of outliers. Additional country-level controls in Column (2) include statutory corporate tax rate, GDP per capita, population size, unemployment rate, GDP growth rate, and exchange rate in the parent country. Heteroskedasticity-robust standard errors are clustered at firm level. ***, **, * denotes significance at the 1%, 5% and 10% levels, respectively.