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Inflexibility in Income Shifting: Implications, Detection and Remedies

Abstract

This study develops theory and discusses implications of inflexibility in tax-motivated income shifting. We show that inflexibility to adjust income-shifting strategies within a tax year in response to losses implies that income-shifting incentives are based on the expected rather than the statutory tax rate differential. This has important implications for empirical research as our finding suggests that using the statutory tax rate differential risks underestimating the tax sensitivity of income shifting. We propose several empirical remedies to mitigate the estimation bias stemming from inflexibility, whenever a direct test is not feasible. The remedies vary in their data requirements, which allows future work on tax sensitivities of income to take into account inflexibility.

JEL-Codes: F230, H250, H870.

Keywords: income shifting, losses, debt shifting, transfer prices.

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1 Introduction

What is the true extent of income shifting by multinational corporations (henceforth MNCs)? The answer to this question is of paramount importance as it determines whether and how policy makers react to tax-motivated profit relocation by MNCs. For example, one reason for the U.S.'s recent corporate income tax cut from 35% to 21% is the alleged large amount of corporate tax revenue loss stemming from U.S. MNCs' extensive use of tax havens. Likewise, the OECD's initiative on 'base erosion and profit shifting' (BEPS), which currently 139 countries support, is based on the presumption of significant tax revenue losses due to MNC's BEPS practices.

Yet, although there is consensus in the literature that MNCs relocate their income from high-tax to low-tax jurisdictions as a means to minimize their overall global tax payments, there remains considerable disagreement as to the significance of income shifting. Most of the international income shifting literature is based on accounting micro-level data that estimate the tax sensitivity of MNCs' reported income. The positive tax sensitivity commonly found in the literature hints to tax-motivated income shifting and can be used to estimate the global amount of income shifting through extrapolation. However, the literature typically finds a rather modest tax sensitivity of reported income. For example, conducting a meta-regression analysis, Heckemeyer and Overesch (2017) estimate a semi-elasticity of reported income with respect to the tax rate differential across countries of 0.8. In the context of the U.S. corporate tax cut, this means that a U.S. MNC with \$1,000,000 of pre-tax profits would shift about \$112,000 of income back home.[1]

These modest tax-sensitivity estimates stand in stark contrast to the high fraction of MNCs' reported income in tax havens found in the literature using macro-level data, which is commonly interpreted as evidence of large scale income shifting. For example, Tørsløv et al. (2020) estimate that, globally, close to 40% of the income of MNCs is shifted to tax havens.[2] So far, researchers still struggle to reconcile the findings in the micro-level and macro-level literatures. From a general perspective, the question is (a) whether the macro-level literature overestimates the income attributed to tax havens, or (b) the micro-level literature suffers from an underestimation of the tax sensitivities of reported income.

In a recent study, Blouin and Robinson (2020) argue in favor of the overestimation explanation by claiming that data relying on country-level profits of MNCs is potentially affected by double counting of foreign income and, accordingly, erroneously attributing too much income to tax havens. Applying the method and data used by Clausing (2016),

[1] The magnitude of income shifting in this example can be calculated as follows: $(35\% - 21\%) \cdot 0.8 \cdot \$1,000,000 = \$112,000$.

[2] For the U.S. in particular, Garcia-Bernardo et al. (2021) find that the share of foreign income booked in tax havens is around 50%-60% between 2015 and 2020. Using country-by-country data for the year 2017, Clausing (2021) estimates that the U.S. revenue loss from income shifting is likely to exceed \$100 billion.

who estimates the U.S. tax revenue loss due to income shifting to be in the range of $77 to $111 billion in 2012, Blouin and Robinson (2020) suggest a tax revenue loss of only $10 billion when correcting for double counting. However, it remains unclear how severe the issue of double counting beyond BEA data indeed is and what other potential biases the suggested correction method of Blouin and Robinson (2020) create. For example, Clausing (2021) emphasizes the suggested correction method would also eliminate foreign-to-foreign income shifting, which is crucial to provide a coherent estimate of the tax revenue loss from income shifting.

In contrast to the overestimation issue, in this study, we pursue the second possible explanation that tax-sensitivity estimates in the literature using firm-level data are underestimated. The possibility of an underestimation of tax sensitivities has already been mentioned in the literature, mainly because micro-level databases suffer from the reporting bias that information about profits in low-tax countries, especially tax havens, is usually not available (Tørsløv et al., 2020). The missing information can lead to an underestimation bias whenever income shifting reacts more to changes in tax-haven countries compared to tax rate changes in non-haven countries. Indeed, the occurrence of non-linear tax sensitivities has recently been highlighted by Dowd et al. (2017), who suggest that costs related to reporting income differ between tax haven and non-haven countries.

We propose a novel reason that can explain both the occurrence of an underestimation bias and the non-linearity in tax sensitivities. In particular, we argue the possibility that MNCs are inflexible to adjust income-shifting strategies following new information in affiliates' profitability. Inflexibility implies that MNCs base their income-shifting strategies on *expected* tax rates as opposed to *statutory* tax rates as they only have an incentive to shift profits out of higher-taxed affiliates if they are profitable, which is ex-ante uncertain. Because statutory tax rates are larger than expected tax rates, responses in MNCs' reported income found in prior studies are attributed to larger tax changes than what are effectively relevant for MNCs, and may thus suffer from an underestimation bias.

While inflexibility may lead to biased tax-sensitivity estimates for any empirical approach using firm-level data, we highlight that it is potentially a greater concern for studies that focus on reported income around zero profitability as a measure for tax aggressiveness (Bilicka, 2019; Johannesen et al., 2020).[3] Specifically, whenever MNCs face inflexibility, there is the possibility that ex-ante predictions about affiliates' profitability do not materialize ex post, which can result in affiliates ending up on the 'wrong' side of

[3]Recently, the so-called 'bunching' approach has also been used in the accounting literature to estimate the corporate elasticity of taxable income, see, e.g., Coles et al. (2020). While Coles et al. (2020) use thresholds and kinks in the corporate tax schedule to estimate corporate tax elasticities, where bunching only occurs on one side of the distribution and reflects a discontinuity, we rather refer to 'concentration around zero' in the context of MNCs' income-shifting incentives because we do not mean to suggest any discontinuity around zero profits.

the profitability distribution as too much income may be shifted. Thus, affiliates located just above zero profitability, for example, may feature opposing income-shifting incentives as increases in the host countries' tax rate will lead to outbound income shifting in affiliates that are profitable before shifting, while the reverse is true for affiliates that are loss making before shifting.

The potential of biased tax-sensitivity estimates necessitates empirical methods to detect inflexibility and take it into account whenever possible. We show that if MNCs have flexibility to adjust income-shifting strategies, that is they can react to new information on the profitability of affiliates within the tax year, the profitability distribution of MNCs' affiliates has a higher mass around zero profitability compared to domestic firms. While this feature is also true if MNCs are inflexible, the profitability distribution features a fatter left tail. Hence, the presence of a higher mass in the negative profitability range is indicative of inflexibility. However, we emphasize that the absence of a fatter left tail cannot be used as a way to rule out inflexibility, but instead requires a more detailed empirical inquiry.

We therefore offer several remedies to mitigate the estimation bias stemming from inflexibility, whenever a direct test is not feasible. The remedies we propose differ in their data requirement, and can demand as little as firms' industry participation or high-level data on licensing contracts, but also detailed information about sales activity in tax havens and firms' internal transactions. If there is sufficient data that only lack information on firms' internal transactions, a suitable approach is to estimate the probability for inflexibility in income shifting and use that probability to construct the tax incentive as a linear combination of the statutory and expected tax rate differentials. Therefore, a corrective approach can be chosen for any granularity level of the available data in future work that investigates tax sensitivities of MNCs' reported income.

Our study on inflexibility advances an important, but less developed area in the otherwise extensive literature on income shifting.[4] In the empirical literature, Klassen et al. (1993) discuss distinctive features of loss-making affiliates, and point out that MNCs have incentives to shift income into these affiliates as they face a tax rate of zero. However, Klassen et al. (1993) drop these affiliates from their sample to avoid any reversed incentives that might bias their estimates. Since then, dropping loss-making affiliates has been the standard approach in the empirical literature on income shifting.

Only a small number of studies examine intra-temporal income shifting in the presence of losses. Gramlich et al. (2004) and Onji and Vera (2010) analyze income-shifting behavior within domestic Japanese trusts ("keiretsus") and find that net operating losses in some affiliates are balanced by shifting income from profitable affiliates. In addition, Onji and Vera (2010) point out that this behavior most likely is driven by tax motives

[4]For an overview of the income-shifting literature, see Hanlon and Heitzman (2010) and Wilde and Wilson (2018).

because the Japanese corporate income tax did not allow for consolidation of the keiretsus' overall profitability. De Simone et al. (2017) study the link between unexplained income of loss affiliates and tax-related factors. Their findings suggest that the potential tax savings and ability of profitable affiliates to shift profits to loss affiliates affect unexplained profits or losses.

Importantly, these studies do not consider the impact of inflexibility to adjust income-shifting strategies as economic conditions change. The problem is less that some shifting from profitable affiliates goes to loss-making affiliates (De Simone et al. 2017), but rather that also ex-post profitable affiliates will base their shifting on their expected domestic tax rate, taking loss probabilities into account. Hopland et al. (2018) are the first to explicitly discuss flexibility in different income-shifting strategies. Their findings indicate that MNCs have flexibility in adjusting internal transfers related to the pricing of intangible assets, but not related to the pricing of tangible assets or income shifting via internal debt. Yoo and Lee (2020) confirm the existence of inflexibility developed by Hopland et al. (2018) using a dataset of worldwide MNCs. Gamm et al. (2018) provide a first analysis to quantify the shift-to-loss incentives based on a simulated proxy for affiliates' marginal tax rate. Both Yoo and Lee (2020) and Gamm et al. (2018) show that loss shifting is particularly pronounced when affiliates' loss carryforwards are near to expire.

The paper proceeds as follows. The model is developed in Section 2, while the tax-efficient behavior under ex-post and ex-ante income shifting is derived in Section 3. Section 4 discusses the implications for the empirical literature and provides possible remedies to overcome the issues caused by inflexibility in income shifting. Section 5 concludes.

2 The model

Consider a general setting in which an MNC has affiliates in n countries. Let country 1 be the country with the lowest tax rate so that $t_i > t_1, i = 2, ..., n$ and label country 1 as the 'tax haven'. The affiliate in the tax haven serves as a pure financial center and does not produce any goods. All other affiliates use capital K_i and an intermediate good S_i to produce a homogeneous final good y_i according to the general production technology $y_i = F(K_i, S_i; \bar{X})$, which is concave in both variable inputs. $\bar{X}$ represents a fixed factor that we interpret as intangible technological know-how. The price p_i of the final good is stochastic and drawn from a cumulative distribution function $H(p)$ with density $h(p_i)$ on the interval $[\underline{p}; \bar{p}]$. We denote by $E(p_i) = \int_{\underline{p}}^{\bar{p}} p_i h(p)\, dp$ the price at which affiliate i expects to sell its goods.

Affiliates need to lease the rights to use the technological know-how in order to produce. The patent rights for this intangible production factor $\bar{X}$ are located in the financial center, which claims license fee income $G_i^X + q_X$. The true arm's-length price is q_X while the deviation G_i^X from the arm's-length price allows for shifting income. The

deviation, however, triggers 'shifting costs' in the non-haven affiliate. Here, we assume convex shifting costs $C^X(P_i^X)$ that are defined over total income shifted via the intangible asset $P_i^X = G_i^X \cdot \bar{X}$ and that feature $\frac{\partial C^P}{\partial G_i^X} \gtreqless 0$ if $G_i^X \gtreqless 0$ and $\frac{\partial^2 C^P}{\partial (G_i^X)^2} > 0$. This concept of shifting costs in transfer pricing mirrors the 'Transactional Net Margin Method' proposed by the OECD (see OECD, 2017, and Juranek et al., 2018).[5] In contrast, the tax-haven affiliate can earn any shifted income without incurring additional shifting costs, e.g., because the tax-haven country does not monitor the tax base.

Deviations from the true arm's-length price (i.e., $G_i^X \neq 0$) can be interpreted in two ways. First, the MNC exploits the ambiguity of transfer pricing regulation to select a more favorable transfer price for the good or service. Second, the MNC ignores the transfer pricing rules altogether and incurs penalties if its selected transfer price is disallowed. In both cases, any deviation from the arm's-length price causes shifting costs related to defending or concealing the true price. Following prior research, both the tax planning costs and expected penalties can be captured by convex cost functions, see, e.g., Haufler and Schjelderup (2000) and Grubert (2003), respectively.

Additionally, each affiliate purchases S_i units of a tangible, intermediate good S from the other related affiliates. The marginal costs for producing or buying the intermediate good from the world market are q_S. However, any affiliate can re-sell the input at price $G_i^S + q_S$ to affiliate i and pretend that it has added value G_i^S to the input good, tailor-made for the needs in affiliate i.[6] As in the case for intangibles, any deviation G_i^S from the true arm's-length price q_S will cause convex shifting costs. For analytical convenience, we assume that these associated shifting costs are given by $C^S(P_i^S) = \frac{\gamma}{2}(P_i^S)^2$, where $P_i^S = G_i^S S_i$ is the total income shifted in affiliate i via the intermediate good and γ is a cost parameter measuring the difficulty of shifting income.[7]

Finally, the headquarters (henceforth HQ) of the MNC endows the financial center with equity E_1 and provides the producing affiliates with the equity necessary to reach both a tax-efficient financing structure and the optimal level of real capital. Thus, capital K_i in affiliate i is financed by equity E_i provided by the HQ and by internal debt D_i^I borrowed from the financial center so that $K_i = E_i + D_i^I$. The financial center uses its equity E_1 to finance its internal lending $\sum_i D_i^I$ to all the other affiliates so that $E_1 = \sum_i D_i^I$. We assume for simplicity and without any consequences for our main results that there is no corporate debt from external capital markets available.[8]

[5]The most prominent alternative, the 'Comparable Unrelated Price Method', would be identical to defining shifting costs convexly over the deviation from the true arm's-length price only. Our inferences do not depend on the chosen method.

[6]As the resold inputs S_i are tailor-made for the use in affiliate i and perfect substitutes in its production process, all producing affiliates j charge the same price $G_i^S + q_S$ to affiliate i.

[7]See Huizinga and Laeven (2008) for a similar approach.

[8]The finance literature perceives internal debt as 'tax-preferred equity' (Chowdhry and Coval 1998; Gertner et al. 1994), and its related costs are different from agency costs of external debt. As long as the costs of external and internal debt are separable, external debt does not add any effect to income-shifting behavior via intra-firm transactions (see Schindler and Schjelderup, 2012).

We define the internal leverage ratio of a producing affiliate as $b_i = D_i^I / K_i$ and assume that both types of financing are free of risk and carry the world-market interest rate r. Similar to transfer pricing, the MNC needs to incur shifting costs $C_i^I(b_i)$ to set-up and operate the financial structure and particularly to circumvent applicable regulations, such as thin capitalization or CFC rules, in over-levered affiliates. Following prior literature (Mintz and Smart, 2004; Schindler and Schjelderup, 2012), we assume these costs are proportional to the amount of capital employed and convex for any positive internal leverage, but zero otherwise, both in absolute terms and on the margin, i.e., $C_i^I(b_i) = \frac{\partial C_i^I(b_i)}{\partial b_i} = 0$ for $b_i \leq 0$.

Given these assumptions, the expected economic profit of affiliate $i > 1$ reads

$$\pi_i^e = E(p_i)y_i - (G_i^X + q_X)\bar{X} - (G_i^S + q_S)S_i - C^X(P_i^X) - C^S(P_i^S) - C^I(b_i)K_i - rK_i. \quad (1)$$

This expression represents expected revenue from the sales of the output good minus the license cost for the intangible good, the input cost for the tangible intermediate good, the shifting costs, and the user cost of capital.

Following most tax codes in OECD countries, expected taxable income differs from economic profit in that opportunity costs of equity are not tax-deductible. To simplify exposition, and without implications for our results, we assume shifting costs are not tax deductible either. The expected taxable income of affiliate $i > 1$ can then be written as

$$E(\pi_i^t) = E(p_i)y_i - (G_i^X + q_X)\bar{X} - (G_i^S + q_S)S_i - rb_iK_i. \quad (2)$$

The first three terms reflect the same interpretation as in Eq. (1) above, while the last term represents the interest expenses for internal debt. Expected taxable income can be positive or negative. Let p_i^0 be the price for which expected taxable profit $E(\pi_i^t)$ of affiliate i is zero. Thus,

$$E(\pi_i^t(p_i^0)) = p_i^0 y_i - (G_i^X + q_X)\bar{X} - (G_i^S + q_S)S_i - rb_iK_i \equiv 0. \quad (3)$$

When the affiliate incurs taxable losses, i.e., $\pi_i^t < 0$, a loss carryforward allows for deducting actual current losses against future profits. However, loss carryforwards are not inflated with interest and their present value decreases over time. Moreover, in many countries loss carryforwards are granted for limited time periods so that MNCs may be restricted from using the loss carryforward at all. In our static model, we capture loss carryforwards by a tax rate t_i^l that applies in the case of a negative tax base. We define this tax rate as the statutory tax rate t_i discounted for m periods by the discount factor $1 + r$ and weighted with the probability $0 \leq \phi_m < 1$ that the loss carryforwards can be claimed and netted against positive profits within m periods such that $t_i^l = \frac{\phi_m}{(1+r)^m}\ t_i < t_i$. Moreover, we introduce an indicator function $\mathbb{1}_i$ that equals one if an affiliate generates

expected positive taxable income and zero if an affiliate generates non-positive taxable income in expectation.

The after-tax surplus of the financial center in country 1 amounts to the receipt of license fees and interest income from each non-haven affiliate, less the development and maintenance costs of intangibles as well as the financial center's aggregate cost of capital, and it reads as follows:

$$\begin{aligned}\pi_1 &= (1-t_1)\sum_i[(G_i^X+q_X)\bar{X}+rb_iK_i-q_X\bar{X}]-r\sum_i b_iK_i \\ &= (1-t_1)\sum_i G_i^X\bar{X}-t_1r\sum_i b_iK_i. \end{aligned} \tag{4}$$

The HQ of the MNC maximizes net income across all affiliates by choosing the tax-efficient income-shifting activity, i.e., by optimizing over internal leverages b_i and the transfer prices G_i^X and G_i^S. In doing so, we assume that affiliates' profits are only taxed in their home country and that the HQ does not face a repatriation tax, which is plausible given that only a few countries operate a worldwide system of taxation.[9]

3 Tax-efficient income-shifting choices

In this section, we analyze MNCs' income-shifting incentives under two scenarios, which differ in the timing of their tax-planning strategies. We define ex-post or flexible income shifting as an MNC's ability to determine the tax-planning strategies after the realizations of financial performance, but before the end of the tax year. In contrast, ex-ante or inflexible income shifting requires an MNC to decide on and commit to its income-shifting strategies before the revelations of financial performance. This means that an MNC only knows the probability distribution for output prices and expected operating profit in its affiliates, and is unable to revisit its decisions during the year. We describe each scenario in detail below.[10]

3.1 Ex-post income shifting

Because the MNC can make its choices after observing financial outcomes under ex-post income shifting, the expected output price is equivalent to the actual output price, i.e., $E(p_i) = p_i$ and the MNC does not face any uncertainty in its tax-avoidance decisions. The

[9] This exemption-based method is applied in the US, the UK, continental Europe, and Japan, and is thus the dominant scheme of taxing MNCs in OECD countries.

[10] We base our analysis on the assumption that it is not value-enhancing to create losses on purpose to benefit from the taxable value of loss-carry forwards. Using corporate losses to reduce tax payments will trigger substantial attention by tax authorities and likely cause audits. In a special report, OECD (2011) points out that corporate loss utilization can be an indicator for aggressive tax planning and outlines strategies to detect artificial losses and curb such tax schemes.

overall after-tax income Π of the MNC consists of the after-tax income in the financial center π_1 plus the sum over the productive affiliates' before-tax incomes $\sum_{i>1} \pi_i^e$ minus the tax payment in profitable affiliates, $\mathbb{1}_i t_i \pi_i^t > 0$, and the taxable value of loss carryforwards in loss-making affiliates, $(1-\mathbb{1}_i) t_i^l \pi_i^t < 0$. Using equations (1) to (4), the maximization problem of the MNC can be written as

$$\begin{aligned} \max_{b_i, G_i^X, G_i^S} \Pi \quad &= \quad \pi_1 + \sum_{i>1} \{\pi_i^e - [\mathbb{1}_i t_i + (1-\mathbb{1}_i) t_i^l] \pi_i^t\} \qquad (5) \\ \text{s.t.} \quad \mathbb{1}_i &= \begin{cases} 1, & \text{if } \pi_i^t > 0, \\ 0, & \text{if } \pi_i^t \leq 0, \end{cases} \\ & \sum_i G_i^S S_i = 0, \quad (\lambda), \quad \mathbb{1}_i \pi_i^t - (1-\mathbb{1}_i) \pi_i^t \geq 0, \quad (\mu_i) \end{aligned}$$

where all shifted interest payments and license fees are accumulated in the financial center and where the shifted transfer payments for the intermediate factor must sum to zero across all productive affiliates $i > 1$ (constraint with Lagrange multiplier λ). Moreover, we take into consideration that the MNC might be *constrained* in its income-shifting strategy. This happens if the MNC has an incentive to shift either more profits out of a profitable affiliate or into a loss-making affiliate, but cannot do so because taxable profits or losses reach a value of zero in this affiliate (constraint with Lagrange multiplier μ).[11]

Differentiating equation (5) for the three income-shifting variables yields

$$\mathbb{1}_i (t_i - \mu_i) + (1-\mathbb{1}_i)(t_i^l + \mu_i) - t_1 = \frac{1}{r} \frac{\partial C_i^I}{\partial b_i}, \qquad (6a)$$

$$\mathbb{1}_i (t_i - \mu_i) + (1-\mathbb{1}_i)(t_i^l + \mu_i) - t_1 = \frac{\partial C_i^X}{\partial P_i^X}, \qquad (6b)$$

$$-[\mathbb{1}_i (1 - t_i + \mu_i) + (1-\mathbb{1}_i)(1 - t_i^l - \mu_i)] + \lambda = \gamma \, G_i^S S_i. \qquad (6c)$$

If affiliate i has positive taxable income ($\mathbb{1}_i = 1$), the rearranged first-order conditions (6a) and (6b) illustrate that the MNC sets a transfer price on licenses above the true arm's-length prices ($G_i^X > 0$), and that the financial center lends internal debt to the non-haven affiliates ($b_i > 0$) in order to shift income to the tax haven. Moreover, if the MNC is not constrained in its income shifting, that is affiliate i has positive taxable income after shifting ($\mu_i = 0$), the MNC shifts income out until the marginal tax savings equal marginal costs of shifting. However, if affiliate i is *profit constrained* ($\mu_i > 0$), the MNC shifts all income that is generated, which implies that it cannot react to any further shifting incentives although the associated benefits exceed the costs.[12]

[11] Our approach is similar to Köthenbürger et al. (2019) who study the implications of constraints in income shifting for affiliates' investment behavior and government policy.

[12] The shadow value of μ_i indicates by how much after tax profits of the MNC will increase if the income-shifting constraint is relaxed by one unit, that is if taxable profits of affiliate i increase by one unit. From equations (6a) and (6b), we can infer that an increase in taxable income by one unit would

Instead, if affiliate i's taxable income is non-positive ($\mathbb{1}_i = 0$), shifting incentives are reduced compared to the profitable case because $t_i^l < t_i$. Moreover, if $t_i^l < t_1$, which we will assume in the following, shifting incentives are reversed, meaning that the MNC shifts income to the loss-making affiliate i.[13] The MNC could even have an incentive to use affiliate i as a profit center as long as it is in a loss position. We will, however, assume that the MNC does not relocate its equity and the ownership rights of the intangible asset.[14] If affiliate i's losses are small, the MNC can only shift income into affiliate i until it reaches zero profitability because any further income that is shifted to the loss-constrained affiliate i ($\mu_i > 0$) would trigger positive tax payments at rate t_i.

Finally, solving equation (6c) for the optimal transfer price on intermediate inputs yields[15]

$$G_i^S = \frac{1}{\gamma \cdot S_i} \sum_{k>1, k\neq i} \frac{\mathbb{1}_i(t_i - \mu_i) + (1-\mathbb{1}_i)(t_i^l + \mu_i) - \mathbb{1}_k(t_k - \mu_k) - (1-\mathbb{1}_k)(t_k^l + \mu_k)}{n-1}. \quad (7)$$

Equation (7) shows that if affiliate i is neither loss-making nor profit constrained ($\mathbb{1}_i = 1$ and $\mu_i = 0$), the transfer price on the intermediate good is determined by the weighted tax rate differential across all non-constrained affiliates as

$$G_i^S = \frac{1}{\gamma \cdot S_i} \sum_{k>1, k\neq i} \frac{t_i - [\mathbb{1}_k(t_k - \mu_k) - (1-\mathbb{1}_k)(t_k^l + \mu_k)]}{n-1}.$$

In bilateral trades, some income is received from higher taxed, profitable and non-profit-constrained affiliates ($t_i < t_k$, $\mathbb{1}_k = 1$ and $\mu_k = 0$), while some income is either shifted to statutorily lower taxed, but profitable affiliates ($t_i > t_k$ and $\mathbb{1}_k = 1$) or to non-profitable, non-profit-constrained affiliates irrespective of the level of statutory taxation ($\mathbb{1}_k = 0$ and $\mu_k = 0$).[16]

However, this balancing of the weighted tax rate differentials is limited when either affiliate i or other affiliates k are profit-constrained ($\mu_i > 0$, $\mu_k > 0$). If $\mu_k > 0$, the MNC would like to shift income either from or to affiliate k, but cannot do so because affiliate k already reached zero taxable income. This implies that the MNC cannot use affiliate k for shifting purposes related to affiliate i. Similarly, if $\mu_i > 0$, affiliate i has exhausted

raise after-tax profits of the MNC by the tax differential $t_i - t_1$ adjusted for marginal shifting costs.

[13] If $t_i^l > t_1$, MNCs have an incentive to create artificial losses by shifting out more income of a loss-making affiliate in order to offset future profits. While such a strategy has its limits both from a regulatory perspective (OECD, 2011), recent empirical evidence suggest that MNCs shift profits into and not out of loss-making affiliates (De Simone et al., 2017; Hopland et al., 2018).

[14] Relocating the profit center at the end of a tax year will not generate substantial tax-free income since what matters for global tax savings is interest payments over the entire year. Furthermore, the transaction costs for temporarily relocating equity and intellectual property are likely very high.

[15] See Appendix A.1 for more details on the derivation.

[16] This relationship corresponds to equation (3) in Huizinga and Laeven (2008). The expressions are not identical, since we do not define shifting costs relative to sales and assume they are not deductible.

its shifting capacity so that small changes in t_i will not result in a change in the transfer price G_i^S. Instead, if affiliate i is loss-making, the interpretation is equivalent to profitable affiliates, with the only difference that the loss-making affiliate i will only receive income, which is shifted from profitable non-constrained affiliates.

3.2 Ex-ante income shifting

In the alternative scenario of ex-ante income shifting, the MNC must commit to its income shifting before profitability of its affiliates is known. Moreover, if the MNC must decide ex ante on transfer prices and the level of internal debt, it cannot revisit these decisions after the output prices are revealed. Thus, the MNC's HQ faces a decision under uncertainty where it can only anticipate the likelihood of incurring losses. We assume that the MNC is risk neutral so that the HQ maximizes *expected* overall income.

Expected tax payments of a non-tax-haven affiliate are

$$\begin{aligned} E(T_i^t) &= t_i \int_{p_i^0}^{\bar{p}} p_i h(p)\, dp \cdot y_i - [1 - H(p_i^0)] \cdot t_i \, [(G_i^X + q_X)\bar{X} + (G_i^S + q_S)S_i + r b_i K_i] \\ &+ t_i^l \int_{\underline{p}}^{p_i^0} p_i h(p)\, dp \cdot y_i - H(p_i^0) \cdot t_i^l \, [(G_i^X + q_X)\bar{X} + (G_i^S + q_S)S_i + r b_i K_i], \end{aligned} \tag{8}$$

where the first line displays tax payments if the affiliate is profitable, while the second line shows the tax payments if the affiliate occurs losses.

The MNC's maximization problem can be stated as

$$\begin{aligned} E(\Pi) &= \pi_1 + \sum_{i>1} E(\pi_i^e) - E(T_i^t), \\ &\text{s.t.} \quad \sum_{i>1} G_i^S S_i = 0 \quad (\lambda), \quad [\mathbb{1}_i - (1 - \mathbb{1}_i)] E(\pi_i^t) \geq 0 \quad (\mu_i), \end{aligned} \tag{9}$$

Differentiating the expected after-tax income of the MNC for the three tax-avoidance channels gives the first-order conditions[17]

$$E(t_i) - t_1 - [\mathbb{1}_i - (1 - \mathbb{1}_i)]\mu_i = \frac{1}{r}\frac{\partial C^I}{\partial b_i}, \tag{10a}$$

$$E(t_i) - t_1 - [\mathbb{1}_i - (1 - \mathbb{1}_i)]\mu_i = \frac{\partial C^X}{\partial P_i^X}, \tag{10b}$$

$$-[1 - E(t_i)] - [\mathbb{1}_i - (1 - \mathbb{1}_i)]\mu_i + \lambda = \gamma \, G_i^S S_i, \tag{10c}$$

where $E(t_i) = [1 - H(p_i^0)]t_i + H(p_i^0)t_i^l$ is the expected tax rate of affiliate i, averaging its statutory tax rate and the tax value of loss carryforwards.

The MNC expects a profitable affiliate i if $E(p_i) > p_i^0$. This happens if the distribution

[17] See Appendix A.2 for a more detailed derivation.

of prices $H(p_i)$ exhibits a sufficiently large mass on higher values of p_i. In this case, $H(p_i^0)$ is low, which implies that the expected tax rate $E(t_i)$ is closer to t_i than to t_i^l. Since $t_i > t_1$, the MNC has an incentive to shift income from the expectedly profitable affiliate i to the profit center. However, when comparing equations (10a) and (10b) with (6a) and (6b), for $\mathbb{1}_i = 1$, it becomes clear that uncertainty about affiliate i's profitability makes the MNC more cautious in its income shifting. The reason is that the MNC has no incentive of shifting income out of affiliate i if it incurs losses in hindsight.

In contrast, the MNC expects that affiliate i incurs losses if $E(p_i) < p_i^0$. In this case, $H(p_i^0)$ is high, which implies – because we assume $t_i^l < t_1$ – that the MNC has an incentive to shift income from the profit center to the loss-making affiliate i. Importantly, although the MNC is more cautious in shifting income, it is possible that the MNC shifts income into (out of) affiliate i although it is profitable (loss-making) in hindsight.

To determine the tax-efficient transfer price structure for the intermediate good from first-order condition (10c), the equivalent rearrangements can be applied that developed equation (7). This leads to an ex-ante tax-efficient deviation from the arm's-length transfer price on intermediate inputs

$$G_i^S = \frac{1}{\gamma \cdot S_i} \sum_{k>1, k\neq i} \frac{E(t_i) - E(t_k) - [\mathbb{1}_i - (1 - \mathbb{1}_i)]\mu_i + [\mathbb{1}_k - (1 - \mathbb{1}_k)]\mu_k}{(n-1)}. \tag{11}$$

The interpretation of condition (11) is similar to the case of condition (7) under ex-post shifting. The crucial difference is that under ex-ante decision making, shifting incentives are based on expected, and not statutory, tax rate differentials. This implies that the MNC can have an incentive to shift from a statutorily low-tax affiliate to a statutorily high-tax affiliate if the probability of incurring a loss is sufficiently larger in the high-tax affiliate.

An interesting result arises with respect to affiliates' ability to concentrate around zero profitability. Even if the MNC is able to position affiliate i's taxable income at zero profitability *in expected value*, the ex ante determined amount of shifted income will eventually be too high or too low for achieving an actual zero-income position. The reason is that the *realized* income at the end of the tax year can differ from its expected value. More specifically, whenever actual profits (losses) of affiliates that are ex-ante income-shifting constrained are larger than the expected profits (losses), the MNC will base its income shifting on a tax rate differential that is too small *in hindsight*. That is, the MNC will shift too little income from (into) such affiliates when they are profitable (loss-making). Thus, income shifting moves ex-ante income-shifting constrained affiliates' profitability toward zero, but to a smaller extent than under ex-post shifting. In contrast, when ex-ante constrained affiliates' actual profits (losses) are smaller than the expected profits (losses), the MNC will base its income shifting on a tax rate differential that is too large *in hindsight*. This implies that too much income is shifted from (into) ex-ante

constrained affiliates when they are profitable (loss-making). We emphasize that such overshifting, for which affiliates invert their income positions after income shifting, can only happen under ex-ante shifting.

4 Implications for the empirical literature

Our theoretical insights provide implications and foundations for the empirical income-shifting literature. In particular, they highlight the condition under which the tax sensitivity of reported income is accurately estimated and allow for drawing conclusions about the shape of MNC affiliates' profitability distribution, relative to the one of domestic firms. In addition, we offer potential detection and remedy strategies to account for the influence of inflexibility.

4.1 Inflexibility and tax incentives

In our theoretical model, we show that when MNCs are fully flexible in the timing of their transactions ('ex-post shifting'), they can ensure that an affiliate's shifting of income is perfectly conditioned on whether the affiliate features operating profits or losses. Consequently, all effects related to loss shifting are clustered in loss-making affiliates while profitable affiliates behave as in the standard models and base their tax planning on statutory tax differentials. Hence, the behavior in profitable and loss-making affiliates is independent of each other.

This property is the reason why researchers, ever since Klassen et al. (1993), regularly drop loss-making affiliates in an effort to avoid confounding tax-sensitivity estimates due to the reversed income-shifting incentive relative to profitable affiliates. However, this procedure depends on the assumption that MNCs are fully flexible to adjust income shifting in response to losses during a tax year. We conclude in:

Proposition 1 *Dropping loss-making affiliates from samples only eliminates confounding loss-shifting incentives if firms have full flexibility to adjust income-shifting strategies ('ex-post shifting').*

The assumption of full flexibility is not innocuous because shifting behavior changes drastically as soon as MNCs face some inflexibility. Under ex-ante shifting, the HQ takes into account the affiliate-specific probability of incurring losses when it decides on its income-shifting strategies rather than actual profits or losses at the end of the year. With limited flexibility to adjust income-shifting strategies within a year, precautionary behavior suggests that income shifting in all affiliates is determined by expected tax rate differentials. This also implies that their shifting behavior will deviate from the one predicted by standard theoretical models. We summarize as follows:

Proposition 2 *If MNCs are inflexible to adjust income-shifting strategies ('ex-ante shifting'), income shifting is based on expected rather than statutory tax rate differentials, irrespective of affiliates' ex-post profitability.*

Hopland et al. (2018) suggest that MNCs are limited in their flexibility to change the internal-debt structures and prices for intermediate inputs. Thus, our results on inflexibility to adjust shift-to-loss incentives provide a potential explanation for why most studies find tax sensitivities that are usually considered low. More specifically, because statutory tax rates are larger than expected tax rates, the previous literature attributed responses in reported income to larger tax changes than effectively relevant for MNCs.

Bilicka (2019) portrays it as a 'puzzle' that there are no observable differences between MNCs that pay taxes and those that do not. We argue that this could be due to MNCs' inflexibility to adjust their income-shifting strategies. Such inflexibility implies that ex-ante identically tax-aggressive affiliates may locate anywhere in the distribution, depending on the affiliate-specific realization of the price shock.

Irrespective of MNCs' flexibility, our model illustrates that taxable income of MNC affiliates should concentrate around zero profitability to a larger extent than income of domestic firms. Under ex-post income shifting, MNCs can ensure that income is shifted out of profitable affiliates and into loss-making affiliates. In contrast, domestic firms do not have any possibility to shift income internationally. Thus, the profitability distribution for affiliates of MNCs under ex-post shifting is compressed compared to domestic firms. We summarize as follows:

Proposition 3 *If firms have flexibility to adjust income-shifting strategies, the profitability distribution of MNCs' affiliates has a higher mass around zero profitability.*

The inference of a higher mass around zero profitability is consistent with the early observations in Grubert et al. (1993) who point out that income-shifting MNCs are able to balance profits and losses across affiliates. Using 1987 data in the U.S., Grubert et al. provide evidence that, compared to domestic firms, MNCs' profitability concentrates to a much larger extent around zero, i.e., MNCs' profitability occurs at a higher frequency in a narrow band around zero than domestic firms' profitability.

Interestingly, the descriptive analysis by Grubert et al. (1993) also indicates a fat tail on the negative side of MNCs' profitability distribution (cf. Figure 7.1), which we argue is consistent with ex-ante shifting. If an affiliate is less profitable than expected, too much income is shifted in hindsight. This may imply that an MNC shifts income out of an affiliate that is ex-post loss making, which results in even higher losses. Hence, if MNCs expect a sufficiently large portion of their affiliates to be profitable, inflexibility can shift the profitability distribution of affiliates of MNCs to the left compared to domestic firms. We summarize as follows:

Proposition 4 *The profitability distribution of inflexible MNCs' affiliates shows a concentration around zero profitability, but to a lesser extent than under flexibility. Moreover, if a sufficiently large share of affiliates are expected to be profitable, the profitability distribution features a fatter left tail.*

Interestingly, this also means that the occurrence of systematically higher losses of MNC affiliates compared to domestic firms can indeed be consistent with successful income shifting if MNCs are inflexible in adjusting their income-shifting strategies. In theory, a fatter right tail in the profitability distribution of MNCs can also occur if MNCs expect a large share of its affiliates to run substantial losses before income shifting.

Furthermore, the possibility of overshifting in high-tax countries might also explain a recent trend in how international sales are organized, namely the emergence of triangular structures with export sales platforms in tax havens. In the international-trade literature, such export sales platforms gained attention recently (e.g., Tintelnot 2017). Laffitte and Toubal (2018) provide first evidence that the possibility of income shifting gives U.S. MNCs an incentive to disconnect sales and production, and place their sales units in low-tax countries to optimize their tax position.[18] These findings complement evidence in Becker et al. (2020) who highlight that MNCs take advantage of international tax differences by shifting risks between affiliates, for example, through cost sharing agreements. Their analysis shows that risks are predominantly allocated to low-tax affiliates before uncertainty in higher-tax affiliates – arising, for example, due to fluctuations in output or input prices – is resolved. Such income and risk shifting, before price uncertainties are fully resolved, corresponds to our concept of ex-ante shifting.

Risk shifting within MNCs will have a significant effect on tax incentives for all other income-shifting strategies. To illustrate this point, consider the extreme case of a non-producing sales affiliate located in a low-tax country. This affiliate buys all output of the productive affiliates in high-tax countries at a guaranteed price, before output price uncertainty is resolved. Then, it resells the goods to the final customers by 'reexporting'. By guaranteeing affiliate-specific fixed sales prices, e.g., by using the cost-plus method, the MNC is able to fully eliminate the output price uncertainty in high-tax affiliates. Similar structures can be used to target input price risk. Eventually, the difference between ex-ante and ex-post shifting disappears, because the profitability risk is shifted to the low-tax affiliate. A prominent example with respect to input-price risk is Apple Inc. which officially routes its products such as iPhones and iPads via its affiliate Apple Sales International before the products are sold to final customers in the Apple stores, see Levin and McCain (2013).[19]

[18] Triangular structures have already been well-known in relationship with circumventing repatriation taxes (Altshuler and Grubert 2002) and with financial arrangements in general (OECD 2007, chapter 5C2), but they also show up in models to avoid or evade value-added taxes (Ainsworth 2012).

[19] Recall that shifting risks to the tax haven is optimal from a tax perspective as $t_i > t_1 > t_i^L$. This

We argue that the rising importance of triangular structures via tax-haven affiliates can explain the discrepancy of which tax incentives matter for MNCs' income shifting. Huizinga and Laeven (2008) highlight that changes in tax rates affect income shifting between all affiliates of an MNC by examining income-shifting incentives using a weighted tax rate differential across all affiliates, also frequently referred to as the 'C measure.' However, using a meta-study which evaluates 27 primary studies on income shifting, Heckemeyer and Overesch (2017) find that the incentives to shift income cannot be explained by such holistic tax considerations. Instead, tax incentives are rather driven by the maximum tax rate differential, that is vis-à-vis the affiliate facing the lowest tax rate (Heckemeyer and Overesch 2017, Table 2).

Our previous discussion provides an explanation for the declining importance of the weighted tax rate differential as the opportunity of clustering risk in the lowest-tax affiliate can fundamentally change the tax responsiveness of income shifting. If all risks are shifted to the tax haven affiliate, the risk of running losses in productive, high-tax affiliates is eliminated and the profitability of high-tax affiliates is de facto determined. Hence, risk shifting eliminates the need to shift losses between high-tax affiliates thereby allowing MNCs to shift income out of high-tax countries and directly into the lowest-tax affiliate.

The outstanding role of a tax-haven affiliate for income shifting is documented, for example, by Davies et al. (2018) and Dowd et al. (2017). Davies et al. (2018) illustrate that income shifting occurs predominantly in the direct transactions between MNC entities and their related tax-haven affiliate. Dowd et al. (2017) find that the semi-elasticity of profits with respect to tax rates is highly non-linear with substantially higher responses for changes in tax rates of tax havens. While Dowd et al. (2017) argue that non-linearity in the tax sensitivity can arise because MNCs should shift income to the affiliate facing the lowest tax rate, risk allocation can serve as a complementary explanation for their finding as it eliminates the necessity to take into account affiliates' loss probabilities.

4.2 Concentration around zero profits

Our discussion of the profit distribution, summarized in Propositions 3 and 4, can be related to the recent idea of using the extent of concentration around zero profits as an indicator for the income-shifting behavior of MNCs (Bilicka, 2019; Johannesen et al., 2020). In general, this approach seems appealing as the concentration around zero profits could provide a very salient manifestation of income shifting. We argue, however, that using concentration around zero profitability as a measure for firms' tax aggressiveness around income shifting has its limits. These limits can be directly related to the key elements of our model, which are inflexibility and constrained income shifting.

means that profits (losses) that would have otherwise occurred in the high-tax affiliate are taxed at a lower rate, $t_1 < t_i$, (can be deducted at a higher rate, $t_1 > t_i^L$,) when the tax-haven affiliate bears the output price risk.

The validity of estimates derived from the 'concentration around zero' approach is based on the assumption that MNCs are flexible in adjusting their income-shifting strategies. In this case, MNCs are able to set income-shifting strategies such that the direction of shifted income is always in accordance with affiliates' actual performance. In other words, MNCs always shift income out of profitable affiliates, while income is shifted into loss-making affiliates, irrespective of whether affiliates are profit- or loss-constrained. Hence, flexibility implies that affiliates, which are profitable (loss-making) before income shifting, will always exhibit a non-negative (non-positive) tax base.

However, if MNCs are inflexible, this pattern can change. Under inflexibility, the ex-post profitability becomes uncertain, meaning that the deviation of affiliates' actual from expected profitability depends on the magnitude of the income shock. As discussed before, whenever the MNC overestimates the affiliates' profits (losses), affiliates that are income-shifting constrained will end up on the 'wrong' side of the profitability distribution after income shifting. Thus, the fact that initially profitable (loss-making) affiliates become loss-making (profitable) after income shifting can only happen in the presence of inflexibility and constraints in income shifting.

Our discussion highlights that focusing on affiliates that concentrate around zero profitability can produce conservative estimates of the tax sensitivity. The reason is that affiliates located close to zero profitability may feature opposing income-shifting incentives. Specifically, an increase in the host countries' tax rate will lead to outward income shifting in an affiliate that is profitable before income shifting, while the reverse is true for affiliates that are loss-making before shifting even though both affiliates can be profitable after income has been shifted. Put differently, a higher tax rate in the host country can lead to a lower (higher) profitability of affiliates that are profitable (loss-making) before income shifting and these two incentives counteract each other. We summarize in:

Proposition 5 *If firms are inflexible in adjusting their income-shifting strategies, focusing on affiliates that concentrate around zero profitability will result in conservative tax-sensitivity estimates as profit- and loss-shifting incentives counteract each other.*

While the possibility of reversed incentives is particularly problematic for affiliates close to zero profitability, the issue is potentially present also in other parts of the distribution and eventually depends on the ability of MNCs to predict the profitability of their affiliates. The more inaccurate MNCs' predictions are, the larger is the uncertainty and thus the potential difference between expected and actual profitability before income shifting.

4.3 Detection of inflexibility and possible remedies

Besides reversed shifting incentives, we have argued that inflexibility prevents MNCs to adjust their income-shifting strategies in response to a loss. In particular, inflexibility leads to a potential bias in tax-sensitivity estimates as MNCs base their income shifting

on expected as opposed to statutory tax rates. Hence, it is important to detect inflexibility and take this behavior into account whenever possible, irrespective of the empirical approach. In this section, we offer ways to detect inflexibility and remedies to mitigate the estimation bias stemming from it.

In Propositions 3 and 4, we highlight that ex-ante and ex-post shifting imply different profitability distributions. Thus, one straightforward way to check whether tax incentives are affected by inflexibility is to descriptively compare the profitability of domestic firms and affiliates of MNCs. A higher mass in the left tail of MNC affiliates' profitability distribution can serve as a good indicator of inflexibility in income shifting. However, as highlighted in Proposition 4, such differences only arise if MNCs expect a sufficiently large share of their affiliates to be profitable. Based on the empirical finding that the share of loss-making affiliates can be as high as 50% (Cooper and Knittel, 2006), it can be premature to conclude that finding no such differences implies flexibility of MNCs.

Moreover, when trying to account for inflexibility, another complication arises as the degree of inflexibility might not only differ across MNCs, but also within the MNC due to the use of several income-shifting strategies. Hopland et al. (2018) suggest that there is some flexibility to adjust transfer prices in intangibles in response to losses, but do not find such flexibility for adjusting internal leverage or transfer prices for tangible intermediate goods. Thus, ideally, to test whether MNCs face inflexibility in their income-shifting strategies, tax incentives should be conditioned on the shifting channel. However, such an investigation requires detailed information about bilateral, internal trading flows and transfer prices. As such data are usually not readily available, we propose several remedies, which can help to reduce the potential bias stemming from ex-ante shifting whenever a direct test of inflexibility is not feasible. The remedies we provide differ in their data requirement such that a corrective approach can be chosen for any granularity level of the available data.

One way to reduce the potential bias is based on our discussion that affiliates can concentrate more precisely around zero profitability if MNCs have flexibility to adjust income shifting after observing financial outcomes. As MNCs appear to have some flexibility to re-adjust their income shifting related to the use of intangible assets, reducing the bias due to inflexibility only demands information about the industry in which the MNCs operate. Even if detailed information about MNCs' shifting channels is not available, firms' industry participation can serve as a proxy for the degree of inflexibility. Firms active in industries featuring high shares of intangible assets, such as the IT-sector, should be affected by inflexibility to a lesser extent than firms in industries in which physical capital dominates, such as the transportation sector. The bias in the tax sensitivity of firms in sectors with large shares of intangible assets should therefore be smaller. We suggest:

Remedy 1 *The bias due to inflexibility in income shifting is less severe in industries with higher shares of intangible assets.*

Yet, although a sector-specific analysis can help to reduce the bias stemming from inflexibility, differences in tax sensitivities across industries are not determinative of ex-ante shifting behavior. This is due to the nature of intangible assets that arm's-length prices are unobservable, which may allow a firm to react more tax sensitively even in the absence of inflexibility.

In addition to information on intangibles and the relevant industry, if information on the structure of firms' licensing contracts is available, Remedy 1 can be fine-tuned further. Empirical studies document that only about 10 to 30% of firms rely merely on fixed license fees, while the rest either exclusively uses variable royalty payments based on sales or sales revenue, or a combined invoicing system, i.e., royalties plus a fixed fee.[20] One prominent example is IKEA, which levies a 3% franchise fee on sales revenue in all affiliates worldwide and channels the royalty payments to a foundation in Liechtenstein (see http://www.thelocal.se/20110126/31650 and Auerbach 2016). A second example is Wal-Mart and its dispute with the New Mexico Taxation and Revenue Department on sales-dependent royalty payments to generate tax-preferred intangible income in Delaware (see Hecht 2006).

We argue that such sales-dependent royalty payments provide MNCs with indisputable flexibility in adjusting their transfer payments to the profitability of an affiliate. As sales revenues and income are highly correlated, variable royalty payments ensure that transfer payments will decrease when the affiliate is in a loss position and increase when the affiliate faces unexpectedly high profits. Thus, sales-dependent royalty payments serve as an 'automatic stabilizer' for income-shifting purposes and provide MNCs with an opportunity to react to the volatility of affiliates' profits despite determining the income shifting ex-ante.[21] Sales-dependent royalty payments are therefore desirable in environments where sales are more volatile.[22] Thus, even with high-level data on licensing contracts can the extent of ex-ante income shifting be potentially investigated. Specifically, a positive correlation between the firms' use of sales-dependent licensing contracts and market volatility should imply that inflexibility is less problematic. Investigating why MNCs can flexibly react to the occurrence of losses is important, especially against the background of the OECD (2013) BEPS Action Plan, which likely reduces MNCs' flexibility to use ad hoc adjustments in transfer prices. We summarize in:

Remedy 2 *The bias arising due to firms' inflexibility in income shifting is less severe for firms using sales-dependent royalty payments.*

[20] See San Martín and Saracho (2010, p. 284) for a brief summary.

[21] The reason why intangible assets allow MNCs to react flexibly to losses remains an open question. While it is difficult to determine arm's-length prices for intangible assets, ad hoc adjustments to license payments may very well trigger red flags in tax authorities which would seriously limit MNCs' flexibility. Sales-dependent royalty payments as an 'automatic stabilizer', however, bypass this problem.

[22] For example, Bousquet et al. (1998) show that sales-dependent royalties lead to higher profits than per unit royalties when demand is uncertain.

Furthermore, other variations between industries can serve to indirectly investigate the extent of ex-ante shifting. A bias in tax sensitivities due to inflexibility arises because firms face uncertainty when they have to determine their income-shifting strategies. Although precautionary behavior in income shifting likely differs across industries in a given period, firms active in less volatile industries should be able to predict future earnings more accurately. More accurate predictions will, in turn, reduce the uncertainty associated with inflexibility and thus reduce the bias associated with it. In the hypothetical case of perfect predictability, firms can likely mimic ex-post shifting even when they cannot adjust income shifting within a year. Thus, examining firms in less volatile industries will likely generate less bias when studying tax sensitivities. Such an analysis may also allow to draw inferences about the relative degree of inflexibility across industries. We summarize in:

Remedy 3 *The bias due to inflexibility in income shifting is less severe in less volatile industries.*

Yet, as all industries at any time face some uncertainty, the bias from inflexibility is likely not eliminated completely. Our discussion of triangular trade and export sales platforms at the end of section 4.1 points to conditions under which the bias from inflexibility may be substantially reduced. Though the pure presence of an MNC in a low-tax country would certainly be too rough of guidance in limiting the bias from inflexibility, more detailed information about whether an MNC has presence in a tax haven can be an indication of reduced inflexibility. If the haven affiliate serves as an export sales platform for triangular trade or as a vendor for trade in intermediate goods, the MNC can shift a substantial part of its risks to the haven affiliate. In effect, the reduction in the uncertainty faced by high-tax affiliates increases the tax sensitivity of income (compare, for example, eqs. (6b) and (10b)). Importantly, the significant role tax-haven affiliates play within the MNC is based on their income being mainly non-active, which implies that the reallocation of risks to the tax-haven affiliate does not feature shift-to-loss incentives as it would be the case if risk is shifted to a producing affiliate (cf. eq. (11)). We summarize our discussion in:

Remedy 4 *The bias due to inflexibility in income shifting is less severe for firms with a tax-haven presence if the tax haven affiliate has sales activity.*

To fully eliminate the bias from inflexibility requires to take into account ex-ante shifting incentives. Our theory illustrates that it is possible to identify inflexible income-shifting strategies due to a different reaction to changes in the loss probability. If the probability of being unprofitable increases, we should only observe a reaction in inflexible income-shifting channels. Incentives for flexible income-shifting strategies are not affected by the ex-ante probability of running losses because they are settled after the revelation of affiliates' profitability.

Because MNCs' income-shifting strategies can vary in their flexibility, it is necessary, in a first step, to determine which channels feature inflexibility in order to apply the appropriate tax incentives. One way to investigate the relevance of statutory or expected tax incentives is to analyze which income-shifting strategies adjust in response to current losses. If a specific income-shifting strategy reacts to the occurrence of losses within a tax year, this channel constitutes a flexible income-shifting strategy (Hopland et al., 2018).

For income-shifting channels that emerge as inflexible, it is, in a second step, necessary to account for ex-ante shifting behavior. One approach to incorporate ex-ante shifting behavior is to predict affiliates' probabilities of incurring losses in future periods based on historical accounting data. This can be accomplished by using a logit model to estimate what determines the likelihood of affiliates to incur a loss. The predicted probabilities can then be used to construct expected tax rate differentials on which inflexible income-shifting strategies rest.[23] We summarize in:

Remedy 5 *The bias due to inflexibility in income shifting is less severe if ex-ante shifting incentives are taken into account by estimating affiliates' loss probabilities.*

Estimating loss probabilities and identifying inflexible income-shifting channels is a potentially suitable approximation to directly identifying ex-ante shifting in the data. It is, however, also the most data-intensive, and most databases simply lack information about firms' internal transactions. Studies based on such databases can therefore analyze income shifting only indirectly and estimate tax sensitivities merely for the average income-shifting strategy. For this reason, it is crucial to know what is the average flexibility of the average income-shifting channel in order to accurately weight statutory and expected tax incentives.

However, when measuring flexibility, a first challenge is to find suitable proxies for the relevant but unobserved income-shifting strategy. For example, one way to indirectly test for the flexibility of internal debt is to rely instead on total debt, which is usually available, and compare MNCs' flexibility of total debt to the one of comparable domestic firms by using matching techniques such as propensity score matching.[24] If suitable proxies can be found for all income-shifting strategies, a second challenge is to create weights for the relevant tax incentives, which can only measure the tax sensitivity of the average income-shifting channel. One possibility is to rely on the p-values of the flexibility analyses in the first step that some have suggested to interpret as continuous indices of the strength of evidence against the null hypothesis (e.g., Amrhein and Greenland, 2018). The average of the p-values of the respective flexibility analyses will then indicate the strength of evidence that the average income-shifting strategy reacts flexibly. This value,

[23]Such an approach has recently been used by Hopland et al. (2021) who investigate tax and non-tax reasons for affiliates' use of parental debt.

[24]Matched domestic firms feature very similar external debt levels so that differences in the flexibility of total debt only arise due to differences in internal debt levels.

which lies between 0 and 1, can thus be used to serve as the inverse weight for the statutory tax incentives, while the complementary value can accordingly be used as the weight for expected tax incentives. That is, the tax incentive for the average income-shifting channel is a linear combination of statutory and expected tax incentives (STR and ETR) of the form $(1-p) \times STR + p \times ETR$. While such an approach has its limits, the ultimate advantage is that it allows to approximate inflexibility based on the underlying firm behavior instead of relying on ad hoc predictions.

5 Conclusions

Estimating the true extent of tax-motivated income shifting by MNCs is of increasing importance to global tax policy makers as they develop strategies to combat abusive profit relocation (OECD 2013). Two issues complicate the estimates. First, researchers are currently debating the extent to which income attributable to tax havens is overestimated (Blouin and Robinson, 2020; Clausing, 2021). Second, the tax sensitivity of reported income may be underestimated or nonlinear (Tørsløv et al., 2020; Dowd et al., 2017). Our study focuses on exploring this second explanation.

We propose a novel reason that can explain both the occurrence of an underestimation bias and the non-linearity in tax sensitivities. We argue the possibility that MNCs are inflexible to adjust income-shifting strategies following new information in affiliates' profitability. Inflexibility implies that MNCs base their income-shifting strategies on *expected* tax rates as opposed to *statutory* tax rates as they only have an incentive to shift profits out of higher-taxed affiliates if they are profitable, which is ex-ante uncertain. Because statutory tax rates are larger than expected tax rates, responses in MNCs' reported income found in prior studies are attributed to larger tax changes than what are effectively relevant for MNCs, and may thus suffer from an underestimation bias.

Specifically, whenever MNCs face inflexibility, there is the possibility that ex-ante predictions about affiliates' profitability do not materialize ex post, which can result in affiliates ending up on the 'wrong' side of the profitability distribution as too much income may be shifted. Thus, affiliates located just above zero profitability, for example, may feature opposing income-shifting incentives as increases in the host countries' tax rate will lead to outbound income shifting in affiliates that are profitable before shifting, while the reverse is true for affiliates that are loss making before shifting.

The potential of biased tax-sensitivity estimates requires empirical methods to detect inflexibility. We offer several remedies to mitigate the estimation bias stemming from inflexibility, whenever a direct test is not feasible. The remedies we propose differ in their data requirements such that a corrective approach can be chosen for any granularity level of the available data in future work that investigates tax sensitivities of MNCs' reported income.

A APPENDIX

A.1 Derivation of the optimal transfer price for intermediate inputs under ex-post shifting

Solving the first-order condition (6c) for shifted income $G_i^S S_i$ and inserting the term into the income-shifting constraint $\sum_{i>1} G_i^S S_i = 0$ allows for deriving the opportunity costs of shifted transfer payments for the intermediate factor as

$$\lambda = \frac{\sum_{i>1}(1 - t_i + \mu_i)}{n-1}. \tag{A.1}$$

When we reinsert this expression into the first-order condition (6c), we find after some rearrangements that the tax-efficient deviation from the arm's-length price of the intermediate factor is determined as[25]

$$G_i^S = \frac{1}{\gamma \cdot S_i} \sum_{k>1, k\neq i} \frac{(t_i - \mu_i) - (t_k - \mu_k)}{n-1}. \tag{A.2}$$

[25] We use that $-(1 - t_i + \mu_i) + \frac{\sum_{i>1}(1-t_i+\mu_i)}{n-1} = -(1 - t_i + \mu_i) + \frac{1-t_i+\mu_i}{n-1} + \frac{\sum_{k>1,k\neq i}(1-t_k+\mu_k)}{n-1} = -\frac{n-2}{n-1}(1 - t_i + \mu_i) + \sum_{k>1,k\neq i} \frac{(1-t_k+\mu_k)}{n-1}$, as well as $(n-2)\frac{1-t_i+\mu_i}{n-1} = \frac{\sum_{k>1,k\neq i}(1-t_i+\mu_i)}{n-1}$.

A.2 Derivation of the First-order Conditions for Ex-ante Tax-planning

To derive the optimal ex-ante income shifting, one needs to take into account that the break-even price p_i^0 is an endogenous variable. In the following, we derive the first-order condition for the license-fee transfer price in the case that all income-shifting decisions need to be taken ex ante and hence that the MNC takes into account that its income-shifting strategies affect the price p_i^0. This first-order condition is given by

$$\begin{aligned}
\frac{\partial E(\Pi)}{\partial G_i^X} &= -\bar{X} + [1 - H(p_i^0)](t_i - \mu_i)\bar{X} + H(p_i^0)(t_i^l - \mu_i)\bar{X} - \frac{\partial C^X}{\partial P_i^X}\bar{X} \\
&+ h(p_i^0)(t_i - \mu_i)\left[p_i^0 y_i - (G_i^X + q_X)\bar{X} - (G_i^S + q_S)S_i - r b_i K_i\right]\frac{\partial p_i^0}{\partial G_i^X} \\
&- h(p_i^0)(t_i^l - \mu_i)\left[p_i^0 y_i - (G_i^X + q_X)\bar{X} - (G_i^S + q_S)S_i - r b_i K_i\right]\frac{\partial p_i^0}{\partial G_i^X} \\
&+ (1 - t_1)\bar{X} = 0. \qquad \text{(A.3)}
\end{aligned}$$

Recall that the price p_i^0 is defined as the price for which taxable income is zero. Hence, the terms in the second and third line vanish as the values of the squared brackets add up to zero. Therefore, after invoking the normalization $\bar{X} = 1$, we obtain

$$\frac{\partial E(\Pi)}{\partial G_i^X} = [1 - H(p_i^0)](t_i - \mu_i) + H(p_i^0)(t_i^l - \mu_i) - t_1 = \frac{\partial C^X}{\partial P_i^X}. \qquad \text{(A.4)}$$

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