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At A Cost: the Real Effects of Transfer Pricing Regulations

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Abstract

Unilateral adoption of transfer pricing regulations may have a negative impact on real investment by multinational corporations (MNCs). This paper uses a quasi-experimental research design, exploiting 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.

JEL Classification Numbers: H25, H87, F23

Keywords: profit shifting, foreign direct investment, corporate tax policy, multinational firms

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I. 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-á-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.[2]

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-á-vis domestic companies (Fuest and others, 2013; OECD, 2013).[3]

TPR may have unintended consequences on MNC investment. 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

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[1] Dharmapala (2014) and Hines (2014) comprehensively discuss 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, De Mooij, and Liu (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 (Crivelli, de Mooij, and Keen, 2016; OECD, 2015; UNCTAD, 2015).

[2] Throughout the paper, we use tax-motivated "manipulation of transfer price" and "transfer mispricing" interchangeably, to refer to the situations that MNCs trade between related parties at prices which are systematically influenced by tax differentials to reduce the total tax liabilities of the MNC group.

[3] From the perspective of the MNC, TPR may also increase tax uncertainty (IMF and OECD, 2017; Mescall and Klassen, 2014). This is discussed in Section II.

(Andrews, Criscuolo, and Gal, 2015). The exact relationship between TPR and investment, however, has received little attention in the literature, both in theoretical and empirical research. Indeed, there is currently no direct empirical evidence regarding the investment effect of TPR.[4]

To fill this gap in the literature, this paper explores the effect of TPR on multinational investment. First, we develop a simple model to infer the likely 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 also reduces the return on its investment in the foreign affiliate. Indeed, TPR increases the cost of capital so that fewer investments in the foreign affiliate are undertaken.

Guided by this theory, the paper then empirically explores the impact of TPR on MNC investment. We employ a micro-level dataset containing rich information on both MNC and purely domestic affiliates. The main dataset comprises 27 countries during 2006-2014. This is combined with information on the introduction date of TPRs and an indicator of their strictness. Our main analysis employs a standard difference-in-difference (DD) approach, where 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 run panel regressions, similar to the estimation approach used in Overesch (2009), Lohse and Riedel (2013) and Buettner and Wamser (2013), to estimate changes in the tax sensitivity of multinational investment due to TPRs.

The results from the DD regressions point to a strong negative impact of TPR on MNC investment: investment in foreign affiliates is, on average, around 11 percent lower following the introduction of TPR, compared to investment in similar firms that are wholly domestic. The panel regression suggest, moreover, that the "TPR-adjusted" corporate tax rate is 23 percent larger, i.e. MNC investment responses to tax rates are almost one quarter larger if TPRs are in place.

Deeper analysis further suggests that the investment response to TPR varies in several dimensions. For instance, the effect size rises in the strictness of the TPR but decreases in the share of intangible assets of firms; and the effect is more robust at the intensive than at the extensive margin of investment. Effects are also found to be larger if the tax differential grows, but this relationship is not monotonous and responses actually become smaller at very large tax differences. Finally, the effect is larger and more robust in countries that also employ thin-capitalization rules. Using a different dataset of consolidated accounts, we find further that lower investment in MNC affiliates does not lead to a similar reduction in total investment by the MNC group. We interpret this as evidence of relocation: the multinationals divert their investment away from countries that introduce TPR toward other countries with no TPRs.

[4]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 – another form of anti-avoidance policy – on investment (Buettner and Wamser, 2013).

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 (Beer and Loeprick, 2015; Marques and Pinho, 2016; Nicolay, Nusser, and Pfeiffer, 2016; Saunders-Scott, 2013, 2015), transfer prices (Bernard, Jensen, and Schott, 2006; Clausing, 2003; Cristea and Nguyen, 2016; Davies and others, 2018; Flaaen, 2016; Liu, Schmidt-Eisenlohr, and Guo, 2017; Vicard, 2015), and capital structure (Blouin and others, 2014; Buettner and others, 2012; Buettner and Wamser, 2013; De Mooij and Hebous, 2017; Merlo and Wamser, 2015). 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, Overesch, and Wamser, 2014). Our paper also directly relates to studies of profit-shifting opportunities on MNC investment (Desai, Foley, and Hines, 2006; Grubert and Slemrod, 1998; Hines and Rice, 1994; Overesch, 2009), and the larger literature on taxation and business investment (Bond and Xing, 2015; Caballero, Engel, and Haltiwanger, 1995; Cummins and others, 1994; House and Shapiro, 2008; Yagan, 2015; Zwick and Mahon, 2017), by offering a new perspective on the investment effect of TPRs.

The results in the paper are important for the current policy debate on international taxation. For instance, the negative investment effects from TPRs can make governments reluctant to introduce them unilaterally or encourage them to adopt more lenient regulations in order to mitigate adverse effects on investment. Binding global coordination can prevent this. 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 (Bucovetsky and Haufler, 2007; Janeba and Smart, 2003; Keen, 2001). The results imply further that coordination should also cover other anti-avoidance rules (such as thin-capitalization rules) as otherwise TPRs might cause substitution into other avoidance channels.

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

II. Transfer Pricing Regulation

The current system of international taxation is largely based on separate accounting. This means that the unconsolidated account of a multinational affiliate terminates at the border. To determine the income in each affiliate, 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

mimic prices that would be used in transactions between unrelated parties.[5] 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 costly for tax authorities to verify whether a transfer price used by a MNC is indeed arm's-length. Consequently, MNCs have 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 origin country. Studies for the US, UK and France find evidence for significant responses of the price wedge to the tax rate differential, as supportive evidence for tax-motivated transfer mispricing by MNCs (Bernard, Jensen, and Schott, 2006; Clausing, 2003; Cristea and Nguyen, 2016; Davies and others, 2018; Flaaen, 2016; Liu, Schmidt-Eisenlohr, and Guo, 2017; Vicard, 2015).

To limit transfer mispricing, several countries have introduced transfer pricing regulations (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 by a MNC for establishing an arm's length price; specify requirements for the documentation needed to support the transfer price 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 TPRs 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 *Strategy Matrix for Global Transfer Pricing* and is summarized in Mescall and Klassen (2014). Panel A in Figure 1 provides an overview of the number of countries with TPR 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 exploits countries that have introduced TPR between 2006 and 2014 among the

[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.

27 countries in our sample. These include: Bosnia and Herzegovina (year of TPR introduction: 2008), Finland (2007), Greece (2008), Luxembourg (2011), Norway (2008), and Slovenia (2007).

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 33 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 has been 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 higher values reflecting more stringent TPR.[8] Alternatively, the *tprisk* variable can be interpreted as a 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.[9] 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.

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[6]These detailed TPR features include 12 regulatory variables on whether: (1) the government allows advance pricing agreements, (2) benchmark data are available to taxpayers, (3) the government requires contemporaneous documentation, (4) cost-contribution arrangement is allowed, (5) commissionaire arrangement is allowed, (6) foreign comparables are allowed to estimate transfer prices, (7) related party setoffs (bundling of transactions) are allowed, (8) the taxpayer is required to pay the tax assessment before going to competent authority, (9) the government identifies an order of transfer pricing methods to use, (10) the government requires disclosure on the tax return concerning related party transactions, (11) the government allows a self-initiated adjustment, (12) 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.

[8]The *tprisk* measure is available for countries whose country-specific detailed TPR characteristics are documented in Deloitte's *Global Transfer Pricing Country Guide*. Among the 27 countries in our sample (Table 1), only Bosnia & Herzegovina is not included in the Global Transfer Pricing Country Guide.

[9]For a discussion of the relationship between tax certainty and investment, see IMF and OECD (2017).

III. 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. The firm can 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 cost per unit of intermediate input traded is 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 TPR. For instance, TPR determines the probability of an adjustment in the transfer price or the penalty in case of detected mispricing. Hence, stricter 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) shows 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 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 $(\partial k/\partial(\tau^h - \tau^s) > 0$.

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 stricter TPR also reduces the marginal product of capital f_k and, therefore, investment $\partial k/\partial\beta < 0$. Intuitively, stricter TPR will require a higher marginal return to capital to break even, and therefore, increases the cost of capital. 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), 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 multinational par-*

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

IV. 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, standalone 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 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.

(a) 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.

(b) Country-level Variables As discussed in Section II, 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*. Information about the presence of thin capitalization rules (TCRs) is obtained from De Mooij and Hebous (2017). 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.[10] 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.

(c) 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. First, the analysis on the tax sensitivity of FDI in Section VI.D 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 VII 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 2014. Investment in the consolidated accounts reflect total investment of the company group. Finally, Section VI.B 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.

V. 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. 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 TPR.

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

A. Difference-in-Difference

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:

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

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 III.[11]

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

[11] Note that this approach assumes away any general equilibrium effects. For instance, if a reduction of multinational investment leads 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. In addition, in cases when TPRs also apply to domestic transactions, we expect that TPRs may also affect domestic investment to the extent that domestic group also engage in transfer mispricing by exploiting differences in the statutory tax rates of domestic affiliates due to losses or loss carried forward. If so, the DD coefficient β_{TPR} would capture the differential effect of the TPR on multinational investment, which would represent a lower bound of the TPR impact on total business investment.

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.

(a) 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:

$$\begin{aligned} Investment_{ikt} = a_i + d_t + \sum_{l=-5}^{-1} \beta_l MNC_i \times TPR_{kt} \times Pre-TPR_l \\ + \sum_{Post-TPR_n} \beta_n MNC_i \times TPR_{kt} \times Post-TPR_n + \beta_{\mathbf{x}} \mathbf{x}_{ikt} + \beta_{\mathbf{z}} \mathbf{z}_{kt} + \varepsilon_{ikt}, \end{aligned} \tag{9}$$

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.[12] 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. The $p-$value of

[12]The coefficients on the $MNC_i \times TPR_{kt} \times Post-TPR_n$ variables also shed lights on the dynamics of the investment effect. The results indicate that TPR has a large negative effect on investment in the first year after its adoption. This is consistent with that investment decisions are forward-looking. The size of its effect is smaller but remains significant in later years, indicating that TPRs have lasting permanent effect on MNC investment.

0.23 does not reject the null hypothesis; our parallel trends assumption therefore passes the placebo test.

B. Panel Regression

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 III is that a tightening of TPR increases the cost of capital on MNC 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 measure 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 with respect to the corporate tax rate in the absence of TPR (i.e. $\beta_{tax} \equiv \frac{\partial lnInvestment}{\partial CIT}$). After the introduction of TPR, the semi-elasticity changes by β_{tax}^{TPR} into $\gamma_{tax} = \beta_{tax}$. Using our sample, we can directly estimate β_{tax} and β_{tax}^{TPR} from the following regression:

$$ln(Investment_{ikt}) = a_i + d_t + \beta_{tax} CIT_{kt} + \beta_{tax}^{TPR} \times CIT_{kt} \times TPR_{kt} + \beta_{\mathbf{x}} \mathbf{x}_{ikt} + \varepsilon_{ikt}. \qquad (10)$$

Since $lnInvestment = \beta_{tax} \times (1 + \frac{\beta_{tax}^{TPR}}{\beta_{tax}}) \times CIT_t$, a change in the semi-elasticity can also be interpreted as (assuming a constant β_{tax}) a change in the effective rate of CIT, namely TPR increases the tax rate in proportion to the fraction $\frac{\beta_{tax}^{TPR}}{\beta_{tax}}$. Each percentage point change in the CIT rate in the absence of TPR (i.e. $\beta_{tax}^{TPR} = 0$) will thus have an equivalent effect in the presence of TPR of $(1 + \frac{\beta_{tax}^{TPR}}{\beta_{tax}}) \times CIT_t$. We can call the latter the "TPR-adjusted" corporate tax rate. A similar exercise can be performed, using the cost of capital instead of the statutory CIT rate, which we can call the "TPR-adjusted" cost of capital. The empirical analysis below will measure these adjustments to infer the corresponding tax adjustment due to the introduction of TPR.

VI. Results

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

A. Baseline

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 -0.049 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.

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 -0.041 and significant at the 1 percent level. It suggests that, on average, the implementation of TPR reduces the investment rate (i.e. investment as a percentage of the fixed assets) by multinationals by 4.1 percentage point. Given that the average gross investment per dollar of fixed asset is 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 an interaction term between MNC_i 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 interaction term suggests that this is indeed the case, with a coefficient of -0.072 that is significant at the 1 percent level.[13] For a country with a relatively lenient TPR regime (index of 3.0), the reduction in MNC investment would thus be 0.216 percentage points; for a country with the strictest regime (index of 5.17), this would be a 0.36 percentage points.

[13]The *tprisk* measure is not available for countries without TPRs, hence the regression in Column (7) explores variation in the strictness of TPR for countries with TPRs.

B. Robustness

Table 5 presents regressions from alternative specifications and samples to test the robustness of the findings in Table 4. Column (1) excludes affiliates with a parent residing in country that has a worldwide tax system, which could mute the incentive for profit shifting compared to territorial taxation. Column (2) clusters the standard errors at the host country level 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, Duflo, and Mullainathan, 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 0.018, but remains statistically significant at the 1 percent level. Moreover, 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, Ichimura, and Todd (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.[14]

C. Heterogeneous Responses

Table 6 explores heterogeneity in investment responses across firms. First, it looks at intensive and extensive margins. Second, it looks at the variation in the size of tax differentials. Third, it explores variation in the intensity of intangible assets. Finally, it examines separately the investment effect of TPR in countries with and without thin-capitalization rules.

(a) Extensive vs. Intensive Margin. The first two columns of Table 6 explore the difference between intensive and extensive margin investment responses. Column (1) 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 (2) examines the intensive margin response

[14]We run an additional robustness check by dropping all Luxembourg affiliates from the estimation sample, to address the concern that these affiliates tend to be specialized in treasury operations and do very little investment in real assets. The results are very similar: the DD coefficient is -0.043 and significant at the 1 percent level.

using the logarithm of investment as the dependent variable, thus excluding observations with negative investment. The DD coefficient is positive and highly significant. Hence, investment reductions due to TPR are most likely due to lower investment by MNCs with positive investment prior to the policy change.

(b) The size of tax differential. Eq. (6) suggests that the tax differential matters for the impact of TPRs on investment, with the impact becoming larger if the tax differential increases.[15] 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:

$$Investment_{ikt} = a_i + d_t + \sum_{j=1}^{4} \beta_j MNC_i \times TPR_{kt} \times \{\mathbf{I}|TaxDiff \in Quartile_j\} + \beta_{\mathbf{x}}\mathbf{x}_{ikt} + \varepsilon_{ikt}, \qquad (11)$$

Column (3) of Table 6 presents the coefficients obtained from this regression. The results suggest that the tax differential indeed matters. At the bottom quartile of tax differential, the response to TPR is negative but insignificant. This may be due to fixed costs associated with changing investment, or because MNCs shift very little profit if tax differentials are small due to the fixed cost of shifting. The investment effect is larger and highly significant in the 2^{nd} quartile of the tax differential, consistent with the theory. However, the impact does not increase monotonically in the tax differential. In fact, the coefficient becomes smaller and less significant in the 3^{rd} and 4^{th} quartile, although it remains negative and significant at 10 percent.

(c) The intensity of intangible assets. For firms investing heavily in intangible assets, it can be difficult to find comparable prices to comply with the arm's length principle. For them, the impact of TPR on investment can be quite different. On the one hand, it might be that TPR offers little guidance as to how transfer prices should be determined. In that case, we might expect that the impact of TPR declines in the share of intangibles. On the other hand, it might also be that TPR is more important for them as it provides tax authorities with greater power to adjust transfer prices. The regression can show which of these is more likely. We test the effect of intangible asset intensity on the relationship between TPR and investment in the following specification:

$$Investment_{ikt} = a_i + d_t + \beta_{TPR} MNC_i \times TPR_{kt} + \beta_{Intang} MNC_i \times TPR_{kt} \times IntangShare_i + \beta_{\mathbf{x}}\mathbf{x}_{ikt} + \varepsilon_{ikt}, \qquad (12)$$

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

[15] 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).

the changing impact of transfer pricing regulation on investment across firms of different intangible asset intensity.

Table 6 Column (4) reports a negative coefficient estimate on the main interaction term $MNC_i \times TPR_{kt}$. The coefficient on the three-way interaction term with the share of intangibles is small but positive and highly significant. Hence, the negative effect of TPR on multinational investment decreases in the firm's intensity of intangible assets. Note that the size of this effect is small: the difference between a firm with no intangibles ($IntangShare = 0$) and a firm with only intangibles ($IntangShare = 1$) is only 0.2 percentage points, i.e. the investment effect drop from -3.2 percentage points to -3.0 percentage points.

(d) Interaction between TPRs and TCRs. MNCs can shift profits through different channels. For instance, apart from the manipulation of transfer prices, they can use intra-company loans to enjoy interest deductions in high-tax affiliates and have the interest taxed in low-tax affiliates.[16] Hence, it might be that MNCs will respond to the introduction of TPR by substituting away from abusive transfer pricing toward debt shifting through the use of intra-company loans (Saunders-Scott, 2015).[17] Hence, TPRs might be less effective in restricting the overall profit shifting by MNCs if there are no TCRs in place due to unlimited substitution. In that case, the introduction of TPR might have little impact on the effective cost of capital for multinationals and we may expect a smaller effect on investment, relative to the case where a TCR is in place.

To examine the interaction between TPRs and TCRs, we divide the host countries in our sample into one group without any TCR, and a group with some TCR during the sample period. We then estimate separately the effect of TPR on multinational investment in each country group, using the DD regression based on Eq. (7). Columns (5) and (6) of Table 6 report these results. Interestingly and consistent with our prediction, the DD coefficient for countries without TCR is -0.013 and insignificant (Column (5)), while the DD coefficient for countries with TCR is almost three times larger and significant at 1 percent (Column (6)). Hence transfer mispricing and debt shifting are likely to be substitutes in MNC profit shifting. The effectiveness of one measure against tax avoidance thus depends critically on other measures. At the same time, the more effective these packages become in limiting profit shifting, the more likely it becomes that they reduce MNC investment.

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[16] Beer, De Mooij, and Liu (2018) reviews existing empirical evidence on six main channels of international tax avoidance, including on transfer mispricing, strategic location of intellectual property (IP), international debt shifting, treaty shopping, corporate inversion/headquarter location, and tax deferral.

[17] Saunders-Scott (2015) examines changes in the reported EBIT following a tightening of thin-capitalization rules for multinational affiliates, using the ORBIS database. The findings suggest that MNCs use transfer mispricing and intra-company debt shifting as substitutes.

D. TPR-adjusted tax elasticity

Table 7 summaries the regression results based on Eq. (10) using a smaller sample that includes only multinational affiliates. Column (1) suggests that without TPR, a one percentage point lower statutory CIT rate in the host country increases 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 regression controls for output (proxied by *log* Sales) and employment (proxied by *log* Number of workers). The results suggest that the estimated semi-elasticity of fixed capital assets 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. Hence, after TPR introduction, corporate tax rates matter about one quarter more for MNC investment than before TPR. The reason is that, as MNCs find it more costly to avoid high tax rates through profit shifting, they become more responsive in their investment to those taxes. Following our interpretation in Section V.B, 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 the same and imply that the "TPR-adjusted" cost of capital is 15 percent larger than the cost of capital without TPR.

VII. Effect on Total MNC Investment

The reduction in fixed capital investment by MNC affiliates identified in Section VI may have two alternative interpretations: it could reflect (i) a reduction in total investment due to a higher cost of capital for the entire MNC company group; or (ii) a relocation of investment to other affiliates of the same MNC group. Both investment responses reduce output in the host country in similar ways. However, they have very different economic implications for the rest of the world. Indeed, lower investment by the MNC group would unambiguously reduce global output, while a reallocation of investments across countries would imply a shift of production toward countries that enjoy an inflow of investment. Global output might still decline due to production inefficiency, but is smaller under the second scenario. 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 strategy based on Eq. (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. 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, leading to attenuation bias.

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 Eq. (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 coefficient becomes insignificant when including 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 adding industry-year fixed effects and industry-country fixed effects in Column (4). Column (5) interacts the discrete interaction term with the top statutory CIT rate in the parent country, and the basic finding remains unchanged.[18] 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 might indeed be due to a relocation effect of investment.

VIII. Conclusions

Despite 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 implications for investment. This paper fills this gap. It uses 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, it is argued 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 causal impact on multinational investment. Our data comprises the period between 2006 and 2014, during which seven 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 more than 11 percent. The reduction in investment is larger if transfer pricing regulation become stricter; and it is also larger for firms that are less intensive in the use of intangible assets. The investment response becomes smaller if the tax differential with other countries becomes very small or in countries that have no thin capitalization rules in place. Regressions based on consolidated statements indicate that aggregate multina-

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

tional investment is not affected by transfer pricing regulations, suggesting that multinational firms relocate investment toward affiliates in other countries rather than cut global investment. Thus, transfer pricing regulations induce spillover effects to other countries.

Our results have important policy implications. For example, unilateral introduction of transfer pricing regulation will distort the international allocation of capital; and the negative investment effect can make countries reluctant to adopt them or make them more lenient. Binding international coordination can prevent this, but might not be beneficial for all countries. Also, broad coverage of different anti-avoidance measures is important, as avoidance channels may be substitutes: restricting only one channel will therefore cause a substitution toward other channels of profit shifting.

More research is needed to understand these real effects of other anti-avoidance regulations, including 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, such as corporate tax rates, is important. These issues are left for further research.

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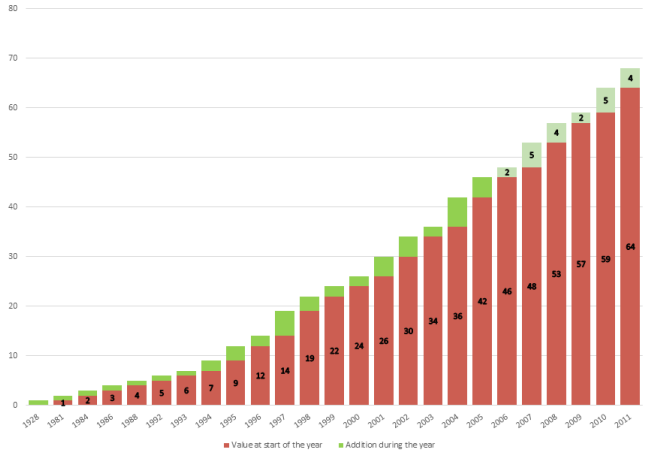
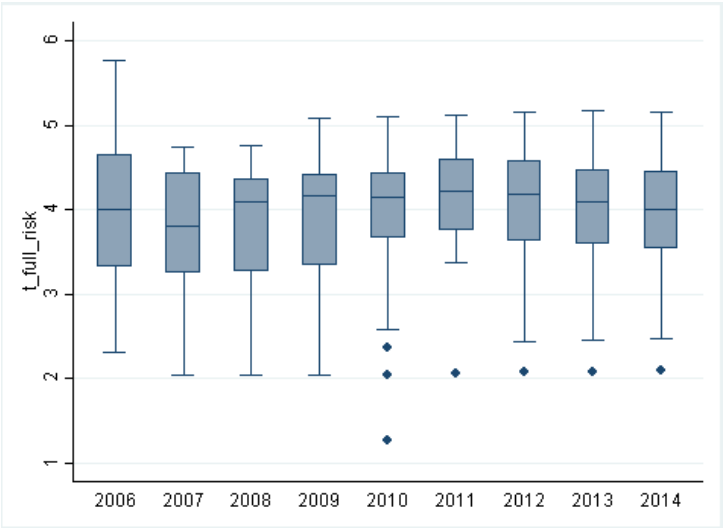
Figure 1. Transfer Pricing Regulations (TPRs)

A. Number of Countries with TPRs

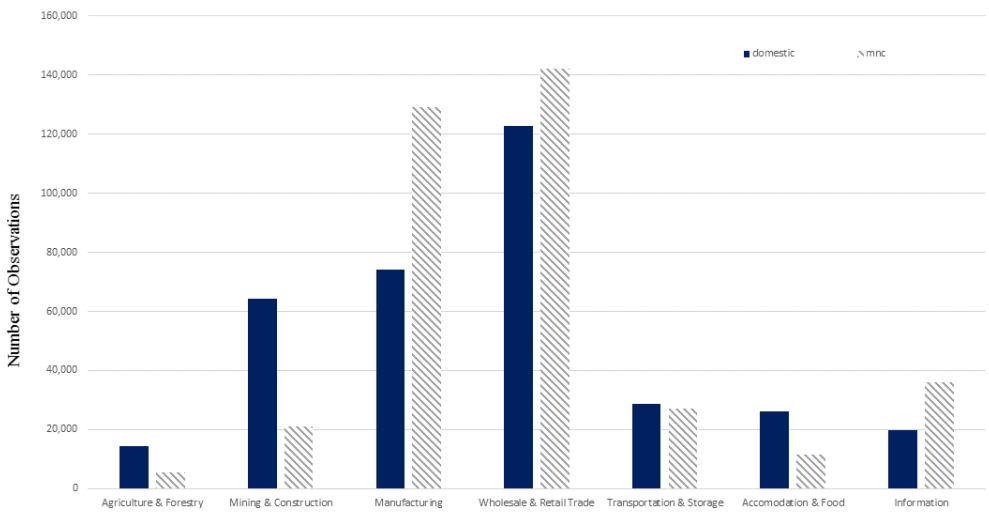


B. Variation in the Strictness of TPRs



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. The dots denote the minimum value of $tprisk$ in later years.

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	30,589	70.73	-47	2,266
Fixed asset ($1,000)	11,528	133,200	689.49	27	14,167
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)	40,579	20,855	42,249	12,977	60,944
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)	
$MNC_i \times tprisk_{kt}$							-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	N	N	N	N	N
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

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

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 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 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 Responses

Firm/Country Characteristic:	Investment Response Margin		Tax	Share of	Host Countries with	
	$I > 0$	$logI$	Differential	Intangible Assets	No TCR	TCR
Dept Var: Investment per $ fixed asset	(1)	(2)	(3)	(4)	(5)	(6)
$MNC_i \times TPR_{kt} \times Quartile_{TaxDiff,1}$			-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)			
$MNC_i \times TPR_{kt}$	0.002	-0.037**		-0.032***	-0.013	-0.036***
	(0.004)	(0.016)		(0.008)	(0.011)	(0.010)
$MNC_i \times TPR_{kt} \times IntangShare_i$				0.002***		
				(0.000)		
$log(Sales_{t-1})$	-0.055***	0.164***	-0.160***	-0.160***	-0.134***	-0.207***
	(0.002)	(0.011)	(0.007)	(0.007)	(0.008)	(0.011)
Cash flow per $ fixed asset	0.005***	0.005***	0.038***	0.038***	0.037***	0.039***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Profitability_{t-1}$	0.104***	0.159***	0.081***	0.082***	0.012	0.212***
	(0.007)	(0.031)	(0.018)	(0.018)	(0.022)	(0.033)
$Sales\ growth\ rate_{t-1}$	-0.020***	0.040***	0.039***	0.039***	0.047***	0.029***
	(0.003)	(0.010)	(0.007)	(0.007)	(0.009)	(0.010)
Firm 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
R^2	0.354	0.827	0.278	0.278	0.278	0.277
N	439507	337110	486,754	486,754	251,430	235,324

Notes: This table presents regression results on the heterogeneous effect of TPR on investment. The dependent variable in Column (1) is a dummy indicator that takes the value of 1 for positive investment, and 0 otherwise. The dependent variable in Column (2) is the level of investment in logarithm. Column (3) 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 (4) 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. Columns (5) and (6) report the effect of TPR in countries without and with thin-capitalization rules, respectively. ***, **, * 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
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 the effect of taxes, including CIT rate and the cost of capital, on multinational investment with and without TPR. 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 1 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	N	N	N
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.