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# Keeping It Simple

## Efficiency Costs of Fixed Margin Regimes in Transfer Pricing

Sebastian Beer, Sebastien Leduc, and Jan Loeprick

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**Keeping it Simple—Efficiency Costs of Fixed Margin Regimes in Transfer Pricing**  
Prepared by Sebastian Beer, Sebastien Leduc, and Jan Loeprick\*

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**ABSTRACT:** Simplifying tax policy comes with costs and benefits. This paper explores simplification options for the taxation of MNEs, an area where administrative and compliance costs of the current rules are large. Simplified approaches seek to reduce these costs by relying on an approximation of the true tax base, potentially distorting resource allocation. We examine the efficiency cost of transfer pricing simplification theoretically and empirically. Using a sample of 300,000 firms located in 22 countries, we estimate that common transfer pricing practices reduce efficiency between 0.25 and 2.2 percent of total factor productivity across sectors. Focusing on the manufacturing sector, we then observe that simplification more than doubles sectoral inefficiency on average. However, large differences exist, with moderate efficiency costs in several sectors.

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WORKING PAPERS

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## Introduction

Fundamental international tax reform initiatives are underway at global, regional, and national levels. Agreement on the introduction of a global minimum tax and allocation of some residual profits to market countries break new ground and suggest a potential retreat in the strict application of the arm's length principle (ALP). Yet, for the foreseeable future, the allocation of a large share of profits from multinational enterprises (MNEs) will continue to be determined by internal transfer prices in line with the ALP,<sup>1</sup> such that administrators will remain confronted with practical challenges and base erosion risks when seeking to determine and verify arm's length outcomes (PCT 2017, IMF 2019).

Human and financial resource constraints as well as the scarcity of relevant information sources make the implementation of the ALP particularly challenging for developing economy administrations (Clavey and others, 2019). Benefits from simplifying applicable rules are potentially large and a range of options have been put forward over the past decade (Durst 2010 and 2016, PCT 2017). These are also part of the ongoing reform discussion at the OECD's Inclusive Framework.<sup>2</sup> Simplification of the ALP can be understood to include a wide range of measures, including some anti-abuse rules and minimum tax regimes, which are typically charged based on turnover or assets (Aslam and Coelho 2021).

The focus of this paper is simplification which removes the requirement for a case-specific analysis, such as deemed pricing approaches for commodities or the use of safe harbor or fixed margin regimes for specific activities or sectors.<sup>3</sup> We argue that both the current application of benchmarking analysis to establish arm's length outcomes as well as its simplification can be interpreted as a form of presumptive taxation – in the sense that the tax base is determined using indirect means.<sup>4</sup> Simplified approaches use less information to reduce administrative and compliance costs but also provide a less accurate approximation of the tax base, with detrimental effects on vertical and horizontal equity. We analyze theoretically and empirically the over and under-taxation stemming from transfer pricing simplification and its impact on resulting sectoral production efficiency, an aspect that has received limited attention in the current debate.

Building on Hsieh and Klenow (2009), we first show in a simple conceptual framework that presumptive rules – such as using as a percentage of assets as a proxy for taxable profit - leads to subsidiary-specific variation in marginal effective tax rates, which alters the division of resources relative to an efficient allocation. In a pure profit-based taxation system and abstracting from profit shifting, a subsidiary's idiosyncratic productivity dictates its demand for input factors, implying that marginal products within an MNE group are equalized in

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<sup>1</sup> Reforms agreed in the OECD's Inclusive Framework (IF) allocate a portion of deemed residual profits of some MNEs to market jurisdictions (OECD 2021). The arm's length principle continues to guide the calculation and allocation of returns outside of those awarded to market countries under the proposed "Amount A" in the OECD's IF. The same applies to 'routine' activities other than baseline distribution and marketing functions, where the proposed "Amount B" may establish a baseline return with a fixed ratio.

<sup>2</sup> A proposal under consideration to apply a fixed margin to some baseline marketing and distribution activities. See [Statement on a Two-Pillar Solution to Address the Tax Challenges Arising from the Digitalisation of the Economy – 8 October 2021 \(oecd.org\)](#)

<sup>3</sup> As illustrated further below, deeming rules can take the form of establishing a minimum profit margin. Minimum taxation rules and fixed margin regime will thus function similarly where all taxpayers seek to report the minimum. Their wider effects will differ, however, as minimum tax regimes are typically less targeted, establishing lower effective tax rates.

<sup>4</sup> Presumptive taxation can take different forms, but typically involves application of a different method to compute taxable income, often by presuming results with reference to outcomes of average firms in scope and by relying on indicators (sales, assets, employees) that can be monitored and verified with limited administrative effort.

equilibrium. The resulting allocation of input factors is optimal. A presumptive system that uses proxies to determine the tax base, in contrast, imposes a higher marginal effective tax rate on less productive firms, reducing their demand for labor and capital relative to a profit-based system. As a result, transfer pricing simplification can alter the allocation of resources within and across MNE groups and their independent competitors, with detrimental effects on aggregate production. The extent of efficiency losses depends on the predictability of profits: where proxy tax bases, such as fixed assets, employees, or other combinations of input factors, allow for an accurate prediction of true profits, the presumptive system will not reduce efficiency while relieving administrative and compliance costs.

To quantify the potential efficiency effects from transfer pricing simplification, we assess the (un)predictability of profits across sectors, employing firm-level information that includes the balance sheets and profit and loss accounts of around 300,000 firms located in 22 countries and operating in 53 sub-sectors. The accuracy of profit predictions under the presumptive regimes determines its (in)efficiency, with more costs occurring the less information is used to inform this prediction. Notwithstanding the flexibility we incorporate in the predictive models, we find that the predictability of profits varies significantly across sectors, pointing to large asymmetries in the potential cost of presumptive taxation. Variation in unpredicted, or residual, profit is lowest among entities engaged in trade, basic manufacturing, and some services; it is highest among entities with head office functions and technical advisory services.

We run a series of regressions to explore the drivers of residual variation across sectors, countries, and time with firm- and country-level predictors. Several results emerge. First, in environments where firms in a sector enjoy, on average, elevated market power, profits are more difficult to predict, leading to increased residual variation. Moreover, we find that variation is higher in low-income countries, which could reflect larger productivity differentials, potentially owing to less competition or a slower propagation of new technologies, measurement problems, less stringent financial reporting requirements, or weaker administrative capacity and enforcement of regulations more broadly.

We subsequently employ the theoretical framework more directly to measure the efficiency costs resulting from simplified transfer pricing rules. We assess two scenarios that are inspired by current tax practices: first, a full information scenario, akin to a benchmarking analysis in transfer pricing, where a broad range of firm-specific and country-level variables are used to approximate firm-specific tax bases. Second, a limited information scenario, where only fixed assets are used as a firm-level predictor for manufacturing firms, replicating the idea of fixed margins. In the full information scenario, we find that efficiency losses already range between 0.25 and 2.2 percent of current productivity. This magnitude aligns with prior assessments of tax-induced efficiency losses from factor misallocation (Restuccia and Rogerson, 2008; Fajgelbau and others, 2019). We then focus on the manufacturing sector to assess the efficiency reduction between the full information scenario and a limited information scenario, where only fixed assets are used. The results suggest that simplification more than doubles sectoral inefficiency on average – from 0.4 percent in the full information scenario to over 1 percent in the simplified scenario. However, large differences exist, with sectoral efficiency losses being smallest in manufacturing of basic metals.

Our findings contribute to three areas of the debate on potential simplifications to transfer pricing comparability analysis. First, our empirical results indicate moderate efficiency costs of simplification in a wider range of

sectors than currently under consideration,<sup>5</sup> including some basic manufacturing, suggesting that there is some scope for broader application of simplified approaches. Second, the results of our work show that while average values, which have been the focus of recent analysis (PCT 2017, TPED 2019) matter, variation in profit margins within a sector or country is equally important given its repercussions on production efficiency and revenue. Third, while limited geographical coverage of firm-level data inhibits definite conclusions, we find that the costs of tax simplification depend on market factors, limiting the scope for standardized cross-country solutions in determining specific returns. And we observe that residual variation of profits is more pronounced in lower income economies. Its impact on efficiency, however, seems to be at least partially mitigated by more concentrated market power in these economies.

Our findings add to the literature on the effects of policy on factor misallocation (Restuccia and Rogerson 2017). Fajgelbau and others (2019) investigate spatial misallocation of workers and firms, and resulting efficiency losses, caused by differences in the tax system across US states in a general equilibrium framework. They find that a harmonization of the tax system increases worker welfare by between 0.6 and 1.2 percent, depending on the response of government spending. Restuccia and Rogerson (2008) analyze efficiency losses from variation in tax rates on firms in a computable general equilibrium framework. The result of this model indicates that total factor productivity is reduced by up to 6 percent when variation in the effective tax burden is uncorrelated with productivity. We show that a presumptive tax system induces a negative correlation between effective tax rates and productivity, resulting in lower productivity losses.

The rest of the paper is structured as follows. We start by summarizing current transfer pricing practices and simplification efforts. We then present the conceptual model to highlight the link between predictability of profits and efficiency losses from simplification measures. The third section presents empirical results, and the fourth section concludes.

## Transfer Pricing and Simplification Options

Implementation of the ALP through standard transfer pricing principles requires that entities within an integrated MNE (so-called “associated enterprises”) be treated as though they are separate entities transacting under normal market forces. This requires identifying these market forces, which is commonly attempted by comparing arrangements between associated entities with those between independent or unrelated firms in comparable circumstances.

In practice, the exercise typically requires a detailed case-specific transaction-by-transaction analysis to allocate profits in line with underlying value creation of MNE entities (see e.g., PCT 2017 and Picciotto 2018). A functional analysis is expected to help distinguish what are deemed to be routine and residual profit generating

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<sup>5</sup> For most countries, the arm’s length principle will continue to guide the calculation and allocation of returns outside of those to be awarded to market countries under the proposed “Amount A and B” in the OECD’s Inclusive Framework.

activities,<sup>6</sup> which has important implications — both conceptual and practical.<sup>7</sup> Characterization of activities or an entity as routine allows restricting comparability analysis to this activity or entity in the transaction using a “one sided method”. A large share of transfer pricing assessments follows this approach. It normally requires conducting a case specific benchmarking analysis using publicly available data sources on independent firms with the goal of identifying those that have a similar profile to the “tested” firm. In theory, transfer prices are to be determined at the transaction level. In practice, studies to justify pricing decisions frequently look at the entity level where financial information is most readily available (Picciotto 2018).

Despite continued efforts to improve available guidance and secure the integrity of the arm’s length principle, transfer pricing practice suffers from conceptual uncertainties (Schatan 2021) and comes with judgement calls and approximations when determining what is comparable enough (Avi-Yonah 2007, PCT 2017). And there is room for tax planning. Persisting profit shifting (Beer and others 2020) and estimates of transfer mispricing (Wier 2018) suggest that the reported tax base often differs from “true” arm’s length profits an MNE entity would generate if it were independent.

Administration of, and compliance with, the arm’s length principle also imposes significant financial and economic costs. Solilová and others (2017) report that transfer pricing compliance costs range between 3.9 percent and 12.7 percent of corporate tax collection, amounting to 0.1 to 0.4 percent of GDP in an average OECD country. An EU study found that the main corporate compliance cost drivers directly or indirectly related to transfer pricing (transfer pricing documentation, clearances and rulings and mutual agreement procedures) account for about 60 percent of all compliance costs (EU, 2011), equivalent to 0.14 percent and 0.33 of turnover. Overall costs may be even more pronounced in developing countries, where inconsistent application of the arm’s length principle can result in significant base erosion and revenue losses, undesirable litigation, and greater taxpayer uncertainty which can undermine investment and long-term growth (IMF and OECD, 2017). The returns to simplifying the ALP are thus likely larger in this context.

Simplification of the process can be achieved by relaxing the degree of comparability that is aimed for, and by aggregating and standardizing the analytical step for specific sectors. Notably, it is already common practice for tax advisory firms, which support MNEs with the preparation of benchmarking studies, to rely on standardized off-the-shelf benchmarks, thus commoditizing and automating the service provided.<sup>8</sup> Going even further into simplification, rather than determining case-specific benchmarks, expected returns can be prescribed under relevant tax legislation whenever transactions or entities are in scope of a specific simplification rule. Practical examples of such rules are limited but include deemed pricing approaches applied to commodities<sup>9</sup> and the use of opt-in and opt-out safe harbor or fixed margin regimes for specific transactions or sectors in scope, such

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<sup>6</sup> An activity or an entity is deemed to be routine if it is deemed routine entity because it makes no unique and valuable contributions, such as intangibles, and if it assumes no significant economic risks. Guidance on how to account for risk in transfer pricing practice has been elaborated with the 2017 revision of the OECD’s Transfer Pricing Guidelines, but conceptual and practical challenges persist (Schatan, 2021).

<sup>7</sup> Function performed, risks assumed, and assets used are assessed to provide clarity on whether activities are characterized by low value added within the group (e.g., functions akin to mere contract manufacturing) or by more substantive participation in the MNE’s value chain (e.g., functions closer to full-fledged manufacturing).

<sup>8</sup> See Hughes (2021), who presents approaches to develop such reference benchmarks for different sub-sectors (Metal Manufacturing, Contract Research Services, Construction and IT and electrical components distribution in North America).

<sup>9</sup> Adopted by several economies in Southern America and Zambia. While not explicitly referencing deemed pricing under the 6<sup>th</sup> method, the OECD TP Guidelines (2017) endorsed the use of the CUP method for commodity transactions following the BEPS discussions. Durst (2016) and Redhead (2018) argue for applying administrative pricing regimes as implemented by Norway for the hydrocarbon sector to hard minerals.



as the simplified approach for low value adding services introduced into the OECD's transfer pricing guidelines in 2017.<sup>10</sup> These rules replace the requirement for establishing case-specific benchmarks with predetermined margins for specific transactions or activities. And, at least conceptually, they seek to provide an approximation of an average arm's length outcome while minimizing profit shifting risks and reducing compliance and administrative costs (Table 1).

**Table 1. Examples of Simplified Approaches Introducing Predetermined Sectoral Benchmarks**

<b>Origin</b>	<b>Description</b>	<b>Observations</b>
Cameroon	Central purchasing fees or commissions are deductible up to 5% of the cost of goods purchased centrally.	This regime aligns with a provision found in the regional corporate income tax directive in the Central Economic and Monetary African Community (CEMAC) and is thus applied in other countries such as Chad, the Central African Republic, Congo, Rep., and Gabon.
Côte d'Ivoire	Côte d'Ivoire caps interest expenses paid to related parties at two basis points above the central bank's lending rate.	Similar provisions are widespread across other countries in the Western African Economic and Monetary Union (WAEMU) and CEMAC as a result of applicable regional tax directives.
Brazil	Brazil only allows the use of the CUP, resale price and cost-plus methods. Predetermined margins for import and export transactions are then applied, with sectoral differentiation for import transactions.	The fixed margin regime is vulnerable to tax planning structures and under-taxes a range of activities (OECD 2019). Ongoing work with OECD to align Brazilian rules with OECD standard will likely result in transformation of current approach with safe-harbor regime with more differentiated margins for in scope sectors.
Dominican Republic	Using the instrument of individual advance pricing agreements, predetermined gross (net) margins on costs (costs and expenses) and a minimum effective tax rate of 2% are applied to accommodation providers in the tourism sector.	Application for the APA allows for mechanical application of fixed sector margin, which takes into account specific and easily observable features (category of accommodation)
Mexico	Mexico introduced a safe harbor for foreign (US) owned manufacturers, requiring a deemed return on assets or operating expenses. Since 2016, mark-up is differentiated for three sub-sectors and depending on capital intensity of firms.	Approach was agreed between Mexico and the US to avoid double taxation. Firms opting out of the safe harbor were required to apply for an APA, but this option has been abolished in 2021.
India	India developed opt-in safe harbor in 2013 (revised in 2017) specifying deemed returns on total operating costs for software development and IT services, contract R&D for software development and pharmaceutical generics, and manufacturing auto components and low value-added services.	Limited take-up of the opt-in safe harbor regime with rates set for minimum operating margins by sector seen as too high.

Sources: PCT (2017), Redhead (2017), Picciotto (2018), PWC (2021), UN (2021).

The expansion of such approaches has been proposed by a range of observers. PCT (2017) argues that (rebuttable) safe harbors may be appropriate for manufacturing, sales and distribution, and a wide range of service providers. The suggested approach for developing economies, where limited public information exists for benchmarking studies, is to build on administrative data to design broad and potentially regional safe harbors. Based on treatment of routine services in the United States, Durst (2010) argues for a similarly broad scope of activities, noting that, conceptually,

<sup>10</sup> Despite this addition, overall, recent reforms efforts led by the OECD furthered the requirement for in-depth examination of the taxpayers and their transactions. Three of the Base Erosion and Profit Shifting (BEPS) project's 15 action items were dedicated to revamping transfer pricing guidance, reemphasizing substance over form, but adding to the complexity of the process without meaningfully altering existing standards (Collier and Andrus, 2017, PCT 2017, Picciotto 2018).

the approach can be applied to all areas where related entities do not generate valuable intangible property. Building on country experience in Brazil, the Dominican Republic, India, and Mexico, Picciotto (2018) suggests focusing efforts on the sectors with elevated economic importance in a country and to design opt-out safe harbors, which place the burden of proof on taxpayers to show that a rule is inappropriate. Ezenagu (2019) proposes a wide application of safe harbor regimes in African countries.<sup>11</sup> Similarly, Hofman and Riedel (2018) argue for a much broader use of safe harbors, noting that presumptive outcomes above the “true” arm’s length result would be acceptable as long the additional tax cost does not exceed a firm’s savings in compliance costs.<sup>12</sup> Proposal by business participants in Inclusive Framework Consultations, summarized in Durst (2020), highlight that simplification options could also be based on a formulary overlay for determining applicable margins with reference to an overall MNE group’s performance. Ongoing deliberations on the introduction of fixed margins for some distribution and marketing activities in the OECD Inclusive Framework further sanction the idea that simplified prescriptive methods can be acceptable alternatives to case-by-case benchmarking exercises, at least for a subset of transactions or entities within an MNE group (OECD 2020).

While simplification of transfer pricing has obvious appeal, it is not a panacea. As highlighted in the context of the Brazilian fixed margin regime (OECD 2019),<sup>13</sup> any rule which seeks to replace resource intensive comparability analysis in current transfer pricing practice with a more mechanical aggregate approach does not eliminate the risks of abuse through aggressive tax planning schemes, can lead to economic double taxation when adopted unilaterally, and may generate efficiency costs, for instance from strategic responses to qualify. Moreover, Brazil’s experience also shows that meaningful deviations from the OECD’s transfer pricing guidelines (e.g., by not allowing taxpayers the right to rebut the profit margin) run the risk of putting countries under scrutiny and pressure to conform with international norms established under the auspices of the OECD. This concern may, however, be less relevant for smaller developing countries as they typically do not have an extensive network of tax treaties. Where treaties apply, and as evidenced by Mexico’s experience, potential conflict and risks from double taxation can be usefully mitigated by negotiating an agreement for the MNE’s allocation of profits under the treaty’s mutual agreement procedure (MAP), an approach which India also pursued. This seems particularly relevant and effective when activities in the sector targeted for simplified transfer pricing rules are primarily undertaken by residents of a single foreign jurisdiction. India’s experience suggests a tradeoff in designing optional simplified transfer pricing regimes, insofar as taxpayers may only opt-in if expected benefits (e.g., in terms of deemed profits, documentation requirements, litigation risks, and risks from double taxation) are sufficiently large. Nevertheless, and as the example of the Dominican Republic illustrates, small developing countries can seemingly be successful in implementing simplified transfer pricing schemes when establishing a well-researched benchmark for a sector of economic importance (in this case, tourism), which can then be effectively enforced on taxpayers (Picciotto, 2018).

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<sup>11</sup> A regional survey in West Africa suggests support among policy makers and business for extensive use of safe harbors (EC 2017) and regional guidance by the African Tax Administration Forum on the design of transfer pricing legislation already includes model provisions on a safe harbor for manufacturing activities (ATAF 2020).

<sup>12</sup> Even where simplified approaches are implemented significant compliance costs linked to international tax obligations will remain, including for issues related to establishing and monitoring deductibility rules, monitoring the withholding tax base, and management reporting on transfer pricing arrangements.

<sup>13</sup> Where wholly owned subsidiaries operating in Brazil have significant profit potential, this potential may not be recognized and instead be located in low tax jurisdictions.

## Conceptual Model

We incorporate presumptive taxation in a simple partial equilibrium model describing the demand for factor inputs,<sup>14</sup> where production is characterized by diminishing returns to scale and firms differ in their productivity. Following the idea of a benchmarking analysis in transfer pricing, we assume the tax base assessed by the tax administration in the presumptive or simplified regime is determined using a statistical model, where input factors, such as fixed assets, are used in predicting profits, but productivity remains unobserved. This setup provides a simple closed-form solution for sectoral productivity that allows quantifying the efficiency effect of tax simplification. For simplicity, we abstract from profit shifting in the model.<sup>15</sup>

### Modelling Transfer Pricing Benchmarking and Its Simplification

We model current transfer pricing practice and simplified approaches as two distinct forms of presumptive taxation, where the tax base is determined indirectly by using information contained in the vector  $X$ . The expected or presumed tax base of profit is given by

$$E[\pi_i|X_i] = \pi_i + \varepsilon_i \quad (1)$$

where  $\pi_i$  is true profit and  $\varepsilon_i$  is a random error that is uncorrelated with the presumed base. This representation encompasses classic types of presumptive taxation: For instance, a turnover based tax would translate into  $E[\pi_i|S_i] = \widehat{m}_i S_i$ , where  $\widehat{m}_i$  is the expected share of profit in sales,  $S_i$  is sales, and the residual would read  $\varepsilon_i = \pi_i - \widehat{m}_i S_i$ . If the tax administration's estimate of this share is unbiased, it holds that  $E[\varepsilon_i] = 0$ .

Formulation (1) also allows interpreting the use of benchmarking studies in transfer pricing practice as a form of presumptive taxation, albeit a non-mechanical one. In transfer pricing practice, profit of a tested party can often be inferred using information from a set of independent entities. This set of independent companies is chosen to resemble the tested party across a range of dimensions, including size, factor combinations, or perceived risk and market power. The profit distribution of the comparator sample is then used to determine the adequacy of the MNE entity's results. The simple average of profits across comparator firms would yield a matching-based estimator of the MNE's true profit, suggesting that the arm's length outcome coincides with  $E[\pi_i|X_i]$ , and  $X_i$  includes the variables that have been used in selecting the comparator sample. However, even where the estimator is unbiased, it is associated with a degree of uncertainty and comparability analyses performed by independent transfer pricing experts can yield different results.

In this context, we model simplification of transfer pricing practice as a reduction of the information contained in vector  $X_i$ . The main result of simplification is an increase in residual variation.

<sup>14</sup> For similar approaches in assessing efficiency effects, see Restuccia and Rogerson (2008) or the Annex of Hsieh and Klenow (2009).

<sup>15</sup> This simplification does not impact the model's implications when profit shifting decisions are independent from real factor allocations.

## MNE Investment Decision Under Presumptive Rules

We next derive the optimal investment decision of an MNE group under presumptive taxation. The MNE group consists of  $N$  subsidiaries, all of which generates sales,  $S_i = A_i K_i^\alpha$ , using capital,  $K_i$ , as the only productive input. The parameter  $\alpha$  determines returns to scale and equilibrium profits, while  $A_i$  reflects subsidiary-specific productivity, which is a stochastic variable. When capital is paid a pre-tax rental rate of  $r$ , profits at the subsidiary level are given by

$$\pi_i = S_i - rK_i \quad (3)$$

We model the presumptive taxation regime as a tax that is levied on the conditional expectation of profit, denoted by  $E[\pi_i|X_i]$ , where  $X_i$  is the conditioning set that includes the observable input (capital) as well as other variables that might help predict profitability at the firm-level, such as information on the business cycle. Net of tax profit reads

$$\pi_i - E[\pi_i|X_i]\tau_i = S_i(1 - \delta_i\tau_i) - rK_i(1 - \tau_i) \quad (4)$$

Where  $\delta_i = E[A_i|X_i]/A_i$  depicts the ratio of expected to actual productivity of subsidiary  $i$  and  $\tau_i$  denotes the statutory tax rate applied to entity  $i$ .

The equation shows that a presumptive profit tax at a rate of  $\tau_i$  is equivalent to sales being taxed at a rate of  $\tau_i\delta_i$  while allowing factor costs to be deductible at a rate of  $\tau_i$ .<sup>16</sup> Accordingly, the term  $\delta_i - 1 = \frac{\tau_i\delta_i - \tau_i}{\tau_i}$  represents a firm-specific tax wedge between output and input taxation that drives distortions in a simplified regime. For instance, when the tax administration relies on average productivities in predicting profits, the ratio of expected to actual productivity would be given by  $\delta_i = \frac{1}{N} \sum_i A_i / A_i$ . The tax wedge would be negative for firms with above average productivity and positive for firms with below average productivity.

The first order condition for the MNE's optimal input choices requires equating, for each subsidiary, the marginal product of capital to its after-tax cost:<sup>17</sup>

$$\frac{\partial S_i}{\partial K_i} = r \frac{1 - \tau_i}{1 - \tau_i\delta_i} \quad \text{for } i = 1, \dots, N \quad (5)$$

The impact of the presumptive regime on an optimal capital allocation depends on the complexity of the presumptive regime and the scope and reliability of a tax administration's information set. When more information is used, firm-specific productivities can be better assessed and the difference between predicted and actual profit becomes smaller. Profit-based taxation can be viewed as a limiting case where the tax administration's information set is infinite. Using all relevant information, the conditional expectation of firm productivity corresponds to actual productivity, implying that  $\delta_i = 1$  for all  $i$ . Equation (5) then implies that the allocation of capital across entities is not affected by tax rates in a pure profit-based regime.

<sup>16</sup> As similar representation of firm-specific wedges would ensue if sales rather than factors of production were observable and firms would differ in the marginal factor costs, they face.

<sup>17</sup> For simplicity, we abstract from profit shifting in the model.

In contrast, in a presumptive regime, the cost of capital varies with more productive entities facing lower marginal effective tax rates. Accordingly, presumptive taxation leads to a misallocation of resources between subsidiaries relative to a system with profit-based taxation, with negative effects on the efficiency with which output is produced within the MNE. In addition, aggregate production is impacted by changes in the allocation across more and less productive MNE groups operating in the same market. Also tax driven changes in demand and resulting price changes impact on the use of resources among independent competitors. All of these are driven by over- and under taxation in the presumptive system. For our theoretical framework we focus on decision making within MNE groups, abstracting from secondary price effects.

## Aggregate Efficiency Losses Under Presumptive Rules

The inefficiency caused by the misallocation of factor input across firms within an MNE can be seen from defining the MNE's total capital stock by  $K = \sum_i K_i$  and total output by  $\sum_i S_i = S \equiv \bar{A} K^\alpha$ , where  $\bar{A}$  is MNE-wide productivity. Rewriting  $\bar{A}$ , using the first order conditions gives

$$\bar{A}(\delta) = \left[ \sum_i \left( A_i \frac{1 - \tau \delta_i}{1 - \tau \bar{\delta}} \right)^{\frac{1}{1-\alpha}} \right]^{1-\alpha} \quad \text{where} \quad \bar{\delta} = \frac{\sum_i \delta_i S_i}{S} \quad (6)$$

Is a sales-weighted average tax parameter.

In a profit-based system, the MNE's total factor productivity is given by  $\bar{A}(1) = \left[ \sum_i (A_i)^{\frac{1}{1-\alpha}} \right]^{1-\alpha}$  which is greater than it is in any type of presumptive regime that introduces variation in marginal effective tax rates.<sup>18</sup> Hsieh and Klenow (2009) derive a similar expression for aggregate factor productivity for a standard model of monopolistic competition. In their definition of aggregate factor productivity, the term  $\frac{1}{1-\alpha}$  is replaced with  $\sigma - 1$ , where  $\sigma$  denotes the elasticity of substitution between inputs used in the production of sectoral output. Imperfect substitutability implies that firms enjoy market power, which plays a similar role like decreasing returns to scale in the present framework.

To get a better sense of how presumptive taxation reduces sectoral factor productivity, we approximate the percentage change in factor productivity as

$$\frac{\bar{A}(\delta) - \bar{A}(1)}{\bar{A}(1)} \approx \left( 1 + \frac{1}{1-\alpha} \right) \frac{\tau^2}{2} \text{Var}(\delta_i), \quad (7)$$

Assuming that the tax wedge and firm-productivity are uncorrelated.

Equation (7) provides three insights. First, the reduction in allocative efficiency is a function of the variation in  $\delta_i$ . Since the ratio of expected to actual productivity directly affects marginal effective tax rates across an MNE's subsidiaries, the expression shows that productivity in a simplified regime will be below potential, even if all countries where the MNE operates applied the same statutory tax rate. Second, efficiency losses are increasing in the returns to scale parameter  $\alpha$ . In a monopolistic competition setup, they would be an

<sup>18</sup> This can be seen from verifying that  $\left[ \sum_i (A_i (1 - \tau \delta_i))^{\frac{1}{1-\alpha}} \right]^{1-\alpha} < \left[ \sum_i (A_i)^{\frac{1}{1-\alpha}} \right]^{1-\alpha} (1 - \tau \bar{\delta})$ .

increasing function of the elasticity of substitution, which is inversely related to market power. Where firms benefit from a strong ability to sell above marginal production costs,  $\sigma$  is small and so is total factor productivity in the profit-based system. While presumptive taxes reduce productivity of the sector, the loss is muted by a low elasticity of substitution and as a result, efficiency losses from presumptive taxation are smaller in less competitive markets. Third, efficiency losses are a quadratic function of the applied tax rate. The higher the tax rates, the more damaging presumptive taxation can be. Finally, the approximation gives an upper bound of efficiency losses as it disregards the negative correlation between the effective tax rate and firm-productivity. In contrast, if high-productivity producers would be disadvantaged, efficiency losses would be higher (see also Rusticcia and Rogerson 2008).

## Empirical Approach

### From Theory to Data

We seek to empirically estimate the degree of efficiency costs associated with transfer pricing simplification across sectors. When the current system is profit-based, the conceptual model suggests the ratio of expected to actual productivity the tax administration would compute is given by<sup>19</sup>

$$\delta_i - 1 = \frac{E[\pi_i|X_i] - \pi}{S_i(1 - \alpha)}, \quad (8)$$

where  $E[\pi|X]$  is a conditional expectation of profit,  $S_i$  denotes sales and  $\alpha$  is the returns to scale parameter. Equation (8) is key for our empirical analysis: it suggests that the conceptual tax wedges implied by a presumptive system that uses observables to approximate the tax base are proportional to residual profit margins – residuals between expected and true profit divided by sales - where the factor of proportionality is given by  $\frac{1}{(1-\alpha)}$ . Equation (7) then suggests that efficiency losses from taxing a predicted tax base can be approximated by measuring the variation in unpredictable profit margins: the larger the share of unexplained profitability, the higher the costs of transfer pricing simplification.

In practice, tax administrations commonly rely on information from independent parties in deriving their predictions of what an MNE subsidiary's true profit is.<sup>20</sup> We follow this approach and predict profit drawing on detailed financial information of independent companies. The first-stage equations we estimate on a sectoral level read

$$\ln(\pi_{its}) = \gamma'_s X_{its} + \alpha_{cs} + \rho_{ts} + \varepsilon_{its} \quad (9)$$

Where  $\pi_{its}$  denotes profits before taxation of company  $i$  in year  $t$  and sector  $s$ . For each sector, we include a vector of country- ( $\alpha_{cs}$ ) and year-specific ( $\rho_{ts}$ ) fixed effects. The extent of distortions depends on the variation or the idiosyncratic residual  $\varepsilon_{its}$ , which in turn depends on the complexity of the presumptive regime, with lesser

<sup>19</sup> When the current system is profit base, firm-profit is given by  $\pi_i = S_i(1 - \alpha)$ . It follows that  $\frac{E[\pi]-\pi}{S(1-\alpha)} + 1 = E[A_i|X]/A_i$

<sup>20</sup> It has been pointed out elsewhere (see e.g., Devereux and Keuschnig, 2009) that MNEs and independent entities likely differ in ways that make it impossible to infer the true earnings of an internationally active organization from a domestic company's profit and loss account.

costs occurring the more information is used. We thus analyze profit predictions in two information scenarios, captured by different explanatory vectors  $X_{its}$ , that are guided by current transfer pricing practice:

- *Full information.* We first explain profit using a comprehensive set of firm-specific explanatory variables, akin to developing a benchmark in transfer pricing comparability analysis. For each sector in the baseline sample, we estimate a separate regression where  $X_{its}$  includes fixed assets, total assets, cost of goods sold, the number of employees, GDP, GDP per capita, GDP growth, and inflation.
- *Limited information.* In a second step, we analyze the effect of simplification using a simpler explanatory model, resembling the idea of a fixed margin. As the predictive power of a given variable differs across sectors, we focus on just one sector, manufacturing, when evaluating the effect of simplification. In the simplified prediction model, we only include fixed assets in  $X_{its}$ .

To infer the effect of simplification on production efficiency, we then build on the arm's length principle's assumption that the distribution of MNEs' true profits, uncontaminated from profit shifting, should resemble the distribution of profits of independent entities. By invoking this assumption, we can infer the effect of simplification on MNEs by analyzing firm-specific tax wedges (as implied by equation (8)) of independent companies operating in that same sector. By focusing on independent entities, however, our estimates are not distorted by profit shifting activities.

A few points are worth stressing. First, the identification approach assumes that the current tax treatment is efficient and neglects existing firm-specific distortions that may reduce total factor productivity. This assumption is strong and unlikely to hold in practice. Second, variation in the theoretical tax wedges depends on the returns to scale parameter  $\alpha$ . As noted earlier, diminishing returns to scale in the model derived above has a similar role as the elasticity of substitution in models of monopolistic competition. Specifically, total factor productivity coincides in these models when  $\alpha = \frac{\sigma-2}{\sigma-1}$ . We follow Hsieh and Klenow (2009) who assume an elasticity of substitution of 3 in their baseline results and use  $\alpha = 0.5$ . Subsequently, we relax this assumption and present results allowing for variation in the scale parameter at the sub-sector level to account for differences in market-power. Third, variation in unpredictable profit margins is an approximate measure of efficiency losses that does not require estimates of firm-specific productivities. We start by exploring this simpler approximate measure and subsequently incorporate firm-specific productivity to gain a better understanding of the size of distortions.

## Data and Predictive Regressions

The ORBIS database includes information on ownership structures, which allows differentiating between MNEs and domestic entities. An industry classifier allows determining a company's main line of business. We select our sample broadly inspired by transfer pricing practice and focus on independent companies with positive profits, sales, and fixed assets. As predictive regressions are computed on a sectoral level, we restrict the sample to companies that belong to sectors, as characterized by the 2-digit Nace code, that comprise at least 200 observations. To approximate the distinction of more routine and non-routine activities in transfer pricing practice, we drop entities where intangible assets amount to more than ten percent of fixed assets. Moreover, we drop independent entities if they are much smaller or larger than MNEs in the same sector.<sup>21</sup> Our baseline

<sup>21</sup> Specifically, in each sector, we drop independent entities if they are smaller than 90 percent of the minimal sales value recorded in the sample of MNEs or larger than 110 percent of the maximal sales value recorded by MNEs.

sample includes about 343,000 entities. We observe these entities between 2011 and 2019. We restrict the analysis of the costs of simplification to the manufacturing sector, for which our sample includes 66,000 independent entities operating in 22 different Nace 2-digit sectors, and 21 countries.

Table 2 presents average coefficient estimates and average standard errors for the predictive regressions, which are performed for 52 subsectors. Overall, the estimations indicate constant returns to scale in the full information scenario (as the sum of firm-level coefficients sums to one) and decreasing returns to scale in the limited information scenario. Higher CIT rates are associated with lower profitability, due to increased cost of capital. Furthermore, market size, proxied by GDP, exerts a positive effect on average profits while GDP per capita has a negative effect, hinting at the need to account for higher average returns in low-income economies when considering fixed margin approaches.

**Table 2. Predictive Regressions**

Subset	All industries	Manufacturing	Manufacturing
Information	Full	Full	Limited
Intercept	-1.31 (2.145)	-2.737 (1.113)	1.89 (0.158)
log(Fixed assets)	-0.014 (0.011)	0 (0.011)	0.6 (0.008)
log(Number of employees)	0.062 (0.016)	0.061 (0.016)	
log(Total assets)	0.534 (0.021)	0.495 (0.022)	
log(Cost of goods sold)	0.393 (0.018)	0.472 (0.019)	
log(1 - CitRate)	0.875 (0.528)	1.199 (0.430)	
log(Gdp)	1.131 (0.996)	1.196 (0.911)	
GdpGrowth	0.004 (0.005)	0.006 (0.004)	
log(GdpPc)	-1.137 (0.987)	-1.266 (0.917)	
Inflation	0 (0.004)	0.002 (0.003)	
Average observations	32968	17454	17454
Average Adj. R2	0.748	0.773	0.63

Notes: Table gives average results for industry-specific regressions. Averaged standard errors are in parentheses.

Table A1 in the Annex summarizes actual and predicted profits. On average, predicted profit is, with a value of almost 500 thousand USD slightly above the average recorded profit (460 thousand USD).



## Variation in Residual Profit Margins

Using the predictive regressions, we compute firm-specific tax wedges based on equation (8). Table 3 presents the distribution of these tax wedges for the baseline sample and the manufacturing subset. On average, we find the approximated wedges in our hypothetical presumptive regime are close to zero under the full information scenario, but at around 20 percent in the limited information scenario.<sup>22</sup> In the manufacturing sample, the variation of unpredictable profit margins is slightly reduced under the full information scenario, but much larger when only fixed assets are used in predicting profit. Taken together, these results suggest important incremental efficiency costs from simplified transfer pricing regimes in the manufacturing sector.

**Table 3. Descriptive Statistics, Firm-Specific Tax Wedges**

	Min.	Median	Mean	Max.	Variance
Baseline sample, full information	-0.468	0.036	0.012	0.377	0.035
Manufacturing sample, full information	-0.431	0.039	0.009	0.291	0.028
Manufacturing sample, limited information	-0.380	0.090	0.202	1.970	0.35

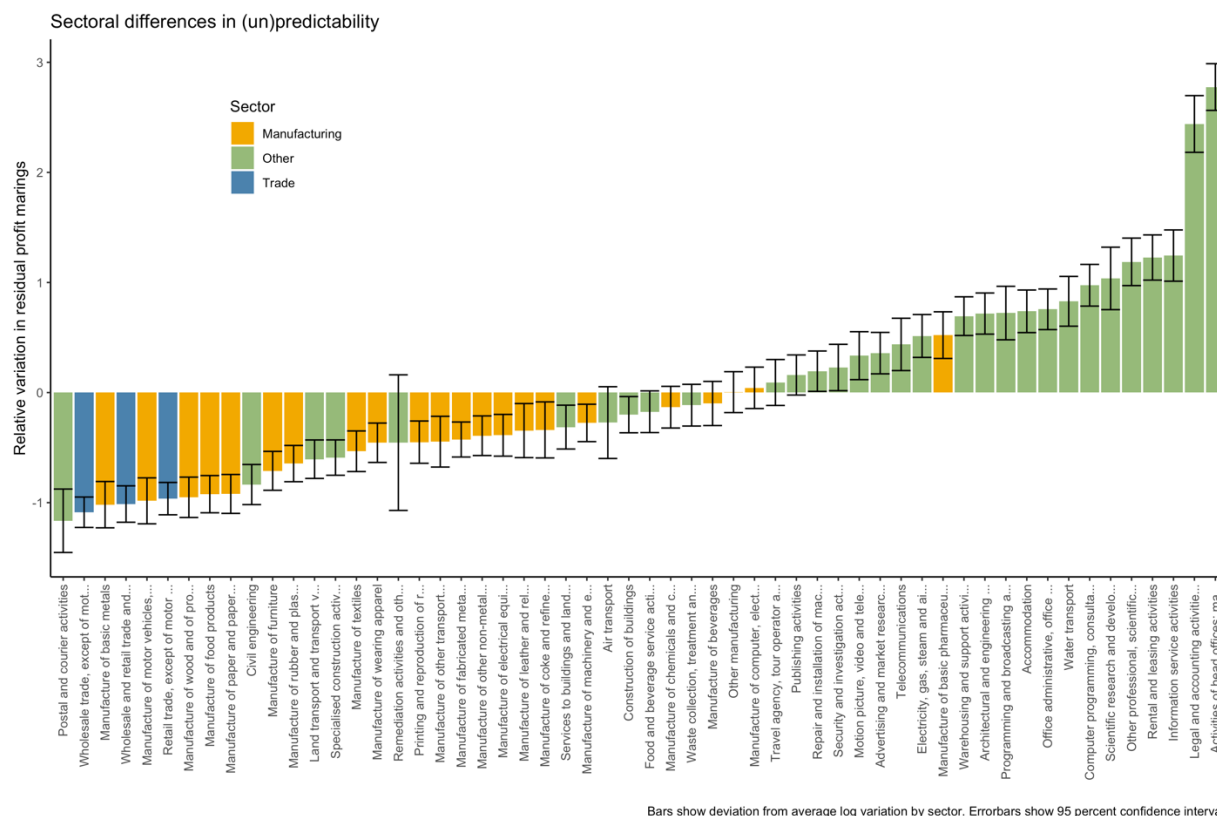
Notes: Table summarizes distribution of firm-specific tax wedges, given by  $\frac{E[\pi_i|X_i]-\pi_i}{S_i(1-\alpha)}$  for two samples and differentiating between two information scenarios for the manufacturing subset.

To better understand the drivers behind residual variation, we analyze the (un)predictability of profits at a year country and sector level. Specifically, we compute the variation in residual profit margins,  $\delta_{ist} - 1$ , using the full information scenario regressions, on a country- year- and industry level. Dropping observations in country sector pairs with fewer than 10 companies to compute the variance, we obtain 3950 independent measures.

As a first step, we compute sectoral averages using these estimated variations. Figure 1 illustrates sectoral deviations from the grand mean, with 95 percent confidence bands illustrated by error bars. The highest variability is recorded among head office activities and the lowest among postal and courier services. Overall, the graph suggests that variation in unpredictable profit margins varies considerably across sectors.

<sup>22</sup> The variation of tax wedges allows deriving potential efficiency costs from simplification (see equation 5). For instance, with a tax rate of 25 percent and an elasticity of substitution of  $\sigma=3$ , the approximate efficiency losses could amount to 0.3 percent ( $0.003=3*0.25^2/2*0.035$ ) under the full information scenario in the baseline sample.

Figure 1. Sectoral Differences in (Un)Predictability



Bars show deviation from average log variation by sector. Errorbars show 95 percent confidence interval.

Several factors may explain observed differences. On the one hand, the variation might reflect differences in the availability of relevant information: in sectors where less observable, intangible assets drive profits, these cannot be reliably predicted. On the other hand, differences in residual variation could also point to non-structural differences between sectors, such as in the dispersion of firm-specific factors, including managerial talent, productivity, or market power. To explore the drivers of this variation, we estimate regressions of the following form

$$\ln(\text{Var}(\delta_{ctk})) = \sum_k \beta_k 1[\text{Industry} = k] + \gamma'X_{ctk} + \varepsilon_{ctk}$$

The dependent variable is logarithmic variation in unpredictable profit margins, at the country- year- and industry-level. We explain this variation with a vector of industry-specific fixed effects,  $\beta_k$ , and other control variables included in X.

Table 4 presents results. In the first specification, we explain log variation in residual profit margins with the CIT rate, GDP, GDP per capita and GDP growth. We find that variation is negatively correlated with income levels (as proxied by GDP per capita), CIT rates, and GDP growth, suggesting a broader range of outcomes for entrepreneurs in less developed economies. In the second specification, we add predicted profit margins from our first-stage regressions, increasing our adjusted R2 from 0.05 to 0.296. The result indicates a classic risk reward tradeoff: the conditional variation of profit margins increases by roughly 1 percent in response to a one percentage point increase in the average predicted return.

Variation in predicted profit margins can be a result of differences in the returns to scale in a sector, variation in fixed costs, or variation in market power. We seek to disentangle these effects in the third specification, which adds the logarithm of mark-ups – which we compute following De Loecker and others (2020) - to control for market power (see Annex 2). Mark-ups exert a significantly positive effect on the conditional variation in profit margins, suggesting that firms with an ability to price output above marginal production costs are characterized by more unpredictable profits. Predicted profit margins continue to exert a positive effect on residual variation.

Finally, the fourth column adds a vector of industry-specific fixed effects. Doing so increases the adjusted R2 from 0.341 to 0.452, indicating that important differences between industries exist that go beyond the variables controlled for in our regressions. When controlling for firm- and country-level differences, some sectors continue to be characterized by below- or above-average residual variation, but many of the differences disappear. Consequently, market conditions, such as monopoly power, GDP growth, or the corporate tax system, which impacts on the cost of capital, are potentially important predictors of residual variation, and the associated potential for simplification. Applying standardized approaches to companies engaged in the same activity in different markets can thus be problematic.

**Table 4. Drivers of Residual Variation**

Dependent variable: $\ln(\text{Var}(\delta_{ctk}))$ , N=3950				
	Model 1	Model 2	Model 3	Model 4
CIT rate	-3.486*** [0.350]	0.017 [0.262]	-0.379 [0.263]	-1.061*** [0.291]
log(Gdp)	0.042*** [0.013]	0.024*** [0.010]	0.057*** [0.010]	0.180*** [0.014]
log(GdpPC)	-0.330*** [0.031]	-0.493*** [0.026]	-0.457*** [0.025]	-0.294*** [0.027]
Gdp Growth	-0.002 [0.004]	0.001 [0.004]	0.008*** [0.004]	0.010*** [0.004]
log(Predicted profit margin)		1.490*** [0.032]	1.363*** [0.031]	1.285*** [0.032]
log(Mark-up)			1.138*** [0.092]	0.989*** [0.090]
Log(Turnover)				-0.187*** [0.025]
Log(Fixed assets)				-0.025 [0.020]
Industry-specific FE	FALSE	FALSE	FALSE	TRUE
Observations	5379	5379	5379	5379
AdjR2	0.055	0.296	0.341	0.452

Notes: \*, \*\*, and \*\*\* indicate statistical significance at the 10, 5 and 1 percent level, respectively. The dependent variable is defined in equation (10).

## Measuring Efficiency Costs More Directly

While our analysis of the predictability of profits across sectors can serve to compare simplification potential across sectors, it is hard to directly interpret the magnitude of residual variation in profit margins. We therefore seek to measure the reduction in total factor productivity resulting from applying simplification more directly, relying on the conceptual framework.

This, however, introduces additional uncertainties. Apart from firm-specific tax wedges, the reduction in total factor productivity also depends on the distribution of firm-specific productivities and the returns to scale parameter in the Lucas-span-of-control model, or the elasticity of substitution in models of monopolistic competition. We follow Hsieh and Klenow (2009) and rely on the monopolistic competition framework.<sup>23</sup> In this context, efficiency losses and firm-specific productivities are defined by:

$$Efficiency\ costs(\delta) = \left[ \sum_i \left( \frac{A_{ist}}{\bar{A}(1)} \frac{1 - \tau\delta_{ist}}{1 - \tau\bar{\delta}} \right)^{\sigma-1} \right]^{\frac{1}{\sigma-1}} - 1, \quad \text{where } A_{ist} = \frac{S_{ist}^{\frac{\sigma}{\sigma-1}}}{(K_{ist}^{1-\beta} M_{ist}^{\beta})}$$

and the tax wedge is defined in equation (8).

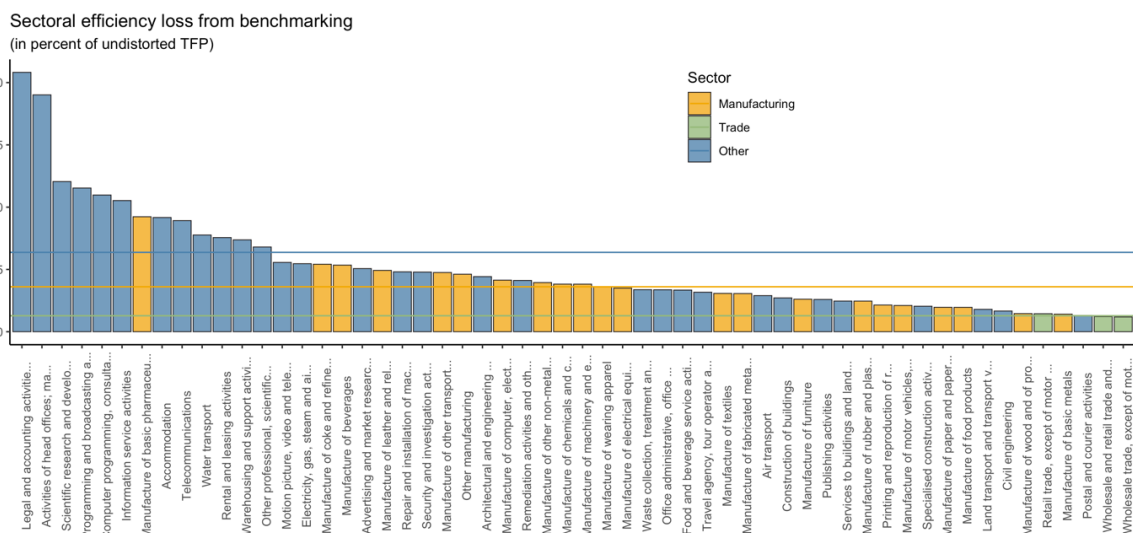
We assume the current allocation of productive factors is efficient and compute the relative reduction in total factor productivity on a sectoral level for a counterfactual scenario where firms are taxed based on our predictive models. Figure 2 presents efficiency losses in the full information scenario, akin to benchmarking practices in transfer pricing. To estimate these, we assume a constant elasticity of substitution across sectors ( $\sigma = 3$ ) and use an average tax rate ( $\tau = 0.23$ ), corresponding to the sample mean.

Our estimates provide a global summary of efficiency losses, depicting the change in total factor productivity for a given sector across all countries in our sample. The reduction in total factor productivity is modest, ranging between 0.3 and 2.3 percent of total factor productivity. This magnitude aligns with previous assessments of tax-induced efficiency losses from factor misallocation (Restuccia and Rogerson, 2008; Fajgelbau and others, 2019) and supports Liang's (2017) observation that external distortions, including taxation of input and outputs, tend to only have a modest overall effect of firm level total factor productivity compared to market imperfections, which drive aggregate productivity differences.

Losses are smallest for trading activities, but at a similarly moderate level for some manufacturing and service activities. In sectors where we observe comparatively large efficiency losses from predicting profit based on an assessment of comparators - such as legal services, R&D, management and consulting - benchmarking to determine arm's length pricing is uncommon in practice and simplification to avoid case-by-case assessments not advisable.

<sup>23</sup> While the expression for aggregate productivity is simpler to derive in the Lucas-span-of-control setup, the assumption of decreasing returns to scale is slightly more restrictive in the empirical application. In approximating productivity at the firm level, and quantifying efficiency losses on a sectoral level, we thus use estimates of market power rather than returns to scale.

Figure 2. Sectoral Efficiency Losses from Benchmarking

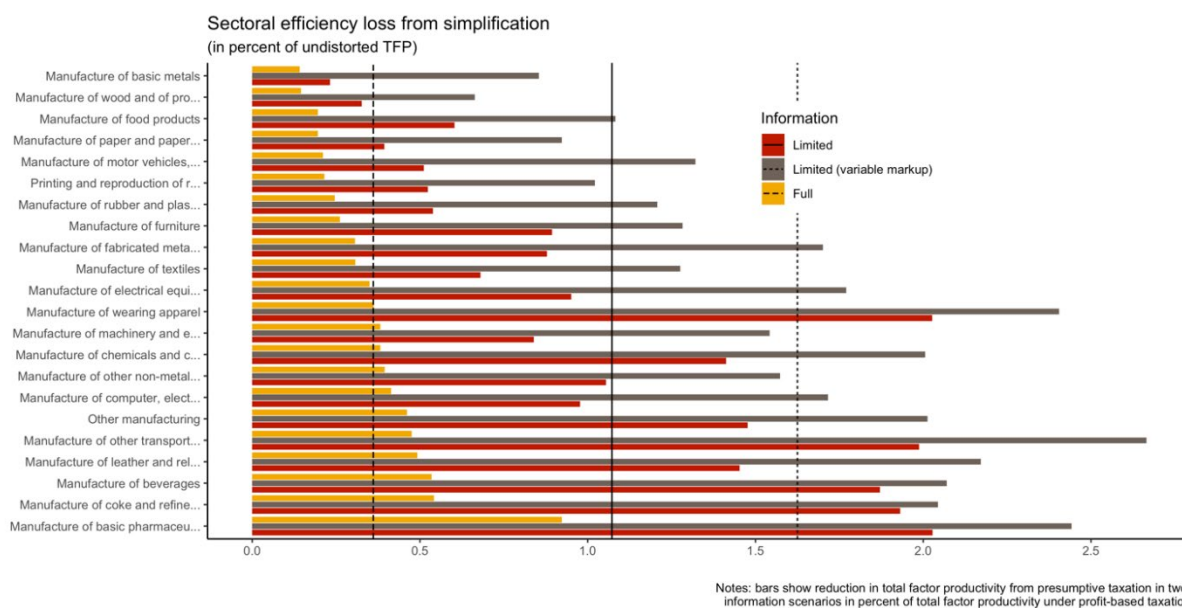


Next, we seek to approximate the idea of a simplified transfer pricing regime (e.g., fixed margin regime), focusing on the manufacturing sector and estimating efficiency losses from using solely fixed assets as a predictor. Figure 3 presents efficiency losses for various subsectors in manufacturing. The yellow bars depict efficiency losses from basing taxation on a prediction using all available information (i.e., akin to standard benchmarking in compliance with ALP), the red bar shows efficiency losses when relying on fixed assets alone, and the grey bar repeats quantification of efficiency losses in the simplified regime, but now allowing for different mark-ups across the sub-sectors.<sup>24</sup> Overall, efficiency losses are now higher when using estimated mark-up for subsectors, suggesting that the constant elasticity of substitution parameter ( $\sigma=3$ ) overestimates market-power for manufacturers in our sample.

The difference between the two information scenarios can be interpreted as the incremental efficiency costs to simplification. On average, the larger efficiency losses from simplification using a fixed margin approach seem proportional to efficiency losses of benchmarking. This observation is not surprising given that both approaches stem from the use of incomplete information. It is noticeable, however, that there are several outliers, where the simplified approach generates larger than expected costs. The value of fixed assets for instance appears to be a poorer proxy for expected profits from apparel, where returns may be driven by valuable branding.

<sup>24</sup> When allowing mark-ups to vary we use the average mark-up observed among firms in our sample of manufacturing firms. See Annex 2 for computation of mark-ups at the firm level.

Figure 3. Sectoral Efficiency Losses from Simplification



## Conclusion

Assessing the desirability of tax simplification options requires contrasting associated costs with potential gains. Our analysis provides insight into the risk of creating distortions when presuming returns for multinational subsidiaries. An assessment of the reliability of different profit predictions illustrates large asymmetries across sectors. Where efficiency losses from predicting profit are comparatively large, benchmarking to determine arm's length pricing is less common practice and simplification to avoid case-by-case assessments not advisable. Our analysis does, however, also indicate that efficiency costs are moderate in several sectors. That by itself does not suffice to determine whether simplified approaches should be applied to these, but it supports exploring the potential for widening their application.

Policy makers need to be mindful of the potential economic costs to transfer pricing simplification, as they should in other policy areas, including other forms of presumptive taxation, such as domestic minimum taxes. Yet, while simplified approaches come with efficiency costs, they can increase welfare if the reduction in compliance and administrative costs and other set of benefits outweigh the impact of resource misallocation. Country experiences suggest that these benefits, which are likely greater for developing economies, include increased taxpayer certainty, lower compliance and administrative cost, and reduced scope for tax avoidance. In light of our findings on the heterogeneity of market conditions across sectors of economic activity, an incremental approach at country or regional level, with simplified rules initially targeting very specific activities may be the most promising route for policy reform.

## Annex I. Descriptive Statistics Profit Predictions

Table A1. Descriptive Statistics: Profits and Predicted Profits – Full Sample

	Min.	Median	Mean	Max.	Variance
Baseline sample, N=1846243					
Profit	0	58	461	5183	1086286
$\pi^{full}$	1	96	499	4911	1011934
Manufacturing sample, N=384009					
Profit	1	125	836	8588	3086555
$\pi^{full}$	2	208	889	7843	2667236
$\pi^{limited}$	3	297	890	6420	1946092

Notes: table provides distribution of profits and predicted profits in two subsamples, in thousands of USD.

## Annex II. Estimation of Firm-Specific Mark-Ups

We follow De Loecker and others (2020) to compute firm-specific mark-ups  $\mu_{ij}$  as

$$\mu_{ist} = \theta_s^L \frac{S_{ist}}{wL_{ist}} \quad (\text{A.1})$$

Where  $\theta_s^L$  is the elasticity of output with respect to intermediate inputs in sector  $s$ ,  $S_i$  are sales, and  $wL$  are intermediate inputs. We use the accounting variable cost of goods sold as a measure for intermediate inputs at the firm-level. Industry-specific elasticities of output with respect to intermediate inputs  $\theta_j^L$  are obtained at the 2-digit NACE level using panel regression methods, by regressing the logarithm of turnover on firm-specific variables, including cost of goods sold, and firm- and time-specific fixed effects.



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# PUBLICATIONS

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Working Paper No. **WPI/2022/193**