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Safe Haven vs. Earnings Stripping Rules: a Prisoner Dilemma?

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Abstract

Internal debt financing can be used by multinational firms to shift profits from high-tax to low-tax countries. Governments apply thin capitalization rules (TCRs), which limit the deductibility of interest expenses, to restrict this behavior. TCRs fall in two main categories: safe haven rules and earnings stripping rules. We derive the locally and the socially optimal type of TCR in a general equilibrium two country model. A unilateral switch from safe haven to earnings stripping rules is welfare improving, because it allows governments to tax at different effective rates domestic and multinational firms. Thus, we provide an explanation for the recently observed trend to replace safe haven rules with earnings stripping rules. Depending on the degree of transfer price manipulation undertaken by multinational enterprises, a prisoner dilemma result emerges, as local governments may have a dominant strategy to choose earnings stripping, even when it is not mutually welfare maximizing.

Keywords: thin capitalization rule, safe haven rule, earnings stripping rule, profit shifting

JEL Code: H25;H7;F23;

1 Introduction

The current international corporate taxation framework provides many opportunities to multinational enterprises (MNEs) to shift profits across jurisdictions. This problem has put large pressure on national governments to respond and improve their tax systems. Furthermore, the OECD has recently launched an initiative on base erosion and profit shifting (BEPS) in order to address this issue (OECD, 2013a,b).

One of the main channels of profit shifting, which is largely addressed by the public finance literature, is the use of internal debt to channel funds from low-tax to high-tax jurisdictions. Governments can prevent this behavior by the use of thin capitalization rules (TCRs), which limit either directly or indirectly the internal or total debt to capital ratio of MNEs' subsidiaries. The use of TCRs is also suggested by the OECD as a measure against base erosion (OECD, 2013a). The TCRs fall into two main categories: safe haven rules (SHRs), which limit directly the internal or total debt to equity ratio and earnings stripping rules (ESRs), which restrict the internal or total interest costs to some proportion of companies' EBITDA.¹

While the US applies ESR since 1989, the SHRs are in more widespread use (Ruf and Schindler, 2012). However, many countries have recently followed the US example and switched to ESRs: Germany and Italy in 2008, Spain and Japan in 2012, Portugal in 2013, Greece in 2014 and others (Merlo and Wamser, 2015).²

This paper considers the optimal thin capitalization rule (ESR or SHR) from social planner's perspective and in a Nash equilibrium between two countries. The governments are free to decide on the corporate tax rate, the type of thin capitalization rule and its rate and the rate of capital cost allowances apart from internal debt, while MNEs can allocate productive capital and shift profits through transfer price manipulation and internal debt. A social planner chooses to apply the earnings stripping rule, when the MNEs are able to engage in aggressive transfer price manipulation and the safe haven rule, when transfer pricing is less tax rate sensitive. Moreover, the social planner is indifferent between SHR and ESR when there is insignificant or no transfer price manipulation. The above results are due to the fact that under earnings stripping rules, the governments effectively tax domestic and multinational firms at different rates. This is welfare increasing if MNEs' marginal concealment cost of transfer price manipulation is low.

Moreover, we can explain the recent trend in replacing SHRs with ESRs. Each local gov-

¹ESRs are usually applied if some debt to equity ratio is exceeded, which is the case in the US (Ruf and Schindler, 2012).

²For a further description and overview of thin capitalization rules, see Ambrosanio and Caroppo (2005) and Dourado and de la Feria (2008).

ernment in the model has a dominant strategy to unilaterally switch from the SH to ES rule, when MNEs engage in transfer price manipulation. Their optimal policy is to relax the earnings stripping rule and increase the statutory tax rate without effectively taxing the MNE's rents more heavily and without inducing profit shifting. However, in doing so they collect more tax revenues from domestic firms. Therefore, when the marginal concealment costs of profit shifting are not too low, a prisoner dilemma result emerges, i.e. local governments have a dominant strategy to choose a TCR, which is not mutually welfare maximizing.

The theoretical literature on TCRs has not discussed the optimal choice between SHRs and ESRs in a general equilibrium interjurisdictional tax competition model. Fuest and Hemmelgarn (2005) analyze the relationship between corporate and personal taxation when MNEs use internal debt financing and there are exogenous thin capitalization rules. Hong and Smart (2010) show that a small open economy's welfare increases if it sets a positive TCR, i.e. allows MNEs to shift profits through internal debt, because this lowers the tax rate sensitivity of FDI and leads to a higher equilibrium statutory tax rate.

Hauffer and Runkel (2012) consider a two-country general equilibrium model in which countries decide on the statutory tax rate and thin capitalization rule. They show that countries compete for real investment mainly through the TCR, which leads to inefficiently lax internal debt limitation. Moreover, they find that a coordinated tightening of the TCR is welfare improving. However, Hauffer and Runkel (2012) do not differentiate between SHRs and ESRs, which is the focus of this paper.

Mardan (2015) shows in a small open economy model that countries with low financial development allow positive internal interest deductions. Moreover, it is the closest to our paper and analyzes the choice between SHRs and ESRs. Mardan (2015) demonstrates that the SHR is welfare maximizing if multinational firms do not manipulate transfer prices and the ESR may be optimal under transfer price manipulation.

Furthermore, Gresik et al. (2015) also analyze the optimal thin capitalization rule in a small open economy model, when MNEs engage in transfer price manipulation. They show that developing countries set more lenient TCRs in order to attract FDI. However, if MNEs engage in aggressive transfer price manipulation, the permissive TCRs may lower welfare of developing countries and a zero-FDI equilibrium may emerge.

Our paper differs in two important aspects from the related literature. First, we derive the optimal TCR in the Nash equilibrium of a two country general equilibrium model. In doing so, we provide rationale for the recently observed replacement of SHRs with ESRs. Second, we

analyze the socially optimal choice between SHRs and ESRs and show under which circumstances it coincides with the decentralized solution. We are able to demonstrate that an intermediate degree of transfer price manipulation exists, for which a prisoner dilemma result occurs and coordinated switch from ESR to SHR is welfare-maximizing.

Moreover, there is a large body of empirical literature, which analyzes the effects of TCRs on investment and debt financing. The impact of TCRs on internal debt, total debt and investment has been analyzed by Weichenrieder and Windischbauer (2008); Overesch and Wamser (2010); Buettner et al. (2012); Wamser (2014); Blouin et al. (2014). While it is in general found that thin capitalization rules have a significant negative effect on debt financing, Weichenrieder and Windischbauer (2008) do not find a negative impact on investment. However, (Blouin et al., 2014) show that it may lower firm value. Furthermore, Dreßler and Scheuering (2012) and Buslei and Simmler (2012) study the switch in Germany to ESR in 2008. They find mixed results of the reform on debt-financing and no negative impact on investment.

The rest of the paper is organized as follows. Section 2 presents the model and Section 3 derives the optimal MNE's investment and profit shifting decisions under different thin capitalization rules. Sections 4 and 5 derive the optimal centralized and decentralized TCR choices, respectively. Lastly, Section 6 provides policy implications and concludes.

2 The Model

Consider a world economy consisting of two high tax countries and one tax haven country. The two high-tax states will be referred to as home and foreign. Variables pertaining to the foreign (home) economy are starred (unstarred). Each of these two states hosts a continuum of agents with unitary mass. There is a multinational enterprise (MNE), which produces a homogeneous good in the two high tax countries and has one affiliate in the tax haven, where no production takes place and the corporate tax rate is zero. Lastly, the agents may choose to set up national, entrepreneurial firms according to their skill levels, which will be defined below.

2.1 The Multinational Firm

The agents in home and foreign own equal shares of the multinational firm. It produces a homogeneous good in each of the high tax countries, employing capital $k(k^*)$, respectively, and one unit of an input good, which is produced in the foreign country at zero marginal costs. The agents in each country are endowed by \bar{k} units of capital and the capital market clearing

condition is given by $k + k^* = 2\bar{k}$. The MNE uses the same production technology in both countries $f(k) = ak^\alpha$, $a > 0$, $\alpha \in]0, 1[$. A proportion of the capital invested in each country is financed by equity. If allowed by governments, the MNE channels equity to each productive subsidiary through the affiliate in the tax haven, which in turn provides internal debt to the respective subsidiary. We denote the amount of internal debt financing as $\delta k(\delta^* k^*)$, where $\delta, \delta^* \in [0, 1]$. Furthermore, the MNE sets the maximum internat debt ratio allowed by the government in each country, as there are no costs of using internal debt.

Moreover, we assume that the second input good is sold at price σ from the foreign to the home subsidiary, where $\sigma \neq 0$ implies transfer price manipulation. Such manipulation is associated with a quadratic concealment cost function $C(\sigma) = 0.5c\sigma^2$.³ Thus, the after-tax profits of the MNE are given by

$$\begin{aligned} \Pi^{MNE} = & f(k) - rk - t(f(k) - (\rho + \delta)rk - \sigma) \\ & + f(k^*) - rk^* - t^*(f(k^*) - (\rho^* + \delta^*)rk^* + \sigma) - C(\sigma), \end{aligned} \quad (1)$$

where r denotes the interest rate, t is the statutory tax rate and ρ the rate of capital cost allowance apart from internal debt (due to e.g. external debt financing). We require $\rho, \rho^* \in [0, 1]$, $(\rho + \delta) \leq 1$ and $(\rho^* + \delta^*) \leq 1$. The MNE chooses the capital stocks k and k^* and the transfer price σ in order to maximize its after-tax profits. Moreover, it sets the internal debt levels δ and δ^* at the highest level allowed by governments, since Π^{MNE} is monotonously increasing in them.

2.2 The Agents and Entrepreneurial Firms

Each agent is endowed with e units of the numeraire good. Furthermore, the agents in the home (foreign) country are endowed by skill levels $s(s^*)$. We assume without loss of generality that $s, s^* \sim U[0, 1]$. Thus, their cumulative distribution functions are given by $G(s) = s$ and $G(s^*) = s^*$, while the density functions are $g(s) = 1 = g(s^*)$.

Each agent can choose either to consume his entire endowment e or set up a private firm, which produces the homogeneous good and has pre-tax profit given by $\pi(s), \pi' > 0 > \pi''$ ⁴.

³The assumption of a concealment cost function of the transfer price manipulation is common in the literature (see e.g. Haufler and Schjelderup (2000)). Alternatively, one could assume that there is a probability of detection by the government which is proportional to σ . In the case of detection, the government imposes a fine proportional to σ , which leads to an expected fine, which is a quadratic function of the transfer price (see Devereux et al. (2008) for this approach).

⁴The modelling approach of entrepreneurial firms follows in a simplified way Kotlikoff and Miao (2013).

Setting up a firm requires paying fixed costs $F \leq e$, and profit is taxed at the rate $t(t^*)$ in each country. Therefore, we can define the skill level \tilde{s} of the marginal agent, who is indifferent between setting up a firm and consuming his endowment by

$$(1 - t)\pi(\tilde{s}) - F = 0. \quad (2)$$

All agents with low skill levels $s < \tilde{s}$ consume their whole endowment and the remaining agents set up a firm and consume $(1 - t)\pi(s) + e - F$. The marginal skill level \tilde{s}^* is defined analogously. Eq. (2) shows that the marginal skill level is increasing in the statutory tax rate at an increasing rate, i.e.

$$\tilde{s}_t = \frac{\pi(\tilde{s})}{(1 - t)\pi'(\tilde{s})} > 0, \quad \tilde{s}_{tt} = \frac{[(1 - t)\pi'(\tilde{s})^2 - \pi(\tilde{s})(1 - t)\pi''(\tilde{s})]\tilde{s}_t + \pi(\tilde{s})\pi'(\tilde{s})}{[(1 - t)\pi'(\tilde{s})]^2} > 0. \quad (3)$$

Therefore, a higher tax rate induces some agents not to set up a firm and consume the entire endowment instead. This effect is increasing in t . Using Equations (2) and (3), we can define total pre-tax profits from entrepreneurial firms Π and their sensitivity to the corporate tax rate:

$$\Pi \equiv \int_{\tilde{s}}^1 \pi(s)g(s)ds, \quad (4)$$

$$\Pi_t = -\pi(\tilde{s})\tilde{s}_t < 0, \quad \Pi_{tt} = -\pi'(\tilde{s})\tilde{s}_t^2 - \pi(\tilde{s})\tilde{s}_{tt} < 0. \quad (5)$$

Lastly, the agents in each country consume their income, which consists of capital income, profits from entrepreneurship, the endowment of the numeraire good and one half of the MNE profits due to the equal distribution of ownership shares. Denoting consumption by $c(c^*)$, we get

$$c = r\bar{k} + G(\tilde{s})e + (1 - G(\tilde{s}))(e - F) + (1 - t)\Pi + 0.5\Pi^{MNE}, \quad (6a)$$

$$c^* = r\bar{k} + G(\tilde{s}^*)e + (1 - G(\tilde{s}^*))(e - F) + (1 - t^*)\Pi^* + 0.5\Pi^{MNE}, \quad (6b)$$

where $G(\tilde{s}) = \tilde{s}$ and $G(\tilde{s}^*) = \tilde{s}^*$ denote the mass of agents in each country, who do not set up a firm.

2.3 The Governments

The government in each high-tax country provides a public good $g(g^*)$ to its residents, which is equal to the collected tax revenues, i.e.

$$g = t\Pi + t(f(k) - (\rho + \delta)rk - \sigma), \quad (7a)$$

$$g^* = t^*\Pi^* + t^*(f(k^*) - (\rho^* + \delta^*)rk^* + \sigma). \quad (7b)$$

The governments maximize the utility of the residents of their respective country, which is given by

$$U = c + (1 + \lambda)g, \quad \lambda > 0. \quad (8)$$

Utility U^* is defined analogously. The above welfare function assumes that the public good has a constant marginal valuation, which is greater than the value of the private good. It is standard in the literature (see e.g. Devereux et al. (2008); Bucovetsky and Haufler (2008); Haufler and Runkel (2012); Kempf and Rota-Graziosi (2014)). Another possible motivation for the utility function (8) is that there exists another distortionary tax with marginal excess burden $\lambda > 0$. Keeping the government revenue constant, higher corporate taxation allows a reduction of the other tax rate and the distortion associated with it.

The timing of events in the following analysis is as follows. At stage 1, the governments choose the type of thin capitalization rule they apply: safe haven or earnings stripping. At stage 2, each government sets the corporate tax rate t , the capital cost allowance ρ and thin capitalization rule δ in order to maximize the utility function (8). At the last stage the agents choose whether to set up a firm, and the multinational firm makes optimal investment and profit shifting decisions. Lastly, production and consumption take place.

The remaining analysis evolves in three parts. Initially we derive the optimal MNE choices in each of the three possible scenarios: when both countries applies safe haven rules, when both countries apply earnings stripping rules and when they differ in the TCRs. In the next section we assume that a centralized choice of the TCRs is possible, i.e. a social planner chooses the globally optimal system, taking into consideration the tax competition equilibrium in the following stages. Lastly, we consider the incentives of governments to set each rule in a Nash game. We will be able to show that a prisoner dilemma type of equilibrium may arise, in which the countries have a dominant strategy to choose a thin capitalization rule, which is not welfare maximizing from the social planner's perspective.

3 MNE's Optimal Investment and Profit Shifting

In this section we analyse the MNE's optimal policies under each possible combination of thin capitalization rules.

3.1 Safe Haven Rules

A safe haven rule limits either the internal to total debt-to-equity (or debt-to-capital) ratio. It is the most widely used method. Blouin et al. (2014) provide data for 54 countries out of which 27 have explicit thin capitalization rules and several have implicit interest deductibility limitations.⁵ Out of these 27 countries, 16 limit the deductible interest for total debt, while 11 apply it to internal debt. Even though the safe haven rule in this model applies only to internal debt, it will be shown that the governments will effectively limit the total debt-to-capital ratio.

Assume that the governments do not allow deductibility of interest for internal debt above δk and $\delta^* k^*$, respectively. As already discussed, the MNE chooses the maximum internal debt allowed by the governments to maximize its post-tax profits. Its optimal investment and transfer price maximize Eq. (1) and are given by

$$f'(k) = z^{SH} r, \quad \text{where} \quad z^{SH} \equiv \frac{1 - (\rho + \delta)t}{1 - t}, \quad (9)$$

$$f'(k^*) = z^{*SH} r, \quad \text{where} \quad z^{*SH} \equiv \frac{1 - (\rho^* + \delta^*)t^*}{1 - t^*}, \quad (10)$$

$$\sigma = \frac{t - t^*}{c}, \quad (11)$$

where we follow Devereux et al. (2008) and define the effective marginal tax on capital (EMTR) as $z - 1 \equiv t \frac{1 - (\rho + \delta)}{1 - t}$ and the superscript SH denotes safe haven rule. The above first order conditions show that investment in each country depends on the cost of capital zr , while the profit shifting decision is only a function of the statutory tax rates. If we interpret ρ as the capital allowance for external debt, then $\rho + \delta$ is the total debt-to-capital ratio. Then, Equations (9) and (10) show that in the absence of limitations, the MNE could use 100% debt finance and set its effective tax on capital to zero, i.e. $z = z^* = 1$.⁶ Therefore, by setting a thin capitalization rule, the MNE effectively increases the EMTR and lowers capital demand in its country.

⁵Merlo and Wamser (2015) analyze 172 countries and show that 61 of them had a fixed debt to equity ratio in 2012 with the number of countries applying TCRs increasing over time.

⁶External debt financing is usually restricted by the agency and bankruptcy costs of debt. Due to these costs, investments are at least partly equity financed even in the absence of TCRs. We do not consider them in the model, as their inclusion would not affect the results.

Therefore, we perform comparative static analysis with respect to the EMTR and the statutory tax rate. Taking into consideration the capital market clearing condition $k + k^* = 2\bar{k}$, we can show the following results⁷

$$\frac{dk}{dz} = -\frac{dk^*}{dz} = \frac{z^*r}{zf^{*''} + z^*f''} < 0, \quad (12a)$$

$$\frac{dr}{dz} = \frac{-r}{z + z^*f''/f^{*''}} < 0, \quad (12b)$$

$$z_\rho^{SH} = z_\delta^{SH} = z_{\rho+\delta}^{SH} = \frac{-t}{1-t} < 0, \quad z_t^{SH} = \frac{1 - (\rho + \delta)}{(1-t)^2} > 0, \quad (12c)$$

$$\frac{d\sigma}{dt} = -\frac{d\sigma}{dt^*} = \frac{1}{c} > 0. \quad (12d)$$

Equations (12a) and (12b) show that an increase in the EMTR (z goes up) dampens capital demand in the respective country, depresses the interest rate and as a result increases the foreign capital demand. This can be achieved either by a tightening of ρ and δ , or by an increase in the statutory tax rate. Lastly, a higher $t(t^*)$ raises the incentives to manipulate the transfer price in upward (downward) direction.

3.2 Earnings Stripping Rules

In this subsection we assume that both countries apply earnings stripping rules. They limit the internal interest expenses to a proportion of the subsidiary's EBITDA (earnings before interest, taxes, depreciation and amortization). Since 1989, the US limits the deductible interest expense to 50% of EBITDA if the debt-to-equity ratio exceeds 1.5:1 (see Ruf and Schindler (2012)). Germany, Italy, Japan, Finland, Norway, Portugal and Spain have also adopted similar rules in the recent years (Mardan, 2015).

Denote the proportion of EBITDA above which deductibility of interest expenses to related parties is not allowed by $\epsilon(\epsilon^*)$. Thus,

$$r\delta k \leq \epsilon(f(k) - \sigma), \quad r\delta^*k^* \leq \epsilon^*(f(k^*) + \sigma),$$

where EBITDA consists of the corporate tax base plus interest expenses and depreciation. The MNE makes use of the total allowed internal debt, which means that after some rearrangement

⁷For the clarity of the expressions, we drop the superscript SH where no ambiguity arises.

its profit function (1) becomes

$$\begin{aligned}\Pi^{MNE} &= (1 - t(1 - \epsilon))(f(k) - z^{ES}rk) + (1 - t^*(1 - \epsilon^*))(f(k^*) - z^{*ES}rk^*) \\ &\quad + \sigma(t(1 - \epsilon) - t^*(1 - \epsilon^*)) - C(\sigma),\end{aligned}\tag{13}$$

where

$$z^{ES} \equiv \frac{1 - \rho t}{1 - t(1 - \epsilon)}, z^{*ES} \equiv \frac{1 - \rho^* t^*}{1 - t^*(1 - \epsilon^*)}.$$

The first order conditions of the MNE are given by

$$f'(k) = z^{ES}r, \quad f'(k^*) = z^{*ES}r,\tag{14}$$

$$\sigma = \frac{t(1 - \epsilon) - t^*(1 - \epsilon^*)}{c}.\tag{15}$$

Equations (14)-(15) differ in one respect to the case of SHRs: profit shifting now depends both on the statutory tax rate and the earnings stripping rule. The reason is that the effective tax on the economic rent is $t(1 - \epsilon)$ and a relaxation of ϵ lowers this effective tax and stimulates profit reporting in the home country. The comparative static analysis gives the following results

$$\frac{dk}{dz} = -\frac{dk^*}{dz} = \frac{z^*r}{zf^{*''} + z^*f''} < 0,\tag{16a}$$

$$\frac{dr}{dz} = \frac{-r}{z + z^*f''/f^{*''}} < 0,\tag{16b}$$

$$\frac{d\sigma}{dt} = \frac{1 - \epsilon}{c} > 0, \quad \frac{d\sigma}{dt^*} = -\frac{1 - \epsilon^*}{c} < 0\tag{16c}$$

$$\frac{d\sigma}{d\epsilon} = -\frac{t}{c} < 0, \quad \frac{d\sigma}{d\epsilon^*} = \frac{t^*}{c} > 0.\tag{16d}$$

where z^{ES} depends in the following way on t, ρ and ϵ :

$$z_{\rho}^{ES} = \frac{-t}{1 - t(1 - \epsilon)} < 0,$$

$$z_{\epsilon}^{EH} = \frac{-z^{ES}t}{(1 - t(1 - \epsilon))} < 0,$$

$$z_t^{ES} = \frac{1 - (\rho + \epsilon)}{(1 - t(1 - \epsilon))^2} > 0 \quad \text{if } \rho + \epsilon < 1.$$

The above results are analogous to the comparative statics under safe haven rules with the main difference that now the thin capitalization rule also affects the incentives of the MNE to shift mobile profits.

3.3 Different Thin Capitalization Rules

If the countries do not apply the same TCR, the MNE's optimal behavior is a mixture of the two symmetric situations. If we assume that the home country government applies a safe haven rule, while the foreign government applies an earnings stripping rule, then the profit-maximizing capital and transfer price are given by

$$f'(k) = z^{SH}r, \quad f'(k^*) = z^{*ES}r, \quad (17)$$

$$\sigma = \frac{t - t^*(1 - \epsilon^*)}{c}. \quad (18)$$

The above first order conditions together with the capital market clearing condition can be totally differentiated with respect to k, k^*, σ, r and the policy variables $t, \rho, \delta, t^*, \rho^*$ and ϵ^* . The resulting comparative statics results are identical to those presented in Equations (12a)-(12d) and (16a)-(16d). Lastly, the other asymmetric situation in which the home (foreign) government applies an earnings stripping (safe haven) rule produces first order conditions which are the mirror image of Equations (17)-(18). Since the countries do not differ in any other aspect, it suffices to consider only the asymmetric case described in this subsection.

4 Centralized Choice of Thin Capitalization Rules

A social planner, who chooses the optimal thin capitalization rule, seeks to maximize the global welfare under consideration of the optimal policies of governments at stage 2. In this section we analyze first the SHR equilibrium and then the ESR equilibrium. At the end we derive the conditions under which each rule is welfare maximizing.

4.1 Safe Haven Rule

If both local governments apply the safe haven rule, then the first order conditions of the MNE are given by Equations (9)-(11) and their comparative static results by (12a)-(12d). Each government maximizes the utility function (8) of the agents residing in the respective country, where private consumptions are given by (6a)-(6b) and the public good Equations (7a)-(7b) can be rearranged to

$$g = t\Pi + t(f(k) - z^{SH}rk - \sigma) + (z^{SH} - 1)rk, \quad (19a)$$

$$g^* = t^*\Pi^* + t^*(f(k^*) - z^{*SH}rk^* + \sigma) + (z^{*SH} - 1)rk^*. \quad (19b)$$

As in Devereux et al. (2008), the tax revenue from the multinational firm can be expressed as the sum of two components: (i) the statutory tax rate times the economic rents reported in the country $(f(k) - z^{SH}rk - \sigma)$ and (ii) the EMTR $(z - 1)$ multiplied by its tax base rk .

Each government is free to choose the statutory tax rate t , the capital allowance rate ρ and the safe haven rule δ . However, Equations (6a), (6b), (19a) and (19b) show that private and public consumption depend on ρ and δ only through their joint impact on z^{SH} . This means that the government is only free to choose the sum of capital cost allowances $(\rho + \delta)$ and in doing so it effectively maximizes welfare over the EMTR. This is in line with the observation that the thin capitalization rules of many countries limit the interest deductibility of total debt and not just internal debt.

Thus, we derive the first order conditions of the home government with respect to t and $(\rho + \delta)$ ⁸:

$$U_t = -\Pi + \Pi_t(1-t) + \tilde{s}_t F - \frac{1}{2}(f(k) - z^{SH}rk - \sigma) + (1+\lambda) \left(\Pi + t\Pi_t + (f(k) - z^{SH}rk - \sigma) - t \frac{d\sigma}{dt} \right) + U_z z_t = 0, \quad (20)$$

$$U_{\rho+\delta} = U_z z_{\rho+\delta} \leq 0, \quad (\rho + \delta) \geq 0, \quad U_{\rho+\delta}(\rho + \delta) = 0, \quad (21)$$

where

$$U_z = r_z \bar{k} - \frac{1}{2} \left((1-t)k \frac{d(zr)}{dz} + (1-t^*)k^* \frac{d(z^*r)}{dz} \right) + (1+\lambda) \left(k(1-t) \frac{d(zr)}{dz} - r_z k + (z-1)rk_z \right).$$

In the above first order conditions we take into account that the total capital cost allowance rate $(\rho + \delta)$ cannot be negative⁹. Denote the symmetric equilibrium values of the policy parameters by \tilde{t}^{SH} , \tilde{z}^{SH} and $\widetilde{\rho + \delta}^{SH}$. Assume that an interior solution exists. Then it is defined by the following Equations:

$$\lambda(\Pi + \tilde{t}^{SH}\Pi_t) + \Pi_t + \tilde{s}_t F + (\lambda + 0.5)(1 - \alpha)f(\bar{k}) - (1 + \lambda) \frac{\tilde{t}^{SH}}{c} = 0, \quad (20')$$

$$\frac{\tilde{z}^{SH} - 1}{\tilde{z}^{SH}} = \frac{(1 + \lambda)(1 - \tilde{t}^{SH}) + \lambda}{(1 + \lambda)/(1 - \alpha) + \lambda}. \quad (21')$$

Thus, in an interior solution, the maximization of utility over the total capital cost allowance defines implicitly the EMTR, while the optimal tax rate equates the marginal benefits of rent taxation to the marginal distortions on the mass of entrepreneurial firms and transfer price manipulation.

⁸The first order conditions of the foreign government are derived analogously.

⁹ $U_t = 0$ is always satisfied for some $t \in [0, 1[$ and we do not need to consider corner solutions explicitly.

On the other hand, if $\rho + \delta = 0$ is binding, then the EMTR is determined solely by the statutory tax rate and the symmetric equilibrium is given by

$$\lambda(\Pi + \tilde{t}^{SH}\Pi_t) + \Pi_t + \tilde{s}_t F + (\lambda + 0.5)(1 - \alpha)f(\bar{k}) - (1 + \lambda)\frac{\tilde{t}^{SH}}{c} + U_z z_t = 0, \quad (20'')$$

$$\tilde{z}^{SH} = \frac{1}{1 - \tilde{t}^{SH}}. \quad (21'')$$

It can be shown that $\rho + \delta = 0$ is binding and the second solution applies, if c is very small. From Eq. (21), we can see that this case holds, when U_z is positive at $\rho + \delta = 0$. Simplifying U_z in a symmetric equilibrium, we get

$$U_z \Big|_{(\rho+\delta)=0} \propto (1-t)(1-\alpha)(1+2\lambda) - t(1+\lambda) \geq 0 \Leftrightarrow \frac{t}{(1-t)} \leq \frac{(1-\alpha)(1+2\lambda)}{(1+\lambda)}.$$

The above result holds if the statutory tax rate is relatively small, i.e. when the marginal concealment costs are negligible. For instance, $c \rightarrow 0$ implies $t \rightarrow 0$ from Eq. (20) and the above inequality always holds.

The above special case is important, because under close to zero marginal concealment costs of transfer price manipulation the tax revenues are also zero in equilibrium (since $z^{SH}(t=0) = 1$). We will see that this does not happen under earnings stripping rules, where the government attracts mobile profits through the thin capitalization rule and not through the statutory tax rate.

Lastly, let us denote the critical value of c for which $\rho + \delta = 0$ becomes binding by $c_{\rho+\delta}^{SH}$. Then, if $c > c_{\rho+\delta}^{SH}$, the governments' first order conditions have interior solution presented by Equations (20') and (21'). If $c < c_{\rho+\delta}^{SH}$, then the equilibrium is given by Equations (20'') and (21'').

4.2 Earnings Stripping Rules

In this section we analyze the equilibrium, which arises when both governments apply an ESR. In this case private consumption is given by Equations (6a)-(6b), the profit of the MNE by Eq. (13), its first order conditions by (14)-(15) and comparative statics by (16a)-(16d). Moreover, the governments are now able to maximize welfare separately over ρ and ϵ , because the earnings stripping rule affects not only the EMTR, but also the transfer price of the MNE¹⁰. The first

¹⁰The assumption that governments are free to decide on both ρ and ϵ means that they effectively constrain total debt as in the case of SHR.

order conditions of the home government are given by

$$U_t = -\Pi + \Pi_t(1-t) + \tilde{s}_t F + (1+\lambda)(\Pi + t\Pi_t) \\ + (1-\epsilon) \left[(0.5+\lambda)(f(k) - z^{ES}rk - \sigma) - (1+\lambda)t \frac{(1-\epsilon)}{c} \right] + U_z z_t = 0, \quad (22)$$

$$U_\rho = U_z z_\rho \leq 0, \quad \rho \geq 0, \quad U_\rho \rho = 0, \quad (23)$$

$$U_\epsilon = -(0.5+\lambda)t(f(k) - z^{ES}rk - \sigma) + (1+\lambda)t(1-\epsilon) \frac{t}{c} + U_z z_\epsilon \leq 0, \quad \epsilon \geq 0, \quad U_\epsilon \epsilon = 0. \quad (24)$$

The solution of the above system of first order conditions consists consists of three different cases, depending on whether interior solutions for ρ and ϵ exist. First, we denote the equilibrium policy parameters by \tilde{t}^{ES} , $\tilde{\epsilon}^{ES}$, $\tilde{\rho}^{ES}$ and \tilde{z}^{ES} . If we assume that in equilibrium $\tilde{\rho}^{ES} > 0$, then $U_z = 0$ and interior solution for ϵ exists if and only if

$$c \leq c_\epsilon \equiv \frac{(1+\lambda)\tilde{t}^{ES}}{(0.5+\lambda)(1-\alpha)f(\bar{k})},$$

where \tilde{t}^{ES} is evaluated in an interior solution and c_ϵ denotes the critical value of the marginal concealment costs below which interior solution exists. Therefore, each country relaxes the earnings stripping rule above zero if the marginal concealment costs of transfer price manipulation are small enough, i.e. if $c < c_\epsilon$. The reason is that in this case it is beneficial for the governments to attract mobile profits through the earnings stripping rule and use the statutory tax rate to tax efficiently the entrepreneurial firms. Only if transfer price manipulation is not severe, i.e. if $c \geq c_\epsilon$, will interest expenses related to internal debt not be allowed.

On the other hand, if in equilibrium $\rho = 0$ is binding, then the first order condition (23) gives $U_z \geq 0$. We can again show that this happens at low values of c . Evaluating U_z at $\rho = 0$, we get

$$U_z \Big|_{\rho=0} \propto (1-t(1-\epsilon))(1-\alpha)(1+2\lambda) - t(1-\epsilon)(1+\lambda) \geq 0 \Leftrightarrow \frac{t(1-\epsilon)}{(1-t(1-\epsilon))} \leq \frac{(1-\alpha)(1+2\lambda)}{(1+\lambda)}.$$

The above inequality is again satisfied only for low values of c . If c is very small, then the solution of Eq. (24) shows that ϵ approaches unity and $t(1-\epsilon)$ approaches zero. If we denote the critical value of c by c_ρ^{ES} , then for $c \leq c_\rho^{ES}$, the constraint $\rho = 0$ is binding and for $c > c_\rho^{ES}$, the constraint is not binding. Lastly, we assume that $c_\rho^{ES} < c_\epsilon$, such that an interior solution in all decision variables exists. This assumption is satisfied under all simulations of the model.

Formally, the solution of the utility maximization problem is given by

$$\begin{cases} \lambda(\Pi + \tilde{t}^{ES}\Pi_t) + \Pi_t + \tilde{s}_t F + U_z z_t = 0, & \text{if } c < c_\rho^{ES}, \\ \lambda(\Pi + \tilde{t}^{ES}\Pi_t) + \Pi_t + \tilde{s}_t F = 0, & \text{if } c_\rho^{ES} \leq c < c_\epsilon, \\ \lambda(\Pi + \tilde{t}^{ES}\Pi_t) + \Pi_t + \tilde{s}_t F + [(0.5 + \lambda)(1 - \alpha)f(\bar{k}) - (1 + \lambda)\frac{t}{c}] = 0, & \text{if } c \geq c_\epsilon, \end{cases} \quad (22')$$

$$\begin{cases} \tilde{z}^{ES} = \frac{1}{1 - \tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES})}, & \text{if } c < c_\rho^{ES}, \\ \frac{\tilde{z}^{ES} - 1}{\tilde{z}^{ES}} = \frac{(1 + \lambda)(1 - \tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES})) + \lambda}{(1 + \lambda)/(1 - \alpha) + \lambda}, & \text{if } c \geq c_\rho^{ES}, \end{cases} \quad (23')$$

$$\begin{cases} \tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES}) = c \frac{(0.5 + \lambda)(1 - \alpha)f(\bar{k}) - U_z z_\epsilon / \tilde{t}^{ES}}{(1 + \lambda)}, & \text{if } c < c_\rho^{ES}, \\ \tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES}) = c \frac{(0.5 + \lambda)(1 - \alpha)f(\bar{k})}{(1 + \lambda)}, & \text{if } c_\rho^{ES} \leq c < c_\epsilon, \\ \tilde{\epsilon}^{ES} = 0, & \text{if } c \geq c_\epsilon. \end{cases} \quad (24')$$

Even though the above solution seems complicated, it is easy to compare it to the case of symmetric safe haven rule, when there are interior solutions. Moreover, a comparison of the welfare levels in the two symmetric equilibria is possible.

4.3 The Social Planner's Choice

Two steps are required for the derivation of the social planner's choice. First, we compare the equilibrium tax rates and as a second step we compare the welfare levels.

On the first point, it must be noted that there are three tax bases, whose taxation needs comparison: (i) the profits of the entrepreneurial firms (Π) taxed at rate t , (ii) the rent of the MNE in a symmetric equilibrium $(1 - \alpha)f(\bar{k})$ taxed at rate t under SHR and at rate $t(1 - \epsilon)$ under ESR and (iii) the return to capital $r\bar{k}$ taxed at the EMTR $(z - 1)$. We can prove that in an interior solution, the following Proposition holds:

Proposition 1 *If $c \geq c_\epsilon$, then $\tilde{\epsilon}^{ES} = 0$, $\tilde{t}^{ES} = \tilde{t}^{SH}$, $\tilde{z}^{ES} = \tilde{z}^{SH}$. If $c < c_\epsilon$, then interior solutions satisfy $\tilde{t}^{ES} > \tilde{t}^{SH}$, $\tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES}) < \tilde{t}^{SH}$, $\tilde{z}^{ES} > \tilde{z}^{SH}$.*

Proof See Appendix A.

The above Proposition states that if profit shifting through transfer price manipulation is negligible, i.e. if $c \geq c_\epsilon$, the two thin capitalization rules are identical. The reason is that at this interval for c the governments do not have incentives to allow any internal debt financing under earnings stripping rules, i.e. $\tilde{\epsilon}^{ES} = 0$. The remaining parameters t and ρ are chosen in the same

way in which t and $\rho + \delta$ are chosen under the SHR. On the other hand, when the marginal costs of transfer price manipulation are small, then the countries choose to fight this profit shifting channel through ϵ . In this way the governments have the possibility to tax the domestic immobile tax base at the statutory tax rate t and the mobile rents of the MNE at the effective rate $t(1 - \epsilon)$. The above proposition states that in equilibrium the statutory tax rate will be above \tilde{t}^{SH} (because it is not influenced by profit shifting) and $t(1 - \epsilon)$ will be below \tilde{t}^{SH} (because it applies only to the mobile rents of the MNE). Effectively, \tilde{t}^{SH} is an average of $\tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES})$ and \tilde{t}^{ES} , because it applies to both tax bases.

Lastly, at lower tax on economic rents $\tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES}) < \tilde{t}^{SH}$, the governments are able to tax more heavily the return to capital, i.e. $\tilde{z}^{ES} > \tilde{z}^{SH}$, because mobility of physical capital is less important¹¹.

The above results do not allow a direct comparison of utility levels unless in the case of $c \geq c_\epsilon$, when the effective tax rates and, therefore, welfare is identical and the social planner is indifferent between the safe haven and earnings stripping rules. In Appendix B. we prove the following result:

Proposition 2 *If $c \geq c_\epsilon$, then welfare is identical in both symmetric equilibria. There exists a unique $\bar{c} \in]0, c_\epsilon[$, such that for $c \in [0, \bar{c}[$ welfare is higher in an ESR-equilibrium and for $c \in]\bar{c}, c_\epsilon[$ welfare is higher in an SHR-equilibrium.*

Proof See Appendix B.

The first part of the above Proposition follows directly from Proposition 1: since $c \geq c_\epsilon$ leads to equal taxation of the domestic firms, the MNE rents and the return to capital, there is no difference in the equilibrium welfare levels. However, when $c < c_\epsilon$ the two thin capitalization rules differ.

When c is very small, then the equilibrium statutory tax rate t under safe haven rules is close to zero, because any increase in the tax rate leads to strong transfer price manipulation. On the other hand, under ESR the governments attract mobile profits through a relaxation of ϵ . Therefore, in this case they set ϵ close to unity, such that the rents of the MNE are not taxed and tax at a positive rate the profits of the domestic firms. This leads to higher welfare under earnings stripping rules for c small enough, i.e. $c < \bar{c}$.

On the other hand, at larger values of c , the transfer pricing effect declines and governments collect less revenues under ESR compared to an SHR due to lower taxation of MNE profits, i.e.

¹¹Capital mobility $k_z < 0$ reduces the MNE tax base, which is less important, when Π^{MNE} is taxed at a lower rate, i.e. when $\tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES}) < \tilde{t}^{SH}$.

$\tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES}) < \tilde{t}^{SH}$ (from Proposition 1). Appendix B. shows that this negative effect outweighs the positive effect of higher taxation of entrepreneurial profits whenever $c \in]\bar{c}, c_\epsilon[$. Moreover, \bar{c} exists and is unique irrespective of the values of the remaining parameters¹².

From Proposition 2, we can directly deduce which thin capitalization rule will be chosen by the social planner depending on the marginal transfer price manipulation costs:

Corollary 1 *The social planner chooses earnings stripping rule if $c \in [0, \bar{c}[$, safe haven rule if $c \in]\bar{c}, c_\epsilon[$ and is indifferent between them when $c \geq c_\epsilon$.*

Proof Follows directly from Proposition 2. \square

Moreover, we use a numerical example in order to illustrate the result. Assume that $\pi(s) = bs^\beta$, $b > 0, \beta \in]0, 1[$. Assume furthermore that the parameters take the following values: $\bar{k} = 1, a = 0.1, \alpha = 0.6, b = 3, \beta = 0.3, e = F = 1, \lambda = 0.2$. Then we can show that $c_{\rho+\delta}^{SH} \approx 1.765, c_\rho^{ES} \approx 13.64, c_\epsilon \approx 15.74$ and $\bar{c} \approx 1.85$. At $c = c_\epsilon$, the resulting equilibrium tax rates are $\tilde{t} = 0.367, \tilde{z} - 1 = 0.428, \tilde{\rho}^{ES} = \widetilde{\rho + \delta}^{SH} = 0.26, \tilde{\epsilon} = 0$. Moreover, the resulting interest rate is $r = 0.04$ and almost ninety percent of the agents set up firms, i.e. $\tilde{s} = 0.118$. We present the equilibrium utility levels U^{SH} and U^{ES} in Figure 1.

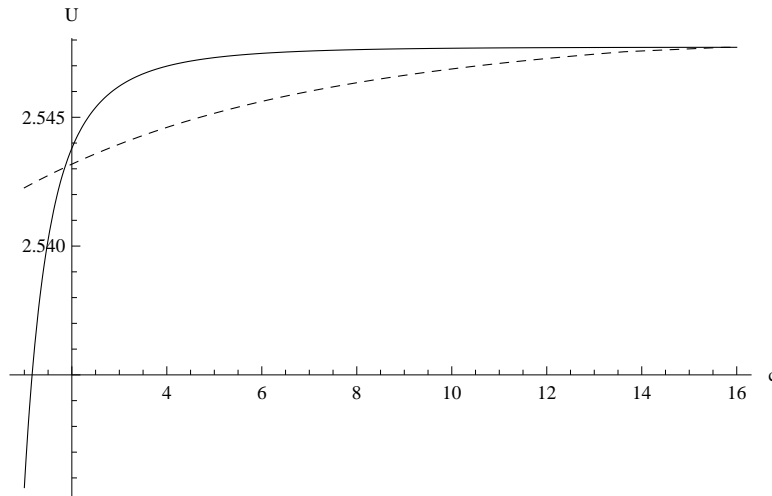


Figure 1: U^{SH} (solid) and U^{ES} (dashed) as functions of c given $\bar{k} = 1, a = 0.1, \alpha = 0.6, b = 3, \beta = 0.3, e = F = 1, \lambda = 0.2$.

In Figure 1 U^{SH} is represented by a solid line and U^{ES} by a dashed line. It can be seen that as c approaches zero, U^{SH} sharply declines, due to the large negative impact of c on the

¹²The parameters of the model determine only the value of \bar{c} .

equilibrium tax rate \tilde{t}^{SH} . However, above $\bar{c} \approx 1.85$, welfare is higher under safe haven rules than under earnings stripping rules. Lastly, from $c_\epsilon \approx 15.74$ onwards, the two thin capitalization rules lead to the same equilibrium utility.

In the next section, we analyze a Nash game between the governments and seek to find whether they choose the same thin capitalization rule as the social planner in equilibrium. Contrary to the results in this section, we will find that local governments have a dominant strategy to switch from safe haven to earnings stripping rules whenever an interior solution exists, which leads to prisoner dilemma for $c \in]\bar{c}, c_\epsilon[$.

5 Decentralized Choice of Thin Capitalization Rules

In order to derive the local governments' optimal thin capitalization rules we need to make two comparisons. First, if one country (e.g. foreign) chooses to apply the safe haven rule, the other country (home) will also choose SHR if $U^{SH} > U^{ES,SH}$, where U^{SH} is home's equilibrium welfare in the symmetric SHR game and $U^{ES,SH}$ is home's utility when it applies ESR and foreign applies SHR. On the other hand, if foreign choose earnings stripping, home will choose the same thin capitalization rule if $U^{ES} > U^{SH,ES}$, where U^{ES} and $U^{SH,ES}$ are defined analogously to U^{SH} and $U^{ES,SH}$.

We have already considered the two symmetric equilibria, which are described by the first order conditions (20)-(24). Since the asymmetric case $\{ES, SH\}$, where home applies earnings stripping and foreign applies safe haven, is the mirror image of the situation $\{SH, ES\}$, we consider only one of these two cases. Assume that the home government applies SHR and the foreign government uses ESR. In this case the MNE's optimal investment and transfer pricing decisions are described by Equations (17) and (18) and the governments' first order conditions are given by

$$U_t = -\Pi + \Pi_t(1-t) + \tilde{s}_t F - \frac{1}{2}(f(k) - z^{SH}rk - \sigma) + (1+\lambda) \left(\Pi + t\Pi_t + (f(k) - z^{SH}rk - \sigma) - t \frac{d\sigma}{dt} \right) + U_z z_t = 0, \quad (25)$$

$$U_{(\rho+\delta)} = U_z z_{\rho+\delta} \leq 0, \quad (\rho+\delta) \geq 0, \quad U_{(\rho+\delta)}(\rho+\delta) = 0, \quad (26)$$

$$U_t^* = -\Pi^* + \Pi_t^*(1-t^*) + \tilde{s}_t^* F + (1+\lambda) (\Pi^* + t^*\Pi_t^*) + (1-\epsilon^*) \left[(0.5+\lambda)(f(k^*) - z^{*ES}rk^* + \sigma) - (1+\lambda)t^* \frac{(1-\epsilon^*)}{c} \right] + U_z^* z_t^* = 0, \quad (27)$$

$$U_\rho^* = U_z^* z_{\rho^*}^* \leq 0, \quad \rho^* \geq 0, \quad U_{\rho^*}^* \rho^* = 0, \quad (28)$$

$$U_\epsilon^* = (1 + \lambda)(1 - \epsilon^*) \frac{t^{*2}}{c} - (0.5 + \lambda)t^*(f(k^*) - z^{*ES}rk^* + \sigma) + U_z^* z^* \epsilon^* \leq 0, \epsilon^* \geq 0, U_\epsilon^* \epsilon^* \quad (20)$$

It is trivial to show that if $c \geq c_\epsilon$, the foreign government sets $\epsilon = 0$ and the first order conditions of the countries become identical. Therefore, when $c \geq c_\epsilon$, no government gains or loses by changing the thin capitalization rule unilaterally. Unfortunately, when $c < c_\epsilon$ we cannot compare analytically the utility levels in the asymmetric equilibrium to U^{SH} and U^{ES} . However, it is possible to show that, if one country switches from SHR to ESR, there exists at least one possible policy, which makes this country better-off without affecting the welfare and optimal policies of the other country. This possible policy exists in an interior solution irrespective of the type of TCR applied by the other government. Therefore, each country has a dominant strategy to switch from safe haven to earnings stripping rules, when there is an interior solution.

In order to prove this, we assume that initially the home country applies the safe haven rule and the foreign applies either safe haven or earnings stripping rules. In the first case, we are in the symmetric equilibrium described by Equations (20)-(21) and the equilibrium policy variables are denoted by \tilde{t}^{SH} , \tilde{z}^{SH} and $\widetilde{\rho + \delta}^{SH}$. Assume now that the home government switches to an earnings stripping rule and chooses to set $\epsilon = \varepsilon$, where ε is a very small positive number. Furthermore, it sets $\rho = \widetilde{\rho + \delta}^{SH} (1 - \varepsilon)$ and $t = \tilde{t}^{SH} / (1 - \varepsilon)$. In this case it is trivial to see that $z = \tilde{z}^{SH}$ and $t(1 - \varepsilon) = \tilde{t}^{SH}$. Therefore, Equations (17) and (18) show that the MNE does not react to this policy change and keeps $k = k^* = \bar{k}$, $\sigma = 0$. This means that the foreign government's first order conditions are not affected, it does not change its policy and its utility remains intact, i.e. $U^* = U^{SH}$. However, by applying this policy the home government has increased its utility above U^{SH} :

$$U(d\epsilon = d\varepsilon) - U^{SH} \approx [\lambda(\Pi + \tilde{t}^{SH}\Pi_t) + \Pi_t + \tilde{s}_t F] \left[\frac{\tilde{t}^{SH}}{(1 - \varepsilon)} - \tilde{t}^{SH} \right] > 0, \quad (30)$$

where the above utility difference is positive from the proof of Proposition 1 (see Equation (A.2)). Therefore, this strategy increases the utility of the agents in the home country without affecting the optimal policy of the foreign government, i.e. without triggering a response from it. This means that in an interior symmetric SHR equilibrium both countries have incentives to switch to earnings stripping rules. Appendix C. shows that an identical strategy always exists for the home government when the foreign government applies an earnings stripping rule and there is interior solution. Therefore, we can state the following Proposition:

Proposition 3 *If $c < c_\epsilon$ and there is an interior solution, each government has a dominant*

strategy to switch from safe haven to earnings stripping rules. If $c \geq c_\epsilon$, the two governments are indifferent with respect to the thin capitalization rules.

Proof See Appendix C.

The intuition behind the above Proposition is the following. Assume that $c < c_\epsilon$. By unilaterally switching to earnings stripping rules, each government taxes the domestic and multinational firms at different effective rates. Therefore, it can raise t and relax the earnings stripping rule ϵ , such that the higher statutory tax rate raises the tax revenues from the domestic firms, but does not lead to an outflow of profits through transfer price manipulation. This is welfare improving, because equilibrium welfare under SHR is always increasing in the tax on domestic firms (technically this means that $\lambda(\Pi + \tilde{t}^{SH}\Pi_t) + \Pi_t + \tilde{s}_t F > 0$, which is proven in Appendix A. and C.).

However, Proposition 1 shows that there exists \bar{c} , such that for $c \in]\bar{c}, c_\epsilon[$, welfare is higher under symmetric safe haven rules. This means that a prisoner dilemma result may appear when c is in this interval, because both governments have a dominant strategy to apply the joint-welfare minimizing thin capitalization rule.

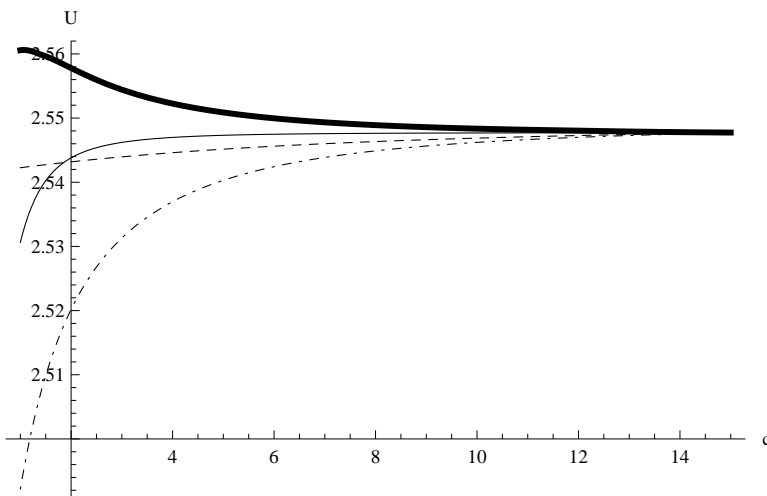


Figure 2: U^{SH} (solid), U^{ES} (dashed), $U^{SH,ES}$ (dot-dash) and $U^{ES,SH}$ (thick solid) as functions of c given $\bar{k} = 1, a = 0.1, \alpha = 0.6, b = 3, \beta = 0.3, e = F = 1, \lambda = 0.2$.

In Figure 2, we consider the Nash equilibrium between the two governments. The thin solid line and the dashed line again represent U^{SH} and U^{ES} . The thick solid line is $U^{ES,SH}$, i.e. the utility of one country if it applies the earnings stripping rule while the other applies the safe haven rule. Figure 2 shows that $U^{ES,SH} > U^{SH}$ for all $c < c_\epsilon$. Therefore, each country prefers

to choose the ESR, if the other employs SHR. On the other hand, the dot-dash line represents $U^{SH,ES}$. It is below U^{ES} for all $c < c_\epsilon$. Thus, the earnings stripping rule is also preferred, if the foreign government applies earnings stripping.

Therefore, there exist three different regions in the above graph, which define three possible Nash equilibria. First, if $c < \bar{c}$, both countries choose the earnings stripping rule, which is also optimal from social planner's point of view. Second, if $c \in]\bar{c}, c_\epsilon[$, a prisoner dilemma appears as the symmetric Nash equilibrium results in ESR applied by the local governments, while the safe haven rule maximizes the global welfare. Lastly, if $c \geq c_\epsilon$, both the local governments and the social planner are indifferent between safe haven and earnings stripping rules.

This result is more general than the prediction from Proposition 3, which states that the earnings stripping rule is a dominant strategy if $c < c_\epsilon$ and there is an interior solution. Actually, at low levels of c , when no interior solution exists, the benefits from a unilateral change to ESR are highest in the numerical example.

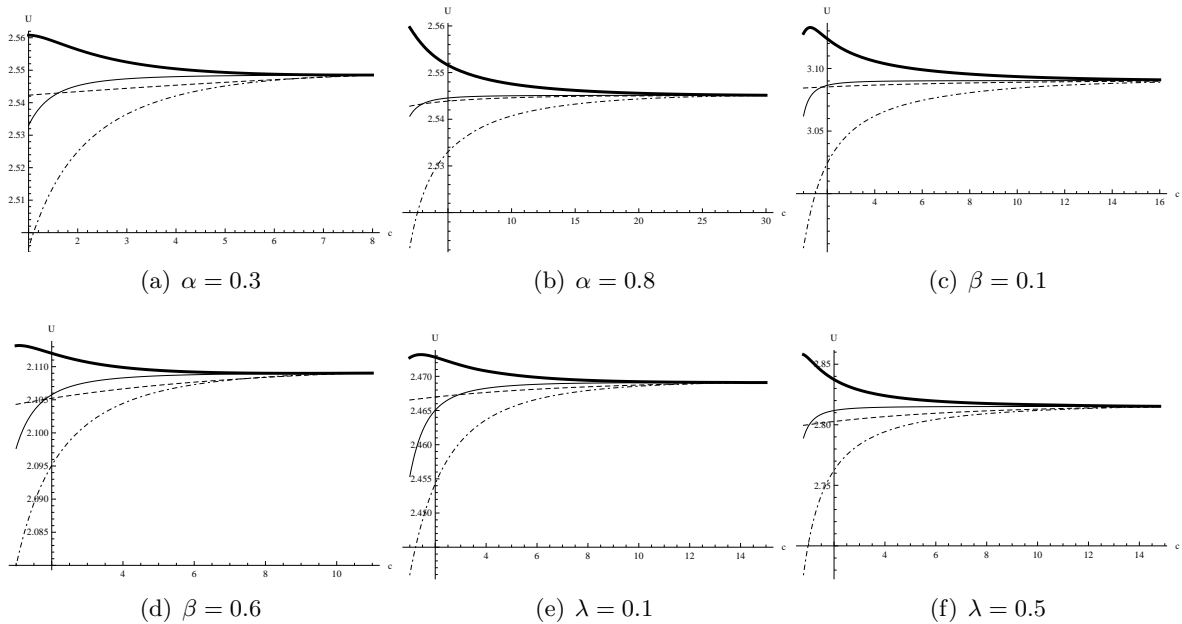


Figure 3: U^{SH} (solid), U^{ES} (dashed), $U^{SH,ES}$ (dot-dash) and $U^{ES,SH}$ (thick solid) as functions of c .

Moreover, in Figure 3 we perform sensitivity analysis and show that this result is robust to changes in the parameter values. In Figure 3 we vary the values of the three most important parameters: α , which determines the sensitivity of capital with respect to the EMTR, β , which determines the sensitivity of \tilde{s} and Π with respect to the statutory tax rate and λ , which

represents the weight of the public good in the utility function. In panels (a) and (b) of Figure 3 we change α to 0.3 (low share of capital in the MNE's production function) and 0.8 (high share of capital), respectively. The results remain qualitatively unchanged. In the next two panels β is changed to 0.1 and 0.6, respectively. In panels (e) and (f) we first set a small weight of the public good ($\lambda = 0.1$) and then a large weight ($\lambda = 0.5$). None of these changes impacts qualitatively the Nash equilibrium, which remains divided in the three regions described above.

The recent replacement of SHRs with ESRs in many countries is an indirect evidence that governments are not indifferent between the two thin capitalization rules and $c < c_\epsilon$ is a range of empirical importance. Moreover, only at $c < c_\epsilon$ is the ES rule positive, i.e. $\tilde{\epsilon} > 0$, which is in line with the actual policies. Furthermore, the observed values of ϵ (50% in the US and Japan, 30% in Germany) result under the following c values in the numerical example: $\tilde{\epsilon}^{ES}(c \approx 8) = 0.3$ and $\tilde{\epsilon}^{ES}(c \approx 4.5) = 0.5$. These values of the marginal concealment cost are in the region where prisoner dilemma arises: $c \in]1.85, 15.74[$. Even though the simulation of the model may not represent reality, it hints that a coordinated change of TCRs may be needed and further research in this direction is justified.

6 Conclusions

This paper has contributed to the literature on thin capitalization rules by deriving the locally and joint welfare maximizing type of thin capitalization rules in an interjurisdictional tax competition model. We find that the social planner's and national optimal policies coincide under aggressive transfer price manipulation by MNEs (when both choose ESR) and under insignificant or absent transfer pricing distortions (when both are indifferent between the TCRs).

However, a wide range of intermediate marginal concealment costs of transfer price manipulation exists, under which a prisoner dilemma emerges, and a coordinated switch to SHR is welfare improving. Moreover, we have found one possible explanation for the recently observed trend of replacement of SHRs by ESRs. This policy allows a separate taxation of MNE and domestic firm profits and is welfare improving if only unilaterally introduced. This is a novel equilibrium, which should be scrutinized by further research.

The paper may be extended in several directions. For example, one may extend it along the lines of Gresik et al. (2015) and investigate whether a zero-FDI equilibrium exists and how it affects the prisoner dilemma result. Second, one may introduce financial constraints as in Mardan (2015). Moreover, empirical research is necessary in order to examine the spillovers of

TCR changes, i.e. how the switch from SHR to ESR of one country affects tax revenues of other countries.

A Proof of Proposition 1

The proof of the first proposition consists of two parts. First, we show that for $c \geq c_\epsilon$, the equilibrium statutory tax rates and EMTR are identical. Second, we compare the equilibrium tax rates when $c < c_\epsilon$ and there are interior solutions.

Assume first that $c \geq c_\epsilon$. Then from the third row of Eq. (24'), $\tilde{\epsilon}^{ES} = 0$. In this case the first order conditions under safe haven rules (20) and (21) coincide with the first order conditions (22) and (23) under earnings stripping rules. Therefore, $\tilde{t}^{SH} = \tilde{t}^{ES}$, $\tilde{z}^{SH} = \tilde{z}^{ES}$ and $\tilde{\rho}^{ES} = \widetilde{\rho + \delta}^{SH}$.

Second, assume that $c < c_\epsilon$, but large enough such that there are interior solutions, i.e. $c > c_{\rho+\delta}^{SH}$ and $c > c_\rho^{ES}$. We use proof by contradiction. Assume that $\tilde{t}^{SH} > \tilde{t}^{ES}$. Then

$$(\lambda + 0.5)(1 - \alpha)f(\bar{k}) - (1 + \lambda)\frac{\tilde{t}^{SH}}{c} < (\lambda + 0.5)(1 - \alpha)f(\bar{k}) - (1 + \lambda)\frac{\tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES})}{c} = 0, \quad (\text{A.1})$$

where the last equality follows from the second row of Eq. (24'). Equations (A.1) and (20') imply

$$\lambda(\Pi + \tilde{t}^{SH}\Pi_t) + \Pi_t + \tilde{s}_t F > 0. \quad (\text{A.2})$$

We can show that the left hand side of Eq. (A.2) is decreasing in the tax rate, i.e.

$$\frac{d}{dt}[\lambda(\Pi + t\Pi_t) + \Pi_t + \tilde{s}_t F] = \lambda(2\Pi_t + t\Pi_{tt}) - \pi'(\tilde{s})\tilde{s}_t^2 - \tilde{s}_{tt}t\pi(\tilde{s}) < 0. \quad (\text{A.3})$$

The second row of Eq. (22') shows that the term $\lambda(\Pi + t\Pi_t) + \Pi_t + \tilde{s}_t F$ equals zero at \tilde{t}^{ES} and together with Eq. (A.3) implies that it can only be positive at a lower tax rate, i.e. if $\tilde{t}^{SH} < \tilde{t}^{ES}$. This contradicts the initial assumption and we conclude that $\tilde{t}^{SH} < \tilde{t}^{ES}$ is always satisfied.

Assume now that $\tilde{t}^{SH} < \tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES})$. Then the second row of Eq. (24') shows that the following inequality must hold

$$(\lambda + 0.5)(1 - \alpha)f(\bar{k}) - (1 + \lambda)\frac{\tilde{t}^{SH}}{c} > (\lambda + 0.5)(1 - \alpha)f(\bar{k}) - (1 + \lambda)\frac{\tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES})}{c} = 0, \quad (\text{A.4})$$

Eq. (20') and (A.4) together imply $\lambda(\Pi + \tilde{t}^{SH}\Pi_t) + \Pi_t + \tilde{s}_t F < 0$. However, Eq. (A.3) has shown that this is only possible for $t > \tilde{t}^{ES} > \tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES})$. This contradicts our assumption and we

conclude that $\tilde{t}^{SH} > \tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES})$ is always satisfied.

Lastly, Equations (21') and (23') show that $\text{sgn}\{\tilde{z}^{SH} - \tilde{z}^{ES}\} = \text{sgn}\{\tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES}) - \tilde{t}^{SH}\}$. Therefore, we conclude that $\tilde{z}^{SH} < \tilde{z}^{ES}$.

B Proof of Proposition 2

First, we write down the utility functions U^{SH} and U^{ES} , which result under symmetric safe haven and earnings stripping equilibria, respectively. They are given by

$$\begin{aligned} U^{SH} &= r\bar{k} + \Pi(1 - \tilde{t}^{SH}) + \tilde{s}e + (1 - \tilde{s})(e - F) + (1 - \tilde{t}^{SH})(1 - \alpha)f(\bar{k}) \\ &\quad + (1 + \lambda) [\tilde{t}^{SH}\Pi + \tilde{t}^{SH}(1 - \alpha)f(\bar{k}) + (\tilde{z}^{SH} - 1)r\bar{k}], \end{aligned} \quad (\text{B.1})$$

$$\begin{aligned} U^{ES} &= r\bar{k} + \Pi(1 - \tilde{t}^{ES}) + \tilde{s}e + (1 - \tilde{s})(e - F) + (1 - \tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES}))(1 - \alpha)f(\bar{k}) \\ &\quad + (1 + \lambda) [\tilde{t}^{ES}\Pi + \tilde{t}^{ES}(1 - \tilde{\epsilon}^{ES})(1 - \alpha)f(\bar{k}) + (\tilde{z}^{ES} - 1)r\bar{k}], \end{aligned} \quad (\text{B.2})$$

where the interest rate r depends on the equilibrium EMTR: $r = f'(\bar{k})/\tilde{z}$.

Initially, we consider the case $c \geq c_\epsilon$. In this situation Proposition 1 states that $\tilde{\epsilon}^{ES} = 0$, $\tilde{t}^{SH} = \tilde{t}^{ES}$ and $\tilde{z}^{SH} = \tilde{z}^{ES}$. Thus, direct comparison of (B.1) and (B.2) shows that $U^{SH}(c \geq c_\epsilon) = U^{ES}(c \geq c_\epsilon)$.

In the case $c < c_\epsilon$, the proof consists of several steps. First, we show that at $c \rightarrow 0$ equilibrium welfare is higher under earnings stripping rules. Second, we prove that both U^{SH} and U^{ES} are concave and increasing functions of c . Lastly, we show that as c approaches c_ϵ , welfare U^{ES} approaches the value of U^{SH} from below. Because both functions are continuous, they must intersect at least once. Due to concavity, there is one unique intersection point below c_ϵ , which we denote by \bar{c} .

Step one requires us to show that $U^{ES}(c \rightarrow 0) > U^{SH}(c \rightarrow 0)$. As c approaches zero, Equations (20'') and (21'') show that $\tilde{t}^{SH} = \tilde{z}^{SH} - 1 = 0$. On the other hand, Equations (22')-(24') give $\tilde{\epsilon}^{ES} = 1$, $\tilde{z}^{ES} - 1 = 0$ and $\tilde{t}^{ES} > 0$ defined implicitly by $\lambda(\Pi + \tilde{t}^{ES}\Pi_t) + \Pi_t + \tilde{s}_t F = 0$ ¹³. Therefore, we can show that

$$U^{SH}(c \rightarrow 0) = r\bar{k} + (1 - \alpha)f(\bar{k}) + (e - F) + [\Pi + \tilde{s}F + \lambda t\Pi]_{t=0}, \quad (\text{B.3})$$

$$U^{ES}(c \rightarrow 0) = r\bar{k} + (1 - \alpha)f(\bar{k}) + (e - F) + \max_t \{\Pi + \tilde{s}F + \lambda t\Pi\}, \quad (\text{B.4})$$

¹³The first order condition with respect to t contains also U_{zz_t} , which vanishes at $c \rightarrow 0$ because $z_t = 0$ at $\epsilon = 1$.

The first three terms of the welfare functions are identical, while the last term is calculated at $t = 0$ in an SHR equilibrium and is maximized over t in an ESR equilibrium. Therefore, $U^{ES}(c \rightarrow 0) > U^{SH}(c \rightarrow 0)$.

The second step requires to show that both U^{SH} and U^{ES} are monotonically increasing in c and concave, i.e. $dU/dc > 0$ and $d^2U/dc^2 < 0$. We use the first order conditions (20'),(20''),(21'),(21'') and (22')-(24') to prove this:

$$\frac{dU^{SH}}{dc} = \begin{cases} [\lambda(\Pi + t\Pi_t) + \Pi_t + \tilde{s}_t F + \lambda f(\bar{k})] \frac{d\tilde{t}^{SH}}{dc} > 0, & \text{if } c < c_{\rho+\delta}^{SH}, \\ [(\lambda(\Pi + t\Pi_t) + \Pi_t + \tilde{s}_t F) + \frac{(1-\alpha)^2 f(\bar{k})\lambda(1+2\lambda)}{\lambda(1-\alpha)+1+\lambda}] \frac{d\tilde{t}^{SH}}{dc} > 0, & \text{if } c_{\rho+\delta}^{SH} < c < c_\epsilon, \end{cases} \quad (\text{B.5})$$

$$\frac{dU^{ES}}{dc} = \begin{cases} [\lambda f(\bar{k})] \frac{d(\tilde{t}^{ES}(1-\tilde{\epsilon}^{ES}))}{dc} > 0, & \text{if } c < c_\rho^{ES}, \\ \frac{(1-\alpha)^2 f(\bar{k})\lambda(1+2\lambda)}{\lambda(1-\alpha)+1+\lambda} \frac{d(\tilde{t}^{ES}(1-\tilde{\epsilon}^{ES}))}{dc} > 0, & \text{if } c_\rho^{ES} < c < c_\epsilon. \end{cases} \quad (\text{B.6})$$

In the above derivatives we have used

$$\frac{d\tilde{t}^{SH}}{dc} = \begin{cases} \frac{(1+\lambda)t}{(1+\lambda)c - c^2(\Delta - \alpha f(\bar{k})(1+\lambda)/(2(1-t)^2(1-\alpha)))} > 0, & \text{if } c < c_{\rho+\delta}^{SH}, \\ \frac{(1+\lambda)t}{(1+\lambda)c - c^2\Delta} > 0, & \text{if } c_{\rho+\delta}^{SH} < c < c_\epsilon, \end{cases} \quad (\text{B.7})$$

$$\frac{d(\tilde{t}^{ES}(1-\tilde{\epsilon}^{ES}))}{dc} = \begin{cases} \frac{t(1-\epsilon)/c}{1+c\alpha f(\bar{k})/(2(1-\alpha)(1-t(1-\epsilon))^2)} > 0, & \text{if } c < c_\rho^{ES}, \\ \frac{t(1-\epsilon)}{c} > 0, & \text{if } c_\rho^{ES} < c < c_\epsilon. \end{cases} \quad (\text{B.8})$$

where $\Delta \equiv \lambda(2\Pi_t + t\Pi_{tt}) - \pi(\tilde{s})\tilde{s}_{tt} - \pi'(\tilde{s})\tilde{s}_t^2 < 0$. Lastly, we can show that U^{SH} and U^{ES} are concave in c by showing that $d^2\tilde{t}^{SH}/dc^2 < 0$ and $d^2(\tilde{t}^{ES}(1-\tilde{\epsilon}^{ES}))/dc^2 \leq 0$. It can be shown that the later is always satisfied, while the first holds if Π_{ttt} and $-\tilde{s}_{ttt}$ are not too positive, which is always satisfied when $\pi(s)$ is a Cobb-Douglas function.

The last step requires to show that as c approaches c_ϵ , U^{ES} approaches U^{SH} from below. This can be done by using the second rows of (B.5)-(B.8), which give

$$\begin{aligned} \lim_{c \rightarrow c_\epsilon} \frac{d(U^{ES} - U^{SH})}{dc} &= \lim_{c \rightarrow c_\epsilon} \frac{(1-\alpha)^2 f(\bar{k})\lambda(1+2\lambda)}{\lambda(1-\alpha)+1+\lambda} \left[\frac{d(\tilde{t}^{ES}(1-\tilde{\epsilon}^{ES}))}{dc} - \frac{d\tilde{t}^{SH}}{dc} \right] \\ &= \frac{(1-\alpha)^2 f(\bar{k})\lambda(1+2\lambda)}{\lambda(1-\alpha)+1+\lambda} \left[\frac{(0.5+\lambda)(1-\alpha)f(\bar{k})}{(1+\lambda)} - \frac{(0.5+\lambda)(1-\alpha)f(\bar{k})}{(1+\lambda) - c_\epsilon\Delta} \right] > 0. \end{aligned} \quad (\text{B.9})$$

Equation (B.9) shows that as c approaches c_ϵ and the two equilibrium utility levels approach the same value, U^{ES} increases faster with c than U^{SH} does, i.e. U^{ES} is below U^{SH} for c slightly below c_ϵ . Since U^{ES} is higher than U^{SH} at $c \rightarrow 0$, we conclude that they must intersect. Due to

the concavity of the equilibrium utilities and the intermediate value theorem, this intersection is unique. \square

C Proof of Proposition 3

We already showed in the main text that for $c \geq c_\epsilon$, the local governments are indifferent between applying each thin capitalization rule and that a unilateral change from the symmetric SHR situation to ESR is beneficial. In this section we prove that the same switching strategy as the one described in the main text is beneficial when the foreign country applies earnings stripping rules and $c \leq c_\epsilon$.

Assume that we are in the asymmetric equilibrium described by Equations (25)-(29). Assume furthermore that $\tilde{t}^{SH,ES} > \tilde{t}^{*SH,ES}$ when $c \leq c_\epsilon$, where superscript SH, ES denotes the situation in which the home government applies SHR and the foreign government applies ESR. Equation (27) shows that in equilibrium $\tilde{t}^{*SH,ES} = \tilde{t}^{ES}$. Since we already showed that at $c = c_\epsilon$, the foreign country sets $\epsilon^* = 0$ and $\tilde{t}^{SH,ES} = \tilde{t}^{*SH,ES} = \tilde{t}^{ES}$, the assumption $\tilde{t}^{SH,ES} > \tilde{t}^{*SH,ES}$ when $c \leq c_\epsilon$ implies that $\tilde{t}^{SH,ES}$ is declining in the marginal concealment costs of transfer price manipulation for $c \leq c_\epsilon$. However, we can show that $d\tilde{t}^{SH,ES}/dc > 0$ always holds¹⁴. Therefore, $\tilde{t}^{SH,ES} < \tilde{t}^{*SH,ES}$ must hold in an asymmetric equilibrium with interior solution. This means that the home government can switch to earnings stripping rules and set $\epsilon = \epsilon, \rho = \widetilde{\rho}^{SH,ES}(1 - \epsilon), t = \tilde{t}^{SH,ES}/(1 - \epsilon)$, where ϵ is slightly above zero. This policy change will not lead to any capital flow or transfer price change, because the MNE's first order conditions will not be affected. Therefore, the foreign government will not react to the home government's policy and the foreign utility will remain unchanged at $U^{*SH,ES}$. However, the home welfare will increase by the following amount:

$$U(d\epsilon = d\epsilon) - U^{SH,ES} \approx [\lambda(\Pi + \tilde{t}^{SH,ES}\Pi_t) + \Pi_t + \tilde{s}_t F] \left[\frac{\tilde{t}^{SH,ES}}{(1 - \epsilon)} - \tilde{t}^{SH,ES} \right] > 0, \quad (\text{C.1})$$

where (C.1) is positive due to $\tilde{t}^{SH,ES} < \tilde{t}^{*SH,ES}$. \square

¹⁴The proof is available from the author upon request.

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