Leveling the Playing Field: Constraints on Multinational Profit Shifting and the Performance of National Firms

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Leveling the Playing Field: Constraints on Multinational Profit Shifting and the Performance of National Firms

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Abstract

A flourishing literature quantifies the corporate tax revenue losses from multinational profit shifting to low-tax economies. Other consequences of international tax avoidance have received little attention. In this paper, we empirically assess the widespread perception that international tax avoidance impacts product market outcomes and can put national competitors of multinational firms at a competitive disadvantage. The empirical identification strategy relies on changes in transfer pricing regulations that constrain multinational profit shifting by strategic mis-pricing of intra-firm trade. Based on rich data on firms in European high-tax countries, we show that tighter transfer pricing provisions raise multinational firms' effective tax costs and significantly increase the observed sales and profits of affected firms' national competitors; mark-ups, in turn, remain largely unchanged. We discuss policy implications of our findings.

Keywords: Multinational firms, international tax avoidance, transfer pricing rules, product market outcomes

JEL Classification: H25, H26, H32, L19

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1 Introduction

Anecdotal evidence suggests that many large multinational enterprises (MNEs) pay strikingly little taxes on their worldwide profit (e.g. Sullivan, 2017, Cerullo, 2019). Media and parliamentary investigations into the tax structures of some of these firms show that many rely on complex and sophisticated international tax avoidance schemes. Recent years have also seen the emergence of a flourishing academic literature that provides systematic evidence that multinational profit shifting is a quantitatively relevant phenomenon (see, e.g. Huizinga et al., 2008, Dowd et al., 2017, Tørsløv et al., 2022). Several shifting channels have been identified. A particularly important one is the strategic mis-pricing of intra-firm trade (see e.g., Heckemeyer and Overesch, 2017, Cristea and Nguyen, 2016, Davies et al., 2018, Liu et al., 2020).

A number of recent papers also discuss the fiscal implications of profit shifting: They quantify the corporate tax revenue losses in high-tax countries (e.g. Tørsløv et al., 2022) and assess the implications for international tax competition (e.g. Keen and Konrad, 2013). Other consequences of profit shifting have been largely ignored, in turn. In this paper, we quantify the impact of profit shifting on product market outcomes. There is a strong presumption among policymakers that international tax avoidance implies an unfair competitive advantage for multinational firms. The introductory section to the OECD's base erosion and profit shifting (BEPS) action plan, which sets the agenda for recent years' worldwide coordinated fight against profit shifting, states:
"Failing to take advantage of legal [profit shifting] opportunities [...] can put [...] [MNEs] at a competitive disadvantage. Similarly, corporations that only compete in domestic markets [...] have difficulties competing with MNEs that shift their profits across borders to avoid or reduce tax" (OECD, 2013, p. 8).
In this paper, we empirically assess the link between profit shifting and product market outcomes. Our analysis draws on rich firm-level data for high-tax countries in Europe and exploits variation in transfer pricing legislation that aims to inhibit tax-motivated mis-pricing of intra-firm trade and related profit shifting to low-tax countries. Specifically, we assess whether closing the gap between the tax costs faced by national firms and MNEs improves national competitors' product market performance.

To obtain guidance for the empirical analysis, we develop a simple monopolistic competition model, where multinational and purely national firms compete in product markets. Production requires an input good, which national entities (NEs) source from national input suppliers. MNEs, in turn, obtain their inputs from a subsidiary located in a low-tax country. In the absence of constraints on multinational profit shifting, MNEs set the input price above the arm's length price to shift income to the low-tax entity. This lowers their effective tax costs and increases their sales at the expense of national

firms. Tighter transfer pricing provisions alter firm behavior. They impose additional tax costs on MNEs by limiting opportunities for trade mis-pricing and by raising firms' tax compliance burden (see, e.g. Durst, 2010).[1] The model predicts that MNEs react to these cost shocks by increasing output prices and lowering sales. This has repercussions on national competitors, whose sales increase. The impact on national firms' mark-ups is theoretically unclear and depends on the shape of the demand function.[2]

We take these hypotheses to the data and assess how changes in transfer pricing regulations impact product market outcomes by quantifying their effect on national firms. Our empirical analysis relies on a difference-in-differences strategy and compares the impact of transfer pricing provisions on NEs' sales and mark-ups, differentiating between NEs that are strongly and weakly exposed to multinational competitors. The base specifications include a full set of host country-year fixed effects and thus non-parametrically control for confounding factors at the host country-level. Put differently, our difference-in-differences strategy compares the response behavior of NEs *in the same country*, which differ in their exposure to MNE competitors. In additional models, we refine this analysis and show that the results remain unchanged when we compare NEs in the same country and the same industry section, which differ in their exposure to MNE-competitors.

As our empirical setting is a two-way fixed effect design, where firms are subject to a staggered treatment, the estimates may be biased in the presence of heterogenous and dynamic treatment effects (e.g. Goodman-Bacon, 2021). In our empirical application, these concerns are dampened by the fact that a substantial fraction of firms in our data are "never-treated" - that is, they operate in markets where they face no multinational competitors. In sensitivity checks, we, moreover, show that our results are robust to using estimators that are unbiased under heterogeneous and dynamic effects (de Chaisemartin and D'Haultfoeuille, 2022a).

The empirical analysis draws on rich firm-level data provided by Bureau van Dijk. The data allows identifying NEs and MNEs with their global affiliate network. The

[1]Durst (2010) stresses that large multinational groups spend millions of US dollars annually to comply with transfer pricing laws. Along similar lines, surveys of tax practitioners reveal that international transfer pricing laws are considered to belong to the most important tax challenges of multinational groups (see, for example, Ernst & Young, 2007).

[2]Note that additional MNE costs from tighter transfer pricing provisions may be variable or fixed in nature. If profit shifting volumes are unrelated to company size, then reductions in shifting activities correspond to a fixed cost increase. If profit shifting positively correlates with company size, reductions in profit shifting reflect an increase in variable costs. Analogously, some compliance costs may be fixed in nature, others variable (transfer price documentation, e.g., becomes more costly the more varieties are traded internationally). In consequence, MNEs may respond to tighter transfer pricing provisions by intensive margin adjustments (reducing their sales) or by extensive margin adjustments (exiting the market). National firms respond by increasing their sales or by entering the market. Our data is not well suited to model entry and exit decisions. We thus focus on intensive margin adjustments.

sample period comprises the years 2004–2013, when numerous high tax countries in Europe unilaterally tightened their transfer pricing provisions - among others by introducing regulations that require firms to contemporaneously document internal transfer prices and report them to the tax authority.[3] We determine the impact of these rules on the product market outcomes of national firms, which differ in their exposure to multinational competitors. Product market outcomes are measured by the value of national firms' sales and input factor use (assets, employment and wage costs). The latter variables serve as proxy for firms' sales *quantity*, which is unobserved in accounting data. We, moreover, follow De Loecker and Warzynski (2012) and Ackerberg et al. (2015) and use the accounting data at hand to estimate firm-specific mark-ups.

Competitors in product markets are identified as entities operating in the same 4-digit industry and the same country. For each national firm in the sample, we construct a measure that captures NEs' exposure to multinational competitors. To avoid obvious endogeneity problems, exposure is calculated for the first sample year and is kept constant throughout the sample frame. We run extensive robustness checks, where we show that changes in the definition of firms' MNE-exposure do not impact our results. Among others, we create measures that capture NEs' exposure to multinational firms that tend to be aggressive profit shifters (that is, we focus on MNE groups with a presence in a tax haven economy).

This firm-level data is linked to information on the tightness of countries' transfer pricing provisions. Transfer pricing rules regulate that intra-firm trade is to be priced at 'arm's length': the internal trade price must correspond to the price that would have been chosen by independent parties. Even conditional on the existence of transfer pricing rules, the regulations widely vary in scope across countries. Their tightness depends on multiple factors, among others, on whether firms are required to contemporaneously document intra-firm transfer prices, on the allowed methods to calculate arm's length prices, on penalty regimes and the strictness with which transfer pricing rules are enforced. We follow Mescall and Klassen (2018) and aggregate these dimensions into one index reflecting the scope of transfer price regulations.[4]

The empirical results indicate that MNEs that become subject to tighter transfer pricing regulations in their host country - as measured by the sketched transfer pricing index - observe an increase in their effective tax costs. This is in line with prior evidence (e.g. Beer and Loeprick, 2015) and suggests that transfer pricing regulations bite and limit tax avoidance activities through mis-pricing of intra-firm trade. We, furthermore,

[3]From 2013 onwards, countries in Europe and around the world engaged in *multilateral* efforts to tighten transfer pricing provisions, in turn. These changes are a common shock to all multinational firms in the European Union and worldwide - and, in part, also directly impact national firms. They are hence less well suited to identify the effect of interest.

[4]This index is used in other prior work, e.g. Liu and de Mooij (2020).

add to the literature by documenting that national firm performance improves when multinational competitors become subject to tighter transfer pricing regulations: NEs significantly increase their sales value and quantity in response to tighter transfer pricing rules if they are strongly exposed to multinational competitors. When comparing NEs, which operate in industries that feature an average MNE-market share (34%) to NEs that are unexposed to MNE-competitors, a one standard deviation increase in the tightness of transfer pricing provisions is found to raise the former firms' sales by 1.9%. When accounting for NEs in industries that are dominated by MNE competitors (i.e. with an MNE-market share close to 1), the estimates suggest that the latter firms' sales rise by 5.7% when the transfer pricing score increases by one standard deviation. We analogously find a significantly positive effect of transfer pricing provisions on national firms' input factor use, which is consistent with increased firm production and sales. While profits increase, the results reject significant changes in national firms' mark-ups.

These findings carry important policy implications. The impact of profit shifting activities - and constraints on them - is shown to go beyond tax revenue losses in high-tax countries that have been in the focus of the existing literature. Product market outcomes are distorted as well, which can have non-negligible distributional and efficiency consequences. The sketched product market distortions may imply that income is redistributed from owners of national firms to owners of multinational firms. If effective corporate tax burdens are, in part, passed on to workers and consumers, there may also be repercussions on the distribution of wages and consumer rent: workers (consumers) of multinational firms benefit at the expense of workers (consumers) of national firms.[5] On efficiency grounds, the findings imply that sales volumes and market shares are not solely governed by productivity differences, but are also shaped by differences in effective tax costs.

Our paper contributes to a growing literature on multinational profit shifting. Existing empirical work is concerned with identifying profit shifting channels and quantifying their relevance (see, e.g. Dharmapala, 2014, Heckemeyer and Overesch, 2017, Riedel, 2018 and Tørsløv et al., 2022 for surveys). Implications of profit shifting are mostly discussed from a fiscal perspective. Other consequences are largely ignored, in turn, including the impact of profit shifting on product market outcomes. An exception is Martin et al. (2020) who document - based on US firm data - that corporate tax avoidance is positively associated with firm-level sales. They show that in particular large MNEs expanded their tax avoidance activities over recent years - responding to a drop in IRS audit rates - which contributed to the observed rise in market concentration.

[5]These arguments presume that there is no full diversification, i.e. that firm owners do not in equal shares participate in MNEs and NEs; workers do not in equal shares supply labor to MNEs and NEs and consumers do not in equal shares consume products from MNEs and NEs.

The evidence in our paper confirms these findings but differs from Martin et al. (2020) in important dimensions: First, our identification strategy relies on changes in transfer pricing provisions, not on variation in tax authorities' tax return auditing strategies. The former constrain *international* tax avoidance activities, while the latter impact both domestic and international tax evasion and avoidance. Our paper thus speaks more directly to the literature and policy debates on multinational profit shifting and countermeasures to combat it. We, moreover, present evidence on the link between multinational profit shifting and product market outcomes in Europe. There are significant institutional differences between the US and the EU and the size and structure of profit shifting differs pronouncedly across world regions (see, e.g. Markle and Shackelford, 2012; Overesch et al., 2020; Tørsløv et al., 2022). It is thus, a priori, unclear whether insights from the US context carry over to Europe.[6]

Our work, moreover, connects to studies on the economic effects of anti-tax avoidance legislation (see, e.g. Buettner et al., 2012, Egger and Wamser, 2015 and Clifford, 2019). Beer and Loeprick (2015) - consistent with our findings - present evidence that transfer pricing legislation lower intra-firm trade mis-pricings and income relocation to low-tax entities. Recent work also documents that anti-shifting legislation impacts firm investment (see Buettner et al., 2018, Merlo et al., 2020 and Liu and de Mooij, 2020). Competitive effects of anti-shifting legislation - that are in the focus of our work - have so far been ignored in this strand of the literature, however.

The remainder of the paper is structured as follows: Section 2 presents a simple theoretical model to guide our empirical analysis. Sections 3 to 5 sketch the data, the empirical identification strategy and results. Section 6 concludes.

2 Theoretical Considerations

In this section, we set up a simple theoretical model to guide our empirical analysis.

[6]Note that our identification strategy also offers advantages. As we assess changes in market outcomes of NEs that are not directly targeted by the policy reforms at hand, endogeneity concerns, e.g. related to firm outcomes shaping governments' policy choices, are by design of lower relevance. Furthermore note that our paper also connects to work by Flach et al. (2021) who analyze the impact of corporate taxes on firms' exporting behavior. In line with our findings, they document that corporate taxes have competitive effects: tax decreases in exporters' destination markets reduce firms' number of exported products and skew export sales towards better performing varieties.

2.1 Household Problem

Consider a country i with L identical households who have CES preferences over a set of differentiated varieties. The utility function is:

$$U = \left[\int_{\omega \in \Omega} (c(\omega))^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}} \tag{1}$$

with $c(\omega)$ denoting the individual consumption of variety ω. The index i is omitted for simplicity. The parameter σ is the elasticity of substitution with $\sigma > 1$.

We assume all consumers have labour income w from inelastically supplying one unit of labor.[7] The budget constraint is given by:

$$w = \int_{\omega \in \Omega} p(\omega) c(\omega) d\omega \tag{2}$$

Standard utility maximization yields individual Marshallian demand:

$$c(\omega) = w(p(\omega))^{-\sigma} P^{\sigma-1}, \tag{3}$$

where P is the overall price index in the country defined as:

$$P = \left[\int_{\omega \in \Omega} (p(\omega))^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}} \tag{4}$$

Consequently, market demand is given by

$$q(\omega) = L \cdot c(\omega) = Lw(p(\omega))^{-\sigma} P^{\sigma-1}. \tag{5}$$

2.2 Firm Problem

Each variety is produced by a single, monopolistically competitive firm using labour ℓ and an intermediate good m according to the production function $F(\ell, m)$.[8] There are Ω_{NE} national enterprises and Ω_{MNE} multinational enterprises. The latter are assumed to own a foreign subsidiary in a low tax country s. While nationals purchase intermediates on the world market at price r, multinationals can source intermediates from

[7] We treat w as exogenously fixed. Alternatively, we could assume the existence of a sector not affected by transfer price regulations (e.g. agriculture) where the value of the marginal product of labour is constant equal to w, which would endogenously fix the wage rate in the economy at w.

[8] Our theoretical analysis abstracts from firm heterogeneity. It would be straightforward to e.g. introduce firm specific productivity - but this would complicate the analysis without material effect on model predictions.

their foreign subsidiary at price p_m. To isolate the allocative impact of transfer price distortions, we assume that MNEs can produce the intermediate good at constant per unit cost equal to the world market price r.

2.2.1 National Firms

Profits of national firms are given by

$$\pi^{NE} = (1 - t_i)\Big(p^{NE}F(\ell, m) - r \cdot m - w \cdot \ell\Big) \tag{6}$$

where t_i stands for the corporate tax rate in country i and p^{NE} is the output price set by national firms. To simplify notation, we suppress the index ω in the following derivations. We characterize the optimal behavior of national firms in two steps.

First, optimal input choices are determined via the cost minimization problem

$$\min_{\ell,m} (1 - t_i)w \cdot \ell + (1 - t_i)r \cdot m \quad \text{s.t.} \quad F(\ell, m) \geq y,$$

where the relevant input costs are expressed net-of-tax, reflecting that input costs are deductible from the corporate tax base. The solution to this minimization problem yields a cost function $C\Big((1-t_i)w, (1-t_i)r, y\Big)$. Because cost functions are homogenous of degree one in input prices, we have:

$$C\Big((1 - t_i)w, (1 - t_i)r, y\Big) = (1 - t_i)C(w, r, y).$$

Second, the firm's optimal price maximizes

$$\pi^{NE} = (1 - t_i)\left(p^{NE} \cdot y - C(w, r, y)\right).$$

Given CES demand, firms set the optimal price as a constant mark-up above marginal cost $C_y(w, r, y) := c(w, r, y)$ (where the subscript denotes the partial derivative):

$$p^{NE} = \frac{\sigma}{\sigma - 1} c(w, r, y). \tag{7}$$

National firms' sales are given by

$$q^{NE} = \left(\frac{\sigma - 1}{\sigma}\right)^{\sigma} \frac{LwP^{\sigma-1}}{c(w, r, y)^{\sigma}}. \tag{8}$$

2.2.2 Multinational Firms

Multinational firms, in addition to producing in country i source their input from a subsidiary in a tax haven country s (which levies a tax rate below the tax rate in

country i, $t_s < t_i$). The profit function of MNEs is defined as:

$$(1-t_i)\Big(p^{MNE}F(\ell,m) - w\cdot\ell - p_m\cdot m\Big) + (1-t_s)(p_m-r)\cdot m - \gamma(p_m-r,\theta)\cdot m, \tag{9}$$

where p^{MNE} denotes the output price set by multinational firms and γ depicts MNEs' costs to conceal transfer price distortions. γ increases in the deviation of the transfer price from its true price $(p_m - r)$ and in the tightness of prevailing transfer price regulations θ. Let $\delta = p_m - r$ denote the transfer price distortion and assume a standard convex concealment costs function where, for $\delta \geq 0$, it holds: $\gamma_\delta > 0, \gamma_{\delta\delta} > 0$, $\gamma_{\delta\theta} > 0$ and subscripts again denote derivatives.[9] The first term of equation (9) reflects profits in country i, the second term profits at the foreign subsidiary and the last term MNEs' concealment costs. Equation (9) can be written as

$$(1-t_i)\Big(p^{MNE}F(\ell,m) - w\cdot\ell - r\cdot m\Big) + \Big(\delta\cdot(t_i-t_s) - \gamma(\delta,\theta)\Big)\cdot m. \tag{10}$$

Note that the first term measures profit in the absence of profit shifting and is thus identical to the profit function of a national enterprise. The second term captures the net gains from profit shifting: the volume of shifted profit $(\delta \cdot m)$ multiplied by the tax rate differential net of the concealment cost incurred by the firm.

In addition to choosing inputs and p^{MNE} optimally, the MNE must also decide on the transfer price distortion δ. We characterize optimal behavior of MNEs in three steps. First, the MNEs' optimal transfer price choice is characterized by

$$(t_i - t_s) - \gamma_\delta(\theta,\delta) = 0$$

and is independent from input choices and p^{MNE} and thus fixes $\delta^\star$. Comparative statics imply that optimal transfer price distortions go down if transfer price regulations become tighter. Formally,

$$\frac{\partial\delta^\star}{\partial\theta} = -\frac{\gamma_{\delta\theta}}{\gamma_{\delta\delta}} < 0.$$

The second step is to solve MNEs' cost minimization problem, where the relevant factor cost for the MNEs are again net-of-tax and, in case of the intermediate input, also adjusted for the gains from profit shifting. Based on equation (10), we therefore

[9]Note that, as $t_s < t_i$, MNEs set $\delta \geq 0$. To isolate the allocative impact of transfer price distortions, we, moreover, assume that MNEs can produce the intermediate good at constant per unit cost equal to the world market price r. The underlying presumption is that MNEs, if they incur concealment costs, can justify a transfer price p_m higher than r, e.g. by pretending to incur production costs higher than r or by reference to trade frictions.

define relevant factor cost as $\tilde{w} = (1 - t_i)w$ and $\tilde{r}$ with:

$$\tilde{r} = (1 - t_i)\left(r - \frac{a(\delta^\star, \theta)}{1 - t_i}\right) := (1 - t_i)\left(r - \tilde{a}(\delta^\star, \theta)\right),$$

where

$$a(\delta^\star, \theta) = \delta^\star \cdot (t_i - t_s) - \gamma(\delta^\star, \theta)$$

measures the MNEs' cost advantage from profit shifting. The solution to the MNE's cost minimization problem

$$\min_{\ell, m} \ \tilde{w} \cdot \ell + \tilde{r} \cdot m \quad \text{s.t.} \quad F(\ell, m) \geq y$$

yields the cost function

$$C(\tilde{w}, \tilde{r}, y) = (1 - t_i)C(w, r - \tilde{a}(\delta^\star, \theta), y).$$

CES demand then again implies constant mark-up pricing

$$p^{MNE} = \frac{\sigma}{\sigma - 1} c(w, r - \tilde{a}(\delta^\star, \theta), y).$$

Note that in the absence of profit shifting opportunities ($\tilde{a}(\cdot) = 0$), the MNE would charge the same price as a national firm. Because intermediate input use allows the MNE to shift profits to the low tax jurisdiction ($\tilde{a}(\cdot) > 0$), however, the MNE has lower (effective) marginal cost and thus charges a lower price and has higher sales than an otherwise identical national firm. Applying the envelope theorem, it is straight forward to show that the marginal cost advantage shrinks with tighter transfer price regulations (i.e., with higher values of θ):

$$\frac{\partial \tilde{a}}{\partial \theta} = \frac{1}{1 - t_i}\left(\delta^\star_\theta (t_i - t_s) - \gamma_\theta - \gamma_\delta \cdot \delta^\star_\theta\right) = -\gamma_\theta < 0.$$

Intuitively, tighter transfer pricing regulations reduce transfer price distortions and thus the cost advantage arising from profit shifting leading to higher effective intermediate input cost. This induces higher marginal production cost $c(w, r - \tilde{a}(\delta^\star, \theta), y)$ as long as the intermediate input m is a normal input, i.e. as long as the cost minimizing use of m increases in y.[10] Consequently, multinational firms charge higher prices if TP regulations are tightened.

[10] See, e.g. Gravelle and Rees (2004). Normal inputs arise for the majority of widely used production functions including all homothetic ones.

2.3 Impact of Transfer Pricing Regulation on National Firms

How do national firms' prices, sales and profits respond to tighter transfer pricing provisions? In the following, we spell out comparative static results that will form the starting point for the empirical analysis to come.

Note first that national firms are not directly affected by the regulation of transfer pricing but indirectly via the impact on the general price level P, which can be decomposed into a national and multinational component:

$$P = \left(\int_{\omega \in \Omega^{NE}} \left(p^{NE}(\omega) \right)^{1-\sigma} d\omega + \int_{\omega \in \Omega^{MNE}} \left(p^{MNE}(\omega) \right)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}}, \tag{11}$$

where Ω^{NE} (Ω^{MNE}) denotes the set of varieties produced by national (multinational) firms. While national firms' prices are unaffected by θ, multinational firms' marginal cost and thus prices increase in response to tighter transfer price regulations (see above). This, in turn, increases the price index and national firms' sales quantity and sales value (see equation (8)). As prices are set as a constant mark-up over marginal cost, NEs' profits equally rise. We summarize this discussion in the following proposition.

Proposition 1 *Tighter transfer price regulation leaves national firms' prices unaffected, but increases their sales and profits.*

Also notice that the model predicts a stronger effect on NEs' sales and profits if the market share of MNEs, Ω_{MNE}, is larger.

While these results were derived under a restrictive demand structure, they are robust to different demand specifications. To see this, consider an alternative popular demand structure, which is linear demand (see, e.g. Melitz and Ottaviano, 2008). With linear demand, tighter profit shifting regulations still increase MNEs' prices, but NEs now move into a less elastic part of the demand function, which induces them to raise prices and mark-ups. This amplifies the positive effect on NEs' sales value and profits. In the empirical analysis to come, we will test the predictions spelled out in Proposition 1. As a preview, note that we find no significant effect of transfer pricing rules on NEs' mark-ups - which is consistent with predictions under CES preferences.

3 Data

The empirical analysis combines firm-level data with information on the tightness of transfer pricing provisions.

Firm level data: The firm data is drawn from Bureau van Dijk's AMADEUS database, which comprises balance sheet data on firms in Europe among others on

sales values, pre-tax profits, assets and employment costs. Ownership data allows us to identify national entities (NEs) and multinational entities (MNEs). In the analysis to come, we classify firms as MNEs if they belong to firm-groups with presence in at least two countries (constructed based on majority-ownership).

The data comprises the years 2004 to 2013 and is available in panel format. This data frame is ideal to test the effect of interest as, in that period, several European countries unilaterally tightened their transfer pricing regulations. In the analysis to come, we exploit these changes for empirical identification. Note that the period thereafter (from 2013 onwards) is less suited as a testing ground as it was dominated by large-scale *international* efforts to tighten anti-profit shifting provisions in a coordinated way. The most prominent initiative was the OECD's 'Base Erosion and Profit Shifting' project that was launched in 2013 by OECD member countries; through the OECD's Inclusive Framework, a vast majority of countries worldwide committed to the project later on; other prominent examples for international efforts to curb profit shifting are the European Union's 'Anti-Tax Avoidance Directive' and most recently the OECD's Pillar 1 & 2 agreements. Policy variation related to these initiatives is not that well suited to identify our effect of interest for two reasons. First, negotiations were lengthy and closely covered by media reports; even when international agreement was forged, it was unclear if and at which speed countries would implement agreed measures into their national law.[11] Policy treatment is thus fuzzy and extends across a period of time.[12] What is more, several new anti-shifting regulations extended to national firms - which implies that they are unsuitable to identify *repercussions* of changes in multinational firms' tax costs on national competitors (see, e.g. OECD (2015) and the description of our empirical identification strategy in Section 5).

The identifying variation in our paper stems from changes in countries' transfer pricing provisions. Low-tax countries have little incentives to enact or enforce transfer pricing regulations - given that they are the beneficiaries of tax-motivated mis-pricing of intra-firm trade and related profit reallocation. During our sample frame, none of the low-tax countries in Europe had effective transfer pricing regulation in place. We thus focus the analysis on high-tax countries with a corporate tax rate higher than 25% (in all our sample years): Belgium, Germany, Denmark, Spain, Finland, France, Great Britain, Italy and Sweden. In total, our data comprises around 21.6 million national firm-year observations and 1 million multinational firm-year observations.

Exposure to MNE competitors: In the main analysis, we focus on national firms' behavior. Our theoretical considerations suggest that the effect of transfer pricing rules

[11]There is no international tax institution that can enforce ratification of the agreements into national tax law.

[12]Some 'BEPS Actions' have to date not yet been implemented by countries.

on NEs hinges on their exposure to multinational competitors. Assuming that product-market competition takes place on the 4-digit industry-country level, we construct the market share of MNEs in market k in country c as:

$$\text{MNE-share}_{kc} = \frac{\sum^{MNE} s_{ik}}{\sum^{MNE+NE} s_{ik}} \tag{12}$$

where s_{ik} is a proxy for the market share of firm i in 4-digit NACE rev. 2 industry k. Specifically, we model firms' market share by business assets rather than business sales, as asset information is better covered in the data but highly correlated with sales. Moreover, to avoid that (treatment-induced) adjustments in firm behavior during our sample frame feed back on the definition of MNEs' market share, we calculate MNE-share$_{kc}$ based on information from the first sample year 2004 and keep this definition constant throughout the sample period. The distribution of the variable is depicted in Figure 1 and indicates that many NEs operate in industries that do not feature MNEs at all; for others, MNEs' market share is significant.

This construction is prone to two potential sources of mis-measurement: First, MNE-share$_{kc}$ might be mis-measured because of incomplete firm coverage in industry-country-cells. While coverage of Bureau van Dijk's data is certainly non-complete, coverage rates in our sample countries tend to be good. Firms in these countries are required by law to file to the national business register. Bureau van Dijk draws on these administrative data sources, rendering the firm coverage comparable to administrative datasets (Kalemli-Ozcan et al., 2015).[13] Comparing Bureau van Dijk's data to official statistics for the manufacturing sector, Kalemli-Ozcan et al. (2015) report sales coverage rates in Europe of about 70%.[14] The coverage ratio is worst for Germany (48%) and best in France (84%). As we rely on (better covered) asset information, coverage rates tend to be even higher in our analysis. Also note that larger (multinational) firms are more likely to be covered in Bureau van Dijk's data: Entities with missing data tend to be small non-incorporated businesses.[15] This limits the quantitative importance of distortions from missing information when calculating MNE-share$_{kc}$.[16]

A second concern is that MNE-share$_{kc}$ may be distorted because of misclassifica-

[13]Kalemli-Ozcan et al. (2015) emphasize that it is "a common misperception that firm-level financial data from national statistical offices always have better coverage than Orbis" (Kalemli-Ozcan et al. (2015), p. 6; see also Gopinath et al. (2017); Bajgar et al. (2020)).

[14]See Table 1 on p. 8 in Kalemli-Ozcan et al. (2015). Kalemli-Ozcan et al. (2015) do not report information on Denmark, which is included in our data.

[15]Bureau van Dijk spends considerable effort to identify and include information on larger firms.

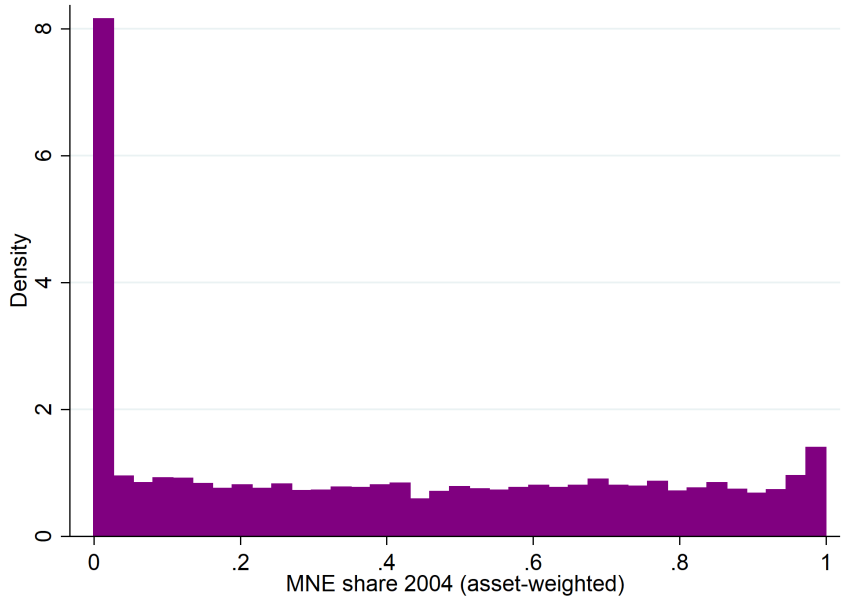
[16]If mis-measurement is random, it biases the coefficient estimate of interest towards zero. If the measurement error is systematic, the estimates may also be biased upwards: If firms are, e.g. more prone to be missing in our data if they are affiliated with industries with a high MNE-share this leads to an upward bias in the estimates.

tions of MNEs as NEs and vice versa. Renationalizations of multinational firms are rare events, and we thus consider it unlikely that we mis-classify NEs as MNEs. Misclassifications of MNEs as NEs may be more prevalent: If ownership links to foreign firms are missing in Bureau van Dijk's data, MNEs may be misclassified as NEs in the analysis.[17] We present robustness checks below, where we gauge the importance of these concerns. The findings do not provide any indication for biased estimates.

The impact of transfer pricing rules on NEs' market outcomes is, moreover, expected to depend on the extent to which competing MNEs actually engage in aggressive international tax avoidance. In additional analyses, we thus define the market share of *tax-aggressive* (as opposed to all) multinational competitors, where tax aggressiveness is proxied by MNE group presence in at least one tax haven economy. Specifically, in this calculation, we account for all MNEs that have a majority-owned subsidiary in a country that appears on standard tax haven lists (defined following Dharmapala and Hines (2009), Hines (2010) or Tørsløv et al. (2022)).

In additional sensitivity checks, we recalculate the MNE's market share MNE-share$_{kc}$ based on 3-digit (instead of 4-digit) industries and as an unweighted average (i.e. setting $s_{ik} = 1$ in equation (12)). Table *A*2 in the Appendix depicts the correlation of the different MNE-exposure measures.

Figure 1: Distribution of MNE-share



Notes: The figure shows the distribution of the total asset weighted MNE-share in 2004.

[17]Note, however, that our sample is restricted to major European countries for whom coverage rates tend to be good.

Transfer Pricing Regulations: Our empirical identification strategy relies on changes in countries' transfer pricing provisions. Transfer pricing regulations require intra-firm trade to be priced at arm's length - that is, they require prices to be set as in trade between unrelated parties. It is the aim of the regulations to prevent strategic trade mis-pricing and related profit reallocation to low-tax countries. Even conditional on transfer pricing provisions being in place - that is countries requiring intra-firm trade to be priced at arm's length - the provisions' strictness varies considerably across countries, among others depending on the existence and scope of transfer price documentation rules (which requires MNEs to contemporaneously document their intra-firm trade prices and show that they align with the arm's length principle), penalties in case of non-compliance and tax authorities' auditing practices. Most of our sample countries already had transfer pricing legislations in place at the outset of our sample frame. But transfer pricing rules underwent significant changes during our sample frame. Several countries unilaterally introduced transfer price documentation requirements (Spain in 2006; Finland and Sweden in 2007; Italy and France in 2010). There were, moreover, adjustments in the allowed methods to calculate arm's length prices. Countries established new opportunities to engage in 'advanced pricing agreements' (where taxpayers and authorities agree on transfer prices for a given period in advance); and saw changes in administrative efforts to enforce transfer pricing rules. All of these provisions shape the perceived tightness of transfer pricing rules and thus the costs that they impose on multinational taxpayers.

We map these rules in one index for the tightness of transfer pricing regulations following Mescall and Klassen (2018). They conducted a survey among transfer pricing experts from around the world, who were asked to assess countries' overall transfer pricing risk on a scale between 1 and 5, with 1 being the least risky and 5 being the most risky. To obtain a measure for the importance of various characteristics of the transfer pricing system in determining the tightness of transfer pricing provisions, Mescall and Klassen (2018) regress this transfer pricing index on 15 characteristics of the transfer pricing system - among others on variables capturing whether transfer pricing rules are in place (yes/no), whether contemporaneous transfer price documentation is required by law or by administrative regulations (yes/no), whether advance pricing agreements are offered (yes/no) and an index for the strictness of transfer pricing rule enforcement.[18]

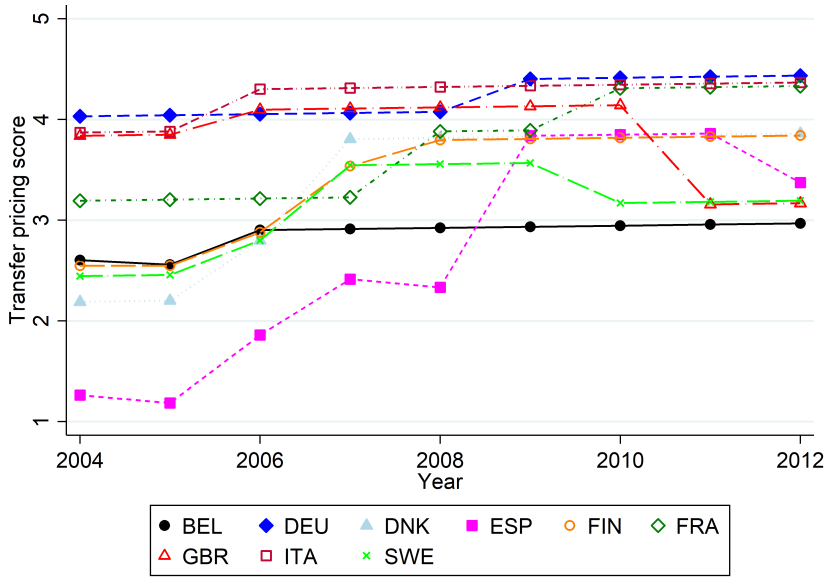
[18]The other 11 characteristics of the transfer pricing system are whether the country (1) requires disclosure on the tax return concerning related party transaction, (2) requires the taxpayer to pay the tax assessment before going to competent authority, (3) identifies an order of TP methods to use, (4) does not allow foreign comparables when determining transfer prices, (5) allows cost-contribution arrangements, (6) does not allow related party setoffs (bundling of transactions), (7) does not allow commissionaire arrangements, (8) allows a self-initiated adjustment, (9) uses proprietary tax data to calculate the transfer price, (10) has discretion over penalty reduction and (11) whether the government

The estimated coefficients serve as weights in the construction of the overall transfer pricing risk score for country-year-cells in our data. Information on characteristics of the transfer pricing system and countries' transfer price enforcement stem from Deloitte's transfer pricing matrix and Ernst & Young's transfer pricing guides (see also Zinn et al., 2014, Lohse and Riedel, 2015, Mescall and Klassen, 2018).

The average transfer pricing score across our sample countries is 3.62, varying considerably between 1.19 and 4.4. Figure 2 depicts the index's time variation during our sample frame, showing a trend towards tighter transfer pricing rules.

Note that other anti-profit shifting provisions like thin capitalization rules remained practically unchanged within our sample period and can hence not be used for empirical identification.

Figure 2: Transfer Pricing Score during our Sample Period



Notes: The figure shows the transfer pricing score of our sample countries during our sample frame: Belgium (BEL), Germany (DEU), Denmark (DNK), Spain (ESP), Finland (FIN), France (FRA), Great Britain (GBR), Italy (ITA) and Sweden (SWE).

Additional data: The data is furthermore augmented by information on statutory and effective corporate tax rates taken from the Oxford University Centre for Business Taxation's corporate tax database. Data on the socio-economic and political background of our sample countries were taken from the World Development Indicators and the World Bank's Worldwide Governance Indicators.

makes the benchmark data available to the taxpayer. The index for the strictness of transfer pricing rule enforcement is the assessed degree of transfer pricing enforcement as a percentage based on the 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.

4 Transfer Pricing Regulations and MNEs' Effective Tax Costs

Our main aim is to determine whether changes in transfer pricing provisions impact national firms' product market outcomes. Before embarking on this analysis, we briefly assess whether tighter transfer pricing rules actually raise MNEs' tax-related cost. They might do so through two channels: First, tighter transfer pricing rules constrain MNEs' opportunities to mis-price intra-firm trade and shift income to low-tax countries. Second, transfer pricing rules put compliance burdens on taxpayers, among others related to the legal requirement to prepare and maintain documentation of prices for international intra-firm trade. Our data allows us to quantify the former (but not the latter) costs. Relying on unconsolidated accounting data, we create two tax cost measures: the tax payments of firm i in country c operating in 4-digit industry k at time t, denoted by TAX_{ikct}, and firms' effective tax rate, i.e. their cash tax payments over pre-tax profits, denoted by ETR_{ikct}. Both measures capture firms' tax burden in country c, the former unconditional and the latter conditional on firms' pre-tax profit. As detailed in the Appendix B, both measures are expected to increase when tighter transfer pricing rules bite and lead to higher corporate tax payments by MNEs in the set of high-tax countries included in our sample.

The formal estimation model reads

$$\ln \text{z}_{ikct} = \beta_0 + \beta_1 \text{TPS}_{ct} + \beta_2 \text{X}_{ct} + \phi_i + \psi_{kt} + \varepsilon_{ikct} \tag{13}$$

where $\text{z}_{ikct} \in \{TAX_{ikct}, ETR_{ikct}\}$ denotes firms' effective tax costs. The sample is restricted to observations with positive tax payments when the dependent variable is corporate tax payments and to observations with positive tax payments and positive pre-tax profits when the dependent variable is the ETR. TPS_{ct} is the transfer pricing score of country c at time t. The specification accounts for full sets of firm fixed effects (ϕ_i) and 4-digit-industry-fixed effects (ψ_{kt}). X_{ct} is a vector of time-varying country control variables - GDP, population, FDI, exchange rate, unemployment rates and the World Governance indicators. Empirical identification hence relies on a comparison of tax cost changes by MNEs in the same industry that do become and do not become subject to tighter transfer price regulations (or experience different changes in transfer pricing provisions).

The results are reported in Table 1. Robust standard errors that account for clustering at the industry(2-digit-NACE)-country level are reported in brackets below the coefficient estimates.[19] In columns (1) and (4), we present baseline estimates, where

[19] Also see Table A1 for descriptive statistics.

the dependent variable is the natural log of TAX_{ikct} and the natural log of ETR_{ikct} respectively. In line with expectations, both specification yield β_1-estimates that are positive and statistically significant. Quantitatively, an increase in the transfer pricing score by 0.75 (corresponding to about one standard deviation, cf. Table A1) raises affiliates' tax payments and effective tax rate by 2.8% and 2.0% respectively.

Table 1: Effect of Transfer Pricing Regulations on MNEs' Tax Payments and ETR

	(1) ln(TAX)	(2) ln(TAX)	(3) ln(TAX)	(4) ln(ETR)	(5) ln(ETR)	(6) ln(ETR)
TPS	0.037**			0.026**		
	(0.018)			(0.013)		
TPS × Tax Haven		0.043***	0.036***		0.040***	0.037***
		(0.013)	(0.011)		(0.008)	(0.007)
Firm FE	✓	✓	✓	✓	✓	✓
Ind-Year FE	✓	✓		✓	✓	
Ctry Controls	✓			✓		
Ctry-Year FE.		✓			✓	
Ctry-IndSec-Year FE			✓			✓
Observations	993,717	993,717	993,717	839,818	839,818	839,818

Notes: The table shows the results of specifications, where we estimate the impact of transfer pricing regulations on MNEs' tax payments and effective tax rate (ETR). The dependent variable is (ln) tax payments (cols. (1)-(3)) and (ln) effective tax rate (cols. (4)-(6)). TPS stands for the transfer pricing score. The sample in cols. (1) to (3) includes only observations with positive tax payments and in cols. (4) to (6) only observations with positive tax payments and positive pre-tax profits. Observations with an effective tax rate above 100% are excluded. Cols. (1) and (4) include country controls ((ln) GDP, (ln) population, (ln) FDI, (ln) exchange rate, unemployment rates, and World Governance indicators) and industry (4-digit NACE)-year fixed effects, cols. (2) and (4) include country-year and industry (4-digit NACE)-year fixed effects and cols. (3) and (6) country-industry section (1-digit NACE)-year fixed effects. Cols. (1) and (4) show the results of the baseline specification (equation (13)), and cols. (2), (3), (5) and (6) the results of a specification where we interact the transfer pricing index with an indicator variable for MNE presence in a tax-haven country (equation (14)). Standard errors, clustered at the industry (2-digit NACE)-country level, are reported in parentheses. Statistical significance is indicated by * p<0.1, ** p<0.05, *** p<0.01.

In additional analyses, we adjust this specification by interacting the transfer pricing score with a dummy variable indicating MNEs with presence in a tax haven country tabbed as aggressive profit shifters. The modified model reads

$$\ln z_{ikct} = \alpha_0 + \alpha_1 \text{TPS}_{ct} \times \text{HAVEN}_{ikc} + \phi_i + \rho_{kt} + \mu_{ct} + v_{ikct} \tag{14}$$

α_1 captures if the tax costs of MNEs with and without tax haven affiliates respond differently to changes in transfer pricing provisions. The notion is that the former engage in more profit shifting activities because of a larger tax rate differential and that their tax costs are hence expected to be more strongly affected by a tightening of transfer pricing provisions. This allows us to exploit within-country-variation in

MNEs' exposure to changes in transfer pricing provisions for empirical identification and to augment the specification by a full set of country-year fixed effects, which non-parametrically control for potential country-level confounders.

The results are presented in columns (2) and (5) of Table 1. In the former specification, the dependent variable is the natural log of TAX_{ikct}, in the latter specification it is the natural log of ETR_{ikct}. The coefficient estimate for α_1 turns out positive and statistically significant in all models, suggesting that tighter transfer pricing rules are associated with an increase in the tax costs of MNEs with tax haven links relative to MNEs without tax haven connections. Quantitatively, the former firms' tax costs are estimated to rise by 3.2% and 3.0% when the transfer pricing score increases by a standard deviation. Specifications (3) and (6) offer additional refinements by controlling for a full set of host country-industry section-year fixed effects. This again leaves the coefficient estimates qualitatively and quantitatively unaffected. Note that similar findings emerge when we rely on an estimator that is robust to heterogeneous and dynamic treatment effects. See Appendix B.

Summarizing, our findings suggest that transfer pricing rules increase firms' effective tax burden in a statistically and economically significant way. Anecdotes, moreover, suggest that transfer pricing rules also entail significant compliance costs and tax risks for affected multinational firms (e.g. Durst, 2010, Ernst & Young, 2007). In line with these observations, MNE activity has, in prior research, been found to decline when transfer pricing provisions are tightened (Liu and de Mooij, 2020).

5 Anti-shifting Provision and Performance of NEs

In this paper, we go beyond this evidence. Following our theoretical consideration, our main interest is to determine the impact of transfer pricing regulations on national firms. Our model predicts that NEs that are exposed to multinational competitors increase their market sales when tighter transfer pricing rules limit multinational competitors' international tax avoidance opportunities and raise their tax compliance costs. The estimation strategy reads

$$ln(y_{ikct}) = \delta \text{TPS}_{ct} \times \text{MNE-share}_{kc} + \rho_i + \zeta_{ct} + \kappa_{kt} + \varepsilon_{ikct} \tag{15}$$

where the dependent variable is the product market outcome of national firm i in country c in 4-digit-NACE industry k in year t. Our main measure for market performance is national firms' operating revenue. As sales quantities are unobserved in accounting data, we complementarily use information on input factor use - assets, number of employees and labor costs - which positively correlate with firm output as sketched

above. We, moreover, assess the impact of transfer price regulations on firms' profits and follow De Loecker and Warzynski (2012) and Ackerberg et al. (2015) in using our firm-level data to construct firm specific mark-ups.

The main coefficient of interest is δ, which captures the impact of the TPS score on national firms' product market outcome, comparing firms with high and low exposure to MNE competitors in output markets. As sketched in Section 3, exposure is measured by MNE-share$_{kc}$, reflecting the MNEs' asset share at the 4-digit-country level.[20] The specification includes a full set of country-year fixed effects (ζ_{ct}) and hence non-parametrically controls for shocks to product market outcomes of firms located in the same country. In the base specification, we, furthermore, include full sets of firm fixed effects (ρ_i) and industry-year fixed effects (κ_{kt}) that absorb time-constant heterogeneity across firms and time-varying shocks at the 4-digit-industry level.

Our empirical strategy is valid if the sales of national firms in the same country in markets with high and low MNE-competitor exposure would have followed a similar trend in the absence of changes in the anti-shifting provision. We test for this presumption below. In additional specifications, we relax the empirical identification assumptions by augmenting the set of regressors by a full set of country–industry section–year fixed effects. The analysis then non-parametrically controls for common shocks to market outcomes of firms in the same country and the same industry section (1-digit NACE). Standard errors are clustered at the industry (3-digit NACE)-country and country-year level.

Table 2: Descriptive Statistics for National Firm Sample

	Mean	Median	P10	P90	Std. Dev.
Operating Revenue in thd. USD	2,507	369	39	3,434	54,344
Cost of Employees in thd. USD	512	117	16	775	8,224
Total Assets in thd. USD	4,731	359	45	3,658	299,418
Profit before Tax in thd. USD	103	8	-48	158	26,392
Corporate Tax Rate	0.32	0.31	0.28	0.37	0.03
TPS	3.62	3.87	2.33	4.36	0.86
MNE Share	0.34	0.28	0.06	0.70	0.23
Tax Haven MNE Share	0.08	0.02	0.00	0.26	0.14

Notes: The table presents descriptive statistics for our estimation sample of national enterprises. P10 stands for the 10th percentile and P90 for the 90th percentile. See Table A2 in the Appendix for information on the correlation of the two MNE share variables.

Main Results: The estimation results for equation (15) are presented in Table 3. Firms' sales value serves as dependent variable. In line with expectation, we find that

[20] We run robustness checks below to assess the sensitivity of our results to other definitions of MNE exposure.

NEs that operate in markets with a larger MNE share experience a stronger increase in the value of their sales than firms in the same country that are less exposed to multinational competitors. When comparing NEs without MNE exposure (that account for a significant fraction of our sample, cf. Section 3) against NEs operating in an industry with an average MNE-share (= 34%, cf. Table 2), the estimates suggest that a transfer pricing score increase by one standard deviation (= 0.86, cf. Table 2) raises the latter firms' sales by 1.9%. When comparing unexposed NEs to NEs that operate in markets that are dominated by MNEs (i.e. markets with an MNE-market share close to 1), a one-standard-deviation increase in the transfer pricing score is suggested to raise the latter firms' sales by 5.7%. In specification (2), we show that this result is qualitatively and quantitatively unaffected when we control for country-industry section-year fixed effects.

Our prior estimates, moreover, suggest that transfer pricing regulations impose a stronger cost shock on MNEs if they engage in significant profit shifting to low-tax countries. Specification (3) accounts for this notion and interacts the transfer price regulation index with the asset share of MNE competitors that are aggressive profit shifters (defined by a majority-ownership link to a tax haven country). Again, the estimated effect turns out positive and quantitatively relevant.

Table 3: Effect of Transfer Pricing Regulations on Market Performance of NEs: Main Results

	ln(Operating Revenue)		
	(1)	(2)	(3)
TPS × MNE-share	0.066***	0.055***	
	(0.023)	(0.014)	
TPS × Tax Haven MNE-share			0.042**
			(0.020)
Firm FE	✓	✓	✓
Ind-Year FE	✓	✓	✓
Ctry-Year FE	✓		
Ctry-IndSection-Year FE		✓	✓
Observations	21,640,055	21,640,055	21,640,055

Notes: The table depicts the baseline estimates, which assess the impact of transfer pricing regulations on market performance of national enterprises. The dependent variable is in all specifications (ln) firm's operating revenue. All specifications include a full set of firm fixed effects. Cols. (1) and (3) include, in addition, country-year and industry (4-digit NACE)-year fixed effects; Col. (2) and (3) country-industry section (1-digit NACE)-year fixed effects. In cols. (1) and (2) we use the total assets weighted MNE share and in column (3) the total asset weighted tax haven MNE share. Standard errors, clustered at the 3-digit NACE-country level and country-year level, are reported in parentheses. Significance levels are depicted by * p<0.1, ** p<0.05, *** p<0.01.

Table 4 presents a number of robustness checks. Specifications (1) and (2) show

that the findings are robust to dropping firms for which information is available for a limited number of years (three consecutive years or less). Specification (3) assesses potential concerns related to mis-classifications of MNEs as NEs. As MNEs' (in contrast to NEs') sales are predicted to decline when transfer pricing provisions are tightened, this may lead to biased estimates if mis-classified firms are not equally distributed across industries with different multinational competitor shares. As the propensity to become an MNE increases with firm size (see Helpman et al. (2004) for seminal work), specification (3) drops large NEs from the sample (firms above the 75th percentile of the size distribution). This does not materially change the results (also not if the size-cut off is adjusted). Complementarily, specification (4) reruns the base estimation with a full set of firm size decile-year-fixed effects. If mis-classifications impact firms' sales trends in given size classes, this is absorbed by these fixed effects. Again, this yields estimates close to our baseline findings. The results are, furthermore, robust to restricting the sample to markets (that is, 4-digit-industry-country-cells) with more than 100 firms in 2004 (cf. specification (5) of Table 4). In specification (6), we, moreover, zoom in on the most salient transfer pricing policy: the existence of contemporaneous transfer price documentation requirements. Consistent with our baseline findings, the results suggest that the introduction of transfer price documentation requirements increases NEs' sales more strongly the stronger their exposure to multinational competitors.

Another potential concern is that the scope of transfer pricing regulations may systematically correlate with other government tax policies, which may differentially impact the behavior of national firms that operate in industries with strong and weak exposure to MNE competitors. We test for this presumption in Table 5 by augmenting the set of regressors by interaction terms between MNE exposure and other tax policies: the country's statutory corporate tax rate, its effective marginal and average corporate tax rate, income taxes, labor taxes and goods & services taxes.[21] This leaves our baseline estimates largely unaffected, and none of the additional interaction effects turns out to be significantly different from zero. Also note that our sample countries saw no other major changes in anti-profit shifting legislation during our sample frame.

Table 6 shows that our findings are insensitive to relying on different definitions of MNEs' market share: Specification (1) reports our baseline estimate. In specification (2), we show that similar results emerge when we calculate the MNEs' market share based on a different year (namely the year 2000, but similar results also emerge for other years); in specification (3), we define markets at the 3-digit-industry-country level; in

[21]The latter taxes (on income, labor, goods and services) are measured by revenues related to these taxes as a percent of total revenue. Information on the statutory and effective corporate tax rates are drawn from the Oxford University Centre for Business Taxation's tax database; information on all other measures is drawn from World Bank's Development Indicator database.

Table 4: Effect of Transfer Pricing Regulations on Market Performance of NEs: Robustness Checks

	ln(Operating Revenue)					
	(1)	(2)	(3)	(4)	(5)	(6)
TPS × MNE-share	0.064***	0.054***	0.072***	0.072***	0.066***	
	(0.024)	(0.014)	(0.023)	(0.023)	(0.026)	
Doc. Req. × MNE-share						0.102***
						(0.031)
Firm FE	✓	✓	✓	✓	✓	✓
Ind-Year FE	✓	✓	✓		✓	✓
Ctry-Year FE	✓		✓	✓	✓	✓
Ctry-IndSection-Year FE		✓				
SizeDec-Ctry-Year FE				✓		
Observations	17,344,210		16,860,402	21,640,055	20,414,467	21,640,055
Without ...						
# Firm-years < 4	✓	✓				
Large NE			✓			
# NACE4-Ctry < 100					✓	

Notes: The table shows results for robustness checks. In all specifications, the dependent variable is the natural log of firms' operating revenues. All specifications include firm fixed effects. In addition, cols. (1), (3), (5) and (6) include country-year and industry (4-digit NACE)-year fixed effects. Cols. (1) and (2) show the results of specification (1) and (2) of Table 3 based on a sample of firms that are observed in at least 4 consecutive years. In col. (3), the sample excludes large national firms (firms above the 75th percentile of the country-size distribution). In col. (4), we add a full set of firm size (average turnover) decile-country-year fixed effects. Col. (5) excludes firms that belong to 4-digit-industry-country cells with less than 100 observations in 2004. Col. (6) interacts the MNE-share with a dummy variable indicating if the country requires contemporaneous transfer price documentation (as opposed to the transfer pricing score as in the other specifications). Standard errors, clustered at the 3-digit-NACE-country level and country-year level, in parenthesis. Significance levels are depicted by * p<0.1, ** p<0.05, *** p<0.01.

specification (4), we define MNEs' market share based on the *fraction* of multinational firms in the market (rather than their asset share). None of these modifications alters the qualitative or quantitative estimate of the effect of interest.

Sales quantity and mark-up The analysis so far has established a link between anti-profit shifting legislations and NEs' market outcomes, measured by *sales value*. These responses may reflect increases in sales quantities or output prices or both. Table 7 tests for effects on sales *quantity*. As firms' sales quantity is unobserved in accounting data, we draw on the observation that sales positively correlate with input factor use. Specifications (1)-(3) of Table 7 thus use firms' assets, costs of employees and number of employees as dependent variable and establish that tighter transfer pricing rules raise NEs' input factor use and, inferred from that, sales quantity by more, the higher NEs' exposure to multinational competitors. While 95% confidence bounds do overlap, effect size in Table 7 is somewhat smaller than in our base specification, which might reflect that production technologies of the firms in our data are, on average, characterized by increasing returns to scale. Specification (4) and (5) quantify the

Table 5: Effect of Transfer Pricing Regulations on Market Performance of NEs: Other Policies

	ln(Operating Revenue)					
MNE Share ×...	(1)	(2)	(3)	(4)	(5)	(6)
TPS	0.064***	0.066***	0.067***	0.065***	0.068***	0.075***
	(0.022)	(0.023)	(0.023)	(0.020)	(0.024)	(0.023)
Statutory Corporate Tax	-0.243					
	(0.391)					
EATR		0.152				
		(0.618)				
EMTR			-0.126			
			(0.180)			
Income Taxes				-0.000		
				(0.004)		
Goods/Service Taxes					0.006	
					0.006	
Labor Tax						0.005
						(0.005)
Firm FE	✓	✓	✓	✓	✓	✓
Ind.-Year FE	✓	✓	✓	✓	✓	✓
Ctry-Year FE	✓	✓	✓	✓	✓	✓
Observations			21,640,055			19,742,605

Notes: The table shows results for robustness checks, where we reestimate the impact of transfer pricing regulations on the market performance of national enterprises, controlling for potentially confounding policies. In all specifications, the dependent variable is the natural log of firms' operating revenues. All specifications include firm fixed effects, country-year and industry (4-digit NACE)-year fixed effects. In all columns, we allow for a differential impact of a country's transfer pricing regulations depending on the MNE share in the firms' 4-digit industry-country-cell. The specifications include regressors for the industries' MNE share interacted with the statutory corporate tax rate (col. (1)), the effective average corporate tax rate (col. (2)), the effective marginal corporate tax rate (col. (3)), taxes on income (col. (4)), taxes on goods and services (col. (5)), labor taxes and social security contributions (col. (6)). The latter three variables are measured relative to overall tax revenue (drawn from the World Development Indicator database). The number of observations in col. (6) is reduced as labor taxes and social security contributions are not available for 2004. Standard errors, clustered at the 3-digit-NACE-country level and country-year level, are reported in parenthesis. Significance levels are depicted by * p<0.1, ** p<0.05, *** p<0.01.

impact of transfer pricing tightness of national firms' profits and EBIT respectively: Consistent with the theoretical predictions in Section 2, profits and EBIT increase more strongly, the stronger NEs' exposure to MNE competitors.

Table 8, finally, assesses the impact of transfer pricing provisions on NEs' mark-ups. As acknowledged in Section 2, the impact on mark-ups is theoretically unclear and hinges on the demand structure. With CES preferences (as in the model of Section 2), prices are set as a constant mark-up on marginal costs. With demand structures characterized by an increasing or decreasing elasticity of demand, mark-ups may, in turn, shift when transfer pricing rules are tightened.

In the empirical application, we follow De Loecker and Warzynski (2012) and derive firm-level mark-ups based on the accounting data at hand. To derive an expression for

Table 6: Effect of Transfer Pricing Regulations on Market Performance of NEs: Alternative MNE-share Definitions

	ln(Operating Revenue)			
TPS × ...	(1)	(2)	(3)	(4)
MNE-share (Baseline)	0.066***			
	(0.023)			
MNE-share (2000)		0.066***		
		(0.021)		
MNE-share (3-dig.-ind.)			0.060*	
			(0.031)	
TPS × MNE-share (# of Firms)				0.391***
				(0.085)
Firm FE	✓	✓	✓	✓
Ind-Year FE	✓	✓	✓	✓
Ctry-Year	✓	✓	✓	✓
Observations	21,640,055	21,639,527	21,640,055	21,640,055

Notes: The table shows results for robustness checks, where we reestimate the impact of transfer pricing regulations on market performance of national enterprises with alternative definitions of the MNE share in industry-country cells. The dependent variable in all specifications is (ln) firms' operating revenue. All specifications include firm fixed effects, country-year and industry (4-digit NACE)-year fixed effects. Col. (1) depicts our base specification. In col. (2), the MNE share is calculated as the asset share of MNEs on the 4-digit industry-country-level in the year 2000 (and not, as in the base analysis, in the year 2004). The number of observations is smaller as industries with no NEs and MNEs are excluded from the analysis. In col. (3), the MNE share is calculated as the asset share of MNEs on the 3-digit industry-country-cell in the year 2004 (and not on the 4-digit industry-country level as in the baseline), and in col. (4), the MNE share is calculated as the unweighted MNE share (number of multinational firms in all firms). Standard errors, clustered at the 3-digit NACE-country level and country-year level are reported in parenthesis. Significance levels are depicted by * p<0.1, ** p<0.05, *** p<0.01.

firms' mark-ups, consider again the NE's cost minimization problem spelled out in Section 2:

$$\min_{\ell,m} (1-t_i)w \cdot \ell + (1-t_i)r \cdot m \quad \text{s.t.} \quad F(\ell, m) \geq y$$

with associated Lagrangian

$$\mathcal{L}(\ell, m, \lambda) = (1-t_i)w \cdot \ell + (1-t_i)r \cdot m - \lambda \cdot \Big(y - F(\ell, m)\Big).$$

The variable definitions correspond to Section 2. The first order condition for the labor input ℓ is given by:

$$(1-t_i)w - \lambda F_\ell = 0 \quad \Longleftrightarrow \quad \frac{(1-t_i)p^{NE}}{\lambda} \cdot \frac{w\ell}{p^{NE}y} = F_\ell \frac{\ell}{y},$$

where the right hand side expression can be obtained by multiplying both sides by ℓ/y and rearranging. Since the net-of-tax marginal cost of production are given by λ, the term $(1-t_i)p^{NE}/\lambda$ measures the net-of-tax mark-up. Note that this expression

Table 7: Effect of Transfer Pricing Regulations on Market Performance of NEs: Alternative Outcomes

ln	Assets (1)	Cost of Empl. (2)	# Employees (3)	Pre-tax Profit (4)	EBIT (5)
TPS × MNE-Share	0.027***	0.042**	0.044***	0.031	0.038**
	(0.009)	(0.018)	(0.013)	(0.019)	(0.019)
Firm FE	✓	✓	✓	✓	✓
Ind-Year FE	✓	✓	✓	✓	✓
Ctry-Year	✓	✓	✓	✓	✓
Observations	21,334,903	15,560,328	11,970,152	13,013,618	10,244,829

Notes: The table shows results for robustness checks of the impact of transfer pricing regulations on the market performance of national enterprises. The dependent variable is (ln) firms' total assets in col. (1), (ln) firms' costs of employees in col. (2), (ln) firms' number of employees in col. (3), (ln) firm's pre-tax profits in col. (4) and (ln) firm's EBIT in col. (5). All specifications include firm fixed effects, country-year and industry (4-digit NACE)-year fixed effects. Number of observations varies due to differences in the coverage of the dependent variables. Standard errors, clustered at the 3-digit-NACE-country level and country-year level, are reported in parenthesis. Significance levels are depicted by * p<0.1, ** p<0.05, *** p<0.01.

is equivalent to the mark-up in a no-tax-scenario (as considered by De Loecker and Warzynski (2012)), as accounting for taxation implies that, in the numerator, the gross price (p^{NE}) is multiplied by $1-t_i$, and, in the denominator, the gross production costs is also in net-of tax form, i.e. multiplied by $1-t_i$. The remainder of the equation shows that the mark-up can be computed using information on the output elasticity ($F_\ell \frac{\ell}{y}$). Notice that this approach does not presume a particular market structure or mode of competition, only cost minimization (De Loecker and Warzynski, 2012).

We use our data to estimate F_ℓ.[22] The key challenge for the identification of production functions is unobserved productivity. We follow Levinsohn and Petrin (2003) and use a control function approach with material inputs to proxy for unobserved productivity (3rd degree polynomial).[23] Since identification of the labor coefficient is not plausible in the first stage (see Ackerberg et al. (2015) and De Loecker and Warzynski, 2012), all parameters are identified in the second stage.

We estimate a Cobb Douglas value added production function in country specific 4-digit industries (with a minimum number of observations of 50). The free variable is labor (number of employees), the state variable capital (total assets), material input

[22] All variables are deflated using input, output and value added prices from the EU-Klems Database. If only for some industries in a country no deflators are available, we exclude these industries. If for all industries in a country prices are not available – which is the case for Spain - we use another country's prices – namely Portuguese - as proxy. Results are very similar when excluding Spain, and also very similar when we use a trans-log and not a Cobb-Douglas production function. Results are available upon requests.

[23] This approach exploits that the demand for a flexible input (like materials) depends on and thus provides information about firm productivity. See Ackerberg et al. (2007) for an early review of the literature.

the proxy, and we control for age. The distribution of our estimated firm mark-ups with and without the first stage residual correction suggested by De Loecker and Warzynski (2012) is depicted in Figure A1 in the Appendix and resembles markup distributions in the prior literature (e.g. De Loecker et al., 2020).[24]

Table 8 presents specifications where we reestimate our baseline model using firms' mark-up as dependent variable. Specification (1) reestimates our baseline model (with operating revenue as dependent variable) in the smaller sample with non-missing mark-ups. In Specifications (2) and (3), the dependent variable is firms' mark-ups, without and with the De Loecker and Warzynski, 2012 first stage residual correction. In both specifications, the coefficient estimate for the interaction of the transfer pricing variable and the MNE-market share turns out to be small and statistically insignificant. In line with our theoretical considerations in Section 2, this rejects the notion that NEs alter their mark-ups in response to tightened transfer pricing provisions.

Table 8: Effect of Transfer Pricing Regulations on Mark-ups of NEs

ln	Oper. rev.	Mark-up	Adj. mark-up
	(1)	(2)	(3)
TPS × MNE-share	0.068***	-0.007	0.007
	(0.022)	(0.007)	(0.008)
Observations	8,199,467	8,199,467	5,774,209
Firm FE	✓	✓	✓
Ind-year FE	✓	✓	✓
Ctry-Year	✓	✓	✓

Notes: Notes: The table shows specifications, which estimate the impact of transfer pricing regulations on mark-ups of national enterprises. For the calculations of the mark-ups, see the main text. Col. (1) shows the base specification (where the dependent variable is firms' operating revenue) for the smaller sample of firm-years, for which mark-ups are available. In col. (2) and (3), we reestimate the model using the estimated mark-up as dependent variable, without and with the De Loecker and Warzynski (2012) first stage residual correction. In all specifications, we control for firm fixed effects, country-year and industry (4-digit NACE)-year fixed effects. Standard errors, clustered at the 3-digit-NACE-country level and country-year level, are reported in parenthesis. Significance levels are depicted by * p<0.1, ** p<0.05, *** p<0.01.

Heterogeneous and dynamic treatment effects: Finally note that our empirical setting is a two-way fixed effect design, where firms are subject to a staggered treatment. Our estimates may, in consequence, be biased in the presence of heteroge-

[24]The mitigate the impact of outliers, we drop observations in the top 1% of the labour cost share distribution, in the bottom and top 1% of the estimated labor elasticity distribution, and in the top and bottom 2.5% of the mark-up distribution.

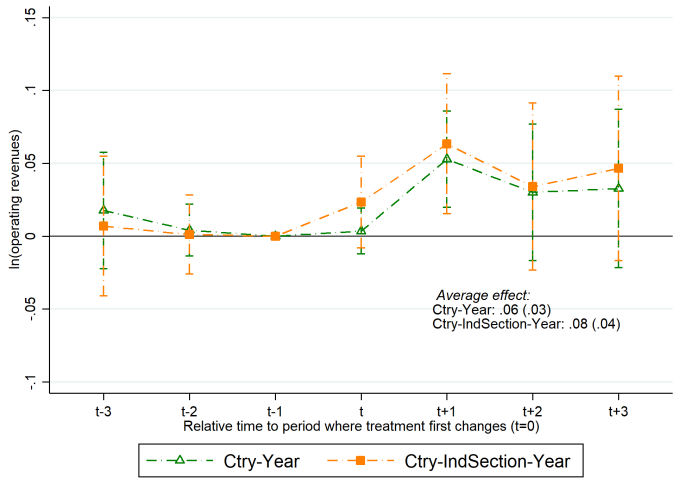
nous and dynamic treatment effects (e.g. Goodman-Bacon, 2021). In our empirical application these concerns are dampened by the fact that a substantial fraction of NEs in our data is unexposed to multinational competitors (see Figure 1). We nevertheless assess the relevance of this concern and follow the recent literature that has proposed estimators that yield unbiased estimates in the presence of heterogenous treatment effects (see Roth et al. (2022), de Chaisemartin and D'Haultfoeuille (2022b) for surveys). The underlying idea of all of these estimators is to compare treated units to "never-treated" or "not-yet-treated" units at a given point in time. While most estimators account for binary treatment only, de Chaisemartin and D'Haultfoeuille (2022a) allow for discrete (non-binary) treatment and for studying effect dynamics. Their estimator thus fits our context best. The value of firm sales serves as dependent variable and we discretize the treatment variable - the interaction between the transfer pricing score and the MNEs' market share measured by assets - in 10 equally spaced groups. Note that variation across groups is induced by changes in the transfer pricing score only as the MNE-share is time-constant. The treatment level is the 4-digit-industry-country-cell and we absorb country-(industry-section)-year fixed effects. Bootstrap standard errors are clustered at the industry–country level. We account for the effect of three leads and three lags of the treatment variable. If we absorb host-country-year fixed effects (host country-industry section-year fixed effects), the average treatment effect is estimated at 0.06 with a standard deviation of 0.03 (0.08 with a standard deviation of 0.04). The full set of estimates is reported in Figure 3. The figure provides no indication for differences in the pre-trends of sales values of treatment and control group. A tightening of transfer pricing legislation, moreover, leads to an immediate and lasting increase in national entities' sales. The post-treatment period estimates are highly stable from $t+1$ onwards. And while the estimates do not gain statistical significance at conventional significance levels in every post-reform period, they are jointly different from zero.

6 Conclusion

A flourishing literature documents that multinational firms shift profits to low-tax countries. The consequences of international tax avoidance have received rather little attention, however, implying that we still lack a complete picture of its welfare costs. Existing studies focus on the fiscal implications of international tax avoidance, that is on corporate revenue losses in high-tax countries and on the impact of profit shifting on corporate tax competition. We are the first who, based on rich European firm level data, test if international tax avoidance impacts product market outcomes and puts national competitors of multinational firms at a competitive disadvantage.

The empirical identification strategy relies on changes in transfer pricing regula-

Figure 3: Effect of Transfer Pricing Regulations on Market Performance of NEs



Notes: The figure shows estimated coefficients for 3 leads and 3 lags of TPS and MNE share interaction on (ln) firm's operating revenues using the estimator proposed by de Chaisemartin and D'Haultfoeuille (2022a). The TPS and MNE-share interaction is discretized into ten equally spaced groups. The group variable is industry (4-digit NACE)-country. The specification includes country-year fixed effects and country-industry section-year fixed effects respectively.

tions. Tighter transfer pricing rules increase MNEs' tax-related costs as they constrain profit shifting to low-tax countries and, simultaneously, come with significant compliance burdens. Our findings confirm that tighter transfer pricing provisions raise multinational firms' effective tax costs. We, moreover, find that they significantly increase the observed sales value, sales quantity and profits of affected firms' national competitors. NEs' mark-ups, in turn, remain largely unchanged.[25]

These findings offer important insights for public, political and academic debates on how to best deal with multinational profit shifting. They document that multinational profit shifting activities - and constraints on them - do not only come with fiscal consequences, but also impact real economic behavior and product market outcomes. This has distributional and efficiency consequences. If owners of national and multinational firms are not fully diversified, the identified competition effect impacts the distribution of income across shareholders. If part of the tax burden is passed on to workers and consumers, there are analogous repercussions on the distribution of wages and consumer rent. On efficiency grounds, the findings imply that firms' sales and market shares are not solely governed by productivity differences but also by differences in effective tax costs. In short: The welfare consequences of profit shifting are broader

[25]Note that we rely on a setting where multinational profit shifting is constrained and MNEs' tax-related costs *increase* (in part also because of increased compliance burdens). It is a fruitful avenue for future research to study whether similar results to the ones reported in this paper emerge when opportunities for profit shifting increase and MNEs' tax costs *fall*.

than so far acknowledged in the literature.

References

Ackerberg, D., Lanier Benkard, C., Berry, S., Pakes, A., 2007. Econometric tools for analyzing market outcomes. In: Heckman, J., Leamer, E. (Eds.), Handbook of Econometrics, 1st Edition. Vol. 6A. Elsevier, Ch. 63.
URL https://EconPapers.repec.org/RePEc:eee:ecochp:6a-63

Ackerberg, D. A., Caves, K., Frazer, G., 2015. Identification properties of recent production function estimators. Econometrica 83 (6), 2411–2451.

Bajgar, M., Berlingieri, G., Calligaris, S., Criscuolo, C., Timmis, J., May 2020. Coverage and representativeness of Orbis data. OECD Science, Technology and Industry Working Papers 2020/06, OECD Publishing.
URL https://ideas.repec.org/p/oec/stiaaa/2020-06-en.html

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

Buettner, T., Overesch, M., Schreiber, U., Wamser, G., 2012. The impact of thin-capitalization rules on the capital structure of multinational firms. Journal of Public Economics 96 (11), 930–938.

Buettner, T., Overesch, M., Wamser, G., 2018. Anti profit-shifting rules and foreign direct investment. International Tax and Public Finance 25 (3), 553–580.

Cerullo, M., 2019. 60 of America's biggest companies paid no federal income tax in 2018. CBS News - April 12, 2019 (https://www.cbsnews.com/news/2018-taxes-some-of-americas-biggest-companies-paid-little-to-no-federal-income-tax-last-year/ [last accessed: 09/05/2022]).

Clifford, S., 2019. Taxing multinationals beyond borders: Financial and locational responses to CFC rules. Journal of Public Economics 173, 44–71.

Cristea, A. D., Nguyen, D. X., 2016. Transfer pricing by multinational firms: New evidence from foreign firm ownerships. American Economic Journal: Economic Policy 8 (3), 170–202.

Davies, R. B., Martin, J., Parenti, M., Toubal, F., 2018. Knocking on tax haven's door: Multinational firms and transfer pricing. The Review of Economics and Statistics 100 (1), 120–134.

de Chaisemartin, C., D'Haultfoeuille, X., Mar. 2022a. Difference-in-differences estimators of intertemporal treatment effects. NBER Working Papers 29873, National Bureau of Economic Research, Inc.
URL https://ideas.repec.org/p/nbr/nberwo/29873.html

de Chaisemartin, C., D'Haultfoeuille, X., Jan. 2022b. Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: A survey. NBER Working Papers 29691, National Bureau of Economic Research, Inc.
URL https://ideas.repec.org/p/nbr/nberwo/29691.html

De Loecker, J., Eeckhout, J., Unger, G., 2020. The rise of market power and the macroeconomic implications. The Quarterly Journal of Economics 135 (2), 561–644.

De Loecker, J., Warzynski, F., 2012. Markups and firm-level export status. American Economic Review 102 (6), 2437–2471.

Dharmapala, D., 2014. What do we know about base erosion and profit shifting? A review of the empirical literature. Fiscal Studies 13 (4), 421–448.

Dharmapala, D., Hines, J., 2009. Which countries become tax havens? Journal of Public Economics 93 (9-10), 1058–1068.

Dowd, T., Landefeld, P., Moore, A., 2017. Profit shifting of U.S. multinationals. Journal of Public Economics 148, 1–13.

Durst, M., 2010. Making transfer pricing work for developing countries. Tax Analysts, 851–854.

Egger, P., Wamser, G., 2015. The impact of controlled foreign company legislation on real investments abroad: A multi-dimensional regression discontinuity design. Journal of Public Economics 129, 77–91.

Ernst & Young, 2007. Precision under pressure? Global transfer pricing survey 2007-2008. Tax Note International.

Flach, L., Irlacher, M., Unger, F., 2021. Corporate taxes and multi-product exporters: Theory and evidence from trade dynamics. Journal of International Economics 132 (fortcoming).
URL https://www.sciencedirect.com/science/article/pii/S0022199621000957

Goodman-Bacon, A., 2021. Difference-in-differences with variation in treatment timing. Journal of Econometrics 225 (2), 254–277.

Gopinath, G., Kalemli-Ozcan, S., Karabarbounis, L., Villegas-Sanchez, C., 2017. Capital allocation and productivity in Southern Europe. Quarterly Journal of Economics 132 (4), 1915–1967.

Gravelle, H., Rees, R., 2004. Microeconomics, 3rd Edition. Prentice Hall.

Heckemeyer, J. H., Overesch, M., 2017. Multinationals' profit response to tax differentials: Effect size and shifting channels. Canadian Journal of Economics/Revue canadienne d'économique 50 (4), 965–994.
URL https://onlinelibrary.wiley.com/doi/abs/10.1111/caje.12283

Helpman, E., Melitz, M., Yeaple, S., 2004. Export vs. FDI with heterogeneous firms. American Economic Review 94 (1), 300–316.

Hines, J. R., 2010. Treasure islands. Journal of Economic Perspectives 24 (4), 103–26.

Huizinga, H., Laeven, L., Nicodeme, G., 2008. Capital structure and international debt shifting. Journal of Financial Economics 88 (1), 80–118.

Kalemli-Ozcan, S., Sorensen, B., Villegas-Sanchez, C., Volosovych, V., Yesiltas, S., 2015. How to construct nationally representative firm-level data from the Orbis global database. NBER Working Papers 21558, National Bureau of Economic Research, Inc.
URL https://ideas.repec.org/p/nbr/nberwo/29873.html

Keen, M., Konrad, K. A., 2013. Chapter 5 - the theory of international tax competition and coordination. In: Auerbach, A. J., Chetty, R., Feldstein, M., Saez, E. (Eds.), Handbook of Public Rconomics, vol. 5. Vol. 5 of Handbook of Public Economics. Elsevier, pp. 257–328.
URL https://www.sciencedirect.com/science/article/pii/B9780444537591000054

Levinsohn, J., Petrin, A., 2003. Estimating production functions using inputs to control for unobservables. Review of Economic Studies 70 (2), 317–341.

Liu, L., de Mooij, R., 2020. At a cost: The real effects of transfer pricing regulations. IMF Economic Review, 268–306.

Liu, L., Schmidt-Eisenlohr, T., Guo, D., 2020. International transfer pricing and tax avoidance: Evidence from the linked tax-trade statistics in the UK. Review of Economics and Statistics 102 (4), 766–778.

Lohse, T., Riedel, N., 2015. Do transfer pricing laws limit international income shifting? evidence from european multinationals. CESifo Working Paper Series 4404, National Bureau of Economic Research, Inc.

Markle, K., Shackelford, D., 2012. Cross-country comparison of corporate income taxes. National Tax Journal 65, 493–528.

Martin, J., Parenti, M., Toubal, F., 2020. Corporate tax avoidance and industry concentration. CESifo Working Paper.

Melitz, M., Ottaviano, G., 2008. Market size, trade, and productivity. Review of Economic Studies 75, 295–316.

Merlo, V., Riedel, N., Wamser, G., 2020. The impact of thin-capitalization rules on the location of multinational firms' foreign affiliates. Review of International Economics 28 (1), 35–61.
URL https://onlinelibrary.wiley.com/doi/abs/10.1111/roie.12440

Mescall, D., Klassen, K. J., 2018. How does transfer pricing risk affect premia in cross-border mergers and acquisitions? Contemporary Accounting Review 35 (2), 830–865.

OECD, 2013. Action Plan on Base Erosion and Profit Shifting. OECD Publishing.
URL https://www.oecd-ilibrary.org/content/publication/9789264202719-en

OECD, 2015. Limiting Base Erosion Involving Interest Deductions and Other Financial Payments, Action 4 - 2015 Final Report. OECD Publishing.
URL https://www.oecd-ilibrary.org/content/publication/9789264241176-en

Overesch, M., Strueder, S., Wamser, G., 2020. Do U.S. firms avoid more taxes than their European peers? On firm characteristics and tax legislation as determinants of tax differentials. National Tax Journal 73 (2), 361–400.

Riedel, N., 2018. Quantifying international tax avoidance: A review of the academic literature. Review of Economics 69 (2), 169–181.

Roth, J., Sant'Anna, P. H. C., Bilinski, A., Poe, J., 2022. What's trending in difference-in-differences?A synthesis of the recent econometrics literature. Tech. rep., arXiv.
URL https://arxiv.org/abs/2201.01194

Sullivan, M. A., 2017. Apple reports high rate but saves billions on taxes. Tax Notes 134, 777–778.

Tørsløv, T. R., Wier, L. S., Zucman, G., 2022. The missing profits of nations. Review of Economic Studies, forthcoming.

Zinn, T., Riedel, N., Spengel, C., 2014. The increasing importance of transfer pricing regulations: A worldwide overview. Intertax 42 (6), 352–404.

Appendix

A Additional Tables and Figures

Table A1 presents descriptive statistics for the MNE-sample that is used in the main text to determine the link between the tightness of transfer pricing provisions and MNEs' effective tax costs. Table A2, for the NE sample, moreover, presents a correlation table of different definitions of MNEs' market share. Figure A1 depicts the distribution of our estimated mark-ups with and without the De Loecker and Warzynski (2012)-correction. In both cases, the distribution resembles those found in earlier literature (e.g. De Loecker et al., 2020).

Table A1: Descriptive Statistics: Effect of TPS on Effective Tax Costs of MNEs

	Mean	Median	P10	P90	Std. Dev.
Tax Payments	2058.495	119	32148.11	5	2047
ETR	0.31	0.30	0.07	0.52	0.19
Statutory tax rate	0.31	0.31	0.26	0.37	0.04
Transfer pricing score	3.63	3.86	2.56	4.36	0.75
I[tax haven sub.]	0.63	1.00	0.00	1.00	0.48

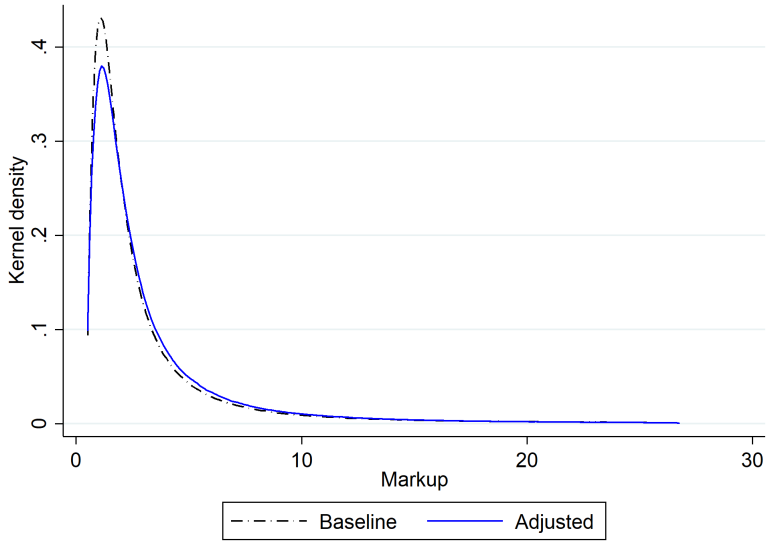
Notes: The table shows descriptive statistics for our MNE estimation sample. The sample includes only firms with positive tax payments (except for the ETR which requires also positive pre-tax profits, and an ETR below 100%). We define tax haven countries as countries that appear on standard tax haven lists as used in Dharmapala and Hines (2009), Hines (2010) or Tørsløv et al. (2022).

Table A2: Cross-correlation MNE-shares

	MNE share	MNE share (2000)	MNE share (NACE3)	MNE share (# firms)	Tax haven MNE share
MNE share	1.00				
MNE share (2000)	0.86	1.00			
MNE share (NACE3)	0.84	0.72	1.00		
MNE share (# firms)	0.63	0.54	0.59	1.00	
Tax haven MNE share	0.618	0.53	0.52	0.38	1.00

Notes: The table shows the correlation between the different MNE-share measures. Our baseline MNE-share is the asset weighted MNE share on the industry (4-digit NACE)-country level in 2004. The alternative measures are (i) the asset weighted MNE-share on the industry (4-digit NACE)-country level in 2000, (ii) the asset weighted MNE share on the industry (3digit)-country level, (iii) the unweighted MNE share (number of subsidiaries) on the industry (4-digit NACE)-country level, and (iv) the asset-weighted MNE shares on the industry (4-digit NACE)-country level, only including MNEs with a tax haven connection (ownership link larger than 50%).

Figure A1: Distribution of Estimated Mark-ups



Notes: The figure shows the distribution of our estimated firm mark-ups with and without the first stage residual correction suggested by De Loecker and Warzynski (2012). Observations with mark-ups in the top and bottom 2.5% of the distribution are excluded.

B Impact of TPS on MNEs' tax payments and ETR

B.1 Theoretical Considerations

As described in the main text, we rely on two measures to capture the impact of transfer pricing rules on firms' effective tax costs: the tax payments of firm i in country c in industry k at time t, TAX_{ikct}, and the effective tax rate ETR_{ikct}. If transfer pricing rules are tightened, we expect less mis-pricing of intra-firm trade, translating into higher tax liabilities TAX_{ikct}. Note that the reverse effect may also be at work: MNEs' sales may go down, which lower firm profits and tax payments. While TAX_{ikct} captures both of these effects, ETR_{ikct} normalizes tax payments on firms' pre-tax profit, defined as follows:

$$\text{ETR}_{ikct} = \frac{TAX_{ikct}}{P_{ikct}} = \frac{t_{ct}(P_{ikct} - TA_{ikct})}{P_{ikct}} \tag{16}$$

where P_{ikct} stand for firm i's accounting pre-tax profit; TA_{ikct} are tax allowances granted (implying that taxable income deviates from firms' accounting profit). t_{ct} is the statutory corporate tax rate levied on corporate income in country c at time t. If tighter transfer pricing rules limit firms' opportunities to transfer income to low-tax countries, this is expected to translate into higher pre-tax profits P_{ikct} and consequently into a higher ETR_{ikct} (as $\frac{\partial \text{ETR}_{ikct}}{\partial P_{ikct}} = \frac{t_{ct} TA_{ikct}}{P_{ikct}^2} > 0$).

B.2 de Chaisemartin and D'Haultfoeuille (2022a)

To assess the effect of the transfer pricing score on MNEs' effective tax rate, we rely on the estimator proposed by de Chaisemartin and D'Haultfoeuille (2022a), which is robust to heterogeneous and dynamic treatment effects. We discretize the transfer pricing score variable defined in the data section into five equally spaced groups and estimate a model of the following form:

$$\ln \text{ETR}_{ikct} = \sum_{j=-2;j\neq-1}^{1} \beta^j (TPS_{ct}^j)^{disc} + \gamma \text{X}_{ct} + \phi_i + \psi_{kt} + \varepsilon_{ikct} \tag{17}$$

where the variable definition corresponds to the main text: ϕ_i reflect firm fixed effects, ψ_{kt} industry-year fixed effects, ε_{ikct} the error term. Bootstrapped standard errors allow for clustering at the 2-digit-industry-country level. Due to lack of suitable control groups, estimation is restricted to a relatively short event window.[26] The average treatment effect is estimated with 0.06 (std.error 0.02) and is hence comparable to our baseline estimates. The first and second post-period effects are estimated with 0.04 and 0.07; both are statistically significant at the 5% level. The coefficient for the pre-reform period is a small -0.01 and statistically insignificant (std.error 0.06).

[26]Note that this limitation does not apply for our main analysis, where we estimate the impact of transfer pricing rules on NEs' sales, differentiating between NEs with different degrees of exposure to MNE competitors. Here, we can draw on a large control group of untreated NEs, which do not have any exposure to MNE competitors at all.