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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 lower their sales. The sales and profits of affected firms' national competitors increase significantly, while mark-ups remain largely unchanged. We discuss policy implications of our findings.

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., 2018). 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., 2018) 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

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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).[2] 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.[3]

We take these hypotheses to the data and assess how changes in transfer pricing regulations impact product market outcomes. The key aim is to quantify 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 heterogeneous 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 sample period comprises the years 2004–2012, 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.[4] 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.

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.[5]

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 and a reduction in their sales. This is in line with prior evidence (*e.g.* Beer and Loeprick, 2015; Liu and de Mooij, 2020) and suggests that transfer pricing regulations bite and limit tax avoidance activities through mis-pricing of intra-firm trade. We, furthermore, 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.

Additional checks support the identification assumptions underlying our empirical estimation design. Dynamic model specifications show that sales of treated and untreated national firms emerged in parallel prior to treatment, corroborating the common trend assumption

[2] 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 and Young, 2007).

[3] Note that additional MNE costs from tighter transfer pricing provisions may be variable or fixed in nature. If profit shifting volumes are unrelated to the size of firm production, 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. In this paper, we will focus on responses at the intensive margin.

[4] 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 Europe and worldwide — and, in part, also directly impact national firms. They are hence less well suited to identify the effect of interest.

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

of our difference-in-differences style approach. We furthermore show that our findings remain unchanged when we control for potential contemporaneous shocks to changes in TP reforms and allow the impact of these shocks to vary across industries with small and large MNE-shares. Our findings furthermore turn out to be robust to modeling industry characteristics other than the MNE-share (*e.g.* firms' average productivity and R&D intensity) and to allow TP rules to exert a differential impact on national firm behavior by the characteristics.

Our empirical 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.[6] 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., 2018 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. 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., 2018). It is thus, a priori, unclear whether insights from the US context carry over to Europe.[7]

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 lowers 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 develop a simple theoretical model to guide our empirical analysis. We present key equations and discuss the intuition underlying our model predictions. The full model is included in Online Appendix A.

2.1. Household problem

Consider a country i with L identical households who have CES preferences over a set of differentiated varieties. Households derive labor income w from inelastically supplying one unit of labor.[8] The problem of the household is

$$\max_{c(\omega)} U = \left[\int_{\omega\in\Omega} (c(\omega))^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}} \quad \text{s.t.} \quad \int_{\omega\in\Omega} p(\omega)c(\omega)d\omega = w, \tag{1}$$

where $c(\omega)$ denotes consumption and $p(\omega)$ the price of variety ω; $\sigma > 1$ is the elasticity of substitution. Solving the household's maximization problem in Eq. (1) yields market demand for variety ω (see the Online Appendix for details).

2.2. Firm problem

Each variety is produced by a single, monopolistically competitive firm using labor ℓ and an intermediate good m according to the production function $F(\ell, m)$.[9] 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 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

$$\pi^{NE} = (1 - t_i)\left(p^{NE} F(\ell, m) - r \cdot m - w \cdot \ell\right) \tag{2}$$

where t_i stands for the corporate tax rate in country i and p^{NE} is the output price set by national firms.[10] National firms choose inputs in a cost-minimizing way and, given CES demand, set the optimal price as a constant mark-up over marginal cost.

[6] 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.

[7] 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.

[8] 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 labor is constant equal to w, which would endogenously fix the wage rate in the economy at w.

[9] 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.

[10] To simplify notation, we suppress the index ω in the following derivations.

2.2.2. Multinational firms

Multinational firms produce in country i, but can 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:

$$(1-t_i)\left(p^{MNE}F(\ell,m)-w\cdot\ell-p_m\cdot m\right)+(1-t_s)(p_m-r)\cdot m-\gamma(p_m-r,\theta)\cdot m, \quad (3)$$

where p^{MNE} denotes the output price set by multinational firms and γ depicts MNEs' cost 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.[11] The first term of Eq. (3) reflects profits in country i, the second term profits at the foreign subsidiary and the last term MNEs' concealment costs.

In addition to choosing inputs and p^{MNE} optimally, the MNE must also decide on the transfer price distortion $\delta = p_m - r$. In Section A of the Online Appendix, we formally characterize the optimal behavior of MNEs in three steps. First, we show that the optimal transfer price distortion equates tax savings $t_i - t_s$ with marginal concealment cost γ_δ. Hence, MNEs distort the transfer price upwards $(p_m > r)$ as long as $t_i > t_s$ to shift profits to their low tax subsidiary. Second, we document that profit shifting lowers the effective unit cost for materials by $a(\delta^\star,\theta) = \delta^\star\cdot(t_i - t_s) - \gamma(\delta^\star,\theta)$. The cost advantage equals shifted profits per unit of m (the optimal transfer price distortion $\delta^\star$ multiplied by the tax gap $t_i - t_s$) net of concealment cost. Intuitively, the cost advantage arises because MNEs can use input purchases from their subsidiary to lower their overall tax burden. This lowers marginal cost and implies, finally, that MNEs charge a lower price and have higher sales than an otherwise identical national firm. See Online Appendix A for details.

2.3. The impact of transfer pricing rules on MNEs and NEs

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):

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

This results in higher MNE prices (while leaving the prices of national firms, which have no profit shifting opportunities, unaffected) and consequently, in higher national firms' sales and profits. See Online Appendix A for details.

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.*

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.

[11] 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.

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). National firms are, inversely, defined as firms without ownership ties to foreign countries, defined in a strict way, that is we disregard firms in national-entity-analyses, even in case of minority ownership ties to foreign countries.

The data comprises the years 2004 to 2012 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.[12] Policy treatment is thus fuzzy and extends across a period of time.[13] 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, Spain, Finland, France, Great Britain, Italy and Sweden. In total, our data comprises around 21.5 million national firm-year observations and almost 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 on NEs hinges on their exposure to multinational competitors.

For our empirical analysis, we assume that product-market competition takes place on the 4-digit industry-country level.[14] We construct the market share of MNEs in market k in country c as:

$$\text{MNE-share}_{kc} = \frac{\sum^{MNE} s_{ikc}}{\sum^{MNE+NE} s_{ikc}} \quad (4)$$

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

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

[14] In robustness checks, we use also MNE's market share MNE-share$_{kc}$ based on 3-digit (instead of 4-digit) industries and as an unweighted average (*i.e.* setting $s_{ikc} = 1$ in Eq. (4)). See Table C2 in the Online Appendix for the correlation of the different MNE-exposure measures.

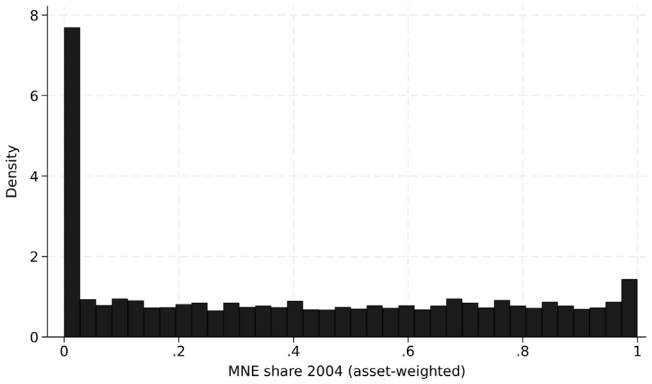

Fig. 1. Distribution of MNE-share.
Notes: The figure shows the distribution of the total asset weighted MNE-share.

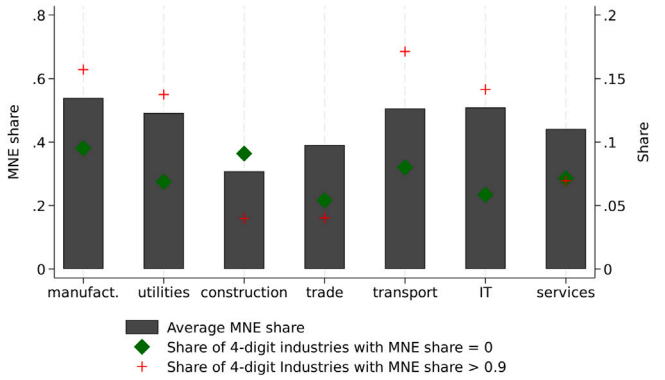

Fig. 2. MNE-Share by industry classes.
Notes: The figure shows the average MNE-share (left axis), the share of 4-digit industries with an MNE-share of zero, and with an MNE-share above 0.9 (right axis) by industry class.

where s_{ikc} is a proxy for the sales of firm i in 4-digit NACE rev. 2 industry k in country c. 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 Fig. 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).[15] 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%.[16] 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.[17] This limits the quantitative importance of distortions from missing information when calculating MNE-share$_{kc}$.

A second concern is that MNE-share$_{kc}$ may be distorted because of misclassifications 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.[18] We present robustness checks below, where we gauge the importance of these concerns. The findings do not provide any indication for biased estimates.

[15] 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).

[16] See Table 1 on p. 8 in Kalemli-Ozcan et al. (2015).

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

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

Variation in the MNE-share across industries & countries: Fig. 1 depicts the distribution of the MNE-share: it is relatively uniformly distributed over the entire range with spikes at the tails. The average MNE-share by broad industry classes is comparable in manufacturing, utilities, transport, IT and service, and somewhat lower in construction and trade (see Fig. 2). Analogously, all broader industry classes comprise a similar fraction of 4-digit industries with a zero MNE-share and all include a relevant fraction of MNE-dominated 4-digit industries with an MNE-share above 90% (see right scale in Fig. 2). What determines variation in MNE-shares across industries and countries? Existing work has identified various determinants of firms' decision to serve foreign markets and become an MNE (see Antràs and Yeaple (2014) for a survey). A seminal literature relates firms' decision to operate internationally to firm productivity (Helpman et al., 2004). Only for firms above specific productivity thresholds, it pays to serve foreign markets and to engage in the fixed costs of moving operations abroad. The market share of MNEs is hence predicted to relate to industries' underlying productivity distribution. The decision of firms to become MNEs, moreover, hinges on benefits from production offshoring to lower-wage countries (see, *e.g.*, Bernard et al., 2006; Feenstra, 2010; Feenstra and Jensen, 2012; Ebenstein et al., 2014); and MNEs' location patterns have been documented to be shaped by market size and institutional determinants, including taxes, tariffs and the regulatory framework (see Antràs and Yeaple (2014) for details).

In Table 1, we present correlates between the MNE-share in 4-digit industry-country-cells and industry characteristics. Most importantly, we use our financial accounting data to construct the average total factor productivity (TFP) of firms in a given 4-digit industry-country cell and draw on administrative patent data from PATSTAT to determine firms' average patent intensity, measured by the quality-adjusted number of patent applications relative to total assets (see Sections D.1 and D.2 in the Online Appendix for data and construction). In line with theoretical expectations, the MNE-share correlates positively with industries' total factor productivity and R&D intensity (cf. Table 1). Many R&D-intensive sectors belong to the 4-digit industries with the highest MNE-share in one or more of our sample countries, including pharmaceuticals, the chemical industry, electronics and engineering. We also find a positive correlation of the MNE-share with industries' average firm size and overall market size. Labor intensity, in turn, correlates only relatively weakly with the MNE-share.

Intuitively, the MNE-shares of the same 4-digit industry, moreover, correlate positively across countries, centering around 0.4 to 0.5 (see Figure C1 in the Online Appendix) - consistent with common factors across countries determining MNE activity within an industry. Still there is also cross-country-variation in the MNE-share. This may relate to industry-level idiosyncratics or to country-level policies: MNE-shares

Table 1
Correlation MNE-share — industry characteristics.

Dependent variable	All firms	National firms
Avg. Total Factor Productivity	0.1986***	0.0467
(*p*-value)	(0.000)	(0.025)
Avg. Patent Intensity	0.1430***	0.0447***
(*p*-value)	(0.000)	(0.003)
Log Avg. Patent Intensity	0.4080***	0.1755***
(*p*-value)	(0.000)	(0.000)
Log Avg. Firm Size	0.5942***	0.1806***
(*p*-value)	(0.000)	(0.000)
Log Market Size	0.4398***	0.0923***
(*p*-value)	(0.000)	(0.000)
Avg. Age	0.1823***	0.0646***
(*p*-value)	(0.000)	(0.000)
Avg. Labor Intensity	−0.0650***	−0.0718***
(*p*-value)	(0.000)	(0.000)

Notes: The table shows pairwise correlation coefficients at the industry-country-level between the MNE-share and different industry-country characteristics, namely the asset-weighted average total factor productivity of firms ('Avg. TFP'), the average patent intensity of firms constructed as firms' quality-weighted number of patents over total assets ('Avg. Patent Intensity'), the log-transformed patent intensity, where we add a small constant (+1) to avoid losing observations before taking the log ('Log Avg. Patent Intensity'), see Sections D.1 and D.2 in the Online Appendix for details on the calculation; the natural log of the average firm size in the industry-country-cell ('Log Avg. Firm Size'), the aggregate size (total assets) of firms in the industry-country cell ('Log. Market Size'); the average age of firms ('Avg. Age') and the average labor intensity ('Avg. Labor Intensity'). p-values are reported in brackets, *** $p < 0.01$.

are *e.g.* expected to be lower if countries' regulatory framework restricts foreign direct investments. Consistent with this notion, we find a mild negative correlation between MNE-shares and the OECD's FDI regulatory restrictiveness index (−0.084, *p*-value <0.00).[19] Idiosyncratic factors may also play a role: If firms draw their productivity from an underlying productivity distribution (Helpman et al., 2004), these draws may differ across countries, leading to cross-country variation in the MNE-share of an industry.[20] One example to illustrate this point is the beer industry in Belgium and Germany. The Belgium market is dominated by Anheuser-Busch InBev, a Belgium company, which is the leading brewer (by company sales) worldwide with a market share of almost 60% in the Belgium beer market (significantly less in other countries), see *e.g.* Verstl (2019). As a comparison, the German beer market, while large in total size, features a significant number of smaller and middle sized local firms (Wharton Knowledge, 2013; Loretz and Oberhofer, 2016). Consistent with this notion, in our analysis, there is a stark 40 percentage point-gap in the MNE asset share in the Belgium brewery and the German brewery market.

Importantly, also note that our main empirical analysis will focus on a sample of *national* firms. We, therefore, augmented Table 1 by a column that illustrates the correlation between the MNE-share of the 4-digit industry-country cell and the average characteristics of *national* firms in the industry. The table indicates that correlation coefficients tend to be smaller in size than when also accounting for MNEs, consistent with intuition: While theory makes predictions on the link between firm characteristics and MNE status, it is less clear how MNE-shares in an industry correlate with characteristics of firms, which remain national.[21]

Finally, the impact of transfer pricing rules on NEs' market outcomes is expected to depend on the extent to which competing MNEs engage in aggressive international tax avoidance; we thus in additional analyses also focus on the market share of *tax-aggressive* multinational competitors. We proxy tax-aggressiveness in two ways. First, we classify MNE groups as tax-aggressive if they have a presence in at least one tax haven economy. Specifically, 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; Tørsløv et al., 2018). Second, we classify MNEs that operate in patent-intensive country-industries as tax-aggressive as patents are a major class of 'profit shifting-assets', which have been found to facilitate shifting behavior (see *e.g.* Karkinsky and Riedel, 2012; Griffith et al., 2014).

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 require 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. All of our sample countries had transfer pricing legislation 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. 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.[22]

We map these rules in one index 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 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.

[19] Note that the index varies at the level of 2-digit industries and countries.

[20] Consider two countries, where the firm in one country obtains a high productivity draw from the right tail of the distribution, resulting in a large firm size, with the firm serving the home and the foreign market (*i.e.* becoming an MNE). Because of frictions, the firm's market share in the home country is larger than in the foreign market. If other firms in the two countries obtain significantly lower productivity draws, the MNE-share in the two countries respectively differs.

[21] The productivity of these national entities is *e.g.* a function of the *distribution* of productivity draws (see *e.g.* Helpman et al., 2004).

[22] Court cases highlight the relevance of transfer pricing rule design and tightness and how they impact multinational firms' tax costs. In Spain, for example, (which tightened its transfer pricing regulations strongest over our sample period, see below), tax authorities aimed to adjust the taxable income of Citresa (a Spanish subsidiary of the Schwepps Group) for 2004, 2005 and 2006. They deemed the arm's length price calculation method used by the company as not appropriate and applied instead another method that was introduced into national TP law in 2006 only. The tax authority lost the case, with the court ruling that the method could only be applied after its introduction. Another court case from France equally illustrates the relevance of transfer pricing regulations for profit shifting and firms' tax costs: McDonalds France entered in 2022 into a settlement agreement with the French tax authorities, which required them to pay back 1.245 billion Euro in taxes and fines, redeeming elevated royalty payments to a related company.

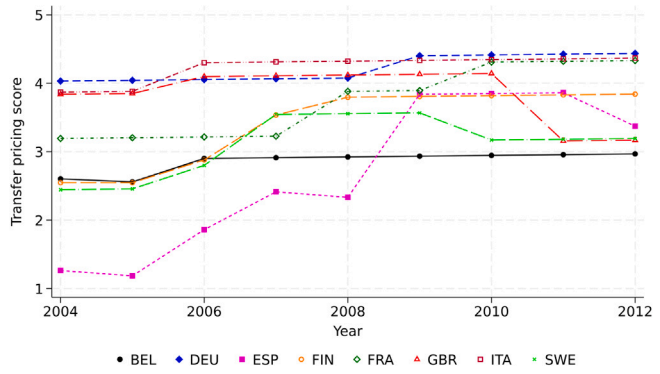

Fig. 3. Transfer pricing score during our sample period.
Notes: The figure shows the transfer pricing score of our sample countries during our sample frame: Belgium (BEL), Germany (DEU), Spain (ESP), Finland (FIN), France (FRA), Great Britain (GBR), Italy (ITA) and Sweden (SWE).

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). Please see Section D.3 in the Online Appendix for further information on the construction.

The average transfer pricing score across our sample countries is 3.62, varying considerably between 1.19 and 4.4. Fig. 3 depicts the index's time variation during our sample frame, showing a trend towards tighter transfer pricing rules. The variation in the TP index stems from different underlying changes in the transfer pricing system. The trend towards tighter provisions is driven by the introduction of regulations that require contemporaneous documentation of transfer prices (Spain in 2008, France in 2010), a tightening of rules on the determination of arm's length prices (Great Britain in 2006, Germany in 2009), a tightening of penalty regimes (Sweden 2007); the availability of advanced pricing agreements (Italy 2005) and tighter transfer pricing rule enforcement (from 2006 onward in Belgium; from 2007 onwards in Spain; from 2006 onwards in the United Kingdom). We will show below that the overall TP index as well as different aspect of transfer pricing rules impact market outcomes in a way consistent with our theoretical expectations. Also note that other anti-profit shifting provisions like thin capitalization rules remained largely unchanged within our sample period and can hence not be used for empirical identification.

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.

4. Transfer pricing regulations and multinational firms' effective tax costs & operating revenue

Our main aim is to determine whether changes in TP provisions impact national firms' product market outcomes. Before embarking on this analysis, we assess whether tighter TP rules impact multinational firm behavior. They may 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, thereby raising firms' effective tax costs. Second, transfer pricing rules impose compliance burdens on multinational 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) cost shift. We furthermore test for sales responses: If TP rules raise MNEs' effective costs, we expect firm sales to drop (see Section 2).

Methodology: To assess the impact of transfer pricing rules on MNE behavior, we rely on unconsolidated accounting data. To study the impact on MNEs' tax costs, we create two 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 Section B of the Online Appendix, 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. To study the impact on MNEs' sales, we use the natural logarithm of operating revenue of firm i in country c operating in 4-digit industry k at time t, denoted by OR_{ikct}. As sales quantities are unobserved in accounting data, we complementarily assess the impact of TP rules on MNEs' input factor use - assets and labor costs - which positively correlate with firm output.[23]

The formal estimation model reads

$$\text{z}_{ikct} = \beta_0 + \beta_1 \text{TPS}_{ct} + \beta_2 \text{X}_{ct} + \phi_i + \psi_{kt} + \varepsilon_{ikct} \tag{5}$$

where $\text{z}_{ikct} \in \{\ln TAX_{ikct}, ETR_{ikct}, \ln OR_{ikct}\}$ denotes the natural log of firms' tax payments, firms' effective tax rate or the natural log of sales as measured by the log of operating revenue. The sample is restricted to observations with positive tax payments when the dependent variable is the log of corporate tax payments and to observations with positive tax payments and positive pre-tax profits when the dependent variable is the ETR or the log of operating revenue. 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-year fixed effects (ψ_{kt}). X_{ct} is a vector of time-varying country control variables — exchange rate, population, FDI, and the World Governance indicators.[24] Empirical identification hence relies on a comparison of tax cost and sales changes by MNEs in the same 4-digit industry that do and do not experience a change in their transfer pricing provisions.

To assess the robustness of the baseline results, we rely on three additional specifications: First, we assess whether the effect is stronger for tax-aggressive MNEs. The notion is that tax-aggressive MNEs engage in more profit shifting activities and that their tax costs and operating revenues are hence expected to be more strongly affected by a tightening of transfer pricing provisions. Our first approach to capture tax-aggressive MNEs focuses on MNE group characteristics and tabs MNE groups with presence in a tax haven country as tax-aggressive profit shifters. Our second approach focuses on market characteristics and assumes that MNEs that operate in patent-intensive industries can draw on 'profit shifting-assets' and thus have a higher ability to engage in aggressive tax avoidance than firms in other industries, as evidenced by prior literature (see *e.g.* Karkinsky and Riedel, 2012; Griffith et al., 2014). The modified estimation equation is presented in Section E of the Online Appendix (cf. Equation E1). An additional benefit of focusing on tax-aggressive MNEs is that we can, in the related specifications, modify our baseline estimation model and augment the vector of regressors by a full set of host country-year fixed effects, which non-parametrically controls for potential time-varying host country confounders.

[23] Note that sales quantities are not observed in accounting data but only sales value. As predicted by our theoretical model, MNEs' output prices are predicted to increase in the wake of TP reforms, while sales are predicted to fall. Any negative reform effect on companies' operating revenue must thus be interpreted as a lower bound to the true impact on firms' sales.

[24] We use lagged values for population and FDI due to endogeneity concerns.

Table 2
Effect of TPS on MNEs' tax costs and operating revenue.

	ln(Tax)	ETR		ln(Operating Revenue)	ln(Assets)	ln(Cost of Employees)
	(1)	(2)	(3)	(4)	(5)	(6)
TPS	0.083***	0.016***	0.016***	−0.044***	−0.030***	−0.024***
	(0.012)	(0.001)	(0.001)	(0.008)	(0.005)	(0.005)
ln(CIT)	0.904***					
	(0.103)					
CIT		0.353***	0.368***	1.294***	0.592***	0.723***
		(0.031)	(0.033)	(0.193)	(0.136)	(0.129)
Firm FE	✓	✓	✓	✓	✓	✓
Ind-Year FE	✓	✓	✓	✓	✓	✓
Ctry Controls	✓	✓	✓	✓	✓	✓
Observations	936,817	788,368	723,099	723,099	788,220	623,035

Notes: The table shows the results of the baseline specification (Eq. (5)), where we estimate the impact of transfer pricing regulations on MNE outcomes. The dependent variable is ln tax payments (Column (1)), effective tax rate (Columns (2)–(3)), ln operating revenue (Column (4)), ln total assets (Column (5)), and ln cost of employment (Column (6)). TPS stands for the transfer pricing score. The sample in Column (1) includes only observations with positive tax payments; from Column (2) onwards with positive tax payments and positive pre-tax profits. Observations with an effective tax rate above 100% are excluded. From Column (3) onwards, the sample includes only firm-year observations for which also operating revenues are observed. All columns include country controls (ln exchange rate, ln population, ln FDI, and World Governance indicators) and industry (4-digit NACE)-year fixed effects. Standard errors, clustered at the 3-digit NACE-country level, are reported in parentheses. Statistical significance is indicated by * p<0.1, ** p<0.05, *** p<0.01.

Second, to assess the plausibility of the common trend assumption and inspect effect dynamics, we estimate a generalized event study model which reads:

$$z_{ikct} = \sum_{j=-4}^{3} \beta_j \text{TPS}_{ct}^{j} + \gamma X_{ct} + \phi_i + \psi_{kt} + \epsilon_{ikct} \quad (6)$$

where we define $\text{TPS}_{ct}^{j} = \Delta TPS_{c,t-j}$ and account for end point binning.

Third and lastly, 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 heterogeneous and dynamic treatment effects (*e.g.* Goodman-Bacon, 2021). We thus follow the recent literature that has proposed estimators that yield unbiased estimates in the presence of heterogeneous 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. We discretize the TPS, *e.g.* the treatment variable, into five equally spaced group. The estimation equation thus resembles the generalized event study, with the main difference that we create the binned treatment variable using $\Delta TPS_{c,t-j}^{D}$, which is the difference of the discretionized TPS. Note that we can only account for 2 leads and 1 lag, as transfer pricing rules change frequently within our data frame, implying that we lack control countries to identify deeper lags.

Since MNEs might not only respond to tighter TP rules by reducing their operating revenue but may also decide to exit markets, we complement our firm-level analysis of the intensive margin response with estimations on the country-industry level that assess the impact of TP rules on MNEs' probability to exit markets. To account for the varying coverage of our data over time, we use the share of exiting MNEs in industry k, country c and year t as dependent variable. We assume that a firm exits if it is (except for the last year) observed for the last time in our data.[25]

Results: The results are reported in Table 2. Robust standard errors that account for clustering at the 3-digit NACE-country level are reported in brackets below the coefficient estimates. In Columns (1) and (2), we report the baseline estimates, where the dependent variable is the natural log of TAX_{ikct} and the ETR_{ikct} respectively. In line with expectations, both specifications 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. Panel A Table C1) raises affiliates' tax payments and effective tax rate by 6.2% and 1.2%-points respectively. Column (3) re-estimates the specification in Column (2) but restricts the sample to firm-year observations for which operating revenues are observed. In Column (4), we use the natural log of MNEs' operating revenue as dependent variable. In line with our expectation, the point estimate is negative and significantly different from zero. Quantitatively, it suggests a decrease in MNEs' operating revenue by 3.7% if the transfer pricing score increases by one standard deviation. This implies a semi-elasticity of operating revenue with respect to the effective tax rate of −2.75 (=−0.044/0.016), which is internally and externally consistent. To see this, note that our own estimates in Table 2 suggest that an increase in the statutory corporate tax rate (CIT) of 10 percentage points raises firms' ETR by 3.7 percentage points and simultaneously lowers firms' operating revenue by 13%. This translates into a semi-elasticity of firms' operating revenue with respect to firms' ETR of around −3.5. The estimated effect size is, moreover, also consistent with prior literature, which estimated semi-elasticities of firms' capital stock with respect to the statutory corporate tax rate of around −3 (see, for example, Liu and de Mooij, 2020). Given that recent studies suggest little substitution effects between capital and labor (see Curtis et al., 2021), and estimate output elasticities below one, a semi-elasticity of firms' operating revenue with respect to firms' ETR of −3 falls well within the ballpark of existing research.

We ran a number of sensitivity checks. A first test focuses on tax-aggressive and non-tax aggressive MNEs. The estimates are reported in Table E1 in the Online Appendix. In line with our expectation, we find that tax-aggressive MNEs are more strongly affected by tighter transfer pricing regulation than other firms. In addition, similar effect patterns emerge when we additionally include country-year fixed effects and thus non-parametrically absorb potential time-varying confounders at the host-country level: Tighter transfer pricing regulations increase tax aggressive MNEs' tax costs and reduce their operating revenue.

In a second robustness check, we estimate a generalized event study, using MNEs' ETR and the log of operating revenue as dependent variable. The estimates are reported in Fig. 4 and suggest no

[25] As in the firm-level analysis, the estimation equation includes country-industry and industry-year fixed effects as well as the country controls discussed above. We estimate models at the country-4-digit industry-level and at the country-2-digit industry level.

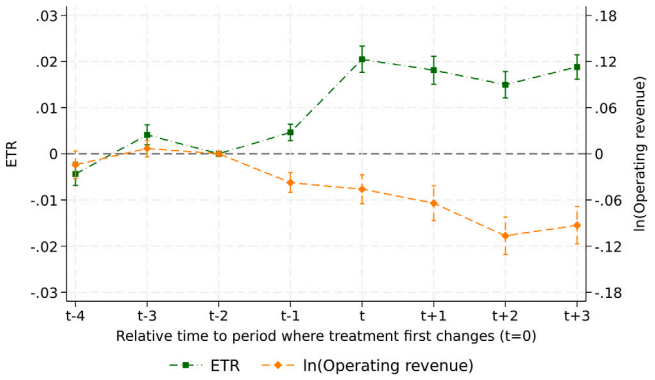

Fig. 4. Generalized Event Study: MNEs' ETR and Operating Revenue.
Notes: The figure shows estimated coefficients for 4 leads and 3 lags of a generalized event study that estimates the impact of TP rule changes on MNEs' ETR and ln operating revenue. The specification includes firm fixed effects, industry-year fixed effects and the set of control variables sketched in the main text. Standard errors are clustered at the 2-digit NACE-country level.

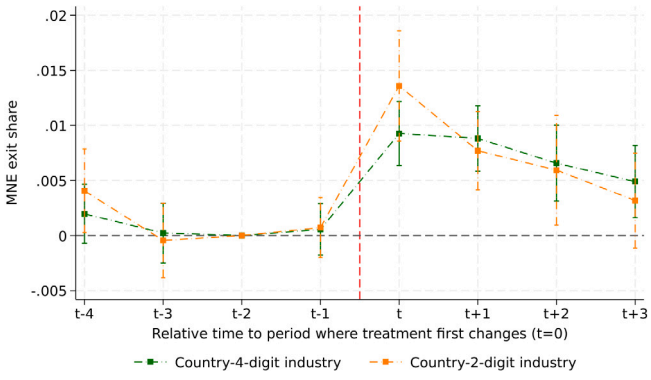

Fig. 5. Generalized event study: MNE Exits.
Notes: The figure shows estimated coefficients for 4 leads and 3 lags of a generalized event study model that estimates the impact of changes in the TP score on the share of MNEs exiting the market. Estimation is on the country-4-digit industry and country-2-digit industry level and the dependent variable is the share of MNEs observed for the last time in our data. The specifications include country-industry and industry-year fixed effects and the set of control variables sketched in the main text. Standard errors are clustered at the 2-digit NACE-country level.

significant pre-trend difference between treated and control firms for MNEs' ETR and operating revenue in the period prior to changes in the transfer pricing regulations. In addition, MNEs' ETR increases and operating revenue decreases from around the time of treatment.[26] The post-reform ETR increase is rather swift compared to the decline in operating revenue. One potential explanation for this is that MNEs immediately adjust their tax avoidance activities in response to the tighter regulation, while effects on sales outcomes are more sluggish to emerge, reflecting that they also depend on the behavior of other market participants, *e.g.* the exit of other MNEs in the market, or the new entry of national firms.

Since the results of the generalized event study could be biased in the presence of heterogeneous and dynamic treatment effects, we also reestimate the model relying on the estimator proposed by de Chaisemartin and D'Haultfoeuille (2022a). The results do not suggest a bias (see Figure E1 in the Appendix): The pre-trend is again flat and the estimated average treatment effect of 0.016 (std.error 0.005) for the ETR and of −0.103 (std.error 0.067) for the log of operating revenue resemble our baseline effects.

To complement the impact of the tightness of transfer pricing regulation on MNEs' intensive margin behavior, Fig. 5 reports the results of the generalized event study using the share of MNE exits on the country-(4-digit or 2-digit)industry level as dependent variable. It shows that the tightening of transfer pricing regulation increases the probability of affected MNEs exiting. The pre-trend is flat and effect dynamics are plausible, with the share of MNE exits jumping up in the year of the policy change. Summing up, the annual effects suggest that a rise in the TP score by one standard deviation increases the share of MNE exits by around 3% (based on the estimation on the country-2-digit industry level). Given our estimated long-run reduction in MNE' sales of around -10% (see Fig. 4), this suggest that MNEs' intensive margin response accounts for 3/4 of the total effect and is thus the more important adjustment margin.

[26] There is a mild anticipating effect in the year before the actual increase of the tightness of transfer pricing regulations. The anticipation effect seems plausible, given that changes in transfer pricing regulations are not implemented over night, and thus companies do know about them before they become effective. Note, moreover, that one key element of our transfer pricing index is the perceived tightness of transfer pricing rule enforcement, which is drawn from interviews with transfer pricing experts. To the extent that these transfer pricing experts draw on retrospective experiences with rule enforcement, tightenings of TP enforcement schemes may be logged with delay – offering an alternative explanation for the mild anticipation effect.

Summarizing, our findings suggest that transfer pricing rules increase firms' effective tax burden in a statistically and economically significant way. While non-testable with our data, anecdotes, moreover, suggest that transfer pricing rules also entail significant compliance costs and tax risks for affected multinational firms (*e.g.* Durst, 2010; Ernst and Young, 2007). In line with these observations and prior literature (Liu and de Mooij, 2020), we further find that MNEs' sales and real activity declines, both at the intensive and extensive margin, when transfer pricing provisions are tightened.[27]

5. Anti-shifting provision and performance of national firms

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

$$ln(y_{ikct}) = \delta \text{TPS}_{ct} \times \text{MNE-share}_{kc} + \rho_i + \zeta_{ct} + \kappa_{kt} + \varepsilon_{ikct} \quad (7)$$

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. Again, we also complementarily use information on input factor use – assets, number of employees and labor costs – which positively correlate with firm output. 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.

[27] Note that these reductions may reflect that MNEs downscale their global real activity. Alternatively, they might also relocate real activity to foreign countries to avoid the tighter transfer pricing regulation. In that case, goods and services could be reimported to the domestic market, which might dampen the impact on local market outcomes. Firms then face additional transport and tariff costs, however, and the mechanism illustrated in our theory section is still at play: the reform induces MNEs' costs to increase and is predicted to lower MNEs' sales (increase NEs' sales) in a given market. Laudage Teles et al. (2023) show, for the introduction of the French transfer price documentation requirements, that decreases in real activity in France are not accompanied by changes in real activity at other (high-tax) group affiliates, pointing to a global reduction in real activity.

The main coefficient of interest is δ, which captures the impact of the TP 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 industry-country level.[28] 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. Standard errors are clustered at the industry (3-digit NACE)-country level.

Our empirical strategy is valid if the sales of national firms in the same country would have followed a similar trend across markets with high and low MNE-competitor exposure in the absence of changes in the anti-shifting provision. We assess the plausibility of this assumption in several ways.

First, 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). Second, we run specifications, where we absorb potential policy and industry confounders in the empirical analysis by adding regressors that allow for a differential impact of other policy choices (*e.g.*, changes in the corporate tax rate) in markets with high and low MNE competitor exposure as well as for a differential impact of changes in transfer pricing provisions by industry characteristics other than the MNE-share (*e.g.* the average productivity or knowledge intensity of firms). Further, we assess the sensitivity of our findings to excluding certain industry-country-cells for which the underlying assumptions are less likely to be valid. Third, we inspect pre-trends and effect dynamics. Since our empirical setting is again a two-way fixed effect design, where firms are subject to a staggered treatment, we use the estimator proposed by de Chaisemartin and D'Haultfoeuille (2022a). We discretize the treatment variable – the interaction between the transfer pricing score and the MNEs' market share – 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. Since in each country a substantial fraction of NEs in our data is unexposed to multinational competitors (see Fig. 1),[29] we are able to include three leads and three lags of the difference of the discretionized treatment variable, $\Delta(\text{TPS}_{c,t-j} \times \text{MNE-share}_{kc})^D$.[30] Bootstrap standard errors are clustered at the industry-country level.

Main Results: The estimation results for Eq. (7) are presented in Table 3. In line with expectation, we find that 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 C1), the estimates suggest that a transfer pricing score increase by one standard deviation (= 0.86, cf. Table C1) 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 Column (3), we allow for non-parametric time trends related to the MNE-share, which has, however, little impact on the point estimate of interest.

Other Firm Outcomes: The baseline analysis 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. Columns (4) to (6) in Table 3 test 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. Columns (4) to (6) 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 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. Columns (7) and (8) quantify the impact of transfer pricing tightness on 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.

In addition, we assess 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. Table F1 in the Online Appendix presents specifications where we reestimate our baseline model using firms' mark-up as dependent variable. Column (1) reestimates our baseline model (with operating revenue as dependent variable) in the smaller sample with non-missing mark-ups. In Columns (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.

Heterogeneity and Dynamic-Robust Treatment Effects: To hedge against the concern of biased estimates due to the presence of heterogeneous and dynamic treatment effects, we also run specifications that rely on the estimator proposed by de Chaisemartin and D'Haultfoeuille (2022a). If we absorb host-country-year fixed effects (host country-industry section-year fixed effects), the average treatment effect using the natural log of operating revenue is 0.057 with a standard deviation of 0.020 (0.069 with a standard deviation of 0.038) and thus very similar to our baseline estimate.

The full set of estimates is reported in Fig. 6. The figure provides no indication for differences in the pre-trends of sales values across industries with different degrees of MNE-exposure prior to the transfer pricing reforms, which supports the common trend assumption for unbiased estimates in our empirical setting. 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.

Robustness – Sample: Table 4 presents a number of robustness checks with regard to sample composition. Column (1) in the upper panel uses only firms that are observed for at least 4 consecutive years. Column (2) includes only industry-country cells with more than 100 firms in 2004. Column (3) excludes the countries (Germany, France and Spain), where major changes in TP rules coincide with the financial crisis. In all three specifications, we obtain very similar estimates to our baseline estimate. The remaining specifications in the table assess to what extent our findings are driven by industry-country cells with 'extreme' MNE-shares or extreme MNE-share developments prior to treatment.

[28] In robustness checks we assess the sensitivity of our results to other definitions of MNE exposure.

[29] Due to this, the concern of biased estimates is also mitigated.

[30] The estimation equation thus resembles – ignoring the selection of the firms used for identification – Eq. (7), except that $\delta \text{TPS}_{ct} \times \text{MNE-share}_{kc}$ is replaced with $\sum_{j=-3}^{3} \delta_j \Delta(\text{TPS}_{c,t-j} \times \text{MNE-share}_{kc})^D$.

Table 3
Effect of TPS on market performance of NEs: main results.

ln	Operating revenue			Assets	Cost of Employment	# Employees	Pre-tax Profit	EBIT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TPS × MNE-share	0.066***	0.055***	0.061**	0.028***	0.042**	0.044***	0.031	0.038*
	(0.024)	(0.015)	(0.024)	(0.010)	(0.019)	(0.014)	(0.020)	(0.020)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Ind-Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Ctry-Year FE	✓		✓	✓	✓	✓	✓	✓
Ctry-IndSection-Year FE		✓						
MNE Share by Ctry-Year FE			✓					
Observations	21,543,027			21,238,315	15,512,687	11,944,573	12,955,932	10,201,427

Notes: The table depicts the baseline estimates, which assess the impact of transfer pricing regulations on market performance of NE. The dependent variable is the natural log of firms' operating revenues (Columns (1)–(3)), the log of firms' total assets (Column (4)), the log of firms' costs of employees (Column (5)), the log of firms' number of employees (Column (6)), the log of firm's pre-tax profits (Column (7)), or the log of firm's EBIT (Column (8)). All columns include firm fixed effects and industry (4-digit NACE)-year fixed effect. Column (2) includes, in addition, country-industry section (1-digit NACE)-year fixed effects, all other specifications country-year fixed effects. In Column (3), we additionally allow for MNE-share-country-specific non-parametric time trends. Standard errors, clustered at the 3-digit NACE-country level, are reported in parentheses. Significance levels are depicted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4
Effect of TPS on market performance of NEs: Estimation sample.

	ln(operating revenue)			
	(1)	(2)	(3)	(4)
Without	# Firm-years < 4	# NACE4-Ctry < 100	France, Germany, Spain	High MNE growth rate 00-04
TPS × MNE-share	0.064***	0.072***	0.083**	0.072***
	(0.025)	(0.027)	(0.040)	(0.024)
Observations	17,298,623	20,395,293	9,245,850	20,088,620
Without	Country-Industries with MNE-share = 0	> 0.9	Industries with MNE-share = 0 in more than 1 country	> 0.9
TPS × MNE-share	0.073***	0.065**	0.077***	0.056**
	(0.026)	(0.025)	(0.027)	(0.026)
Observations	20,929,201	21,256,935	20,089,191	20,535,670
Firm FE	✓	✓	✓	✓
Ind-Year FE	✓	✓	✓	✓
Ctry-Year FE	✓	✓	✓	✓

Notes: The table shows results for robustness checks with regard to the estimation sample. All specifications include firm fixed effects, country-year and industry (4-digit NACE)-year fixed effect and use the natural log of firms' operating revenues as dependent variable. Upper panel: Column (1) uses only firms that are observed in at least 4 consecutive years, Column (2) only firms in 4-digit industry-country cells with at least 100 observations in 2004, Column (3) excludes countries that changed their TP regulation during the financial crisis (France, Germany and Spain) in the years 2007 and 2008 and Column (5) excludes industry-country cells with MNE growth rates between 2000 and 2004 above the 90% percentile. Lower panel: Column (1) excludes industry-country cells with a MNE-share of zero, Column (2) excludes industry-country cells with a MNE-share above 0.9. Column (3) excludes industries with an MNE-share of zero in at least two countries, Column (4) excludes industries with a MNE-share above 0.9 in at least two countries. Standard errors, clustered at the 3-digit-NACE-country level, in parenthesis. Significance levels are depicted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Column (4) of the upper panel reports the results when excluding industry-country cells with high MNE growth rates prior to our sample frame, between 2000 and 2004. This hedges us against findings that are confounded by industries with strong underlying – tax policy-unrelated – industry dynamics in multinational and national firm activity. Columns (1)-(4) in the lower panel exclude firms in industry-country-cells from the estimation, where the MNE-share is either zero or very high (> 0.9). Columns (1) and (2) do so restrictively, disregarding industry-country-cells, in which the MNE-share is zero or > 0.9; Columns (3) and (4) drop industry-country-cells with extreme MNE-shares more broadly: All firms in industries are excluded, if the industry features a zero or high MNE-share in more than one country.[31] In all specifications, we obtain estimates similar to our baseline model.

Robustness – Omitted Variables: Another potential concern for our empirical setting are omitted variables. First, 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 by augmenting the set of regressors by interaction terms between MNE exposure and other tax policies (see Panel A of Table 5): These are the country's statutory corporate tax rate, its effective marginal and average corporate tax rate, income taxes, labor taxes and goods & services taxes.[32] In all columns, our baseline estimates are largely unaffected, and none of the additional interaction effects turns out to be statistically different from zero at conventional significance levels. Also note that our sample countries saw no other major changes in anti-profit shifting legislation during our sample frame.

[31] If 4-digit industries feature extreme MNE-shares in several countries, it becomes more likely that underlying trends in these industries might act as a confounder in the empirical analysis (albeit truly common shocks are absorbed by a full set of industry-year fixed effects in all specifications).

[32] 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 5
Effect of transfer pricing regulations on market performance of NEs: absorbing potential policy and industry confounders.

	ln(operating revenue)					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Interactions of Country Variables with MNE-share						
	Statutory Corporate Tax	EATR	EMTR	Income Taxes	Goods/ Service Taxes	Labor Tax
TPS × MNE-Share	0.064***	0.066***	0.067***	0.065***	0.068***	0.075***
	(0.023)	(0.024)	(0.024)	(0.021)	(0.025)	(0.024)
MNE-Share ×...	−0.243	0.155	−0.125	−0.000	0.006	0.006
	(0.416)	(0.672)	(0.204)	(0.004)	(0.007)	(0.005)
Firm FE	✓	✓	✓	✓	✓	✓
Ind.-Year FE	✓	✓	✓	✓	✓	✓
Ctry-Year FE	✓	✓	✓	✓	✓	✓
Observations			21,543,027			19,646,437
Panel B: Interactions of Country-Industry Variables with TPS						
	TFP	ln Patent Intensity	ln Firm Size	Labor Share	ln Market	FDI Restrictiveness Index
TPS × MNE-Share	0.076***	0.068***	0.055**	0.067***	0.066***	0.082**
	(0.023)	(0.024)	(0.026)	(0.024)	(0.023)	(0.032)
TPS ×...	−0.003	−0.009	0.013*	0.054	0.000	−0.005
	(0.049)	(0.010)	(0.007)	(0.059)	(0.006)	(0.062)
Firm FE	✓	✓	✓	✓	✓	✓
Ind.-Year FE	✓	✓	✓	✓	✓	✓
Ctry-Year FE	✓	✓	✓	✓	✓	✓
Observations			21,543,027			14,825,892

Notes: The table presents estimates that rule out that our results are driven by confounding policy shocks (Panel A) and confounding industry-country-level variation (Panel B). In Panel A, the baseline model is augmented by regressors for the industries' MNE-share interacted with the statutory corporate tax rate (Column (1)), the effective average corporate tax rate (Column (2)), the effective marginal corporate tax rate (Column (3)), taxes on income (Column (4)), taxes on goods and services (Column (5)), labor taxes and social security contributions (Column (6)). The latter three variables are measured relative to overall tax revenue (drawn from the World Development Indicator database). The number of observations in Column (6) is smaller than in the baseline specification as labor taxes and social security contributions are not available for 2004. In Panel B, the specifications include additional regressors for the TP score interacted with industry characteristics, namely the average total factor productivity (TFP, Column (1)), the natural log of the average patent intensity, *i.e.* the quality-adjusted number of patents over total asset on the industry-country level (Column (2)), the average firm size (Column (3)), the average labor share (Column (4)), the natural log of market size (aggregated total assets of all firms in the industry, Column (5)), and FDI Restrictiveness Index (Column (6)). In all columns, we include firm fixed effects, country-year and 4-digit NACE industry-year fixed effects and use the natural log of firms' operating revenues as the dependent variable. Standard errors, clustered at the 3-digit-NACE-country level, are reported in parenthesis. Significance levels are depicted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

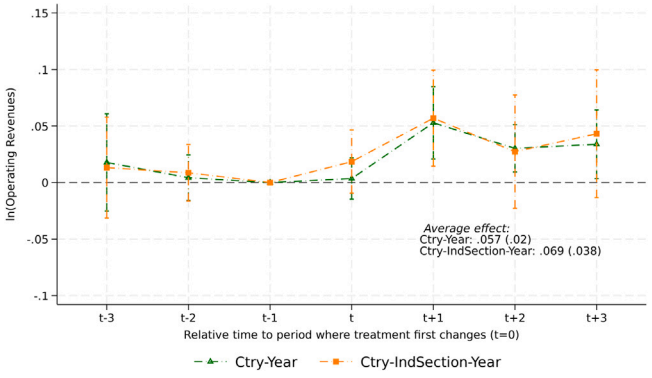

Fig. 6. Effect of TPS on Market Performance of NEs.
Notes: The figure shows estimated coefficients for 3 leads and 3 lags of TPS and MNE-share interaction on ln firm's operating revenues using the estimator proposed by de Chaisemartin and D'Haultfoeuille (2022a). The TPS and MNE-share interaction is 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. Bootstrapped standard errors are clustered at the industry (3-digit NACE)-country level.

Second, our estimates could be biased if the MNE-share correlated with other market, *e.g.*, country-industry characteristics. While our estimation strategy accounts for 4-digit industry-year fixed effects, and thus absorbs common shocks that hit all firms in the same 4-digit industry, we cannot a priori rule out confounders that might be at play at the industry-country-level. As illustrated in Table 1, the correlation between firm characteristics and the MNE-share in industry-country-cells is relatively weak, however, which dampens related concerns. In Panel B of Table 5, we, nevertheless, absorb potential industry-level confounders by adding interaction terms between the TP score and other industry-country characteristics (see Panel B of Table 5): firms' average total factor productivity, average R&D intensity (as measured by patent intensity), average size, average labor share and market size as measured by the aggregate of total assets of all firms in an industry-country cell. Again, our baseline estimates are largely unchanged. Finally, note that our general result pattern also speaks against our results being biased by industry confounders: While we find that tighter TP provisions raise the sales of NEs, our prior analyses showed that they lower the sales of MNEs. Industry-level confounders would, in turn, most likely move sales of firms in the same direction.

Robustness TPS and MNE-share: Panel A of Table 6 shows that our findings are also insensitive to relying on different definitions of MNEs' market share: Column (1) reports our baseline estimate. In Column (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 Column (3), we define markets at the 3-digit-industry-country level; in Column (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. In addition, we find similar effects when using the share of tax aggressive MNEs (see Table E2 in the Appendix).

Table 6
Effect of TPS on market performance of NEs: MNE-share and TPS components.

	ln(operating revenue)			
	(1)	(2)	(3)	(4)
Panel A: Alternative MNE-shares				
	Baseline	2000	3-digit-industry	# of firms
TPS × MNE-Share	0.066***	0.066***	0.061*	0.393***
	(0.021)	(0.032)	(0.081)	
Observations	21,543,027	21,543,311	21,543,341	21,543,785
Panel B: TPS Components - Part 1				
	Benchmark Data	No Foreign Comparables	Contemp. Documentation	Penalty Uncertainty
Expected sign	–	+	+	+
... × MNE-Share	−0.027	0.081*	0.102***	0.040
	(0.034)	(0.043)	(0.033)	(0.048)
Observations	21,543,027			
Panel C: TPS Components - Part 2				
	APA	Secret Comparables	Enforcement	Age of Rules
Expected sign	–	+	+	+
... × MNE-Share	−0.023	−0.041	0.141*	0.016**
	(0.041)	(0.058)	(0.084)	(0.007)
Observations	21,543,027			
Firm FE	✓	✓	✓	✓
Ind-Year FE	✓	✓	✓	✓
Ctry-Year	✓	✓	✓	✓

Notes: The table shows results for robustness checks, where we modify the definition of the MNE-share in industry-country cells (Panel A) and the individual TP score components (Panel B and C). All columns include firm fixed effects, country-year and industry (4-digit NACE)-year fixed effects and use ln firms' operating revenue as dependent variable. Panel A: Column (1) depicts our base specification. In Column (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). In Column (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 base analysis), and in Column (4), the MNE-share is calculated as the unweighted MNE-share (number of multinational firms in all firms). Panel B and C: All columns show the results of the individual components of the TP score that have variation over time interacted with the MNE-share. Standard errors, clustered at the 3-digit NACE-country level, are reported in parenthesis. The components are given above the columns, along with the expected sign of the component on NEs' sales. See Online Appendix D.3 for details on each component. Significance levels are depicted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Panel B of Table 6, furthermore, disentangles the aggregate TP index (which accounts for various aspects of TP regimes, which shape the tightness of the anti-profit shifting provision, as described above) and shows that similar findings to our baseline estimates emerge if we account for particular aspects of TP provisions. Specifically, when interacting the individual components of the TP score with the MNE-share, out of the eight components that vary across our sample period, the coefficient estimates for seven have the expected sign and four coefficient estimates are statistically significant at conventional significance levels, including key characteristics like the existence of TP documentation requirements, the tightness of TP enforcement regimes and the construction of arm's length prices.[33] Thus, it is not merely one aspect of TP regulations that drives the results.

Heterogeneity Firm Size: Column (1) in Table 7, in a further robustness check, includes a full set of firm-size decile fixed effects (where firm size is measured by total assets at the outset of the sample frame), thus allowing for different sales developments of firms in different firm size classes. This again leaves our estimates of interest unaffected. Columns (2)-(3), moreover, split the sample into firms in the upper quarter of the firm size distribution and other entities, thus allowing the size of our treatment effect to vary across firms of different size. There are two potential reasons why effects might differ between larger and smaller NEs. The first is mis-classification of MNEs as NEs. As MNEs' (in contrast to NEs') sales are predicted to decline when transfer pricing provisions are tightened, mis-classification may lead to biased estimates. The propensity to become an MNE increases with firm size (see Helpman et al. (2004) for seminal work), potentially exacerbating the problem for larger firms in our data.[34] The second reason why the impact of the TP rules on NEs' operative revenue may differ by NEs' size is that larger NEs are more likely to offer products and services that are closer substitutes to the goods offered by MNEs. The findings in Columns (2)-(3) of Table 7 point towards a larger impact on large firms, in line with the substitutability argument. This result is confirmed in Column (4), which presents estimates from a firm-size weighted regression.

Market Size: Our findings so far have established that the sales of NEs increase in response to tighter transfer pricing regulations, while

[33] The expected sign of the effect of individual components of the TP rule tightness is indicated above the respective specifications. Most determinants of the tightness of the TP score enter positively, implying that a higher realization of the variable reflects tighter TP provisions; this is the case if contemporary TP documentation is required, penalty uncertainty increases, there is tighter TP rule enforcement, stricter rules for the calculation of arm's length provision (which is the case if tax administration does not allow to draw on foreign comparables), the age of the rules increases (reflecting that effective implementation of TP rules takes time). There are two determinants that lower the tightness of TP regimes and therefore enter negatively, namely the option to engage in advanced pricing agreements and the availability of benchmark data for the calculation of transfer prices.

[34] The size of the bias is a priori unclear as it depends on mis-classified firms entering our estimation sample for national firms and mis-measurement of the treatment variable (namely the MNE-share in the interaction with the TP score).

Table 7
Effect of TP regulations on market performance of NEs: Firm size.

	ln(operating revenue)			
	(1)	(2)	(3)	(4)
	SizeDec-Year-FE	4th quartile	1th-3rd quartile	Weighted
TPS × MNE-Share	0.052**	0.100***	0.042	0.124***
	(0.025)	(0.024)	(0.026)	(0.044)
Firm FE	✓	✓	✓	✓
Ind-Year FE	✓	✓	✓	✓
Ctry-Year	✓	✓	✓	✓
Observations	21,518,825	5,413,016	16,130,011	21,518,825

Notes: The table shows the results of sensitivity checks, which assess the robustness of our findings with regard to firm size-related concerns. All columns include firm fixed effects, country-year and industry (4-digit NACE)-year fixed effects and use ln firms' operating revenue as dependent variable. Column (1) shows the results when including firm-size deciles-year fixed effects (where firm size is measured by total assets in the first year, in which the firm is observed). Column (2) uses only large firms in the 4th quartile of the total asset size distribution, Column (3) uses only small firms in the first to third quartile of the total asset distribution. Column (4) shows the results of a size weighted regression. To remove the impact of outliers, firm size is winsorized at the 1 and 99 percentile. Standard errors, clustered at the 3-digit NACE-country level, are reported in parenthesis. Significance levels are depicted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

the sales of MNEs decline. A natural follow-up question is to ask how the regulations impact overall market size. While our data does not allow us to estimate this change directly, we provide a back-of-the envelope calculation based on our estimates for the intensive margin response.[35] In the estimation sample, the average industry has a MNE-share of 34%. Our estimates suggest that a change in the transfer pricing score by one unit reduces MNEs' operating revenue by 10% (see Fig. 4); accounting for MNEs' market share of 34%, this translates into a total quantity reduction of 3.4%. In an industry with an average MNE-share, NEs' operating revenue, in turn, rises by 4.2% if the transfer pricing score increases by one unit (0.124 (see Column (4) of Table 7) × 0.34). Accounting for a market share of NEs in the average industry of 66%, this translates into a total quantity response of 2.8%. Thus more than 80% of the reduction in MNE sales is replaced by NE sales.

Discussion: Our findings suggest that a tightening of anti-profit shifting regulations is associated with shifts in market outcomes. To the extent that these shifts stem from increases in MNEs' effective tax costs, tax-induced market distortions are reduced. Adjustments in market outcomes may, moreover, also relate to changes in MNEs' compliance burdens from TP regulation, requiring a more nuanced interpretation of our findings as the additional costs on MNEs then do not map into additional revenue collection by the government and this channel, ceteris paribus, implies that (in the absence of any tax avoidance by MNEs), MNEs are disadvantaged relative to national competitors by additional compliance burdens. This channel is likely of inferior relevance, however, as prior evidence finds no indication for a link between TP compliance burdens and MNEs' real economic behavior (see Laudage Teles et al., 2023).

Note, moreover, that our analysis offers a perspective on the short- and medium-run effect of changes in TP policies. In the longer run, the observed effects may be exacerbated. Prior evidence suggests that changes in profit shifting opportunities and firms' effective tax costs may impact firms' research and development activities and, in consequence, firms' product and process innovations (see *e.g.* Schwab and Todtenhaupt, 2021); this can, in the long run, exacerbate the shifts in product market outcomes, with MNEs further loosing market shares and NEs further gaining.

In the long-run, a reduction in MNE activity might, on the contrary, also have negative repercussions on domestic firms as they may lose out because of reduced knowledge transfers and technology spillovers from MNEs. Existing empirical evidence, however, suggests that these effects are most likely small. While the literature documents upstream spillovers between MNE subsidiaries and local firms, these spillovers tend to originate from activities with shared ownership (Javorcik, 2004). Recent evidence in Amiti et al. (2023), moreover, suggests that positive spillover effects may in fact not relate to the multinational status of firms per se but rather to the higher likelihood of MNEs to be a "superstar" firm.[36]

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 regulations. 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. Importantly, there are, moreover, shifts in product market outcomes: MNEs' sales decline. And tighter anti-profit shifting rules significantly increase the observed sales and profits of affected firms' national competitors.[37]

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

[35] The intensive margin is suggested to be the more important adjustment margin: For MNEs, we find that market exits are less important for the overall quantity response than the reduction in operating revenue when transfer pricing rules are tightened. For NEs, we find that large NEs are more strongly affected at the intensive margin, suggesting that the impact on new and smaller entrants (extensive margin response) is again more limited.

[36] Also note that the size of the effect may hinge on market characteristics, *e.g.* the level of product differentiation across competitors, capacity constraints or particularities of the cost structure. While modeling potential effect heterogeneity in these domains is certainly of interest, we leave a thorough assessment to future literature.

[37] 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*.

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 than so far acknowledged in the literature.

Declaration of competing interest

We declare that we have no relevant or material financial interests that relate to the research described in the paper. No party had the right to review the paper prior to its circulation. We have not received any financial or in-kind support from an interested party with a stake related to the research described in the paper. All of the above also applies to our partners and relatives.

Data availability

The authors do not have permission to share data.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jpubeco.2024.105116.

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