

Double tax discrimination to attract FDI and fight profit shifting: The role of CFC rules*

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Abstract

Governments worldwide use targeted tax policies to trade off the gains from increased FDI against the cost of excessive profit shifting by multinational firms. We show that optimal tax systems generally incorporate both thin capitalization rules, which tax discriminate between purely national and multinational firms, and controlled-foreign-company (CFC) rules, which discriminate between home-based and foreign-based multinationals. Introducing CFC rules is optimal if investment elasticities of home-based and foreign-based multinationals differ due to transaction costs for FDI. We also analyze the effects of reduced transaction costs for FDI and reduced costs for debt shifting on the optimal policy mix. Our results support the recent development of these anti-avoidance rules in OECD countries.

Keywords: Multinationals, profit shifting, controlled foreign company rules, thin-capitalization rules

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1 Introduction

Foreign direct investment (FDI) has been among the most important dimensions of the continuing globalization of the world economy. Governments try to attract FDI because it can provide a number of benefits such as increased employment, higher wages and positive technological spillovers to domestic firms that spur economic growth.¹ In order to attract FDI, governments often make use of preferential tax regimes. The reason for using such targeted policies is that tax breaks are confined to large, internationally mobile firms that undertake FDI, while the losses for corporate tax revenues are minimized by keeping the tax burden stable for smaller firms that operate only in the home country. A policy that features prominently in this regard is to allow multinational companies to shift some of their profits to affiliates in low-tax countries; an option that is not available to purely national firms.² International profit shifting is in turn one of the most important reasons behind empirical results that, in high-tax host countries, subsidiaries of multinational groups pay between 33% and 50% less in corporate taxes, relative to comparable domestic firms (Egger et al., 2010).

In recent years, however, many countries have seen a need to respond to increasingly aggressive profit shifting by multinational firms. One important channel of profit shifting is that multinationals deduct interest expenses from the tax base of an affiliate hosted in a high-tax country, which arise from loans granted by a related foreign entity located in a tax haven. An increasing number of countries has thus limited the amount of tax-deductible interest expenses using *thin-capitalization rules* (see Büttner et al., 2012 and Table 1 below). By choosing the tightness of these thin-capitalization rules, the host country can change the effective tax rate of multinational companies without changing its statutory tax rate. Hence, thin-capitalization rules allow governments to balance the gains from FDI against the costs arising from profit shifting.

An important aspect of thin-capitalization rules is that the tax deductions they allow can equally be used by home-based and foreign-based multinationals. However, due to the existence of trade costs that create a “home market bias” (see, e.g., Krugman, 1980), the elasticity with which investment by home-based multinationals responds to tax incentives is generally lower than that of foreign-based multinational companies. As a result, governments would also like to tax discriminate between home-based and

¹Haskel et al. (2007) and Keller and Yeaple (2009), among others, empirically demonstrate the positive technological spillovers of inward FDI for the United Kingdom and the United States, respectively. Hijzen et al. (2013) find positive effects of inward FDI on wages and employment in a cross-country study using microeconomic data from both developed and developing countries.

²The rationality of policies permitting some profit shifting for multinational firms is demonstrated, for example, by Peralta et al. (2006) and by Hong and Smart (2010).

foreign-based multinationals by setting less generous thin-capitalization rules for the former. However, this tax discrimination *between* multinationals is generally not possible using thin-capitalization rules alone.³

In this paper, we show that one policy allowing governments to tax discriminate between home-based and foreign-based multinational companies is the use of *controlled-foreign-company (CFC) rules*.⁴ CFC rules have recently received considerable attention in the OECD’s ‘Action Plan on Base Erosion and Profit Shifting’ (BEPS), which regards them as a core measure to combat ‘excessive’ deductions for interest expenses and other financial transactions (OECD, 2013, action 3; 2015). CFC rules generally focus on so-called ‘passive income’, for example interest payments and royalties, which can easily be placed in affiliates in tax havens without having a substantial physical presence there.⁵ They reserve the right of the tax authority in the parent country of a multinational firm to add the (passive) income from this multinational’s foreign affiliates in low-tax countries to the parent company’s tax base, thus subjecting it to the higher rate of the parent country.⁶ Typically, CFC rules stipulate a minimum effective tax rate that must be levied in the host country of the affiliate in order to avoid this additional taxation in the parent country. The closer this minimum tax rate is to the statutory corporate tax rate in the parent country, the stricter is the CFC rule. Importantly, CFC rules do not apply to multinationals headquartered abroad. In sum, CFC rules allow a parent country to increase the effective tax rate of its *home-based* multinational companies only.

In 2014, more than 30 countries worldwide used CFC rules to limit profit shifting by multinational companies. Table 1 summarizes both CFC rules and thin-capitalization rules of all OECD countries for which we could retrieve data for the years 2000 (or 2004) and 2014, and compares the regulation over time.⁷ The table shows that many countries have tightened their thin-capitalization rules since the year 2000. CFC rules have also been tightened during the same period, but in a smaller set of OECD countries.

³In its 2002 *Lankhorst-Hohorst ruling*, for example, the European Court of Justice has decided that thin-capitalization rules in the European Economic Area must not be designed in a way that discriminates between multinationals from different EU member states.

⁴CFC rules were first introduced as ‘Subpart F’ legislation in the United States in 1964. See Deloitte (2014) for a recent overview of CFC rules employed worldwide, and Lang et al. (2004) for a detailed discussion from a legal perspective.

⁵See Dischinger and Riedel (2011) for evidence that patents are placed in low-tax countries and Bergin (2012) for a case study of tax avoidance in the United Kingdom. An empirical study of which countries become tax havens is Dharmapala and Hines (2009).

⁶CFC rules therefore override the tax-exemption principle, under which the parent country does not tax the profits of foreign affiliates of a resident MNC. This scheme, also labelled the ‘source country principle’ of corporate taxation, is applied by most OECD countries, with the prominent exception of the United States. See Becker and Fuest (2010) for a recent discussion and analysis.

⁷Thin-capitalization rules are characterized either by a ‘safe harbor’ debt-to-equity ratio for which interest payments are always tax-deductible, or by an earnings stripping rule, which specifies the share of

Table 1: CFC Rules and Thin-Capitalization Rules (TCR) in OECD Countries: 2000 (2004) and 2014

country	2000 (2004)				2014				change	
	CIT ^a	CFC rule ^b	TCR type ^c	ratio	CIT ^a	CFC rule ^b	TCR type ^c	ratio	CFC ^{d,e}	TCR ^d
Australia ^f	30	BL ^g	SHR	3:1	30	BL ^g	SHR	1.5:1	0	+
Austria ^f	34	-	-	-	25	-	-	-	0	0
Belgium ^f	33.99	-	-	-	33.99	-	SHR	5:1	0	+
Canada	28	28	SHR	2:1	26.5	26.5	SHR	1.5:1	0	+
Chile	17	-	SHR	3:1	20	-	SHR	3:1	0	0
Czech Republic ^f	28	-	SHR	4:1	19	-	SHR	4:1	0	0
Denmark ^f	30	30	SHR	4:1	24.5	24.5	SHR/ESR	4:1/80% EBIT	0	+
Estonia ^f	35	-	-	-	21	7	-	-	+	0
Finland	29	17.4	-	-	20	12	ESR	25% EBITDA	0	+
France ^f	33.33	22.22	SHR/ESR	1.5:1	33.33	16.67	SHR	1.5:1/25% EBITDA	-	+
Germany	40	30	SHR	3:1	30	25	ESR	30% EBITDA	+	SC ^h
Greece ^f	35	-	-	-	26	13 + BL ^g	ESR	60% EBITDA	+	+
Hungary	18	10	SHR	3:1	19 ⁱ	10	SHR	3:1	-	0
Iceland ^f	18	-	-	-	20	13.33	-	-	+	0
Ireland ^f	12.5	-	-	-	12.5	-	-	-	0	0
Israel ^f	36	20	-	-	26.5	15	-	-	+	0
Italy	37	BL ^g	-	-	27.5	13.75 + BL ^g	ESR	30% EBITDA	+	+
Japan ^f	30	25	SHR	3:1	25.5	20	SHR/ESR	3:1/50% EBITDA	-	+
Korea (Rep.) ^f	37	15	SHR	3:1	22	15	SHR	3:1	+	0
Luxembourg ^f	30.38	-	SHR	85:15	21	-	SHR	85:15	0	0
Mexico ^f	33	BL ^g	-	-	30	BL ^g	SHR	3:1	0	+
Netherlands ^f	34.5	-	SHR	3:1	25	-	-	-	0	-
New Zealand ^f	33	33	SHR	3:1	28	28	SHR	1.5:1	0	+
Norway	28	18.67	-	-	27	18	ESR	30% EBITDA	0	+
Poland	19	-	SHR	3:1	19	-	SHR	3:1	0	0
Portugal	25	15 + BL ^g	SHR	2:1	23	13.8 + BL ^g	ESR	50% EBITDA	0	SC ^h

Table 1: CFC Rules and Thin-Capitalization Rules (TCR) in OECD Countries: 2000 (2004) and 2014 continued

country	2000 (2004)			2014			change			
	CIT ^a	CFC rule ^b	TCR type ^c	ratio	CIT ^a	CFC rule ^b	TCR type ^c	ratio	CFC ^{d,e}	TCR ^d
Slovak Republic	19	-	-	-	22	-	-	-	0	0
Slovenia	25	-	-	-	17	-	SHR	4:1	0	+
Spain	35	26.25 + BL ^g	SHR	3:1	30	22.5 + BL ^g	ESR	30% EBITDA	0	SC ^h
Sweden	28	15.4	-	-	22	12.1	-	-	0	0
Switzerland	24.1	-	ACS ^j	-	17.9	-	ACS ^j	-	0	0
Turkey ^f	30	-	-	-	20	10	SHR	3:1	+	+
UK	30	22.5	-	-	21	15.75	-	-	0	0
US	39	39	SHR	1.5:1	39	39	SHR	1.5:1	0	0

^a Statutory corporate income tax rate.

^b Minimum statutory tax rate in host country.

^c Safe harbor rule (SHR) or earnings stripping rule (ESR) with amount of interest income up to which interest payments are deductible.

^d Tightened rule indicated by +, relaxed rule by -, unchanged rule by 0.

^e Comparison refers to the CFC rule as a percentage share of the residence country's CIT rate.

^f First set of entries refers to year 2004.

^g Income arising in black-listed jurisdictions is taxed in the residence country.

^h System change from safe harbor to earnings stripping rule (generally intended to tighten thin-capitalization restrictions).

ⁱ The first 500m HUF (approx. 1.6m Euro) of income are taxed at a rate of 10%.

^j Asset-class specific.

Sources: International Bureau of Fiscal Documentation: European Tax Handbook (2000, 2014); Ernst & Young Global Tax Guide 2004 and 2014 (<http://www.ey.com/GL/en/Services/Tax/Global-tax-guide-archive>); OECD Tax Database (<http://www.oecd.org/tax/tax-policy/tax-database.htm>)

Despite their empirical relevance, CFC rules have so far been left out of theoretical analyses of how governments should respond to the profit shifting activities of multinational firms. In the present paper we aim to fill this void and address two main issues involving CFC rules. First, we ask under which conditions CFC rules are part of the government's optimal tax mix when the latter can endogenously choose the statutory corporate tax rate, the thin-capitalization rule, and the CFC rule. In a second step, we analyze how the optimal policy mix changes as a result of increased mobility of FDI (i.e., reduced transaction costs for FDI) on the one hand, and increased financial mobility (i.e., reduced profit shifting costs for multinationals) on the other. In doing so, our model is the first to explain the role of CFC rules in international taxation, and it highlights how and why countries may want to tax-discriminate between *multinational* companies.

To pursue these issues, we set up a model of two symmetric countries and a continuum of tax havens with different tax rates. There are three types of firms in each country: purely national firms, home-based multinationals, and foreign-based multinationals. All firms choose their investment levels and the multinational companies additionally choose the tax-optimized financial structure of their investment by shifting debt to a tax haven of their choice.

Our analysis delivers the following results. In the policy optimum, each government will set the thin-capitalization rule so as to permit multinationals operating in the home country to deduct some internal debt from the corporate tax base, provided that the multinationals' investments react sufficiently elastic to the reduction in capital cost. Therefore, some tax discrimination will occur between purely national versus multinational firms. In addition, each government is more likely to impose a binding CFC rule on its home-based multinational, the larger are the transaction costs for FDI and thus the larger is the 'home bias' of multinationals' investment. In this case, governments would like to tax discriminate between home-based and foreign-based multinational companies, in favour of the latter, but cannot do so via the thin-capitalization rule. Thus, governments use the CFC rule to bring about the desired increase in the effective taxation of home-based multinationals. As a result, purely national firms, home-based multinationals, and foreign-based multinationals are all taxed at different effective rates in the policy equilibrium.

Furthermore, based on an initial equilibrium where both thin-capitalization and CFC rules are set at interior levels, a reduction in the transaction costs for FDI tightens the optimal thin-capitalization rule, because a higher level of inward FDI makes it more costly to allow internal debt to be deducted from the domestic tax base. At the same time, the diminished home bias of multinationals reduces the need to tax discriminate

tax-deductible interest payments in relation to EBIT(DA). In either case, a higher ratio implies a more lenient thin-capitalization rule.

between home-based and foreign-based multinationals and thus leads to a laxer CFC rule in the policy optimum. In contrast, reduced costs for debt shifting to the tax haven will lead to a simultaneous tightening of both thin-capitalization rules and CFC rules. Both of these measures increase the corporate tax base and prevent multinationals from taking advantage of the lower costs of debt shifting to the tax haven.

Interpreting economic integration as a simultaneous reduction in the transaction costs for FDI and in the costs of profit shifting, a clear-cut incentive emerges for countries to tighten their thin-capitalization rules under economic integration, whereas the case for tighter CFC rules is more mixed. These model results are consistent with the observed policy changes over time, summarized in the last two columns of Table 1, that thin-capitalization rules have been tightened in more countries, and relaxed in fewer, as compared to CFC rules.

The existing literature on CFC rules is almost exclusively empirical.⁸ Ruf and Weichenrieder (2012, 2013) show for German-based multinationals that CFC rules are effective in curbing passive investment and have a strong impact on the decision of where to locate internal banks and profit centers. Egger and Wamser (2015) focus instead on the question of how CFC rules affect German multinationals' real investment decisions, using a regression discontinuity design at the thresholds where CFC rules become binding. They find a substantially negative local treatment effect on real investment around the thresholds, implying that a binding CFC rule significantly increases effective capital costs. The only studies on CFC rules not using German data are Altshuler and Hubbard (2003) and Mutti and Grubert (2006). Altshuler and Hubbard (2003) show that tighter U.S. CFC rules restricted tax deferral by U.S. multinationals. Mutti and Grubert (2006) analyze the increased use of so-called 'check-the-box' rules, introduced in 1997, which allow U.S. multinationals to work around the United States' CFC rules.⁹

In comparison to CFC rules, thin-capitalization rules have received some more attention in the recent literature. From a theoretical perspective, Hong and Smart (2010) and Haufler and Runkel (2012) show that thin-capitalization rules can be used as an instrument to differentiate between the effective taxation of national and multinational firms. In a tax competition equilibrium, thin-capitalization rules will then be set inefficiently lax, in order to attract investment by multinational firms. Mardan (2017) analytically

⁸The only theoretical contribution of which we are aware is Weichenrieder (1996). He shows that CFC rules increase capital costs and decrease the foreign investment of home-based multinationals. His analysis does not endogenize CFC rules or other tax policies towards multinationals, however.

⁹'Check-the-box' rules give U.S.-based multinationals the option to create hybrid entities for tax purposes. Affiliates in tax havens are then treated as resident companies by their host governments, but are viewed as branches by the U.S. Internal Revenue Service, thus rendering the U.S. CFC rules ineffective. Blouin and Krull (2015) find that these 'check the box' regimes triggered a 6.4% reduction in effective tax rates for U.S. multinationals, in particular benefitting their non-U.S. income.

compares the effects of alternative thin-capitalization rules and shows that optimally set thin-capitalization rules become stricter as the level of financial development increases. From an empirical perspective, there is substantial evidence that thin-capitalization rules are effective in restricting internal borrowing and debt shifting, but they also have negative effects on real investment activity. Examples of this literature are Overesch and Wamser (2010), Büttner et al. (2012, 2016), and Blouin et al. (2014).

The remainder of this paper is organized as follows. Section 2 presents our model and derives the optimal financing and investment decisions of national and multinational firms. Section 3 turns to the optimal tax policy choices made by each country's government. Section 4 analyzes the effects of lower transaction costs for FDI and lower costs of profit shifting on the governments' optimal mix of thin-capitalization and CFC rules. Section 5 discusses several extensions of our main analysis. Section 6 concludes.

2 The model

2.1 The basic framework

We set up a model of two countries, a home country labeled h and a foreign country labeled f . Additionally, there exists a continuum of tax-haven countries offering preferential effective tax rates t_k , which are continuously distributed in the range $[0, 1)$. Capital is perfectly mobile across countries and countries h and f are small in world capital markets so that the rate of return to capital is fixed at $r > 0$.

There are two representative multinational companies (henceforth MNCs), one headquartered in each of countries h and f . Each MNC has a producing affiliate in both countries h and f , and a financial center in one of the tax-haven countries. We assume that all affiliates are fully owned by the parent company.¹⁰ While the MNC's producing subsidiaries are tied to the countries h and f , the MNC is completely flexible in choosing the tax haven in which it places its internal bank, and it can costlessly move from one tax haven to another in order to minimize its overall tax payment. While the assumption of zero relocation costs between tax havens is clearly a simplification, the physical presence of MNCs in tax-haven countries is typically minimized. The relocation costs for the MNC's internal bank can therefore be expected to be very low, in contrast to the relocation costs that would arise for the MNC's producing affiliates.

Furthermore, there is also one representative purely national firm in each country h

¹⁰For an analysis of debt shifting in the presence of variable ownership structures, see Schindler and Schjelderup (2012).

and f . The division between national firms and MNCs is exogenous to our analysis, arising for example from differential fixed costs of setting up an ‘internationalized’ organizational structure.¹¹

All firms use capital to produce a homogeneous output good that is sold in the world market at a price normalized to one. The good is produced with capital and some fixed factor, leading to a production function with positive but decreasing returns to investment. Production technologies are allowed to differ between national firms and MNCs, but are the same for all affiliates of MNCs. For the national firms, the capital use is denoted by d_i , with $i \in \{h, f\}$, and production is given by $g(d_i)$. For the MNCs, capital use is k_i^j , where the superscript j denotes the ownership country (the country where the headquarters reside) and the subscript i indicates the country where capital is employed. Production by affiliates of the MNCs is given by $f(k_i^j)$.

For simplicity, our analysis ignores external capital markets and assumes that all firms can raise sufficient equity to finance their optimal investment levels. MNCs can, however, place their equity in the tax-haven affiliate, which then becomes an internal bank and grants internal loans to the affiliates in countries h and f . This generates interest income in the tax haven but deductible interest expenses in countries h and f , in total leading to aggregate tax savings for the MNC.¹² Our analysis thus focuses on these tax-related internal borrowing decisions, which empirically are one of the main channels by which profits are transferred from high-tax to low-tax countries (see Egger et al., 2014, for recent evidence). In this context, we ask under which conditions CFC rules are employed to supplement thin-capitalization rules, which are the primary policy instrument to address debt shifting in MNCs.¹³

The governments of countries $i, j \in \{h, f\}$ can deploy three different tax instruments, in order to simultaneously attract FDI and minimize the tax revenue losses from profit shifting. These are (i) the statutory corporate tax rate t_i ; (ii) a thin-capitalization rule limiting the deductibility of interest to a ‘safe-harbor’ debt-to-asset ratio λ_i ; and (iii) a CFC rule that taxes the MNC’s passive income in the headquarters country j whenever

¹¹This follows most of the literature on discriminatory tax competition, which assumes exogenous differences in the international mobility of capital tax bases. For an analysis that endogenizes the degree of international firm mobility, see Bucovetsky and Haufler (2008).

¹²In our setting, internal debt is therefore used exclusively in order to save taxes. For an analysis where internal debt also serves to overcome capital market imperfections, see Mardan (2017).

¹³A different channel by which MNCs shift profits to low-tax countries is through transfer pricing. The primary instrument to address this form of profit shifting is the enforcement of the *arm’s length principle*. As arms-length taxation will generally not be able to eliminate all profit shifting, however (see, e.g., Keuschnigg and Devereux, 2013), it may also have to be supplemented by CFC legislation. In such a setting, we would expect that CFC rules are part of the optimal policy mix under conditions that are very similar to the ones derived here.

the tax rate for the MNC’s internal bank (i.e., the tax rate t_k of the chosen tax haven) falls below a minimum threshold τ^j .

More specifically, the thin-capitalization rule permits *all* MNCs investing in a host country i to shift internal interest payments to the affiliate in the tax haven up to a safe-harbor ratio $0 \leq \lambda_i \leq 1$ of (internal) debt to capital employed (see footnote 3). As long as this safe-harbor ratio is not exceeded, we assume that the internal loan transaction with the tax-haven affiliate is not associated with any transaction costs for the firm. Hence, given the tax savings, affiliates will always find it optimal to engage in internal lending until the safe-harbor share λ_i of internal interest payments is exhausted.

If financial leverage exceeds the safe-harbor ratio, tax deductibility on ‘excessive’ interest expenses would be denied by the thin-capitalization rule. However, MNCs typically have additional ways to ‘stretch’ existing thin-capitalization rules, for example by utilizing holding structures for which higher leverage ratios are permitted (Weichenrieder and Windischbauer, 2008). Another option is to misdeclare internal debt as external debt, which is fully deductible under most thin-capitalization rules, and to disguise the ownership in the internal bank.¹⁴ Such restructuring will, however, cause additional costs for the MNC, which we call ‘concealment costs’ in the following. Hence, in excess of the safe-harbor share of internal debt λ_i that is covered by the thin-capitalization rule, affiliates will be able to deduct a further, endogenous share β_i^j of their capital costs in the host country by means of internal debt shifting to a tax haven. Therefore, a MNC based in country j and investing in country i realizes a total amount of (gross) tax savings in country i equal to $t_i r(\lambda_i + \beta_i^j)k_i^j$ by shifting debt to a tax haven.

CFC rules allow governments to limit these tax advantages that the *home-based* MNC obtains from internal leverage. They reserve the right of tax authorities in the MNC’s parent country to tax the profits of an affiliate in a tax haven by adding this affiliate’s income (or a part of it) to the profits declared in the parent country.¹⁵ CFC rules apply when the affiliate in the tax haven is only lightly taxed, and when its primary activity is to provide debt or patent services to other affiliates in the same corporate group, that is when it generates so-called passive income. Typically, CFC rules stipulate a minimum effective tax rate τ^j that must be levied in a host country, in order to avoid additional taxation in the parent country. This instrument applies to both the internal debt within

¹⁴See Ruf and Schindler (2015), sections 2.1 and 3.1 for a detailed discussion of these strategies. In line with these arguments, empirical studies indicate that many MNCs are able to deduct interest payments in excess of the limitations imposed by thin-capitalization rules; see, e.g., Blouin et al. (2014).

¹⁵CFC rules come in two different variants. Under the “tainted income approach” only the passive income of the low-tax affiliate is added to the tax base of the parent company. Under the “pro-rata approach” both passive and active income of the low-tax affiliate is added to the parent’s tax base, but only in proportion to the parent’s ownership share. In our model these two approaches coincide, because the tax-haven affiliate earns only passive income, and it is fully owned by the parent company.

the limit of the legally stipulated thin-capitalization rule λ_i , and to the firm's optimal level of 'excess' leverage β_i^j .

Under our assumptions that an infinite number of tax havens with varying tax rates exists, and that the MNC can costlessly switch between them, the MNC will always locate its internal bank in a tax-haven country k whose statutory tax rate t_k is equal to the lowest possible tax rate τ^j that just avoids the CFC rules of its home country j . Hence, the tax rate τ^j , specified in the CFC rule, will also be the tax rate that the MNC pays, in equilibrium, in the tax-haven country. In the presence of a binding CFC rule, the (net) tax gain from debt shifting for a MNC affiliate based in country j and investing in country i is thus reduced to $(t_i - \tau^j)r(\lambda_i + \beta_i^j)k_i^j$.

The statutory tax rate, the thin-capitalization, and the CFC rule then jointly affect two decision margins of the MNC: (i) the investment levels in each of the countries h and f ; and (ii) the use of internal debt in financing its producing affiliates.

2.2 Firms' decision problems

National firms. Unlike MNCs, purely national firms do not have the opportunity to use internal debt as a tax-planning instrument. The cost of capital r can not be deducted from the tax base, and hence, the corporate tax combines a tax on profits with a 'pure' capital tax. The optimization problem of the national firms reduces to the decision on the investment level d . Profits of the national firms are

$$\pi_i^d = (1 - t_i)g(d_i) - rd_i. \quad (1)$$

The optimal investment level is then implicitly defined by the first-order condition

$$(1 - t_i)g'(d_i) = r. \quad (2)$$

A higher statutory tax rate t_i affects the investment levels of national firms by

$$\frac{\partial d_i}{\partial t_i} = \frac{g'(d_i)}{(1 - t_i)g''(d_i)} < 0 \quad \forall i \in \{h, f\}. \quad (3)$$

Since the costs of financing the investment are not tax-deductible for national firms, but the returns from the investment are taxed, a higher statutory tax rate induces national firms to reduce their investment levels. The governments' remaining tax instruments do not affect national firms.

Multinational firms. Under the ruling international standard of separate accounting, profits are considered separately for each entity of a MNC. For a MNC that is headquartered in country j and has an affiliate in country i , affiliates' net profits are

$$\pi_i^j = (1 - t_i)f(k_i^j) - \rho_i^j k_i^j - \mathbb{1}sk_i^j, \quad (4)$$

where ρ_i^j are the effective capital costs of the affiliate, which are derived below. The indicator variable $\mathbb{1}$ takes on the value of unity if $i \neq j$ and zero otherwise, implying that FDI causes additional transaction costs s per unit of capital invested. These costs incorporate additional information costs, or monitoring costs that are higher when the manager's division is geographically separated from the firm's headquarters (Grossman and Helpman, 2004).¹⁶ This gives rise to a 'home bias' in our model where, in equilibrium, the home affiliate of the home-based MNC chooses a higher investment level than the home affiliate of the foreign-based MNC.

The MNC's capital costs in a host country i are reduced by the tax deductibility of internal debt. As described above, the net tax gain per unit of internal debt in the presence of a binding CFC rule imposed by the MNC's parent country j is $(t_i - \tau^j)r$. The amount of internal debt that is shifted to the tax haven depends on the share of internal debt λ_i that is tax-deductible under the thin-capitalization rule, and on the excess leverage β_i^j . The latter, however, causes concealment costs that reduce the net gain from the extra leverage and increase the capital cost. Concealment costs are assumed to be a linear function of the capital costs and a convex function of the extra leverage share β_i^j and are given by $C_i^j = (\delta/n)(\beta_i^j)^n r k_i^j$, where $n > 1$. With these specifications, the capital costs of an affiliate of MNC j in country i per unit of investment k_i^j are¹⁷

$$\rho_i^j = \left[1 - (t_i - \tau^j)(\lambda_i + \beta_i^j) + \frac{\delta}{n}(\beta_i^j)^n \right] r. \quad (5)$$

Since the capital costs do not depend on the investment level, we can solve the MNC's maximization problem sequentially. We first derive the MNC's profit-maximizing financial structure and then turn to the MNC's decision on how much to invest and produce in each country, given the minimized capital cost. The MNC's optimal leverage ratio is obtained

¹⁶Introducing transaction costs for FDI is consistent with empirical evidence showing that FDI is falling in the distance between the home and the foreign affiliate of MNCs (Egger and Pfaffermayr, 2004; Kleinert and Toubal, 2010).

¹⁷From eq. (5), we see that the investment costs of an affiliate in country i would be fully tax-deductible, leading to effective capital costs of $\rho_i^j = (1 - t_i)r$, if the headquarters country allowed the internal bank to be placed in a tax haven with a zero tax rate ($\tau^j = 0$) and if there is no binding thin-capitalization rule so that $\lambda_i = 1$. In this case, the affiliate would not have an incentive to use any extra leverage ($\beta_i^j = 0$) and consequently would not incur any concealment costs.

by differentiating the effective capital cost in eq. (5) with respect to β_i^j , giving

$$\beta_i^j = \left(\frac{t_i - \tau^j}{\delta} \right)^{\frac{1}{(n-1)}}. \quad (6)$$

From eq. (6), the effects of the host country's corporate tax rate and the headquarters country's CFC rule on the affiliate's optimal leverage ratio are

$$\frac{\partial \beta_i^j}{\partial t_i} = \frac{1}{(n-1)} \left[\frac{(t_i - \tau^j)^{2-n}}{\delta} \right]^{\frac{1}{(n-1)}} > 0, \quad \frac{\partial \beta_i^j}{\partial \tau^j} = -\frac{\partial \beta_i^j}{\partial t_i} < 0. \quad (7)$$

The response of β_i^j to changes in the tax parameters t_i and τ^j is best seen when considering the special case of $n = 2$. In this case the derivative simplifies to $\partial \beta_i^j / \partial t_i = 1/\delta$ and the response of the excess leverage to changes in the net tax gain factor ($t_i - \tau^j$) is simply given by the inverse of the concealment cost parameter δ .

Using eq. (6) in (5) gives the effective capital cost under the optimized financial structure:

$$(\rho_i^j)^* = \left\{ 1 - (t_i - \tau^j)\lambda_i - \frac{(n-1)}{n} \left[\frac{(t_i - \tau^j)^n}{\delta} \right]^{\frac{1}{n-1}} \right\} r. \quad (8)$$

From eq. (8), we can derive the effects of all tax instruments on the effective capital costs of each affiliate. In country h , three different entities of MNCs need to be considered: the home affiliate of the home-based MNC, the home affiliate of the foreign-based MNC, and the foreign affiliate of the home-based MNC. The effect of the home country's tax parameters t_h , λ_h and τ^h on these three firm types are

$$\frac{\partial \rho_h^h}{\partial t_h} = -(\lambda_h + \beta_h^h)r, \quad \frac{\partial \rho_h^h}{\partial \lambda_h} = -(t_h - \tau^h)r, \quad \frac{\partial \rho_h^h}{\partial \tau^h} = (\lambda_h + \beta_h^h)r; \quad (9a)$$

$$\frac{\partial \rho_h^f}{\partial t_h} = -(\lambda_h + \beta_h^f)r, \quad \frac{\partial \rho_h^f}{\partial \lambda_h} = -(t_h - \tau^f)r, \quad \frac{\partial \rho_h^f}{\partial \tau^h} = 0; \quad (9b)$$

$$\frac{\partial \rho_f^h}{\partial t_h} = 0, \quad \frac{\partial \rho_f^h}{\partial \lambda_h} = 0, \quad \frac{\partial \rho_f^h}{\partial \tau^h} = (\lambda_f + \beta_f^h)r. \quad (9c)$$

Turning first to the effects on the home-based MNC's home affiliate in eq. (9a), we see that an increase in country h 's statutory tax rate lowers the effective capital costs, because it increases the value of deducting (internal) debt from the corporate tax base. Similarly, a more lenient thin-capitalization rule reduces the cost of capital by decreasing the corporate tax base. Finally, an increase in τ^h , which implies a tightened CFC rule, decreases the gains from debt shifting and therefore raises the effective capital costs.

Equation (9b) shows the tax effects on the foreign-based MNC's affiliate in the home

country h . Changes in h 's statutory tax rate t_h and in the thin-capitalization rule λ_h affect the capital costs of the foreign-based MNC in a way analogous to the home-based MNC [see eq. (9a)]. However, the foreign-based MNC is not affected by a change in country h 's CFC rule τ^h . Finally, the tax effects on the home-based MNC's affiliate in the foreign country f are given in eq. (9c). This shows that neither the statutory tax rate t_h nor the thin-capitalization rule λ_h affect the capital costs of this affiliate. However, country h 's CFC rule applies to the home-based MNC's affiliate in the foreign country. Thus, an increase in τ^h increases the effective capital costs of this affiliate.

We now turn to the MNCs' investment decisions, given the optimized financial structure. Maximizing profits in eq. (4) implicitly determines optimal investment by

$$(1 - t_i)f'(k_i^j) - \rho_i^j - \mathbb{1}s = 0 \quad \forall i, j = h, f. \quad (10)$$

An increase in the effective capital costs ρ_i^j decreases investment by

$$\frac{\partial k_i^j}{\partial \rho_i^j} = \frac{1}{(1 - t_i)f''(k_i^j)} < 0 \quad \forall i, j = h, f. \quad (11)$$

Note here that the per-unit transaction cost s does not affect the sensitivity with which the MNC's investment responds to changes in the cost of capital.

Applying the implicit function theorem on the first-order condition (10) and using eqs. (9a)–(9c) delivers the effects of the home country's statutory tax rate t_h on the investment decision of each MNC:

$$\frac{\partial k_h^j}{\partial t_h} = \frac{f'(k_h^j) - (\lambda_h + \beta_h^j)}{(1 - t_h)f''(k_h^j)} < 0, \quad j = h, f; \quad \frac{\partial k_f^h}{\partial t_h} = 0. \quad (12)$$

Similar to purely national firms, the statutory tax rate t_h negatively affects investment levels for all affiliates located in country h , because not all costs of capital can be deducted. However, the investment of the foreign affiliate of the home-based MNC is not affected by the home country's statutory tax rate. The investment effects of the other tax instruments (λ_h and τ^h) result from their effects on the capital costs of different MNC entities given in (9a)–(9c), in combination with the negative effect of (firm-specific) capital costs on investment levels in (11).

Finally, from condition (10), a rise in the transaction costs of FDI changes the investment levels of the home-based and foreign-based MNCs by

$$\frac{\partial k_i^j}{\partial s} = \frac{1}{(1 - t_i)f''(k_i^j)} < 0, \quad i \neq j, \quad \frac{\partial k_i^i}{\partial s} = 0. \quad (13)$$

Larger transaction costs reduce the foreign-based MNC's investment incentives and hence inward FDI, but do not affect investment by the home-based MNC. Therefore, they result in an increased 'home bias'. Moreover, since home and foreign affiliates respond in the same way to changes in capital costs ρ [eq. (11)], the lower investment level of the foreign-owned affiliate implies that the *elasticity* with which this affiliate responds to a change in its effective capital cost exceeds that of the home affiliate of the home-based MNC.

3 Optimal tax policy

In our general model, we define welfare in country h as a weighted average of domestic tax revenue and the sum of the profits of national firms and the home-based MNC.¹⁸ Thus,

$$W_h = t_h \cdot T_h + \gamma \cdot \Pi^h, \quad (14)$$

where T_h is the total tax base in the home country, $\Pi^h = \pi_d + \pi_h^h + \pi_f^h$ are the total profits of firms headquartered in h , and $0 \leq \gamma \leq 1$ is the relative welfare weight placed on domestically owned firms' profits. The welfare discount on firms' profits either reflects the fact that raising corporate tax revenue is important for society (for redistributive reasons, or to reduce other distortive taxes), or that domestic firms are partly owned by third-country investors that do not enter the domestic welfare function. For $\gamma = 0$, we would have a Leviathan government that is solely interested in maximizing its tax revenue.

The domestic tax base T_h is given by the sales of all entities producing in country h , less the permitted deduction of internal debt for the home affiliates of the home-based and foreign-based MNCs:

$$T_h = g(d_h) + f(k_h^h) - (\lambda_h + \beta_h^h)rk_h^h + f(k_h^f) - (\lambda_h + \beta_h^f)rk_h^f. \quad (15)$$

The home government (and analogously the foreign government) maximizes national welfare in eq. (14) by choosing the statutory tax rate t_h , the thin-capitalization rule λ_h and the CFC rule τ^h , subject to the optimal financing and investment decisions of the different firm types discussed in the previous section.

Optimal statutory tax rate. All firm types in country h are affected by changes in its statutory tax rate. Differentiating the welfare function with respect to t_h implicitly

¹⁸Note that consumers in the home country are not affected by tax policy in our model, because the price of the single output good is determined in the large world market.

determines the optimal statutory tax rate:

$$\begin{aligned}
\frac{\partial W_h}{\partial t_h} &= (1 - \gamma) [g(d_h) + f(k_h^h) - (\lambda_h + \beta_h^h)r k_h^h] + [f(k_h^f) - (\lambda_h + \beta_h^f)r k_h^f] \\
&+ t_h \left\{ g'(d_h) \frac{\partial d_h}{\partial t_h} + [f'(k_h^h) - (\lambda_h + \beta_h^h)r] \frac{\partial k_h^h}{\partial t_h} + [f'(k_h^f) - (\lambda_h + \beta_h^f)r] \frac{\partial k_h^f}{\partial t_h} \right\} \\
&- t_h r \left(\frac{\partial \beta_h^h}{\partial t_h} k_h^h + \frac{\partial \beta_h^f}{\partial t_h} k_h^f \right) = 0. \tag{16}
\end{aligned}$$

The first-order condition (16) states that raising the statutory tax rate t_h increases welfare in country h due to the net gain $(1 - \gamma)$ from taxing domestic profits (the first term on the right-hand side) and from the taxation of the foreign-based MNC's profits (the second term). However, a higher statutory tax rate also reduces the domestic tax base, and hence tax revenues, as a result of lower investments by all firms that operate in the home market (the third term). Finally, the tax base of the home country is further reduced because all affiliates of MNCs operating in country h have an incentive to increase the variable internal debt level β_i^j (the fourth term).

Evaluating condition (16) at $t_h = 0$ shows that the negative third and fourth terms vanish at this point, and hence $\partial W_h / \partial t_h$ is unambiguously positive at $t_h = 0$. Therefore, the statutory tax rate will always be positive in the government's tax optimum, $t_h^* > 0$.

Optimal thin-capitalization rule. For any statutory tax rate $t_h > 0$, the introduction of a thin-capitalization rule $\lambda_h > 0$ (i.e., granting some tax deductibility of internal debt) reduces the tax base of the MNCs, but it does not affect purely national firms. Thus, the thin-capitalization rule allows governments to tax discriminate between purely national firms and MNCs. Differentiating the welfare function (14) with respect to λ_h leads to

$$\begin{aligned}
\frac{\partial W_h}{\partial \lambda_h} &= t_h \left\{ [f'(k_h^h) - (\lambda_h + \beta_h^h)r] \frac{\partial k_h^h}{\partial \rho_h^h} \frac{\partial \rho_h^h}{\partial \lambda_h} + [f'(k_h^f) - (\lambda_h + \beta_h^f)r] \frac{\partial k_h^f}{\partial \rho_h^f} \frac{\partial \rho_h^f}{\partial \lambda_h} \right\} \\
&- t_h r \left(k_h^h + k_h^f \right) - \gamma k_h^h \frac{\partial \rho_h^h}{\partial \lambda_h} \leq 0. \tag{17}
\end{aligned}$$

The first term on the right-hand side of the first-order condition (17) is positive, as an increase in λ_h reduces the effective capital costs and thus induces the home affiliates of the home-based and foreign-based MNCs to expand their investment in the home country [see eq. (11)]. The second term is negative, however, as a more generous thin-capitalization rule allows MNCs to deduct a higher share of their financing costs from the corporate tax base. Finally, the third term is positive again, as a reduction in its capital costs increases the profits of the home-based MNC's home affiliate.

In sum, the optimal thin-capitalization rule balances the gains from increased investment by MNCs against the net welfare cost of a reduced tax base. To obtain a strictly positive deductibility of internal debt $\lambda_h^* > 0$ in the optimum, the investment by MNCs in country h must be sufficiently responsive to tax incentives, i.e., $\partial k_h^j / \partial \rho_h^j$, $j \in \{h, f\}$ must be sufficiently large.¹⁹ If this is the case, the government will find it optimal to tax discriminate in favor of MNCs vis-à-vis purely national firms by selectively narrowing the tax base for the former group. Moreover, the thin-capitalization rule will be the more generous (λ_h is higher), the higher is the welfare weight of firms' profits (γ) in the government's objective function. We summarize in:

Proposition 1 *In the tax optimum, the government will tax discriminate between national firms and MNCs by setting a thin-capitalization rule that allows a positive deductibility of internal debt ($\lambda_h > 0$), if MNCs' investments react sensitively to the reduction in effective capital costs.*

Note that we have imposed the restriction on governments that thin-capitalization rules must be identical for home-based and foreign-based MNCs (see footnote 3). Conceptually, however, we can separate the effects that the thin-capitalization rule has on the home-based and the foreign-based MNC, respectively. Assuming that λ_h is positive in the policy optimum (cf. Proposition 1), we can then rewrite condition (17) as $\Delta^h + \Delta^f = 0$, where we define:

$$\Delta^h \equiv [f'(k_h^h) - (\lambda_h + \beta_h^h)r] \frac{\partial k_h^h}{\partial \rho_h^h} \frac{\partial \rho_h^h}{\partial \lambda_h} - rk_h^h - \gamma \frac{k_h^h}{t_h} \frac{\partial \rho_h^h}{\partial \lambda_h}, \quad (18a)$$

$$\Delta^f \equiv [f'(k_h^f) - (\lambda_h + \beta_h^f)r] \frac{\partial k_h^f}{\partial \rho_h^f} \frac{\partial \rho_h^f}{\partial \lambda_h} - rk_h^f. \quad (18b)$$

With symmetry (i.e., $\tau^h = \tau^f$) and in the presence of transaction costs $s > 0$, the positive first term is unambiguously larger in eq. (18b) as compared to eq. (18a). This follows from the presence of a 'home bias' ($k_h^f < k_h^h$) and the concavity of the production function, which implies a larger marginal return to investment for the foreign-based MNC. At the same time, the investment sensitivity with respect to a change in the capital cost is the same for the two MNCs [see eq. (11)]. Moreover, since investment is lower for the foreign-based MNC, the negative second term in eq. (18b) is smaller than in eq. (18a). Together these two terms capture the fact that the elasticity of investment with respect to changes in capital costs is larger for the foreign-based than for the home-based MNC. Therefore, if differentiated thin-capitalization rules were permitted, the home country could attract

¹⁹See Haufler and Runkel (2012, Proposition 2) for a similar condition in a setting with thin-capitalization rules only.

inward FDI more efficiently by setting a more lenient thin-capitalization rule (a higher level of λ_h) for the foreign-based MNC, provided that the welfare weight of domestic profits [the positive last term in eq. (18a)] is sufficiently low. Indeed, such a discriminatory thin-capitalization policy would always be optimal for a Leviathan government ($\gamma = 0$).

In this case, a *common* thin-capitalization rule will thus imply a higher level of λ_h than would be optimal for the home-based MNC only, but a lower level of λ_h than would be optimal for the foreign-based MNC. Evaluating the two shadow values in eqs. (18a) and (18b) at a common thin-capitalization rule for both MNCs must then yield $\Delta^h < 0 < \Delta^f$. We will use this result in our interpretation of the optimal CFC rule, to which we turn now.

Optimal CFC rule. The CFC rule reduces the net tax gain from internal debt by increasing the tax rate in the MNC's internal bank. Consequently, such a rule not only raises the cost of capital for the home affiliate but also for the foreign affiliate of the home-based MNC and thus deters outward FDI. Therefore, the question arises as to why the government should use a CFC rule alongside an optimized thin-capitalization rule.

Differentiating the welfare function (14) with respect to τ^h results in

$$\begin{aligned} \frac{\partial W_h}{\partial \tau^h} &= -t_h \frac{\partial \beta_h^h}{\partial \tau^h} r k_h^h + t_h [f'(k_h^h) - (\lambda_h + \beta_h^h)r] \frac{\partial k_h^h}{\partial \rho_h^h} \frac{\partial \rho_h^h}{\partial \tau^h} \\ &\quad - \gamma [k_h^h (\lambda_h + \beta_h^h) + k_f^h (\lambda_f + \beta_f^h)] r \leq 0. \end{aligned} \quad (19)$$

The first term on the right-hand side is positive, showing that a tighter CFC rule increases tax revenues in the home country by reducing the extra leverage β_h^h that the home affiliate of the home-based MNC chooses in its financial optimum. In contrast, the second term is negative, because a tighter CFC rule increases the effective capital costs of the home-based MNC's home affiliate and this reduces investment and tax revenues. Finally, the third term is also negative as all affiliates of the home-based MNC lose profits due to their higher costs of capital.

The first-order condition for the CFC rule can be linked to our previous discussion that the government would like to tax discriminate between foreign-based and home-based MNCs. Using the optimal thin-capitalization rule in an interior optimum [eqs. (17) and (18b)] along with eqs. (9a)–(9c), the first-order condition for the CFC rule in (19) can be rewritten as

$$t_h r k_h^h \left[\left(-\frac{\partial \beta_h^h}{\partial \tau^h} \right) - \frac{(\lambda_h + \beta_h^h)}{(t_h - \tau^h)} \right] + t_h \Delta^f \frac{(\lambda_h + \beta_h^h)}{(t_h - \tau^h)} - \gamma k_f^h (\lambda_f + \beta_f^h) r \leq 0. \quad (20)$$

The first term in eq. (20) combines the positive effect of a tighter CFC rule on the home country's tax base with the negative effect that results from the lower investment incentives for the home-based MNC. This term is more likely to be positive, on net, if the home-based MNC's excess leverage responds elastically to changed tax gains from placing its internal bank in a tax haven. As we have discussed above [eq. (7)], this elasticity will be the larger, the smaller is the MNC's cost (δ) of concealing excess leverage from tax authorities. The second term is positive in the presence of a sufficiently strong 'home bias', which implies $\Delta^f > 0$ from our discussion of eqs. (18a)–(18b). Thus, besides the motive to curb profit shifting, the home government's incentive to implement a binding CFC rule also arises from the motive to tax discriminate between foreign-based and home-based MNCs. This can be achieved by means of the CFC rule, because this rule increases the effective capital cost of the home-based, but not of the foreign-based MNC. The more pronounced is the 'home bias', and hence the larger is Δ^f , the more likely is the government to implement a binding CFC rule. Finally, the intuition for the negative third term is the same as in condition (17), because a higher weight on the home-based MNC's profits earned abroad reduces the incentive to set a strict CFC rule. We summarize in:

Proposition 2 *In the tax optimum, the government is more likely to set a binding CFC rule ($\tau^h > 0$), if (i) the home-based MNC's financing structure responds elastically to the increase in capital costs; (ii) transaction costs for FDI are high and the CFC rule serves as an instrument to tax discriminate between home-based and foreign-based MNCs; (iii) the welfare weight on profits in the government's objective function is low.*

Condition (i) in Proposition 2 is supported by recent empirical evidence from Egger et al. (2014), which indicates that debt shifting in MNCs responds highly elastically to tax incentives. For a panel of German-owned MNCs, the authors find that a one percentage point increase in the host country's tax rate raises the internal-debt-to-capital ratio of the borrowing affiliate by 0.92 percentage points.

Condition (ii) indicates that CFC rules are less likely to be part of an optimal tax system when transaction costs for FDI fall and the need to differentiate between the effective taxation of home-based and foreign-based MNCs is therefore reduced. This could explain, for example, why the United States have weakened their existing CFC rules ('subpart F rules') by introducing the 'check-the-box' regime (see footnote 9). The relative importance of the capital stock from inward FDI (k_h^f) has significantly increased in the United States during the last three decades, indicating falling transaction costs for FDI.²⁰

²⁰The FDI inward capital stock, as a percentage of GDP, has roughly tripled in the United States since 1990 (UNCTAD 2016, Annex Table 7). In contrast, the total capital stock, as a share of GDP, has remained roughly constant.

From eq. (18b), this reduces Δ^f and hence the incentive to use CFC rules as a way to increase the taxation of home-based vis-à-vis foreign-based MNCs.

Condition (iii) reinforces this argument when, for a positive welfare weight $\gamma > 0$, foreign investment and hence the foreign-earned profits of home-based MNC's increase. Grubert (2012) documents, for a sample of more than 750 U.S.-owned MNCs, that their average pre-tax share of profits earned abroad has increased from 37 percent in 1996 to 51 percent in 2004. Recall that a binding CFC rule reduces the profits of all affiliates of the home-based MNC, but additional domestic tax revenue is collected only from the affiliate in the home country. Therefore, as the profit share of foreign affiliates increases, a CFC rule becomes relatively less attractive from the perspective of the MNC's parent country. Accordingly, condition (iii) can also potentially explain why the U.S. government has relaxed its existing CFC rules by means of check-the-box provisions.

Putting Propositions 1 and 2 together, the optimal thin-capitalization rule discriminates between purely national firms' and MNCs' investment, whereas the optimal CFC rule introduces a second tax discrimination between the investments of home-based and foreign-based MNCs. In the following, we assume that the home and the foreign countries set interior values of both λ_i and τ^j in their policy optimum. Table 1 reveals that many countries do indeed simultaneously employ binding CFC rules and binding thin-capitalization rules. Starting from such an interior optimum, we then analyze how reduced transaction costs for FDI on the one hand, and reduced costs for profit shifting on the other, affect the optimal mix of countries' tax policies vis-à-vis MNCs.

4 Increased mobility of FDI and financial flows

Our model incorporates two exogenous parameters that can be utilized to capture two major changes in economic conditions that have occurred in recent decades. A first development is the strong increase in FDI. Worldwide, the inward stock of FDI, as a percentage of GDP, has more than tripled in the last 25 years, from less than 10% in 1990 to more than 33% in 2015 (UNCTAD 2016, Annex Table 7). This development is captured in our model by a fall in the transaction cost parameter for FDI, denoted by s , which corresponds to a reduction in the 'home bias' of MNCs' investments. In the following we will label a reduction in s as 'increased mobility of FDI'.

A second important development is that MNCs shift an increasing share of their profits to tax havens, in order to minimize their overall tax payments. Zucman (2014), for example, documents that 20% of the total profits of U.S. firms accrued in tax havens in 2014, representing a tenfold increase since the 1980s. In our model, this is captured

by a fall in the concealment cost parameter δ , which characterizes the ease with which MNCs can build up excess leverage and shift interest payments to their preferred tax haven. A reduction in δ is termed ‘increased financial mobility’ in what follows.

To analytically determine the comparative-static effects of changes in s and δ on the simultaneous choices of the thin-capitalization rule λ_h and the CFC rule τ^h , we need to make some simplifying assumptions. First, we focus on a Leviathan government that maximizes tax revenues only, and thus set the weight of firms’ profits in the government’s objective (14) at $\gamma = 0$. Moreover, we assume that countries h and f are fully symmetric and treat $f''(k)$ as a constant. Finally, we fix the statutory tax rate t_h in our analytical derivations and focus only on the two endogenous tax-base parameters λ_h and τ^h .²¹

Totally differentiating the first-order conditions for λ_h and τ^h in (17) and (19) leads to:

$$\begin{bmatrix} \alpha_1 & \alpha_2 \\ \alpha_3 & \alpha_4 \end{bmatrix} \begin{bmatrix} d\lambda_h \\ d\tau^h \end{bmatrix} = \begin{bmatrix} \alpha_5 \\ 0 \end{bmatrix} ds + \begin{bmatrix} \alpha_6 \\ \alpha_7 \end{bmatrix} d\delta, \quad \text{where} \quad (21)$$

$$\begin{aligned} \alpha_1 &= \frac{\partial^2 W^h}{\partial(\lambda_h)^2} < 0, & \alpha_2 &= \frac{\partial^2 W^h}{\partial\lambda_h\partial\tau^h} = \frac{\partial^2 W^h}{\partial\tau^h\partial\lambda_h} = \alpha_3 > 0, & \alpha_4 &= \frac{\partial^2 W^h}{\partial(\tau^h)^2} < 0, \\ \alpha_5 &= \frac{\partial^2 W^h}{\partial\lambda_h\partial s} < 0, & \alpha_6 &= \frac{\partial^2 W^h}{\partial\lambda_h\partial\delta} < 0, & \alpha_7 &= \frac{\partial^2 W^h}{\partial\tau^h\partial\delta} > 0. \end{aligned} \quad (22)$$

The terms α_1 to α_7 are derived and signed in eqs. (A.1) and (A.4) in Appendix A, under the condition that FDI transaction costs s are not too large in the initial equilibrium.²²

Increased mobility of FDI. We start by analyzing how a change in the FDI transaction cost parameter s affects the equilibrium policies. Applying Cramer’s rule to the equation system (21) and using the signed terms in (22), we immediately arrive at

$$\frac{d\lambda_h}{ds} = \frac{\alpha_4\alpha_5}{|A|} > 0; \quad \frac{d\tau^h}{ds} = -\frac{\alpha_3\alpha_5}{|A|} > 0, \quad (23)$$

where $|A| = \alpha_1\alpha_4 - \alpha_2\alpha_3 > 0$ must hold to obtain a local maximum (see the appendix).

Hence a *reduction* in the transaction costs for FDI leads to a tighter thin-capitalization rule (a fall in λ_h), but also to a less strict CFC rule (a fall in τ^h) in the government’s policy optimum. The intuition for the change in the optimal thin-capitalization rule is as follows. The fall in the FDI cost parameter s increases the level of inward FDI from eq. (13). Thus, it increases the fiscal cost for the home government of granting a generous

²¹These simplifying assumptions are relaxed again in the extensions analyzed in Section 5.

²²The appendix also shows that an interior solution for τ^h in our setting requires that the concealment cost function is not too convex and $1 < n < 2$.

deductibility of interest to the home affiliate of the foreign-based MNC by means of a high level of λ_h . At the same time, the fall in s does not change the investment response of this affiliate to its capital costs ρ_h^f [see eq. (11)] and therefore does not change the ‘benefits’ for the home country of granting a higher deductibility of internal debt. In sum, this gives each government an incentive to tighten its thin-capitalization rule when transaction costs for FDI fall.

At the same time, a reduction in the ‘home bias’ of MNCs’ investments reduces the incentive for governments to tax discriminate between home-based and foreign-based MNCs; i.e., it reduces the value of Δ^f in the second term of (20).²³ This implies that, given the optimal adjustment of λ_h , there is less need to selectively increase the effective tax rate for the home-based MNC by means of CFC regulation. At the same time, reduced FDI costs have no direct effect on the sensitivity with which financial flows respond to tax incentives and therefore do not affect the first term in (20). Hence, it will be optimal for each country to relax its CFC rule by lowering τ^h . We summarize these findings in:

Proposition 3 *Increased mobility of FDI (a fall in s) leads to stricter thin-capitalization rules (λ_h falls) and to laxer CFC rules (τ^h falls), if governments maximize tax revenues and the transaction cost parameter s is sufficiently low initially.*

Increased financial mobility. The effects of a change in the income shifting cost parameter δ are more involved, because this parameter directly affects the first-order conditions of both optimal policy instruments λ_h and τ^h . In Appendix A [eqs. (A.7) and (A.9)], we show that

$$\frac{d\lambda_h}{d\delta} = \frac{\alpha_4\alpha_6 - \alpha_2\alpha_7}{|A|} > 0, \quad \frac{d\tau^h}{d\delta} = \frac{\alpha_1\alpha_7 - \alpha_3\alpha_6}{|A|} < 0, \quad (24)$$

where $|A| > 0$ as before.

Consequently, falling costs of income shifting lead to both a tighter thin-capitalization rule (λ_h falls) and a tighter CFC rule (τ^h rises). The direct effect on the optimal CFC rule in eq. (20) is straightforward. A lower level of δ will increase the excess leverage ratio β for any given set of optimal policies, implying that a tightening of the CFC rule will have a larger beneficial effect on tax revenues [see eq. (7)]. Accordingly, the first term in (20) becomes larger (and more likely to be positive) when δ is reduced. In contrast, the motive to tax discriminate between the home-based and the foreign-based MNCs [the

²³Recall from our discussion of (18b) that $\Delta^f > 0$ always holds when the home-based MNC’s profits do not enter the government objective function ($\gamma = 0$). This is what we assume here.

second term in (20)] is not directly affected by a change in δ . In sum, the net benefit from tightening the CFC rule is increased and τ^h accordingly rises by the direct effect.

Turning to the optimal thin-capitalization rule, the rise in β following a reduction in the parameter δ implies that the positive first term in the first-order condition (17) becomes smaller. Intuitively, if β is increased, there is less additional revenue to be gained from a given increase in investment that is induced by a more generous thin-capitalization rule. At the same time, the negative effect on the domestic tax base caused by a more generous thin-capitalization rule [the second term in (17)] is unchanged. Therefore, the direct effect of a fall in δ calls for a tightening of the thin-capitalization rule.

The complication in signing the total effects in (24) arises from the fact that the tightening of each policy instrument λ_h and τ^h leads to an indirect effect that tends to work in the opposite direction. For example, if a tighter thin-capitalization rule is in place, then a tightening of the CFC rule has a stronger negative effect on the investment of the home-based MNC and this indirect effect tends to work in the direction of reducing τ^h . As we show in the appendix [eqs. (A.7) and (A.9)], the direct effects dominate the indirect effects for both policy instruments, if transaction costs s are sufficiently low initially, and if the exponent n of the concealment cost function is sufficiently bound away from its minimum value of 1. We can then summarize:

Proposition 4 *Increased financial mobility (a fall in δ) leads to a stricter thin-capitalization rule (λ_h falls) and to a stricter CFC rule (τ^h rises), if FDI mobility costs s are small initially and if the concealment cost function is sufficiently convex ($n \gg 1$).*

Summarizing the results in Proposition 4, reduced costs of income shifting to the tax haven imply a more aggressive tax planning by the MNC, resulting in a larger excess leverage ratio β . Therefore, it is beneficial to tighten the thin-capitalization rule (i.e., to reduce the safe-harbor ratio λ), in order to limit the total amount of debt shifting ($\lambda + \beta$) to the tax haven. Moreover, the higher excess leverage β implies that the revenue gains from employing a tighter CFC rule are increased. In the government's optimum, the CFC rule is thus tightened as well.

Combining Propositions 3 and 4, we can see that increased mobility of FDI and increased financial mobility will both lead to stricter thin-capitalization rules in the government's policy optimum whereas their effects on the optimal CFC rule are mutually offsetting. Increased FDI mobility reduces the incentive to set a strict CFC rule, because of the lower incentive to tax discriminate between home-based and foreign-based MNCs, whereas higher financial mobility leads to stricter CFC rules, due to the increased profit shifting opportunities. Since real-world developments in the past decades have included

both a fall in the costs of FDI (a fall in s) and a fall in the cost of shifting debt to tax havens (a fall in δ), we should thus expect to see an unambiguous tightening of thin-capitalization rules, but a less clear picture regarding CFC rules among the countries that do employ such restrictions on debt shifting.

Indeed, this pattern can be found in Table 1. From the 34 OECD countries in our sample, 14 have tightened their thin-capitalization rules during the period 2000-2014 and three more countries switched from a safe-harbor approach to earnings-stripping rules in an attempt to tighten their thin-capitalization rules. During the same time period, only one country (the Netherlands) has relaxed its thin-capitalization rule.²⁴ In contrast, CFC rules have been tightened in only eight countries in the sample, and they have been relaxed in three countries (France, Hungary, Japan). Overall, the trend towards a tightening of thin-capitalization rules has therefore been much more pronounced among OECD countries than the trend towards a tightening of CFC rules.

5 Extensions

In this section, we analyze three extensions of our basic model. We first endogenize the statutory tax rate and analyze numerically how the tax rate responds to increased mobility of FDI and to increased financial mobility. We then ask whether the different tax instruments are set too high or too low in the decentralized policy equilibrium, relative to a Pareto efficient benchmark. Finally, we consider an asymmetric policy equilibrium where one country gives a higher weight to domestic corporate profits in its objective function than the other.

Endogenizing the statutory tax rate. A first extension of our analysis is to endogenize the statutory tax rates, which we have held fixed in our analysis of Section 4. It is not possible to analytically derive the simultaneous effects of variations in the exogenous parameters s and δ on the three endogenous variables t , λ , and τ . We can, however, determine these effects by means of numerical calculations. In Table 2, we present the results of some illustrative simulations for the case where both countries h and f simultaneously adjust their optimal tax policies to changes in the exogenous parameters of the model.

To interpret the simulation results in Table 2, we first turn to the effects of increased FDI mobility in rows (1)–(3). We know from eq. (23) that a reduction in s tightens the

²⁴This trend is even strengthened when the time horizon for the comparison is prolonged. Büttner et al. (2012, p. 930) document that less than one-half of all OECD countries had thin-capitalization rules in the mid-1990s, but two thirds of all OECD countries had enacted thin-capitalization rules by 2005.

Table 2: Simulation results for increased mobility of FDI and financial flows

	s	δ	λ	τ	t	β	ρ	k_h^h	k_f^h	$t \times T$
Increased mobility of FDI: reduction in s										
(1)	0.20	0.60	0.669	0.148	0.559	0.151	0.715	9.52	5.81	36.02
(2)	0.10	0.60	0.651	0.147	0.559	0.153	0.721	9.34	7.20	36.99
(3)	0.00	0.60	0.614	0.144	0.557	0.154	0.736	9.07	9.07	38.12
Increased financial mobility: reduction in δ										
(4)	0.10	0.65	0.711	0.121	0.573	0.163	0.666	10.26	7.75	37.53
(5)	0.10	0.60	0.651	0.147	0.559	0.153	0.721	9.34	7.20	36.99
(6)	0.10	0.55	0.555	0.176	0.543	0.133	0.788	8.39	6.61	36.51

Note: Parameters held constant: $r = 1$, $f(k) = 10k^{0.5}$, $g(d) = 10d^{0.5}$, $\gamma = 0$, $n = 1.2$

thin-capitalization rule in the government's optimum, but relaxes the CFC rule. These mutually offsetting effects on the corporate tax base imply that the induced changes in the optimal tax rate are small. Similarly, the incentives for firms to use excess leverage β and the effects on MNCs' cost of capital ρ are seen to be moderate. The main change from increased FDI mobility is the alignment of home and foreign production (k_h^h vs. k_f^h). Since the costs for FDI fall, this is associated with an overall increase in investment that expands the corporate tax base and increases tax revenues ($t \times T$).

The effects of increased financial mobility are shown in rows (4)–(6) of Table 2. From eq. (24), the fall in δ causes a simultaneous tightening of both the thin-capitalization rule and the CFC rule. With a tax base that is unambiguously broadened, investment of both home-based and foreign-based MNCs will respond more elastically to a change in the domestic tax rate, causing the optimal statutory tax rate to fall.²⁵ Interestingly, the broadening of the corporate tax base may be so strong that the induced fall in the statutory tax rate, in combination with the tighter CFC rule (the rise in τ), causes the excess leverage β to fall in equilibrium. In our simulations, the shrinking tax gain of shifting internal debt to a tax haven dominates the direct effect of the fall in δ and causes the MNCs' costs of capital ρ to rise. This reduces both home and foreign investment, as well as overall tax revenues.

The tax competition equilibrium. Next, we consider a decentralized policy equilibrium where each of the two symmetric countries chooses its set of policy measures independently. We assume that an interior equilibrium is reached where the first-order conditions (16), (17), and (19) are all met with equality. It then follows that, starting from a decentralized policy equilibrium, the marginal effect of a change in country i 's policy instrument on the joint welfare of the two regions equals the marginal effect on

²⁵This corresponds to theoretical results in the literature on optimal thin-capitalization rules; see Hong and Smart (2010) and Haufler and Runkel (2012).

the welfare of country j ($j \neq i$). Using the governments' objective (14) and the tax base definition (15), it is straightforward to derive

$$\frac{\partial W_f}{\partial t_h} = -\gamma \left[f(k_h^f) - (\lambda_h + \beta_h^f) k_h^f r \right] < 0; \quad (25)$$

$$\frac{\partial W_f}{\partial \lambda_h} = \gamma k_h^f (t_h - \tau^f) r > 0; \quad (26)$$

$$\frac{\partial W_f}{\partial \tau^h} = t_f \left\{ \left[f'(k_f^h) - (\lambda_f + \beta_f^h) r \right] \frac{\partial k_f^h}{\partial \rho_f^h} \frac{\partial \rho_f^h}{\partial \tau^h} - \frac{\partial \beta_f^h}{\partial \tau^h} k_f^h r \right\}. \quad (27)$$

Equation (25) shows that the externalities arising from the statutory tax rate are negative when there is a positive weight of corporate profits in the government objective function ($\gamma > 0$). In this case, the statutory tax rate is too high in the decentralized tax equilibrium, in comparison to the Pareto efficient benchmark. Intuitively, neither t_h nor λ_h affect the cost of capital of country f 's MNC, and hence do not impact tax revenues in country f . However, each country taxes the profits of foreign-owned affiliates that operate within its territory, leading to a transfer of resources from the (foreign) shareholders of the foreign-based MNC to the domestic treasury.²⁶ Similarly, equation (26) shows that the thin-capitalization rule is too strict in the decentralized tax equilibrium. Again, this implies a higher effective tax rate on foreign profits, relative to the efficient benchmark, and hence a transfer of resources from foreign shareholders to the domestic government.

Finally, the marginal effect of τ^h in (27) is ambiguous, a priori. We can, however, use the first-order condition (19) for τ^h to determine the sign of the net effect. If, for simplicity, we ignore mobility costs of FDI ($s = 0$), then the two terms in (27) are identical to the first two terms in (19). For $\gamma > 0$, the sum of the first two terms in (19) must then be positive in an interior tax equilibrium. Hence, the sum of the terms in (27) must also be positive, implying that the CFC rule is set too lax in the decentralized policy equilibrium (τ^h is too low). Intuitively, each country allows its home-based MNC to partially escape taxation in the foreign country by shifting profits to the tax haven, thus redistributing income from the foreign treasury to the home-based MNC.

Notice that all these externalities disappear when governments maximize tax revenues only and $\gamma = 0$ holds. In this case, it is immediate from (25) and (26) that the statutory tax rate and the thin-capitalization rule are set at their globally efficient (i.e., tax revenue maximizing) levels. Moreover, the sum of the terms in (27) is also zero in an interior optimum if we assume, as before, that $s = 0$ and that (19) is met with equality. Intuitively, a tighter CFC rule in country h reduces investment in country f , but it also reduces the

²⁶This *tax-the-foreigner* effect is well-known from the literature; see, e.g., Huizinga and Nielsen (1997).

Table 3: Simulation results for asymmetric countries

	γ_h	γ_f	t_h	t_f	λ_h	λ_f	τ_h	τ_f
(1)	0.00	0.00	0.557	0.557	0.614	0.614	0.144	0.144
(2)	0.25	0.00	0.496	0.529	0.535	0.519	0.065	0.127
(3)	0.25	0.25	0.478	0.478	0.496	0.496	0.052	0.052

Note: Parameters held constant: $r = 1$, $f(k) = 10k^{0.5}$, $g(d) = 10d^{0.5}$, $s = 0$, $\delta = 0.6$, $n = 1.2$

excess leverage β_h^f . These effects will just offset each other when we start from a symmetric tax equilibrium without frictions for FDI.

Country asymmetries. Finally, we consider the effects of introducing an asymmetry between the two countries. The most straightforward difference between countries is that governments may put different valuations on the profits of home-owned firms, relative to the collection of tax revenue. The simulation results for the case where the home government has a higher valuation of domestic profits, $\gamma_h > \gamma_f$, are presented in Table 3. As shown in row (2) of the table, the home country will then have a lower statutory tax rate, a more lenient thin-capitalization rule (a higher level of λ), and a more lenient CFC rule (a lower τ) in its tax optimum, relative to the foreign country.

It is straightforward to explain these effects from the first-order conditions for optimal tax policies. The lower statutory tax rate in country h emerges from eq. (16), as a higher level of γ reduces the positive first term, and hence the optimal statutory tax rate in this country. In the first-order condition for the thin-capitalization rule, eq. (17), the parameter γ_h enters the last term with a positive weight. This implies a higher level of λ_h in the tax optimum, relative to λ_f . Finally, a more lenient CFC rule can be traced back to the first-order condition (19), where the negative last term is rising in the profit weight parameter γ , reducing τ_h in the tax optimum.

In row (3) of Table 3, the higher weight of profits in the governments' welfare function is extended to country f . The new, symmetric equilibrium features lower tax rates, tighter thin-capitalization rules and more lenient CFC rules in both countries, relative to the case where $\gamma_h = \gamma_f = 0$ [row (1)]. The higher weight of firm profits reduces optimal statutory tax rates in both countries. Falling tax rates imply in turn that the investment responses to a more generous thin-capitalization rule are now smaller, since fewer taxes can be saved [see eq. (11)]. This effect tends to tighten thin-capitalization rules in both countries (λ falls), relative to the case where $\gamma_h = \gamma_f = 0$. At the same time, CFC rules are relaxed in both countries (τ falls). This results directly from the higher weight of firm profits, but also because lower statutory tax rates reduce the equilibrium levels of β [see eq. (6)] and thus reduce the revenue gains from tighter CFC legislation.

6 Conclusions

Many governments have to cope with less tax revenue as multinational companies are exploiting legal arbitrage opportunities in order to shift profits from high-tax to low-tax countries. In response to this development, the OECD calls for introducing and strengthening CFC rules in its member countries in its ‘Action Plan on Base Erosion and Profit Shifting’ (OECD, 2013, 2015). Many governments have introduced such rules and the recent empirical literature shows that financial and real decisions taken by multinational companies are sensitive to changes in CFC rules. Yet, the theoretical literature has so far neglected the analysis of CFC rules. In this paper, we aim to partially fill this gap by explaining the role and the effects of CFC rules in international taxation.

Several implications can be drawn from our analysis. First, our model delivers insights into the question of why some countries use CFC rules alongside thin-capitalization rules, which are the primary policy instrument of governments to address debt shifting in multinational companies. A core reason is that the government is able to tackle ‘excessive’ debt shifting, which is beyond the influence of existing thin-capitalization rules. Moreover, in contrast to the thin-capitalization rule, the CFC rule also allows the governments to increase the effective tax rate of home-based multinationals when multinationals’ investments exhibit a ‘home bias’ and investment of foreign-based multinationals responds more elastically to tax incentives. In this case, the optimal policy is to use relatively lenient thin-capitalization rules to attract FDI, but increase the effective tax rate on the home-based multinational by means of a binding CFC rule. Thus, we highlight how and why countries may discriminate between *multinational* companies.

Second, we rationalize the observed policy changes in the fields of thin-capitalization and CFC regulation over the last decades. During this period, both the mobility of FDI and the mobility of financial flows has accelerated dramatically, allowing multinationals to exploit profit-shifting opportunities to a greater extent. Our analysis shows that a fall in the mobility costs of FDI tightens the thin-capitalization rule, but relaxes the CFC rule. In contrast, a fall in the costs of debt shifting to tax havens tightens both the thin-capitalization rule and the CFC rule in the policy optimum. These results are consistent with the development of thin-capitalization and CFC rules in the OECD countries as summarized in Table 1.

A more rigorous test of our theoretical predictions could be based on country-specific proxies for the mobility costs of FDI on the one hand, and the exposure of national corporate tax bases to debt shifting by multinationals on the other. A suitable proxy for the former might be the ‘Inward FDI Performance Index’ collected by UNCTAD, whereas indicators of the latter could be the shares of corporate profits accruing in tax havens

(see Zucman, 2014, for the case of U.S. multinationals), or the (inverse) number of Tax Information Exchange Agreements (TIEAs) that a country has signed with tax havens. According to our results, the openness to inward FDI on the one hand and to profit shifting to tax havens on the other will jointly predict the tightness of thin-capitalization and of CFC rules that are adopted by optimizing governments.

Appendix A: Changes in economic conditions

To determine the signs of the derivatives in (23) and (24), we first derive the α -terms given in (22). Using $\beta^{n-1} = (t - \tau)/\delta$ from (6), these are

$$\begin{aligned}
\alpha_1 &= \frac{2tr^2}{(1-t)f''} (t - \tau) \left[\frac{1 - \tau}{1 - t} + 1 \right] < 0, \\
\alpha_2 &= \alpha_3 = -\frac{tr^2}{(1-t)f''} \left[\frac{t - \tau}{1 - t}(\lambda + \beta) + \frac{\beta}{n-1} - \frac{[f'(k) - 2(\lambda + \beta)r]}{r} \right], \\
\alpha_4 &= -\frac{(2-n)trk}{(n-1)^2} \frac{\beta}{(t - \tau)^2} + \frac{tr}{(1-t)f''} \left\{ \frac{(\lambda + \beta)^2 r}{1 - t} - \frac{\beta[f'(k) - 3(\lambda + \beta)r]}{(t - \tau)(n-1)} \right\} < 0, \\
\alpha_5 &= \frac{(1 - \tau^h)r}{1 - t_h} \frac{\partial k}{\partial s} < 0, \\
\alpha_6 &= \frac{2tr^2\beta^n}{(1-t)f''} \left[\frac{1 - \tau}{(1-t)} \frac{1}{n} + \frac{1}{(n-1)} \right] < 0, \\
\alpha_7 &= \frac{trk}{(n-1)^2} \frac{\beta}{\delta(t - \tau)} - \frac{tr}{(1-t)f''} \left\{ \frac{\beta^n(\lambda + \beta)r}{n(1-t)} + \frac{\beta^2 r}{n(n-1)\delta} - \frac{\beta[f'(k) - 2(\lambda + \beta)r]}{(n-1)\delta} \right\}.
\end{aligned} \tag{A.1}$$

Among these terms, α_4 is the second-order condition for the CFC rule τ^h ; this has to be negative to ensure a maximum. Sufficient conditions for α_4 to be negative are that $n < 2$ in the first term and $[f'(k) - 3(\lambda + \beta)r] < 0$ in the second term. In what follows, we assume that these conditions are both satisfied.

To sign α_2 and α_7 we further assume that transaction costs s are small in the initial equilibrium. More precisely, we assume symmetry of countries h and f and $s = 0$ in the initial equilibrium, arguing that the resulting conditions will approximately hold also when s is positive, but small. With this assumption and using $\gamma = 0$, the first-order condition for the thin-capitalization rule [eq. (17)] simplifies to

$$\frac{k}{(t - \tau)} = \frac{[f'(k) - (\lambda + \beta)r]}{-(1-t)f''}. \tag{A.2}$$

Using (A.2) in the simplified first-order condition for the CFC rule [eq. (19)] gives

$$\frac{\beta}{(n-1)} = \lambda + \beta \tag{A.3}$$

as a further condition that must hold in an interior, symmetric equilibrium. Using (A.2) and (A.3) in the expressions for α_2 and α_7 in (A.1) gives

$$\alpha_2 = \alpha_3 = -\frac{tr^2}{(1-t)f''} \left[\frac{t - \tau}{(1-t)}(\lambda + \beta) - \frac{[f'(k) - 3(\lambda + \beta)r]}{r} \right] > 0,$$

$$\alpha_7 = \frac{(2-n)tr\beta}{(n-1)^2\delta} \frac{k}{(t-\tau)} - \frac{tr}{(1-t)f''} \left\{ \frac{\beta^n(\lambda+\beta)r}{n(1-t)} + \frac{\beta^2r}{(n-1)\delta} \left[\frac{1}{n} + \frac{1}{(n-1)} \right] \right\} > 0, \quad (\text{A.4})$$

which can now be unambiguously signed from the second-order condition for the optimal CFC rule [the term α_4 in (A.1)].

We are now able to investigate the sign of the determinant $|A| = \alpha_1\alpha_4 - \alpha_2\alpha_3$. Using (A.3) and rearranging terms leads to

$$\begin{aligned} \alpha_1\alpha_4 - \alpha_2\alpha_3 = & \\ & \frac{2t^2r^3}{(1-t)^2[f'']^2} \left[\frac{1-\tau}{1-t} + 1 \right] \frac{2-n}{n-1} [f'(k) - (\lambda+\beta)r] (\lambda+\beta) \\ & + \frac{t^2r^3}{(1-t)^2[f'']^2} \left[\frac{t-\tau}{1-t} + 4 \right] \frac{t-\tau}{1-t} (\lambda+\beta)^2r \\ & - \frac{t^2r^2}{(1-t)^2[f'']^2} [f'(k) - 3(\lambda+\beta)r] [f'(k) + (\lambda+\beta)r] > 0, \end{aligned} \quad (\text{A.5})$$

which is unambiguously positive from the sufficient conditions for the second-order condition α_4 to be negative.

Increased mobility of FDI (fall in s): From the terms in (A.1) and (A.4) we immediately obtain the effects of changes in the FDI mobility cost parameter s on the optimal levels of λ and τ , as summarized in eq. (23) of the main text.

Increased financial mobility (fall in δ): To determine the effects of changes in δ on the optimal policies λ^h and τ^h we need to calculate the terms $\alpha_1\alpha_7 - \alpha_3\alpha_6$ and $\alpha_4\alpha_6 - \alpha_2\alpha_7$ [cf. eq. (24)]. For the effect on the CFC rule τ^h , we get, after rearranging

$$\begin{aligned} \alpha_1\alpha_7 - \alpha_3\alpha_6 = & \\ & \frac{2t^2r^3}{(1-t)^2(f'')^2} \frac{\beta}{n-1} \frac{1-\tau}{1-t} \frac{(1-t)kf''}{\delta(n-1)} \\ & + \frac{2t^2r^3}{(1-t)^2(f'')^2} \frac{\beta}{n-1} \frac{1-\tau}{1-t} \frac{\beta^{n-1}}{n} [f' - (\lambda+\beta)r] \\ & + \frac{2t^2r^3}{(1-t)f''} \frac{\beta}{n-1} \frac{k}{\delta(n-1)}. \end{aligned} \quad (\text{A.6})$$

Using (A.2) and simplifying results in

$$\alpha_1\alpha_7 - \alpha_3\alpha_6 = -\frac{2t^2(1-\tau)(t-\tau)r^3}{\delta(1-t)^3(f'')^2} \frac{\beta [f' - (\lambda+\beta)r]}{n(n-1)^2} + \frac{2t^2r^3\beta k}{(1-t)f''(n-1)^2\delta} < 0. \quad (\text{A.7})$$

For the effect on the thin-capitalization rule λ_h , we get

$$\begin{aligned}
\alpha_4\alpha_6 - \alpha_2\alpha_7 = & \\
& + \frac{2t^2r^2}{\delta(1-t)^2(f'')^2} \frac{\beta}{(n-1)^2} \left[\frac{1-\tau}{1-t} \frac{\beta r}{n} + \frac{\beta r}{n-1} \right] (2-n) [f' - (\lambda + \beta)r] \\
& - \frac{2t^2r^2}{\delta(1-t)^2(f'')^2} \frac{\beta}{n-1} \left[\frac{1-\tau}{1-t} \frac{\beta r}{n} + \frac{\beta r}{n-1} \right] \left[\phi - \frac{1-\tau}{1-t} (\lambda + \beta)r \right] \\
& + \frac{t^2r^2}{\delta(1-t)^2(f'')^2} \frac{\beta}{(n-1)^2} \left[\phi - \frac{1-\tau}{1-t} (\lambda + \beta)r \right] [f' - (\lambda + \beta)r] \\
& - \frac{t^2r^2}{\delta(1-t)^2(f'')^2} \frac{\beta}{n-1} \left[\phi - \frac{1-\tau}{1-t} (\lambda + \beta)r \right] \left[\phi - \frac{\beta r}{n} \frac{1-\tau}{1-t} \right], \tag{A.8}
\end{aligned}$$

where $\phi = f' - 2(\lambda + \beta)$. After some simplifications, we arrive at

$$\begin{aligned}
\alpha_4\alpha_6 - \alpha_2\alpha_7 = & \frac{(2-n)t^2r^2\beta[f' - (\lambda + \beta)r]}{(1-t)^2(f'')^2(n-1)^2\delta} \left[f' - \frac{(2-n)}{n} \frac{(1-\tau)}{(1-t)} (\lambda + \beta)r \right] \\
& - \frac{t^2r^3\beta^2}{\delta(1-t)^2(f'')^2(n-1)} \left\{ f' - (\lambda + \beta)r \left[3 + \frac{(t-\tau)}{(1-t)} \right] \right\} \left[\frac{(1-\tau)}{(1-t)} \frac{1}{n} + \frac{1}{(n-1)} \right]. \tag{A.9}
\end{aligned}$$

In (A.9), the second term is positive since $[f' - 3(\lambda + \beta)r] < 0$ from the second-order condition α_4 in (A.1). Since $(2-n) > 0$ the first term is also positive provided that $n > 1$ is sufficiently above unity. Equations (A.7) and (A.9) then sign (24) in the main text. \square

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