Immobilizing Corporate Income Shifting:
Should It Be Safe to Strip in the Harbor?

Thomas A. Gresik, Dirk Schindler, and Guttorm Schjelderup[1,2]

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Abstract. Many subsidiaries can deduct interest payments on internal debt from their taxable income. By issuing internal debt from a tax haven, multinationals can shift income out of host countries through the interest rates they charge and the amount of internal debt they issue. We show that, from a welfare perspective, thin capitalization rules that restrict the amount of debt for which interest is tax deductible (safe harbor rules) are inferior to rules that limit the ratio of debt interest to pre-tax earnings (earnings stripping rules), even if a safe harbor rule is used in conjunction with an earnings stripping rule.

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[1] Gresik: University of Notre Dame (e-mail: tgresik@nd.edu); Schindler: Norwegian School of Economics (e-mail: Dirk.schindler@nhh.no): Schjelderup: Norwegian School of Economics (e-mail: guttorm.schjelderup@nhh.no).
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1. Introduction.

Earnings stripping is a tactic multinational firms use to shift taxable income from high-tax to low-tax countries by financing a subsidiary located in a high-tax country with loans from the parent (internal debt) issued through a subsidiary located in a low-tax country, often a tax haven. Since interest payments on debt are generally tax deductible, while dividend payments on equity are not, the use of internal debt is a preferred form of financing because it reduces a multinational's overall corporate income tax payments. While earnings stripping can benefit host countries by increasing the marginal return to FDI it also erodes a host country's tax base.

The concern among a number of countries about the tax base erosion effects associated with earnings stripping led the OECD to launch its Action Plan 4 on Base Erosion and Profit Shifting (OECD, 2013). The final report (OECD, 2015) calls for the use of best practices in the design of rules to prevent tax base erosion through the use of internal debt interest expenses. In the EU, the negative impact of earnings stripping has been amplified by the U.S. "Check-The-Box" (CTB) legislation.[3] For U.S. multinationals, CTB enables the parent company to structure an affiliate in a host country so that it is treated as a corporation/subsidiary by the host country and as a branch by the United States. In so doing, the U.S. parent can use internal debt to strip taxable income out of a host country into a tax haven without generating an offsetting tax liability in the United States (as subpart F income).[4] The use of CTB by American multinationals to facilitate the use of earnings stripping strategies has generated on-going

[3] CTB was passed in 1997 to simplify the process by which a U.S. firm could elect its tax status as a corporation or a partnership.
[4] Blouin and Krull (2015) provide a more detailed description of the tax implications of CTB.

demands by EU governments for the United States to rescind CTB. The fact that this is unlikely to happen magnifies the need for strong, effective internal debt policies.

Earnings stripping is also at the heart of the contentious debate about corporate inversions. By moving the parent corporation of a multinational from the United States to a country with a lower tax rate (pretty much the rest of the world), the new parent corporation could load up its U.S. subsidiaries with internal debt in order to strip pre-tax income out of the United States. This concern prompted legislators such as Senator Charles Schumer to propose legislation specifically intended to curb earnings stripping activity.[5]

A multinational can use internal debt to shift profits out of a high-tax country in two ways: by choosing the amount of internal debt and by choosing the interest rate it will charge. To moderate the tax revenue losses from both choices, a host country can adopt a thin capitalization rule to limit the amount of internal debt[6] and it can audit the interest rate a subsidiary pays on internal debt to assess compliance with an arm's-length standard. The arm's-length standard is imposed as part of a host country's transfer price regulations and is used to ensure that the interest rate is in line with what a third-party lender would charge for a loan of comparable size, term, and risk. However, as with the auditing of other transfer prices on intangibles, host countries face difficulties auditing interest rates since variations in firm risk profiles in each host country are difficult for governments

[5] See McKinnon (2014).

[6] A number of empirical papers find evidence on the tax sensitivity of debt financing and the effectiveness of thin capitalization rules. Desai et al. (2004), Huizinga et al. (2008), Egger et al. (2010), Mintz and Weichenrieder (2010), and Møen et al. (2011) study the tax sensitivity of debt. For evidence of the effectiveness of thin capitalization rules, see, e.g. Weichenrieder and Windischbauer (2008), Büttner et al. (2012), Blouin et al. (2014), and Wamser (2014).

to assess.

In this paper, we develop a general equilibrium framework with both labor and capital that allows us to analyze the welfare effects of the various thin capitalization rules observed in practice, when used in conjunction with a country's transfer price regulations.

Table 1 reports the variation in thin capitalization rules among 160 countries in 2013. In practice, most countries rely only on auditing of interest rates to determine the rate at which an independent lender would have been willing to lend to the firm. Among countries that have thin capitalization rules, most use a safe harbor rule.[7] Safe harbor rules allow a subsidiary to deduct interest payments on internal debt only if the subsidiary's debt-equity ratio does not exceed a given level. For example, if a host country has a safe harbor rule that sets a maximum debt-equity ratio of 3:1, then a subsidiary located in that host country could deduct all of the interest payments it makes to its parent as long as no more than 75% of the subsidiary's capitalization comes from internal debt.

Table 1: Number of countries with each type of thin capitalization rule in 2013

None or Only Interest Rate Auditing	Safe Harbor	Earnings Stripping	Safe Harbor and Earnings Stripping	Safe Harbor or Earnings Stripping	Special Rules
100	45	4	2	6	3

Data comes from Ernst and Young (2013), Guitierrez et al. (2013), and Ostaszewska (2013). Total number of countries equals 160.

A smaller number of countries use an earnings stripping rule. These are rules in which interest payments on internal debt are tax-deductible in a host country only as long as the total interest payments (amount borrowed internally

[7] See also Blouin et al. (2014).

times the interest rate) do not exceed a given percentage of the subsidiary's pre-tax earnings, normally defined as EBITDA.[8] The use of earnings stripping rules has emerged in recent years because of the perception that safe harbor rules are ineffective. A few countries use both types of rules, whereby a subsidiary must satisfy either both or one of the rules.

Notable countries that use interest rate auditing without a thin capitalization rule include Austria, Finland, Ireland, India, the Netherlands, and Norway.[9] Although the number of countries using an earnings stripping rule, alone or in conjunction with a safe harbor rule is small, they include significant economies. The countries using only an earnings stripping rule in 2013 are Germany (enacted in 2008), Italy (enacted in 2008), Portugal (enacted in 2013), and Spain (enacted in 2012). Denmark (enacted in 2008) and Japan (enacted in 2013) impose both a safe harbor rule and an earnings stripping rule. Bulgaria (enacted 2007), France (enacted 2011), Guam, Northern Mariana Islands, the United States (enacted in 1998 along with its territories), and the U.S. Virgin Islands impose an earnings stripping rule and a safe harbor rule but require that only one be satisfied. For France, a company need only satisfy one of the rules. For Bulgaria, the United States, and its affiliated territories, the earnings stripping rule is marginal in that it is effective only if the safe harbor limit is exceeded. Notice that, with the exception of the United States and its territories, the countries that have enacted earnings stripping rules have done so since 2007. Hong Kong, Sweden, and the United Kingdom do not have thin capitalization rules but use other special rules to limit debt financing.

Our analysis will show that the thin capitalization policy among all possible combinations, including those observed in practice, which maximizes a

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[8] EBITDA stands for earnings before interest, taxes, depreciation, and amortization.
[9] Finland and Norway adopted earnings stripping rules in 2014.

host country’s national income is an earnings stripping rule. Our finding is in accord with the main recommendation in Action Plan 4 (OECD, 2015).

The optimality of an earnings stripping rule comes from the fact that earnings stripping rules create a trade-off among firms between the amount of internal debt issued and the interest rate charged. Stand-alone safe harbor rules are inferior because they limit the amount of internal debt without imposing any restrictions on the interest rate a subsidiary pays. For the same amount of interest on internal debt, an earnings stripping rule gives multinationals an incentive to reduce its transfer price costs by lowering its interest rate below the transfer price chosen under a safe harbor rule, and increasing the amount of internal debt. Because safe harbor rules constrain the amount of internal debt issued to a subsidiary without limiting the optimal interest rate (transfer price) that is charged, the reduction in the interest rate under an earnings stripping rule has only a second-order reduction in multinational profit while the corresponding increase in internal debt generates a first-order gain. On the margin, for the same amount of interest paid on internal debt, an earnings stripping rule then generates a larger marginal return to FDI and a marginal increase in national income. Simulations suggest an increase in national income ranging from .05% to .8% if a host country switches from a safe harbor rule to an earnings stripping rule.

The rest of our paper is organized as follows. Section 2 provides a literature review. Section 3 presents a model in which multinational firms can shift profit with debt financing and transfer prices. To allow for the hybrid policies observed in Bulgaria, Denmark, France, Japan, and the United States, a host country will choose a thin capitalization policy that consists of both a safe harbor limit and an earnings stripping limit. Section 4 derives the optimal firm responses to all possible host country thin capitalization policies. Section 5 describes which limits will be binding in any positive-FDI equilibrium. The host country's optimal thin capitalization policy is then derived in section 6. Two extensions of the base model are discussed in section 7 and concluding remarks are offered in section 8. Detailed proposition proofs can be found in Appendix 1.

2. Related literature.

The trade-off host countries face from income-shifting by multinationals is well known. When a host country cannot tax income from mobile and immobile investment differently, Hines (2010) and Hong and Smart (2010) show that tax havens can increase national welfare. Slemrod and Wilson (2009) show that with differential taxation, tax havens must reduce national welfare.

The focus in Hong and Smart (2010) was on the welfare effects of safe harbor rules in the absence of transfer pricing. In a companion paper, Gresik et al. (2015) extend Hong and Smart (2010) by adding transfer price behavior and show that the positive investment effect in Hong and Smart (2010) is more likely to dominate in host countries with developed economies whereas the negative tax base erosion effect is more likely to dominate in developing economies. The reason is that transfer pricing, all else equal, has a detrimental effect on welfare that comes into play most when a host country's institutions are weak (e.g., with respect to auditing tax bases). None of these papers looked at the impact of earnings stripping rules.

Two other papers analyze rules that restrict leverage ratios in a theoretical framework. Haufler and Runkel (2012) use a tax competition model to show that if countries set tax rates and safe harbor rules, smaller countries have an incentive to set more permissive safe harbor rules because they face a more elastic tax base. More closely related to our paper is Mardan (2017) who investigates earnings stripping rules and safe harbor rules in a setting with two countries and capital as the only input. His focus is on how credit market constraints may affect leverage and thin capitalization rules. He finds no clear cut preference for safe harbor or earnings stripping rules.[10]

To our knowledge, we are the first to provide a general equilibrium analysis of a multinational's response to both traditional thin capitalization rules as well to a broad class of hybrid rules, including all hybrid rules observed in practice, and we are the first to analyze the welfare implications of both traditional and hybrid rules. We are also the first to show that an earnings stripping rule maximizes a host country's national income in an economy without additional constraints such as credit market imperfections.

3. A model of profit-shifting via debt and transfer prices.

Our model focuses on the interaction between a single multinational firm and a single host country. It generalizes the model of Hong and Smart (2010), which focuses only on safe harbor rules, by adding a transfer pricing channel and earnings stripping rules. The multinational is headquartered outside the host country. It operates two subsidiaries, one is located in the host country and the other is located in a tax-haven country that levies a zero tax rate on corporate income. The parent corporation injects all of the capital that will be received by the host-country subsidiary into the tax-haven subsidiary. The tax-haven subsidiary then finances the host country subsidiary with equity, E, and/or debt, B, so that $E = B + K$. Because there is only a single representative multinational, K also equals the amount of the host country's inbound FDI. The composition of the capital invested in the tax-haven subsidiary is not essential to our analysis so we assume the tax-haven subsidiary is financed entirely with equity from the parent. In addition, income shifting is done between related parties and the vast majority

[10] Kalamov (2015) studies the equilibrium choice of safe harbor and earnings stripping rules with two host countries but in a model in which the multinational cannot shift income into a tax haven with transfer pricing.

of thin capitalization rules in place target intra-firm transactions and internal debt only.[11]

The host country economy consists of workers, who inelastically supply one unit of labor, and a representative entrepreneur, who owns a domestic firm. The domestic firm can employ L_d units of labor at a wage rate w to produce $G(L_d)$ units of output that are sold in a competitive market. The output price is normalized to one. The production function, $G(\cdot)$, is strictly increasing and strictly concave in L_d. The pre-tax profit of a domestic firm is

$$\pi = G(L_d) - wL_d . \tag{3.1}$$

The host country levies a profit tax rate of t so that domestic firms have a post-tax profit of $(1 - t)\pi$.

The host-country subsidiary of the multinational firm (henceforth simply "the subsidiary") operates with the production function, $F(L_m, K)$, where L_m denotes the amount of host-country labor it employs. $F(\cdot,\cdot)$ is strictly increasing, strictly concave, and homogeneous of degree 1 in both inputs. The multinational faces the same competitive wage rate, w, as that faced by the domestic firms and it sells its output in a competitive market whose price is also normalized to one. Denote the multinational's economic cost (direct plus opportunity cost) of capital by r.

We assume that the multinational's economic cost of capital reflects, in part, a firm-country-specific risk of the investment so that r need not simply equal a worldwide interest rate. A firm's actual economic cost of capital will depend

[11] The main exceptions are Bulgaria, Denmark, Germany, Spain and Portugal, whose thin capitalization rules apply to a subsidiary's total debt.

upon risk factors such as a firm's CAPM beta, as well as the specific investments available to the firm in each country. This assumption reflects the reality tax authorities face in determining the arm's-length interest rate associated with internal debt. Moreover, the fact that many countries apply arm's-length price auditing standards to the interest rates multinationals charge for internal debt is evidence that countries need to evaluate a range of interest rates charged by firms on their internal debt.[12] The idiosyncratic cost of capital allows the multinational to charge its host country subsidiary an interest rate, σ, that can differ from r. That is, σ is the transfer price of internal debt. When $\sigma > r$, the multinational is able to shift even more income out of the host country than debt financing alone allows.

The multinational incurs transfer pricing costs of $c(\sigma - r)B$ to reflect any transfer price auditing the host country may conduct, without which a firm would have the incentive to set σ at the maximum possible value. These transfer pricing costs consist of two components. First, the cost function, $c(\cdot)$, is increasing and strictly convex in the difference between σ and r, which we take to be the arm's-length interest rate. We also assume that $c(0) = 0$ and $c'(0) = 0$. Second, the multinational's transfer pricing costs are proportional to the amount of debt as the total amount of shifted profit will equal $(\sigma - r)B$.[13] We consider the

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[12] For example, in the U.K. the revenue authority "may challenge interest deductions on the grounds that, based on all of the circumstances, the loan would not have been made at all or that the amount loaned or the interest rate would have been less, if the lender was an unrelated third party acting at arm's length" (Ernst & Young, 2013, p. 1367). The set of "circumstances" that are relevant to calculating an arm's-length interest rate include not just the overall risk profile of the subsidiary but also characteristics of the host country.

[13] The primary method tax authorities use to determine if an interest rate is "arm's-length" is the Comparable Uncontrolled Price (CUP) method. With this method, the tax authority compares a tested firm's interest rate with the interest rate paid

alternative assumption that $c(\cdot)$ depends on the total amount of income shifted in section 7.

In addition to incurring costs associated with its transfer pricing behavior, the multinational may also incur costs arising from the use of internal debt, which we denote by $D(B,K)$. The literature is divided on how to handle such costs. One approach is based on the argument that debt financing can generate deadweight costs possibly due to the need to hire lawyers and accountants to exploit loopholes that allow thin capitalization rules to be less binding. The firm itself does not know how to exploit these loopholes so it incurs costs related to the use of internal debt even if its debt level is within the limits set by thin capitalization rules.[14]

A second approach, which we adopt in a modified version, is that excessive interest expenses cannot be deducted from the corporate tax base implicitly because firms cannot exploit loopholes to conceal excessive debt. Consequently, there are no auditing costs related to the use of debt.[15] This approach is closely related to the common argument that internal debt is simply tax-favored equity (Stonehill and Stitzel (1969) and Chowdhry and Coval (1998)), so that $D(B,K) \equiv 0$. By this argument, the optimal amount of debt would be

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by firms with comparable credit risks, loan sizes, and loan durations. A tested firm is penalized only if its interest rate falls outside the interquartile range of the comparability group. The strict convexity of $c(\cdot)$ comes from the fact that the probability a tested firm's interest rate is viewed as extreme will be increasing with deviations from r. The actual size of the penalty in practice is linear in the amount borrowed. See OECD (2010) for more details.

[14] Egger et al. (2010), Mintz and Smart (2004), and Mardan (2017) refer to non-specific deadweight costs of internal debt while Schindler and Schjelderup (2012) appeal to the need for experts to introduce debt-financing costs of $D(B/K)$ that are strictly increasing and strictly convex in the subsidiary's debt to equity ratio for $B > 0$.

[15] We thank one of the reviewers for this argument.

100% in the absence of a thin capitalization rule. Büttner et al (2012) provide evidence that does not support this theory. From a micro-level panel data set of German affiliates across 36 countries from 1996 – 2004, they find average internal debt to equity ratios ranging from .24 to .33 for affiliates in countries with no thin capitalization rule. This data suggests that multinationals consider other factors in addition to tax advantages in choosing how much internal debt to provide.

In particular, as a firm's debt-equity ratio approaches one, there are other costs associated with defending or dealing with its internal debt levels. For example, Delaware has no mandated minimum equity requirement for corporations, "but inadequate capitalization can be alleged by a plaintiff seeking to pierce the corporate veil of limited liability" (Clark et al 2016). In such cases, the courts can consider a corporate structure a "scheme to evade" and firm owners can lose their limited liability protection.[16] This risk is increasing as a corporation's debt share gets close to 100%.

Another argument, that is complementary to the low-equity argument, is due to Chowdhry and Nanda (1994). They argue that internal debt, like external debt, can create agency costs associated with an increased probability of bankruptcy. Although one might expect internal debt to play no role in the potential for default, Chowdhry and Nanda show that it is optimal for a multinational to issue internal debt with the same seniority as external debt. This means that if a firm were to default on its internal debt, its external debt would be callable. In a similar vein, Fahn et al (2017) provide evidence that highly leveraged firms also receive more expensive terms from outside suppliers who are concerned with default risk.

To address this range of arguments, we will present our analysis for the

[16] For example, see Schmoll v. ACandS, 703 F Supp. 868 (D.Or. 1988).

case in which internal debt is simply tax-favored equity, that is, $D(B,K) \equiv 0$. Then in Appendix 1, we present a more general analysis for when the marginal cost of internal debt is increasing, that is, $D_B(B,K) > 0$. The main implication of modelling such debt-financing costs is that the optimal level of debt without any thin capitalization rules can be bounded away from 100%, even if by only a very small amount. As long as the marginal cost with respect to debt, holding fixed the subsidiary's debt-equity ratio, is not so large that reducing these costs is the primary margin for a multinational, the main results we present for the case in which $D(B,K) \equiv 0$ continue to hold.[17] We will also point out the results that do not generalize due to the undesirability of 100% debt financing, as they are presented.

The subsidiary faces the same tax rate on host country profit as do domestic firms. When the host country imposes no thin capitalization rules, the multinational's after-tax profit is defined as

$$(1-t)(F(L_m,K) - wL_m - \sigma B) + \sigma B - rK - c(\sigma - r)B - D(B,K), \tag{3.2}$$

where from this point forward we will assume that $D(B,K) \equiv 0$. Notice that the subsidiary's interest expense, σB, is tax deductible in the host country. According to (3.2), the multinational can avoid any transfer price costs by setting $\sigma = r$ even if $B > 0$. The tax savings from internal debt net of transfer price costs equals $(t\sigma - c)B$, which implies that the unconstrained optimal transfer price

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[17] Our results also extend to the case in which internal debt initially has positive agency effects, so that $D_B < 0$ for low values of B. We provide more details in section 6.

satisfies $c' = t$.[18] By the strict convexity of $c(\cdot)$, $t\sigma > c$ for all σ such that $c' \leq t$. For any positive values of K and L_m, totally differentiating (3.2) implies that

$$B(t - c')d\sigma + (t\sigma - c)dB = (t\sigma - c)dB > 0$$

for $B = 0$ and $c' \leq t$. Thus, in the absence of any thin capitalization rules, a multinational that chooses to invest in the host country has an incentive to use some debt financing.

If the host country adopts a safe harbor rule, then the subsidiary will be able to deduct its interest expense against its host country income if, and only if,

$$B \leq b_s K \tag{3.3}$$

where $0 \leq b_s \leq 1$. If the host country adopts an earnings stripping rule, then the subsidiary will be able to deduct its interest expense against its host country income if, and only if,

$$\sigma B \leq b_e(F - wL_m) \tag{3.4}$$

where $0 \leq b_e \leq 1$. The term $F - wL_m$ represents the host subsidiary's EBITDA so an earnings stripping rule requires that its interest payments do not exceed a given

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[18] Eq. (3.2) implies that the transfer price costs $c(\sigma - r)B$ are incurred outside the host country. If 100% of these costs were incurred within the host country, the optimal transfer price involves even greater welfare distortions as the optimal transfer price would satisfy $c'(\cdot) = t/1 - t > t$ for all $t > 0$. Since our main results are unaffected by the location of the transfer price costs, we assume they are incurred in the tax haven for simplicity.

percentage of its pre-tax earnings. Setting b_s = 1 is equivalent to imposing no safe harbor limit on internal debt while setting b_e = 1 is equivalent to letting the multinational strip out all of its pre-tax host country earnings through its internal debt financing. Ineq. (3.4) need not bind for a profit-maximizing firm, even when the subsidiary is financed entirely with debt. For example, if the multinational employs labor so that $F_L = w$, then setting $B = K$ in (3.4) requires $F_K \geq \sigma / b_e$. Thus, with $b_e > 1 - t$ and sufficiently costly transfer price regulation, σ will be small enough so that (3.4) can be slack.

Aggregate worker consumption equals wage income, w, plus taxes, T. Since a profit-maximizing multinational will employ labor so that $F_L = w$, regardless of the thin capitalization rule the host country adopts, equilibrium host tax revenue equals

$$T = t\pi + t(F - wL_m - \sigma B) = t\pi + t(F_K K - \sigma B)\,. \tag{3.5}$$

Entrepreneur income equals $(1-t)\pi$. Thus, host country national income equals $Y = w + \pi + t(F_K K - \sigma B)$. If the host country weights worker and entrepreneur consumption differently than tax revenues, the host welfare function would be

$$W = \beta_c[w + (1-t)\pi] + \beta_T[t\pi + t(F_K K - \sigma B)] \tag{3.6}$$

where β_c and β_T are non-negative welfare weights on consumption and tax revenues.[19]

[19] Adding a third welfare weight to distinguish between worker and entrepreneur consumption does not have a qualitative effect on our results.

4. Optimal Firm Behavior.

Allowing for the possibility that a host country imposes safe harbor and earnings stripping rules on the multinational, the firm's profit-maximization problem can be written as

$$
\begin{aligned}
\max_{K,L_m,B,\sigma}\ & (1-t)(F-wL_m)+t\sigma B-rK-c(\sigma-r)B \\
s.t.\ (1)\quad & g_1(K,L_m,B,\sigma)\equiv \sigma B-b_e(F-wL_m)\le 0 \\
(2)\quad & g_2(B,K)\equiv B-b_sK\le 0.
\end{aligned}
\tag{4.1}
$$

Although (3.3) and (3.4) are soft constraints in the sense that a multinational could choose to violate them by incurring the cost of losing part of its interest expense tax deduction, (4.1) treats them as hard constraints. When $D(B,K)\equiv 0$, the multinational has no strict incentive to violate either constraint. If D_B is even slightly positive at optimal debt levels, the multinational will have a strict incentive not to violate either constraint.

To solve the multinational's profit-maximization problem, define the Lagrangian to be

$$
\Lambda=(1-t)(F-wL_m)+t\sigma B-rK-c(\sigma-r)B-\mu(\sigma B-b_e(F-wL_m))-\zeta(B-b_sK) \tag{4.2}
$$

where μ and ζ are the Lagrange multipliers. The necessary first-order conditions associated with (4.2) are

$$
\begin{aligned}
(a)\quad & \zeta+\mu\sigma=t\sigma-c, \\
(b)\quad & \mu=t-c'(\sigma-r), \\
(c)\quad & (1-t+\mu b_e)(F_L-w)=0,
\end{aligned}
\tag{4.3}
$$

and

$$
(d)\quad F_K=(r-b_s\zeta)/(1-t+\mu b_e).
$$

Depending on the values of b_s and b_e, the profit-maximizing responses of the multinational will result in only one constraint binding or both constraints binding. Figure 1 illustrates these possibilities for fixed (strictly positive) values of K and L_m. The thick solid line identifies the values of σ and B for which the earnings stripping constraint is satisfied with equality, that is $g_1 = 0$. The solid horizontal lines correspond to safe harbor constraints for three different policy parameters, $b_s^{high} > b_s^{med} > b_s^{low}$. The dashed curves are iso-profit curves.

In the absence of any thin capitalization rule, the profit-maximizing transfer price, denoted by σ^*, solves $t = c'$. Thus, without a thin capitalization rule, the optimal transfer price equates the marginal tax savings with the marginal cost of transfer pricing. σ^* is greater than r for all $t > 0$ and is independent of K, L_m, and B. The profit-maximizing amount of debt is $B = K$. Even though setting $b_s = 1$ implies that the host country imposes no safe harbor rule, the safe harbor constraint (3.3) is still a binding constraint because the multinational's optimal debt level is a corner solution.[20]

If the host country only imposes a binding safe harbor rule (i.e., $\zeta > 0$ and $\mu = 0$), the multinational's profit-maximizing transfer price is still σ^*. This case will arise if b_s is sufficiently small (still possibly 1) and b_e is sufficiently large as illustrated in Figure 1 by point c.

If the host country imposes only a binding earnings stripping rule (i.e., $\zeta = 0$ and $\mu > 0$), then (4.3.b) implies that $c' = t - \mu < t$ and hence that $\sigma < \sigma^*$. Thus, introducing an earnings stripping rule gives the multinational the incentive to shift less income with its transfer price. Since an earnings stripping rule limits

[20] With $D_B > 0$, it need not be optimal for the subsidiary to be fully debt-financed, in which case (3.3) will not bind when $b_s = 1$.

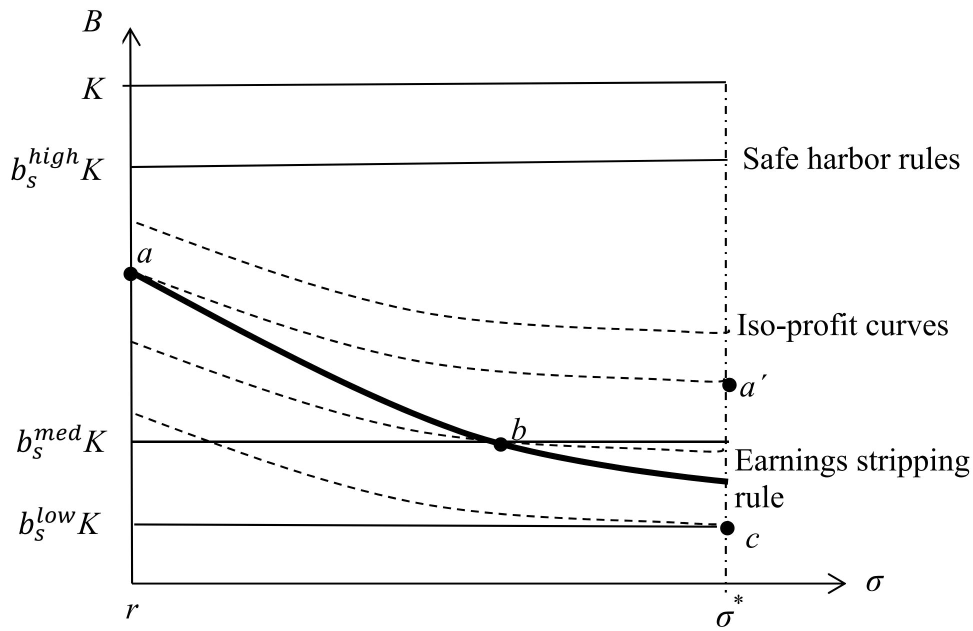

Figure 1: Optimal transfer price and debt given *K* and *L_m*. Point *a* is profit-maximizing when only the earnings stripping constraints binds. Point *b* is profit-maximizing when both constraints bind. Point *c* is profit-maximizing when only the safe harbor constraint binds.

σB, the multinational can shift the same amount of income by substituting debt financing for transfer pricing. Starting with a transfer price of σ^*, the first-order loss in profit from a lower transfer price is zero, while the ability to increase *B* without violating the earnings stripping limit generates a strictly positive first-order gain in profit. Without marginal debt-financing costs, the only transfer price consistent with (4.3.a-b) and $\zeta = 0$, is $\sigma = r$. The optimal choice of σ and *B* would then correspond to point *a* in Figure 1. It will arise when b_s is sufficiently large and b_e is sufficiently small. When $D_B > 0$, the optimal transfer price would still be less than σ^* but greater than *r*.

Finally, if the host country imposes both a binding safe harbor rule and a binding earnings stripping rule (i.e. $\zeta > 0$ and $\mu > 0$), then (4.3.b) implies that the multinational will again choose $\sigma < \sigma^*$. Point *b* in Figure 1 illustrates this possibility which can arise with intermediate values of b_s and b_e. If b_e is sufficiently large so that the earnings stripping rule can bind at $B = K$, then both constraints will bind even with $b_s = 1$ because full debt financing is again a corner solution. From this discussion, we see that a binding earnings stripping rule, alone or in conjunction with a safe harbor rule results in the multinational choosing a lower transfer price than it would with only a safe harbor rule.

Proposition 1. *A profit-maximizing multinational operating under a binding earnings stripping rule will choose a transfer price strictly less than* σ^*.

Recall from Table 1 that the United States uses an earnings stripping rule which applies only if the safe harbor rule is violated while France allows a firm to satisfy either its safe harbor rule or its earnings stripping rule. Since the earnings stripping constraint is negatively sloped (as illustrated in Figure 1), a firm under an American or a French rule would never be constrained by the earnings stripping rule while the safe harbor rule is slack and it would never end up being constrained by both rules. Thus, with an American or French-type policy, the firm's choice of σ and *B* will either correspond to the choice under a stand-alone safe harbor rule or a stand-alone earnings stripping rule. Proposition 2 describes the firm's optimal choice under American or French rules.

Proposition 2. *Consider a binding American or French hybrid policy, (b_s,b_e). There exists a debt-equity ratio,* $\bar{b}$*, such that for all* $b_s < \bar{b}$ *only the earnings stripping rule will determine the multinational's behavior and for all* $b_s > \bar{b}$ *only the safe harbor rule will determine the multinational's behavior.*

When $D \equiv 0$, $\bar{b}$ is the debt-equity ratio associated with point a' in Figure 1. In order for a hybrid policy to generate multinational behavior that differs from the behavior under a single rule, the policy must require that both rules be satisfied. Denmark and Japan use this type of policy.

The above propositions do not say anything about how the multinational's optimal capital and labor choices or how the equilibrium wage rate is affected by b_s and b_e. To capture these effects, we now characterize equilibrium behavior.

5. Host Country Equilibria.

A host country equilibrium consists of profit-maximizing multinational choices, defined by (4.3) and the associated complementary slackness conditions, profit-maximizing employment by domestic firms, defined by

$$G_L(L_d) = w, \tag{5.1}$$

and a wage rate that clears the host labor market,

$$L_m + L_d = 1. \tag{5.2}$$

We assume for simplicity that a positive-FDI equilibrium exists for each b_s and b_e, although Gresik et al. (2015) shows that, with a constant returns to scale multinational production function, such an equilibrium may not exist. Our main result is not affected by this assumption.

Proposition 3 establishes the values of b_s and b_e for which only one rule binds and for which both rules bind in equilibrium.

Proposition 3. *There exist safe harbor limits,* $b_s^{SH}(b_e)$ *and* $b_s^{ES}(b_e)$ *such that*

$b_s^{SH}(b_e) < b_s^{ES}(b_e)$ and for all $b_s^{SH}(b_e) < b_s < b_s^{ES}(b_e)$ both the safe harbor and the earnings stripping constraints will bind in equilibrium. When both constraints bind in equilibrium, equilibrium FDI is increasing in b_s and the equilibrium transfer price is decreasing in b_s.

Proposition 3 shows that both thin capitalization rules will bind in equilibrium over a range of values of b_e and b_s. When both constraints bind, (4.3.d) implies that the multinational's effective cost of capital equals

$$\frac{r - b_s(\sigma c' - c)}{1 - t + b_e(t - c')} \tag{5.3}$$

so that an increase in b_s, that is, a weakening of the safe harbor rule in (5.3), lowers the effective cost of capital by lowering the shadow price, $\zeta = \sigma c' - c$. In equilibrium, the multinational will respond by increasing *K*. We will show in the next section that it is this increase in the subsidiary's total capitalization that will allow us to evaluate the welfare effects of different thin capitalization rules.

Figure 2 illustrates the main implications of Proposition 3. If b_s is sufficiently small relative to b_e, only the safe harbor rule will bind in equilibrium. If b_s is sufficiently large relative to b_e, only the earnings stripping rule will bind in equilibrium. For all positive values of b_e, there are values of b_s for which both constraints will bind. These three regions are labelled in Figure 2 as "SH only", "ES only", and "SH+ES". The dashed lines are iso-welfare curves. For all non-negative welfare weights, β_c and β_T, the iso-welfare curves must be vertical in the "SH only" region and horizontal in the "ES only region" as marginally tightening a non-binding rule will not change any equilibrium outcomes. Thus, a host country's optimal thin capitalization rule will depend on how host welfare varies across parameter values when both constraints bind.

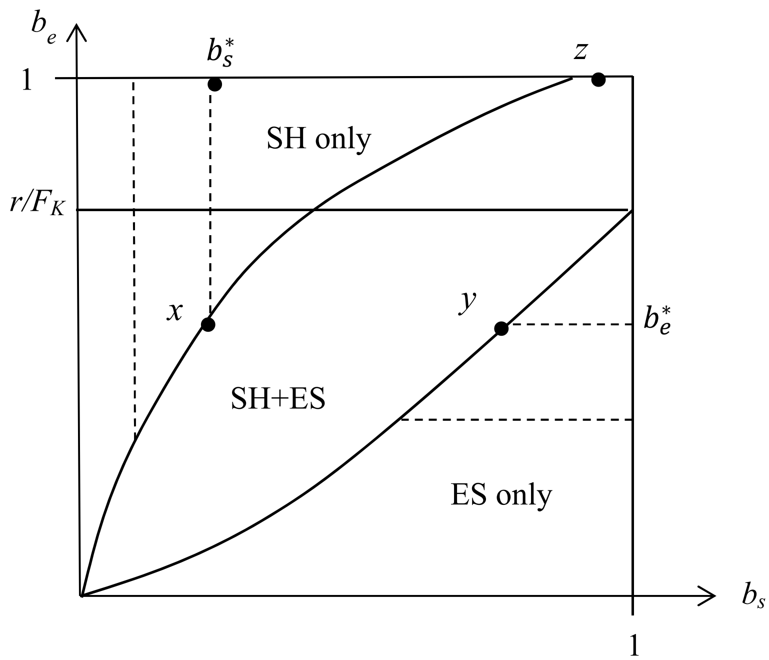

Figure 2: Binding thin capitalization policies. Binding thin capitalization rules in equilibrium for each value of b_s and b_e. Thin dashed lines are iso-welfare curves.

6. Host Country Welfare.

Host welfare is affected by FDI in three ways: tax revenues from the FDI, increased wages, and lower profits for domestic entrepreneurs. Given the definition of host welfare in (3.6), if both rules bind in equilibrium, host welfare can be written as

$$W^{SH/ES} = \beta_c[w + (1-t)\pi] + \beta_T[t\pi + t(1-b_e)F_K K]. \qquad (6.1)$$

Differentiating $W^{SH/ES}$ with respect to b_s implies that

$$\frac{dW^{SH/ES}}{db_s} = \beta_c \frac{dw}{db_s} + [(1-t)\beta_c + t\beta_T]\frac{d\pi}{db_s} + \beta_T t(1-b_e)\frac{d(F_K K)}{db_s}. \tag{6.2}$$

By using the binding earnings stripping rule to define the multinational's taxable income when both constraints bind, (6.2) reveals that all of the welfare effects associated with relaxing the safe harbor rule can be reflected entirely through the real effects a change in b_s has on wages, entrepreneur profit, and the multinational's capital and labor decisions.

The proof of Proposition 3 shows that the constant returns to scale properties of F imply that $dL_m = -F_{KL}dK/(F_{LL}+G_{LL})$ and $dw = G_{LL}F_{KL}dK/(F_{LL}+G_{LL})$. Coupled with the fact that $d\pi = -L_d dw$,

$$\begin{aligned}\frac{dW^{SH/ES}}{db_s} = \Bigg\{ &\beta_c \frac{F_{KL}G_{LL}}{F_{LL}+G_{LL}} - [(1-t)\beta_c + t\beta_T]\frac{L_d F_{KL}G_{LL}}{F_{LL}+G_{LL}} \\ &+ \beta_T t(1-b_e)\left(F_K + \frac{F_{KK}G_{LL}K}{F_{LL}+G_{LL}}\right)\Bigg\}\cdot\frac{dK}{db_s}.\end{aligned} \tag{6.3}$$

When $\beta_c = \beta_T = 1$, the host country seeks to maximize national income and the term in braces in (6.3) equals

$$t(1-b_e)F_K - (1-t(1-b_e))\frac{G_{LL}F_{KK}K}{F_{LL}+G_{LL}} > 0 \ . \tag{6.4}$$

Since we know from Proposition 3 that K is increasing in b_s when both constraints bind, national income is strictly increasing in b_s throughout the SH+ES region. (We analyze the case of tax revenue maximization in section 7.1.)

Consider then the policy $(b_s, b_e) = (b_s^*, 1)$ for any $b_s^* \in (0,1)$ such that the safe harbor rule binds in equilibrium while the earnings stripping rule is slack. This policy is illustrated in Figure 2. By Proposition 3 there exists $b_e^* < 1$ so that at (b_s^*, b_e^*), the safe harbor rule binds while the earnings stripping rule binds weakly ($\mu = 0$). This new policy corresponds to point *x* in Figure 2. For all $b_e \in (b_e^*, 1]$, only the safe harbor rule binds so $W(b_s^*, 1) = W(b_s^*, b_e^*)$. Now increase b_s until, the earnings stripping constraint binds strictly and the safe harbor rule binds weakly $(\zeta = 0)$ or until $b_s = 1$. The first possibility is illustrated by point *y* in Figure 2. Refer to the value of b_s at point *y* as $\hat{b}_s$. By Proposition 3, increasing b_s in the region for which both constraints bind decreases the multiplier on the safe harbor rule, ζ, and increases the multiplier on the earnings stripping rule, μ. Because $dK / db_s > 0$ and given (6.4), $W(\hat{b}_s, b_e^*) > W(b_s^*, b_e^*)$. Finally, note that a further increase in b_s to 1 moves the economy into the region where the earnings stripping rule binds and the safe harbor rule is slack, or that $W(\hat{b}_s, b_e^*) = W(1, b_e^*)$. If policy *x* instead implies that $b_e > r / F_K$, then the second possibility arises and $\hat{b}_s = 1$. It is still true that $W(\hat{b}_s, b_e^*) > W(b_s^*, b_e^*)$ but now both constraints will bind due to the fact that the optimal amount of debt is a corner solution.

A third possibility arises if both constraints bind at the policy $(b_s^*, 1)$, such as at point *z*. This possibility arises when a sufficiently weak safe harbor rule allows the multinational to shift optimally all of the subsidiary's income out of the host country. A sufficient condition for this possibility to arise is, with $B = K$, that $\sigma^* < r / (1 - t)$. Because $\sigma^* > r$, this condition will be satisfied only for sufficiently large tax rates. When a policy such as *z* exists, the host country strictly prefers the policy (1,1), a no thin capitalization policy, to *z*. It is important to note that this possibility will not arise if the optimal unconstrained level of debt is strictly less than *K*.

These arguments lead to the main result of our paper, Theorem 1.[21]

Theorem 1. *For any t > 0 and for any safe harbor limit* $b_s^* \in (0,1)$*, (i) if only the safe harbor rule binds with* $b_e = 1$*, then there exists an earnings stripping limit* $b_e^* \in (0,1)$*, such that the stand-alone earnings stripping rule,* $(1, b_e^*)$*, generates strictly higher national income than the stand-alone safe harbor rule,* $(b_s^*, 1)$*, and (ii) if both rules bind at* $(b_s^*, 1)$*, then the policy (1,1) generates strictly higher national income than the policy* $(b_s^*, 1)$.

Theorem 1 implies that for any strictly positive tax rate, the optimal stand-alone earnings stripping rule generates strictly higher national income than the optimal stand-alone safe harbor rule. However, Theorem 1 makes a stronger statement: For any positive tax rate and *any* binding stand-alone safe harbor rule with $b_s < 1$, either a binding stand-alone earnings stripping rule or the weakest policy (1,1) generates strictly higher national income. Because Theorem 1 holds for any positive tax rate, it also applies to the optimal tax rates as long as the

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[21] If one allows for agency benefits of debt financing as suggested in footnote 17, then at low enough values of b_s the safe harbor constraint must bind regardless of the value of b_e. This change would not alter our main result. While the region in Figure 2 for which only the ES rule binds would not include small values of b_s, it would still include sufficiently large values of b_s, which is what is needed for the statement of Theorem 1 to remain valid.

optimal rate is strictly positive.

The superiority of an earnings stripping rule arises because an earnings stripping rule encourages the firm to avoid the tax on the normal rate of return on mobile capital by charging a less distorted interest rate and issuing more internal debt, for the same amount of income shifted under a safe harbor rule. This substitution reduces the tax wedge for the firm and the host country because the increase in debt financing induces a first-order gain in the firm's and the host country's return to FDI and the reduction in the interest rate increases the host country's return while having only a second-order effect on the firm's return.

Theorem 1 also raises concerns about thin capitalization policies that impose both a safe harbor rule and an earnings stripping rule.

Proposition 4. *The national income maximizing thin capitalization policy never generates an equilibrium in which only the safe harbor constraint holds with equality, and it never generates an equilibrium in which both constraints bind with* $b_s < 1$*.*

Proposition 4 is a corollary to Theorem 1 and follows directly from the above inequality, $W(\hat{b}_s, b_e^*) > W(b_s^*, b_e^*)$. It calls into question the thin capitalization policies of Denmark (0.8,0.8) and Japan (0.75,0.5). To the extent that both the safe harbor and earnings stripping rules bind in these countries, each country could increase its national income by setting a weaker safe harbor limit. A weaker safe harbor limit would result in a lower transfer price and more FDI, both of which would increase the host country's national income.

The following example illustrates the potential national income gains from switching to an earnings stripping rule.

Example. Assume $F(L_m, K) = K^{.4} L_m^{.6}$, $G(L_d) = L_d^{.7}$, $c(\sigma, r) = 5(\sigma - r)^2$, $r = .1$, and $t = 1/4$. The capital factor of .4 for the multinational is standard for FDI in recent decades[22] and the labor exponent reflects the presence of domestic rents as one would expect in developed economics. The coefficients on the transfer price and debt financing functions were chosen to generate an optimal safe harbor limit of approximately 3/5. Following the structure of Figure 2, for each earnings stripping rule, $b_e^* < 1$, the proportional increase in national income between points *x* and *y* is graphed in Figure 3. The gains in national income range from .05% to .3%. For countries with weaker transfer price enforcement, the gains could be as high as .8%. At .1%, the gain to a $3 trillion economy would be $3 billion. Lowering λ (domestic rents) or lowering transfer price costs increases the welfare gains from switching to an earnings stripping rule. Lowering the subsidiary's capital share or increasing debt financing costs decreases these welfare gains.

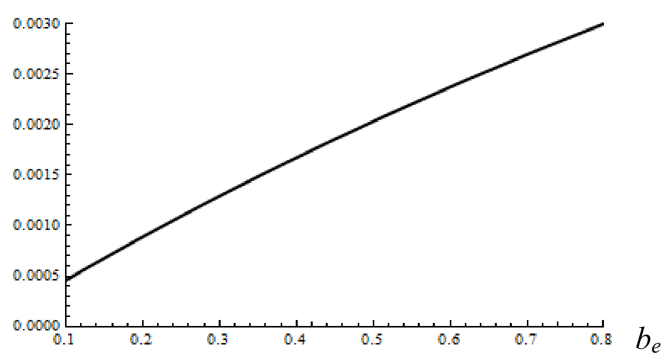

Figure 3. Percentage increase in national income. The percentage increase in national income due to a switch from a safe harbor rule to an earnings stripping rule, $W(\hat{b}_s, b_e^*)/W(b_s^*, b_e^*) - 1$, as a function of b_e.

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[22] See Karabarbounis and Neiman (2013).

7. Extensions.

7.1 Tax revenues.[23]

One reason a host country might prefer to stick with a safe harbor rule is if the gains in national income that come from a switch to an earnings stripping rule come at the cost of tax revenues. To investigate this possibility, we consider the case of $\beta_c = 0$ and $\beta_T = 1$, which implies the host country's objective is to maximize tax revenues. If tax revenues are maximized by a safe harbor rule, a switch to an earnings stripping rule would put pressure on a country's fisc. The term in braces in (6.3) now becomes

$$t(1-b_e)F_K - \frac{tG_{LL}(L_d F_{KL} - (1-b_e)KF_{KK})}{F_{LL} + G_{LL}}, \tag{7.1}$$

the sign of which is ambiguous.

Using the same parameter values as in Figure 3, Figure 4 shows that although tax revenues need not be strictly increasing throughout the region in which both constraints bind, tax revenues are still higher with an earnings stripping rule than a safe harbor rule. For some alternative parameter values, it is possible to have tax revenues fall for high values of b_e.

7.2 Transfer price costs.

Our base model assumes that transfer price costs are convex in the transfer price but linear in the level of debt. This is in line with the most commonly employed auditing method used by host governments, the comparable uncontrolled price method or CUP. Consider instead that transfer price costs are

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[23] We thank one of the reviewers for suggesting this issue.

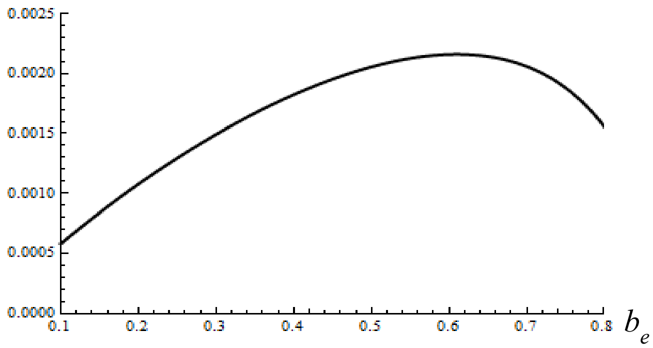

Figure 4. Percentage increase in tax revenue. The percentage increase in tax revenues due to a switch from a safe harbor rule to an earnings stripping rule, $W(\hat{b}_s, b_e^*)/W(b_s^*, b_e^*) - 1$, as a function of b_e.

represented by the strictly convex function $c(P)$ where the total income shifted is $P \equiv (\sigma - r)B$, $c(0) = 0$, and $c'(P)P > 0$ for $P \neq 0$. This formulation is consistent with the comparable profit methods used by tax authorities to audit transfer prices and is related to the transactional net margin method discussed in OECD (2010).

Using the cost function $c(P)$ has two main effects on the analysis. First, a percentage increase in the transfer price σ has the same effect on the marginal transfer price cost $c'(P)$ as does an equivalent percentage increase in B. Second, the first-order condition for optimal transfer pricing now unequivocally determines the level of total shifted income P and not just the transfer price σ as in (4.3.b). Indeed, the corresponding first-order condition now becomes

$$\mu = t - c'(P). \tag{7.2}$$

It follows that the optimal transfer price is chosen to ensure that the optimal level of income shifting is equal to the value of P that solves (7.2), given the optimal choice of debt B. Since there is no incentive to facilitate transfer pricing by reducing the total transfer price costs, the debt level is chosen to optimize the capital structure.

Under the cost structure $c(P)$, the optimal level of debt and total capital is independent of the choice of P when there is no binding earnings stripping rule $(\mu = 0)$. In this case, the optimal transfer price is chosen to achieve the optimal amount of shifted income. In the absence of a binding earnings stripping rule, transfer pricing works like a lump-sum income-shifting device that only has the effect of reducing tax revenue in the host country.[24] If the earnings stripping rule binds $(\mu > 0)$, the optimal level of debt and total capital is now determined only by the choice of P. Again, the transfer price is chosen only to achieve the optimal level of shifted income. In contrast to our base model, transfer pricing only affects debt, capital costs and total investment indirectly. In either case, the government has a first-order incentive to curb income shifting. But doing so requires a binding earnings stripping rule because only a binding earnings stripping rule will directly limit the level of income shifting. Importantly, a safe harbor rule alone does not limit transfer pricing or the level of shifted income. It only restricts debt and increases capital costs as in the base model. All other mechanisms and effects in the model remain unchanged by the change in the transfer price cost structure. In particular, with this formulation it is straightforward to show that dK / db_s is positive throughout the region of thin capitalization limits for which both rules bind so that Theorem 1 continues to hold. Detailed calculations can be found in Appendix 2.

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[24] See also the comparison of the transfer pricing effects under CUP and the comparable profit method in Nielsen et al. (2014), in which the authors analyze a model with transfer pricing on an intermediate good.

8. Conclusion.

Thin capitalization rules are an important instrument for protecting a host country's corporate tax base, especially in view of the debate on tax base erosion by multinationals. They are also an important instrument in countries whose multinationals may consider changing the parent's country of residence to a lower tax country. Once the parent is located in a low-tax jurisdiction, it can use internal debt to strip earnings out of the once-parent/now-subsidiary in the high-tax jurisdiction.[25] In 2013, 57 countries had such rules in place and most of them used safe harbor rules. Recently, a number of developed countries have introduced earnings stripping rules. Four countries used earnings stripping rules only in 2013. Norway, Greece, and Finland followed suit in 2014. Five countries apply a combination of safe harbor and earnings stripping rules.

In this paper, we characterize the set of equilibria for all possible combinations of safe harbor and earnings stripping rules in a general-equilibrium model with both capital and labor choices. Our model allows multinationals to shift income via internal debt financing and transfer pricing. We show that the optimal policy that maximizes the host country's national income is a pure earnings stripping rule with no safe harbor restriction. This result is consistent with the main recommendation in Action Plan 4 (OECD, 2015), as well as the recent trend in earnings stripping adoptions.

Our finding follows from the insight that, beginning with the interest rate a multinational would set under a safe harbor rule, under an earnings stripping rule a small reduction in the interest rate generates zero marginal profit loss while an increase in internal debt that keeps the multinational's total interest deduction

[25] During the corporate inversion debates in late 2014, this concern led Senator Charles Schumer to propose legislation specifically intended to curb earnings stripping activity. (See McKinnon(2014)).

constant generates a strictly positive marginal profit gain. Thus, an earnings stripping rule provides a multinational with a less costly way to mitigate its tax burden. For a host country, this less costly income shifting strategy increases the multinational's marginal return to FDI while holding interest payments fixed and thus increases host country income.

If we extend our model to allow for decreasing returns to scale in production, transfer pricing also lets the multinational shift economic profit, which is not desirable from an optimal tax policy point of view. As long as the rents are not too large, an earnings stripping rule is still more effective at curbing transfer price distortions and is therefore a better choice from a host country's perspective.

Finally, we note that Theorem 1 can be robust to the introduction of some forms of firm heterogeneity. Suppose there are several multinationals that do not compete at the product level, each with a subsidiary that has a different production function. If the boundary of the region of thin capitalization rules for which both the safe harbor and the earnings stripping constraint will bind is the same for all the subsidiaries, then Theorem 1 will continue to hold. This would be the case if each firm's debt-financing cost function had the functional form $D(B,K)=\delta(B/K)\cdot K$ with $\delta'>0$, as discussed in Appendix 1, which is the functional form most commonly used in the theory and empirical literature. We will explore the impact of firm heterogeneity when this boundary does vary in future work.

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Appendix 1 – Proofs and derivations

Preliminary definitions when D_B > 0. In this appendix, we will relax the assumption that $D(B,K) \equiv 0$ and instead assume that (i) $D(0,K)=0$ for all $K \geq 0$, (ii) $D_B(0,K)=0$ for all $K>0$, (iii) $D_K(B,K)<0$ for $B>0$, and (iv) $D(B,K)$ is strictly convex in *B* and *K*. Allowing for positive debt-financing costs modifies first-order conditions (4.3.a) and (4.3.d). Eq. (4.3.a) becomes $\zeta + \mu\sigma = t\sigma - c - D_B$ and (4.3.d) becomes $F_K = (r + D_K - b_s\zeta)/(1 - t + \mu b_e)$. The proofs that follow will refer to these more general expressions. Recall that in the absence of a binding earnings stripping rule that (4.3.b) implies that $\sigma = \sigma^*$. This result is unaffected by the introduction of strictly positive debt-financing costs.

Define $\hat{B}(\sigma)$ to be the solution to (4.3.a) when $\zeta = \mu = 0$. If no solution to (4.3.a) exists, define $\hat{B}(\sigma) = K$. $\hat{B}(\sigma)$ is the profit-maximizing amount of debt in the absence of any thin capitalization rule, given the transfer price σ. If D_B is sufficiently large, then $\hat{B}(\sigma) < K$. For all σ such that $\hat{B}(\sigma) < K$, the assumptions on $c(\cdot)$ and $D(\cdot,\cdot)$ imply that $\hat{B}(\sigma)$ is strictly increasing in σ. Thus, define $\sigma^+ = \min\{\sigma \geq r \mid \hat{B}(\sigma) = K\}$. If $\hat{B}(\sigma) < K$ for all $\sigma \in [r, \sigma^*]$, define $\sigma^+ = \sigma^*$. When $D \equiv 0$, $\sigma^+ = r$. Also, denote the equilibrium that arises when no thin capitalization rule exists by $K^*, B^*, \sigma^*, L_m^*, L_d^*$, and w^*. Then $\overline{b}_s \equiv \hat{B}(\sigma^*)/K^*$ and $\overline{b}_e \equiv \sigma^*\hat{B}(\sigma^*)/(F(K^*, L_m^*) - w^* L_m^*)$. A safe harbor constraint with $b_s > \overline{b}_s$ will never bind, nor will an earnings stripping constraint with $b_e > \overline{b}_e$.

Proposition 1. *A profit-maximizing multinational operating under a binding earnings stripping rule will choose a transfer price strictly less than* σ^*.

Proof of Proposition 1. If the multinational sets its transfer price, σ, under a binding earnings stripping rule, then $\mu > 0$. By (4.3.b), it must then be that $c' < t$. Since $c(\cdot)$ is strictly convex and $c' = t$ at σ^*, it must be that $\sigma < \sigma^*$. Furthermore, substituting (4.3.b) into (4.3.a) implies that $\zeta = \sigma c' - c - D_B$, where ζ must be non-negative. Notice at $\sigma = r$ that $\zeta = -D_B \leq 0$. Thus, $\sigma > r$ when $D_B > 0$. ■

Proposition 2. *Consider a binding American or French hybrid policy, (b_s,b_e). There exists a debt-equity ratio, $\bar{b}$, such that for all $b_s < \bar{b}$ only the earnings stripping rule will determine the multinational's behavior and for all $b_s > \bar{b}$ only the safe harbor rule will determine the multinational's behavior.*

Proof of Proposition 2. Fix K and L_m. Given b_s and b_e, define $(\sigma(b_e), B(b_e))$ to be the solution to the multinational's profit-maximization problem if it faces only a binding earnings stripping rule at b_e or if it faces a binding earnings stripping rule and the profit-maximizing amount of debt implies $B = K$. (When $D_B \equiv 0$, $\sigma(b_e) = r$ if $b_e \leq r / F_K$, and $\sigma(b_e) = b_e F_K > r$ if $b_e > r / F_K$). Also, define $B^\dagger(b_e)$ so that firm profit at $(\sigma^*, B^\dagger(b_e))$ is equal to firm profit at $(\sigma(b_e), B(b_e))$. Since the slope of an isoprofit curve $(d\Pi = 0)$ equals $-B(t - c') / (t\sigma - c - D_B) < 0$ for all $\sigma < \sigma^*$, $B^\dagger(b_e)$ is well-defined. Finally, define $\bar{b} = B^\dagger(b_e) / K$.

From the preliminary material presented at the beginning of this appendix, note that $\hat{B}(\sigma^*)$ is the firm's first-best debt level when it charges the subsidiary σ^*. For all $B < \hat{B}(\sigma^*)$, Π is strictly increasing in B. Thus, if $b_s < \bar{b}$, the profit-maximizing values of σ and B under just the safe harbor rule, $(\sigma^*, b_s K)$, must generate profit less than the profit at $(\sigma^*, B^\dagger(b_e))$ and hence also less than at $(\sigma(b_e), B(b_e))$. Under an American or French rule, it will be optimal for the multinational to exceed the safe harbor rule and just satisfy the earnings stripping rule. If $b_s > \bar{b}$, the multinational must earn more profit at $(\sigma^*, b_s K)$ than at $(\sigma^*, B^\dagger(b_e))$, and hence also more than at $(\sigma(b_e), B(b_e))$. Now under an American or French rule, it will be optimal for the multinational to satisfy the safe harbor rule and violate the earnings stripping rule. ■

The following statement of Proposition 3 is modified to reflect the possibility of non-zero debt-financing costs.

Proposition 3. *If $dD_B(b_s K, K)/dK$ is non-negative but not too positive, for each value of $b_e \in (0, \bar{b}_e)$ there exist safe harbor limits, $b_s^{SH}(b_e)$ and $b_s^{ES}(b_e)$ such that $b_s^{SH}(b_e) < b_s^{ES}(b_e)$ and for all $b_s^{SH}(b_e) < b_s < b_s^{ES}(b_e)$ both the safe harbor and the earnings stripping constraints will bind in equilibrium. When both constraints bind in equilibrium, equilibrium FDI is increasing in b_s and the equilibrium transfer price is decreasing in b_s.*

Proof of Proposition 3. This proof consists of two parts. The first part establishes comparative statics on K and σ with respect to b_s when both constraints (3.3) and (3.4) bind in equilibrium. The second part then establishes that there are values of b_s and b_e for which both constraints will bind in equilibrium.

Comparative statics.

Define $(K^{**}, L_m^{**}, L_d^{**}, B^{**}, \sigma^{**}, w^{**})$ to be an equilibrium in which both constraints bind given b_s and b_e if , and only if it satisfies (i) $B = b_s K$, (ii) $\sigma B = b_e(F - wL_m)$, (iii) $F_L = w$, (iv) $G_L = w$, (v) $L_m + L_d = 1$,

(vi) $F_K = (r + D_K + b_s D_B - b_s(\sigma c' - c))/(1 - t + b_e(t - c'))$, (vii) $\mu = t - c' \geq 0$, and (viii) $\zeta = \sigma c' - c - D_B \geq 0$. Totally differentiating (iii), (iv), and (v) implies that $dL_m = -F_{KL} dK/(F_{LL} + G_{LL})$. Totally differentiating (ii) and (vi) given (i) then yields

$$b_s d\sigma + \sigma db_s = F_K db_e + b_e \frac{F_{KK}G_{LL}}{F_{LL}+G_{LL}} dK \tag{A.1}$$

and

$$\begin{aligned}&[(1-t+b_e(t-c'))\frac{F_{KK}G_{LL}}{F_{LL}+G_{LL}} - \nabla^2_{KK} D(b_s K, K)]dK \\ &\quad = -(t-c')F_K db_e + (KD_{BK} + b_s KD_{BB} - (\sigma c' - c - D_B))db_s .\end{aligned} \tag{A.2}$$

(A.1) and (A.2) imply

$$dK^{**} / db_s = (KD_{BK} + b_s KD_{BB} - (\sigma c' - c - D_B)) / X \tag{A.3}$$

and

$$d\sigma^{**} / db_s = -\sigma + b_e \frac{F_{KK}G_{LL}}{F_{LL}+G_{LL}} \cdot \frac{dK^{**}}{db_s} \tag{A.4}$$

where $X = [(1-t+b_e(t-c'))\frac{F_{KK}G_{LL}}{F_{LL}+G_{LL}} - \nabla^2_{KK} D(b_s K, K)] < 0$ since $D(\cdot,\cdot)$ is strictly convex. If $KD_{BK} + b_s KD_{BB}$ is not too positive at $B = b_s K$, then $dK^{**} / db_s > 0$ and $d\sigma^{**} / db_s < 0$. That is, an increase in b_s when both constraints bind results in an increase in the equilibrium level of FDI and a decrease in the equilibrium transfer price.

Existence of values of b_s and b_e for which (3.3) and (3.4) bind in equilibrium.

Fix $b_e > 0$. When $b_s = 0$, ES constraint (3.4) will hold with a strict inequality for any *w*. Hence, there are values of b_s and b_e for which only SH constraint (3.3) binds in equilibrium. When $b_s = 1$, two separate cases need to be considered: (i) $\sigma^+ = r$ and (ii) $\sigma^+ > r$. The assumption that $D(B,K) \equiv 0$ is sufficient but not necessary for subcase (i) to arise.

Subcase (i). For each $0 < b_e < r / F_K$, (3.3) with $b_s = 1$ will not bind. Thus, by continuity, there exists two values of b_s, denoted by $b_s^{SH}(b_e) = b_e F_K / \sigma^*$ and $b_s^{ES}(b_e) = b_e F_K / r$, such that only (3.3) binds when $b_s \le b_s^{SH}(b_e)$ and only (3.4) binds when $b_s \ge b_s^{ES}(b_e)$. For each $b_e \ge r / F_K$, (3.3) with $b_s = 1$ will bind so $b_s^{ES}(b_e) = 1$. Then for all $b_s \in (b_s^{SH}(b_e), 1]$, both constraints will bind.

Subcase (ii). Once again, define $(\sigma(b_e), B(b_e))$ to be the solution to the multinational's profit-maximization problem if it faces only a binding earnings stripping rule at b_e or if it faces a binding earnings stripping rule and the profit-maximizing amount of debt implies $B = K$. For each $0 < b_e < \sigma^+ / F_K$, (3.3) with $b_s = 1$ will not bind, so $b_s^{SH}(b_e)$ is still defined by $b_e F_K / \sigma^*$. However, $b_s^{ES}(b_e) = b_e F_K / \sigma(b_e)$ because once $b_s > b_e F_K / \sigma(b_e)$, $(\sigma(b_e), B(b_e))$ is feasible and by definition it maximizes profit among all choices for which the earnings stripping constraint holds with equality . Then both constraints will bind for all $b_s^{SH}(b_e) < b_s < b_s^{ES}(b_e)$. For $b_e \ge \sigma^+ / F_K$, (3.3) with $b_s = 1$ will bind, $b_s^{SH}(b_e)$ is still defined by $b_e F_K / \sigma^*$, $b_s^{ES}(b_e) = 1$, and both constraints will bind for all $b_s \in (b_s^{SH}(b_e), 1]$.

In both subcases, there is always a range of values of b_s and b_e for which both constraints will bind. Thus, by (A.4) $\partial \sigma^{**} / \partial b_s < 0$ and $\partial K^{**} / \partial b_s > 0$. ■

Comments on the sufficient condition in Proposition 3: The total effect on the firm's effective cost of capital via $D(\cdot,\cdot)$ from an increase in b_s is equal to $dD_B(b_s K, K) / dK$. By assuming that the firm's marginal debt-financing costs (when $B = b_s K$) do not increase too quickly, we are ensuring that the relaxation of the safe harbor rule is the dominant effect on the effective cost of capital. If the marginal financing cost effect was the dominant effect, then a firm would reduce its FDI in response to a weaker safe harbor rule in order to save on financing costs. The assumption that $dD_B(b_sK,K)/dK \geq 0$ is sufficient to guarantee that $d\zeta/db_s < 0$ so that a weaker rule does not bind more strongly. Note that if $D(B,K) = \delta(B/K)\cdot\gamma(K)$ with $\delta' > 0$, $dD_B(b_sK,K)/dK$ can be bounded above as long as $\gamma(\cdot)$ is not too convex. $dD_B(b_sK,K)/dK \equiv 0$ if $\gamma(K) = K$. Thus, this sufficient condition is satisfied by the debt-financing cost functions used in the literature.

Comments on the statements of Proposition 4 and Theorem 1: The statements of Proposition 4 and Theorem 1 need to be modified to include the same sufficient condition as in Proposition 3. In addition, the upper bounds on values of b_s^* and b_e^* must be adjusted to account for the possibility of neither constraint binding when b_s and b_e are sufficiently close to one.

Appendix 2 – Section 7.2 analysis

In this appendix, we present the analysis associated with our discussion in section 7.2 in which we consider an alternative formulation for transfer price costs that depend on the total amount of income that is shifted.

Denote the transfer price cost function by $c(P)$ where $P = (\sigma - r)B$ denotes the total income shifted, $c(0) = 0$ and $c'(P)P > 0$ for $P \neq 0$. Eq. (3.2) is modified so that the multinational's after-tax global profit equals

$$\mathit{\Pi} = (1-t)(F(L_m,K) - wL_m) - rK + t(P + rB) - c(P) - D(B,K) \qquad \text{(A.5)}$$

and the Lagrangian in (4.2) is modified so that

$$\mathit{\Lambda} = \mathit{\Pi} - \mu(P + rB - b_e(F - wL_m)) - \zeta(B - b_sK). \qquad \text{(A.6)}$$

First-order conditions (4.3) become

(a) $\zeta + \mu r = tr - D_B$,

$(b)\ \mu = t - c'(P)$, (A.7)

$(c)\ (1 - t + \mu b_e)(F_L - w) = 0$,

and

$(d)\ F_K = (r + D_K - b_s\zeta) / (1 - t + \mu b_e)$.

Eqs. (A.7.*b*-*d*) are identical to (4.3.*b*-*d*) while (A.7.*a*) differs slightly due to the change in the definition of the transfer price costs.

The new transfer price cost function does not change equilibrium equations (5.1) and (5.2), the formula for welfare when both constraints bind as given in (6.1), nor the formula for $dW^{SH/ES} / db_s$ as given in (6.3). This means the optimal thin capitalization policy will depend only on dK / db_s, as is the case Proposition 4 and Theorem 1.

To calculate dK / db_s, note that (A.7.*a*-*b*) implies that $\zeta = rc'(P) - D_B$ and $\mu = t - c'(P)$. Moreover, when both constraints bind in equilibrium, $\zeta > 0$, $\mu > 0$, $B = b_s K$, and $P + rb_s K = b_e F_K$. Using the fact that (5.1), (5.2), and (A.7.*c*) imply $dL_m = -F_{KL}dK / (F_{LL} + G_{LL})$, totally differentiating the earnings stripping constraint and (A.7.*d*) yields

$$\begin{aligned} dP + rb_s dK + rKdb_s &= b_e[F_K + F_{KK}KdK + F_{KL}KdL_m] \\ &= b_e[F_K + F_{KK}G_{LL}K / (F_{LL} + G_{LL})]dK \end{aligned} \tag{A.8}$$

and

$$\begin{aligned} &(1 - t + \mu b_e)\frac{F_{KK}G_{LL}}{F_{LL} + G_{LL}}dK - c''(P)b_e F_K dP \\ &= \nabla^2 DdK - rb_s c''(P)dP + (KD_{BK} + BD_{BB} - (rc'(P) - D_B))db_s. \end{aligned} \tag{A.9}$$

Solving (A.8) and (A.9) for *dP* and *dK* implies that

$$\frac{dK}{db_s}=\frac{D_{BB}B+D_{BK}K-rc'(P)-rK(b_eF_K-rb_s)c''(P)}{\left\{(1-t+b_e(t-c'(P)))\frac{F_{KK}G_{LL}}{F_{LL}+G_{LL}}-\nabla^2 D-(b_eF_K-rb_s)c''(P)\left(b_eF_K-rb_s+b_eK\frac{F_{KK}G_{LL}}{F_{LL}+G_{LL}}\right)\right\}} \tag{A.10}$$

where $P>0$ implies $b_eF_K-rb_s>0$ and $\mu>0$ implies $t-c'(P)>0$.

As with Propositions 3 and 4 and Theorem 1, as long as $dD_B(b_sK,K)/dK=D_{BB}B+D_{BK}K$ is not too positive, the numerator of (A.10) will be strictly negative.

The denominator will also be strictly negative as long as the equilibrium is stable. (When transfer price costs are linear in *B* as in our base model, all equilibria must be stable.) To demonstrate this fact, notice that at any equilibria for which both constraints bind, the multinational's first-order conditions, (A.7.*c*-*d*), simplify down to $F_L=w$ and

$$(1-t+tb_e)F_K-r-c'(P)(b_eF_K-rb_s)-b_sD_B-D_K=0\,. \tag{A.11}$$

Totally differentiating these first-order conditions implies

$$F_{KL}dK+F_{LL}dL_M=dw \tag{A.12}$$

and

$$\begin{aligned}&(1-t+b_e(t-c'(P)))(F_{KK}dK+F_{KL}dL_m)-\nabla^2 DdK\\&-(b_eF_K-rb_s)c''(P)((b_eF_K-rb_s)dK+b_eK(F_{KK}dK+F_{KL}dL_m))=0.\end{aligned} \tag{A.13}$$

Solving (A.12) and (A.13) implies that

$$\frac{dL_m}{dw}=\frac{-\left[(1-t+b_e(t-c'(P)))F_{KK}-\nabla^2 D-(b_eF_K-rb_s)c''(P)(b_eF_K-rb_s+b_eKF_{KK})\right]}{F_{LL}\nabla^2 D+(b_eF_K-rb_s)^2c''(P)F_{LL}}. \tag{A.14}$$

Because $dL_d/dw=1/G_{LL}$, equilibrium stability requires that $d(L_m+L_d)/dw<0$ or that the denominator in (A.10) is negative.

Thus, $dK / db_s > 0$ if $dD(b_s K, K) / dK$ is not too positive and our results assuming transfer price costs of $c(\sigma - r)B$ continue to hold.