Playing Easy or Playing Hard to Get: When and How to Attract FDI

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Abstract

We study the link between a country's institutional quality in tax collection and its optimal corporate tax policies in a model of heterogeneous multinationals that can shift income using both debt and transfer prices. Countries with weak institutional quality can be made worse off adopting policies that attract FDI as the benefits from higher wages and production are more than offset by tax base erosion. Countries with moderate institutional quality can gain from under-utilizing their ability to collect taxes, since the benefit of attracting more FDI outstrips the benefit of increased tax revenue. Countries with very strong institutions benefit from FDI and should utilize their full ability to collect taxes.

Keywords: FDI, thin capitalization rules, transfer pricing, institutional quality

JEL Classifications: F23, H26, H32, F68

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1 Introduction

The rising importance of foreign direct investment (FDI) is the hallmark of globalization, and policymakers around the world perceive FDI as beneficial for economic development, tax revenue, income growth, and employment. The literature on the benefits of FDI documents that large multinationals, expanding into foreign markets, create welfare gains (e.g., Bernard, Eaton, Jensen, and Kortum (2003) and Melitz (2003)) and that the effects from multinational production on wages and welfare are more important than traditional gains from trade (Ramondo and Rodrìguez-Clare (2013)). At the same time, this literature has largely neglected the role of international tax avoidance, despite the fact that it is a major concern according to the OECD (OECD 2013). Tørsløv, Wier, and Zucman (2018), for example, estimate that close to 40% of multinational profits are shifted to tax havens globally each year. Estimates based on IMF macro data reveal that tax revenue losses from base erosion are economically significant, amounting to 1% of GDP in developed countries and 1.5% of GDP in developing countries (Crivelli, de Mooij, and Keen (2016)). In this paper we ask two main questions: Is it beneficial for all countries to attract FDI when multinationals can avoid taxes and shift income to tax havens? And, how does a host country's institutional quality in tax administration influence its optimal corporate tax policies?

We show that institutional quality in tax revenue administration, that is, the ability to audit and correct abusive transfer prices by multinationals, is a crucial factor to consider when assessing the welfare effects of policies that can attract FDI. Weak institutional quality may actually make a country that adopts policies to attract FDI worse off. For all host countries, FDI can increase welfare via higher wages and production, but can reduce welfare through lower domestic profit and lower corporate tax revenue. With weaker institutional quality, multinationals can shift more taxable income out of the host country thereby increasing corporate tax revenue losses. We identify conditions under which a country's welfare costs of FDI outweigh its benefits. Perhaps paradoxically, we also show that among countries for which FDI improves welfare, some countries can actually increase welfare from FDI by under-utilizing their ability to correct abusive income shifting. These countries have intermediate levels of institutional quality and they gain from attracting more FDI by not fully enforcing their ability to curb income shifting.

Our results are obtained in a model of national welfare maximization, multinationals with heterogeneous fixed entry costs, and immobile domestic firms. Multinationals can shift income with both transfer prices and internal debt, the two most commonly used instruments to reduce tax payments. We allow the host country to choose its corporate income tax rate, a thin capitalization rule to limit income shifting by excessive interest deductions, and the intensity with which transfer prices are audited. Most previous studies of the welfare effects of income shifting have only considered the use of debt to shift income (e.g, Hong and Smart (2010)) or non-specific methods of income shifting (e.g., Slemrod and Wilson (2009)). A novelty of our analysis is that we consider the welfare effects of a host country's corporate tax policies in the presence of both debt financing and transfer pricing with heterogeneous firms. Firm heterogeneity takes the form of fixed costs for setting up a subsidiary in a host country. This feature allows us to capture both intensive and extensive margin effects of FDI.[1]

A key discovery in our analysis pertains to how transfer pricing and debt financing interact and how they affect the welfare of different countries. Permissive thin capitalization rules make the corporate income tax more similar to a cash flow tax and encourage an increase in FDI because more host income can be shifted to tax haven affiliates. In effect, host governments can discriminate more between investment sources, subjecting relatively immobile domestic investment to higher tax rates than the highly mobile international investment.[2] However, permissive thin capitalization limits can also facilitate more aggressive transfer pricing on the interest rate paid by the host subsidiary. A country with weaker institutional quality, all else equal, will attract more FDI because each multinational can use its transfer prices to shift more income out of the host country than will a country with stronger institutional quality. With more FDI, the weaker country experiences higher wages but also reduced domestic profit. With lower tax revenues paid by the domestic firm and the subsidiaries, weaker institutional quality in tax revenue administration can result in larger welfare losses from transfer pricing than in countries with stronger institutional quality.

[1] Gresik, Schindler, and Schjelderup (2017) examined the interplay between debt financing and transfer pricing in a model with a representative multinational. That paper focused on the optimal design of thin capitalization rules holding the host country tax rate constant.

[2] This view has been advocated by Hines (2010, p 120) who states, "tax avoidance opportunities presented by tax havens allow other countries to maintain high capital tax rates without suffering dramatic reductions in foreign direct investment."

It follows from our analysis that the welfare consequences of attracting FDI may vary across countries, and this variation in consequences can lead to qualitatively different tax policies, especially among developing, emerging, and developed countries. Developing countries are characterized by a large informal sector, reliance on a small number of large firms for tax revenue, and scarce tax administration resources.[3] For developing countries, sufficiently permissive tax policies are needed to attract FDI, but this may be a bane rather than a boon. Emerging economies may have better quality in tax revenue administration and may benefit from attracting FDI if the tax base erosion can be partly curtailed. Developed countries, in contrast, stand to gain from FDI as they in general have a quite advanced tax administration.

Our finding that pursuing FDI can reduce a country's welfare if its institutional quality is weak is in line with concerns voiced by non-governmental organizations over the possibility that FDI may be a burden to a country if multinationals can strip out most of the benefits of FDI and that developing countries may be especially vulnerable. This concern is mirrored by literature on development economics. OECD (2002) documents in a meta-study that the benefits of FDI hinge on appropriate host country policies and a basic level of development in a country. Several empirical studies also support our findings. They indicate that the net effect of FDI depends on country characteristics, particularly the strength of local financial markets and institutional quality.[4] The importance of institutional quality is empirically well known. Acemoglu, Johnson and Robinson (2001), for example, estimate that, if a country initially lies in the 25th percentile for institutional quality, and can improve its institutions so that it moved into the 75th percentile, national income would be increased sevenfold.

Our results showing how optimal host country tax policies can differ with institutional quality are also consistent with observed policies. In 2018, 42 countries used a safe harbor rule that imposes a debt to equity (or asset) ratio above which interest payments on debt are no longer tax deductible. The limits range from 0.5 to 0.85. In contrast, 95 countries imposed no limit which is effectively

[3]Developing countries are reliant on corporate tax revenue to fund basic infrastructure. Corporate tax revenue make up more than 25 percent of total tax revenue in developing countries, a number in stark contrast to developed countries where the comparable number is 3-4 percent, see Avi-Yonah (2016). A significant informal sector (e.g., see Dharmapala, Slemrod, and Wilson (2011)) and weak institutional quality make it difficult for these countries to rely on personal income tax revenues instead of relying heavily on domestic firms. For example, Fjeldstad and Moore (2008) report that 286 domestic companies contribute about 70 per cent of domestic tax revenue in Tanzania.

[4]See Alfaro and Chauvin (2018) for a survey of how financial markets matter for the benefits of FDI.

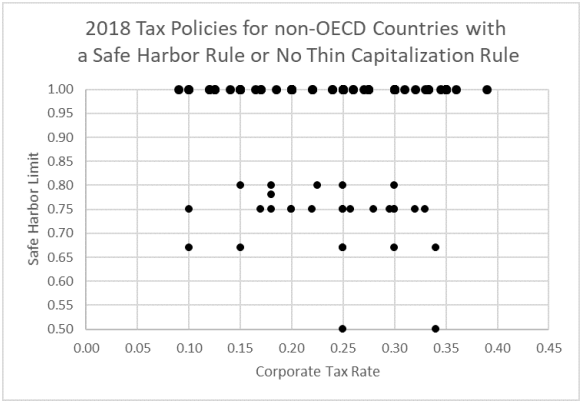

Figure 1: Safe Harbor Limits and Tax Rates
Data collected from EY (2018). The figure includes data from all non-OECD countries with safe harbor rules or no thin capitalization rule except for tax haven countries. Tax haven countries are defined as countries with a zero corporate tax rate and no thin capitalization limit: Bahamas, Bahrain, Bermuda, Bonaire, BVI, Cayman Is., Guernsey, Isle of Man, Jersey, Maldives, and UAE.

a safe harbor limit of one.[5] Figure 1 plots the 2018 corporate tax rates and safe harbor limits for non-OECD countries (excluding 11 tax haven countries that all have zero tax rates and safe harbor limits of one). A notable feature of the data is the 20 percentage point gap or bifurcation between countries that have no thin capitalization limit (or a limit of 1) and those that have safe harbor limits strictly less than one. This bifurcation arises in our model because of a natural non-convexity in equilibrium country welfare. A country that benefits from attracting FDI must choose between two distinct policies that are each locally optimal: one that generates taxable income from the FDI and one that does not.[6]

Developed countries tend to have advanced tax administrations to curb aggressive transfer pricing while attracting welfare-enhancing FDI. The optimal policy for these countries is a combination of moderate thin capitalization limits and moderate tax rates as reflected in the data. In equilibrium, these countries attract FDI that generates strictly positive taxable income. At the other end of the institutional quality spectrum, developing countries tend to have weak tax administrations.

[5] In addition, 23 predominately OECD countries used an earnings stripping rule that imposes a maximum limit on interest payments to earnings, with limits ranging from 10% to 60%. Five countries used a combination of safe harbor and earnings stripping rules and four countries used some other type of rule. Data was collected from EY (2018) and is available from the authors on request.

[6] Dharmapala and Hebous (2017) and Bilicka (2019) provide evidence of a significant percentage of affiliates that report zero (or negative) taxable income. In our one-period model, there are no tax benefits from generating negative taxable income by an affiliate. See also note 15.

Conditional on attracting FDI, the optimal tax policy for these countries encourages aggressive income shifting by setting a high thin capitalization limit and a high tax rate, whose burden falls only on domestic firms (consistent with Hines (2010)). The result is FDI that attracts no taxable income. Emerging countries tend to have intermediate levels of institutional quality. Some of these countries will be close to indifferent between the moderate policies used by developed countries and the aggressive income shifting policies of developing countries. As a result, two similar countries can have very different optimal policies.

A second empirical observation is that some countries with good institutional quality, such as Austria, Ireland, Israel, and Sweden, have thin capitalization rules that our theory would seem to associate with low quality countries. To reconcile the policies of these countries with our model's predictions, we make the following observations. If a country's optimal policy when it uses its full institutional quality collects modest or no tax revenues from subsidiaries, then under-utilizing its institutional quality will attract more welfare-enhancing FDI and sacrifice little or no tax revenues from subsidiaries.[7] Thus, a country that might prefer moderate tax policies given full utilization of its institutional quality can earn greater welfare by under-utilizing its institutional quality and being less aggressive in curbing income shifting. We believe the result that countries with intermediate levels of institutional quality can benefit from under-utilization is new to the FDI literature.

In the next section, we discuss related literature. We set up the model in section 3. A motivating example is presented in section 4. Equilibrium firm choices for each possible host country policy are derived in section 5. Section 6 considers a host country's optimal safe harbor limit and tax rate, and identifies when a country would choose to under-utilize its institutional quality. We extend our analysis to consider earnings stripping rules in section 7, and offer concluding remarks in section 8.

2 Literature review

Our study is related to the literature on the pros and cons of FDI. There is a large literature that spans several topics and it is outside the scope of this paper to review this literature. We shall therefore concentrate our literature review on those papers that are most closely related to our

[7] Stronger countries will not choose to under-utilize their institutional quality because they would lose too much subsidiary tax revenue.

study.

Our paper can be seen as part of the literature that studies how tax havens affect welfare and tax policies when multinationals can shift income. Most of this literature suggests that tax havens worsen the role of tax competition among countries and therefore lower welfare. But there are results showing the opposite. Desai, Foley and Hines (2006) argue that while tax base competition, in our case over thin capitalization limits, may reduce revenues in high-tax jurisdictions, it may have offsetting effects on real investment that are attractive to the same governments. This argument is based on the insight from the tax competition literature that when capital is perfectly mobile, a source tax on capital falls on immobile factors of production (Gordon, 1986). The reason is that capital outflows following a tax increase lower worker productivity and thus wages. From a policy point of view, it is therefore better to tax workers directly. Tax base competition may thus help firms avoid the capital tax on mobile capital partly or wholly, and reduce the adverse effects of inefficient policies.

Using a formal model, Hong and Smart (2010) show that providing a tax deduction for interest payments on subsidiary debt allows host countries to maintain or even increase high corporate tax rates, without reducing foreign direct investment. Besides facilitating income shifting out of the host country, the tax deductibility of interest payments also reduces the multinational's after-tax cost of capital and encourages the multinational to increase its overall capital investment in the host country. Increased investment increases the demand for labor, which in turn increases the host wage rate and host welfare. In their model, it turns out that the optimal policy of the government is to allow the multinational firm to be financed by debt only, effectively eliminating thin capitalization rules. This is optimal because the capital tax on the normal return on capital is fully shifted to labor. Consequently, the corporate tax becomes a non-distortive tax on economic profits making it optimal for the government to levy a 100% tax on economic profits. However, contrary to the optimal tax policy predicted by Hong and Smart (2010), Figure 1 shows there are many countries either that do not permit full debt financing or that shift the full tax burden on domestic firms.

The argument that tax havens and income shifting is needed to overcome inefficient tax policies that harm a country has been challenged by Slemrod and Wilson (2009). If it is desirable to tax immobile domestic investment at a higher rate than mobile international investment, one can ask

why politicians do not do so. Slemrod and Wilson (2009) show in a formal model that the net welfare advantage to attracting FDI disappears when the host country can charge domestic investors and foreign investors different tax rates. Nevertheless, their optimal tax rate on multinationals remains positive. The driving force behind their result is that a wage tax can be avoided by workers and is costly to enforce. In contrast, the corporate tax distorts firm investment, but has the advantage of saving enforcement costs and indirectly taxing workers. Hence, it is beneficial to tax the normal rate of return, but tax havens limit the power of tax authorities in doing so.

Our analysis sets itself apart from the literature on income shifting and FDI in at least two respects. First, our model combines two of the most common channels for income shifting: transfer pricing and internal debt financing. There is an older literature on optimal transfer price regulation (e.g., Gresik and Nelson (1994)) but that literature did not focus on the specific role of FDI or on tax havens. The literature focusing on the efficacy of FDI usually incorporates one channel only and generally considers income shifting with just debt.[8] Allowing multinationals to shift income with transfer prices and debt adds an additional important dimension to the analysis.[9] If multinationals have two instruments at their disposal (debt and the transfer price), it is no longer optimal to fully tax exempt the normal rate of return. This has profound effects on tax policy. Second, in contrast to previous literature, our results are in line with what we observe in data. Our analysis produces variation in tax rates and thin capitalization rules consistent with the variation in tax systems adopted by developed, developing and emerging countries.

3 A model of income shifting via debt and transfer prices

There is a single host country whose economy consists of workers who inelastically supply one unit of labor, a representative entrepreneur who owns a domestic firm, and possible multinational activity. The domestic firm employs L_d units of labor at a wage rate w to produce $G(L_d)$ units of output that are sold in a competitive market. The production function $G(\cdot)$ is strictly increasing

[8] Gresik, Schindler, and Schjelderup (2017) is an exception.

[9] See Heckemeyer and Overesch (2017) who find that the effect of transfer pricing on the semi elasticity of profits with respect to international tax differentials is four times higher than the one of debt shifting.

and strictly concave in L_d. The pre-tax income of the domestic firm is

$$\pi = G(L_d) - wL_d. \tag{1}$$

The host country levies a corporate income tax rate of t so the domestic firm has a post-tax profit of $(1-t)\pi$.

There exist a continuum of multinational firms of mass one that maximize after-tax global profit and are headquartered outside the host country. Each multinational can choose to open an operating subsidiary in the host country by incurring a fixed cost $\phi \geq 0$. The value of ϕ for a multinational is independently drawn from a uniform distribution on $[\underline{\phi}, \bar{\phi}]$, where $0 \leq \underline{\phi} < \bar{\phi}$. This variation in fixed entry costs is consistent with the empirical evidence in Arkolakis (2010) and Eaton, Kortum, and Kramarz (2011). The operating subsidiary is endowed with the production function $F(l_m, k)$, where l_m denotes the amount of host country labor it employs and k denotes the amount of capital invested in the subsidiary. $F(\cdot, \cdot)$ is strictly increasing, strictly concave, and is homogeneous of degree $\eta \in (0, 1)$ in capital and labor. This last assumption implies that F exhibits decreasing returns to scale. The subsidiary pays the same competitive wage rate as the domestic firm and sells its output in a competitive market whose price is also normalized to one. Denote the multinational's economic cost of capital by r.

All of the FDI is channeled to the host country subsidiary through a financing subsidiary located in a tax haven, and takes the form of equity, E, and/or internal debt, B, so that $k = E + B$. Following most corporate tax codes worldwide, we assume that interest expenses are tax deductible, but costs of equity are not. For simplicity we do not allow the subsidiary to take on external debt, although one of the determinants of the parent's cost of capital may be the amount it borrows from international markets.[10] We assume that the multinational's economic cost of capital reflects, in part, a country-firm-specific risk of the investment so that r need not simply equal a worldwide interest rate.[11] The idiosyncratic cost of capital allows the multinational to charge its host country

[10] Davies and Gresik (2003) study the role of debt borrowed from host country investors.

[11] While the norm in the tax competition literature is to assume all multinationals can finance investments at a worldwide interest rate, our assumption is consistent with corporate finance textbooks that make clear that a firm's economic cost of capital varies with its CAPM β. In addition, the opportunity cost of investing in a host country will also depend on country-specific factors related to the multinational's available projects in the host country and the strength of the host country's legal system.

subsidiary an interest rate R that can differ from r and implies that the multinational's taxable income in the host country, denoted by Π_T to distinguish pre-tax income from after-tax profit, equals

$$\Pi_T = F(l_m, k) - wl_m - RB. \tag{2}$$

That is, R is the transfer price of internal debt. Allowing the multinational to use its transfer price on debt to shift income out of the host country is a simple and direct way to see the linkages between debt shifting and transfer pricing. Moreover, disputes between tax authorities and multinationals over interest rates charged between affiliates are commonplace in many countries.

The multinational incurs transfer price costs of $C(R - r, B; \alpha) = \alpha c(R - r)B$ to reflect any transfer price auditing the host country may conduct. These transfer price costs consist of three components. First, the cost function $c(\cdot)$ is increasing and strictly convex in $R - r$, as we take r to be the arm's-length interest rate.[12] Second, the multinational's transfer price costs are proportional to the amount of debt, as the total shifted income out of the host country will equal $(R - r)B$. The transfer price costs are linear in B to coincide with the standard practice in most countries of using a "comparable price" rule for ensuring that a company's transfer price is effectively an arm's-length price. While the size of any non-compliance penalties is proportional to B, the auditing costs per dollar of debt will depend on $R - r$ in a non-linear way.[13] Third, we use the parameter $\alpha > 0$ to capture different levels of transfer price auditing sophistication/intensity by the host country. In practice, α is chosen by each host country to trade off the welfare benefits and costs of stronger regulation. For each country, their choice is limited by the sophistication and institutional capacity of its revenue authority. If for the same welfare benefits, some countries face higher marginal regulatory costs than other countries (due for instance to less financial sophistication, weaker court systems, or higher levels of corruption), then one would expect firms to incur auditing

[12] If $c(\cdot)$ is linear, the multinational will either shift no income with R or the maximum amount possible. This would make the firm's transfer price independent of t, which is not consistent with the empirical evidence such as Cristea and Nguyen (2016), Davies et al. (2018), and Flaaen (2017).

[13] Under the most common and preferred method among host countries, the comparable price auditing method, a revenue authority collects comparable price data from firms engaged in independent or arm's-length transactions. An audited firm's transfer price is typically deemed to be non-compliant if it falls outside the inter-quartile range of the comparable data. Thus, the probability that a firm is non-compliant, and subject to tax avoidance penalties, depends in an increasing way on the difference between a firm's transfer price and its actual cost. See Gresik and Osmundsen (2008) for more details.

costs in those countries consistent with a smaller value of α. To simplify the presentation of our analysis, we initially treat α as exogenously reflecting a country's institutional capacity related to its auditing sophistication. We then present some comparative static results to indicate how changes in institutional capacity affect a host country's optimal tax policy and identify a range of values of α for which a country would choose intentionally to under-utilize its institutional capacity by behaving as a less sophisticated country.

A key reason for financing a subsidiary with debt instead of equity is that interest payments on debt are tax deductible while equity payments are not. With the same rate applied to the subsidiary's host country income as is applied to the income of the domestic firm, the multinational's global after-tax profit equals

$$\Pi = \begin{cases} (1-t)\Pi_T + RB - rk - \alpha cB - \phi & \text{if } \Pi_T \geq 0 \\ F - wl_m - rk - \alpha cB - \phi & \text{if } \Pi_T < 0. \end{cases} \tag{3}$$

The first line of (3) is the sum of a multinational's after-tax operating profit plus the net value of the income it shifts into the tax haven, $RB - rk - \alpha cB$, minus its fixed entry cost. The second line of (3) reflects a host country policy that disallows a tax deduction for subsidiary losses. The term $-\alpha cB$ still appears in this second line because transfer pricing remains costly for the multinational. It just does not create any benefit once taxable subsidiary income is non-positive. Regardless of the value of Π_T, the fixed entry costs are never tax deductible.[14]

Because shifting income is costly, the multinational in this case only shifts income until its subsidiary has zero taxable income.[15] Notice at fixed values of l_m and k for which $F - wl_m - rk \geq 0$, $\Pi_T < 0$ implies that Π is strictly decreasing in R for $R > r$. This means that at an optimum a multinational will always set its transfer price so that $\Pi_T \geq 0$.

To discourage multinationals from financing foreign operations entirely with debt, the host

[14] Allowing ϕ to be tax deductible would not affect any of a multinational's intensive margins and would only eliminate extensive margin effects at $t = 1$.

[15] In most countries, losses can be carried forward to offset taxable income in future years or they can be eventually repatriated to the parent company. These options have no effect in a single period model. In practice, loss offsets are still imperfect because they can expire and because they are not adjusted for inflation. Even in a dynamic model, the value to a firm of creating negative taxable subsidiary income is less than 100%. This is what our model captures. In addition, allowing for loss offsets increases the welfare costs of income shifting and makes it more likely that our subsequent analysis would imply that a country should not attract FDI.

country can adopt a thin capitalization rule. As indicated in the Introduction, the most common choice is no rule at all followed by a safe harbor rule. Consistent with this usage and as in Hong and Smart (2010) and Büttner et al. (2012), we model thin capitalization rules as the maximum proportion, b, of a multinational's capital investment for which interest expenses can be tax deductible. The choice of $b = 1$ is equivalent to choosing no rule at all. For any $b < 1$, if the multinational were to choose $B > bk$, where recall that $k = E + B$, the interest payments on $B - bk$ of the parent debt would not be tax deductible but the higher debt level would increase total transfer price costs if $R > r$. Thus, this safe-harbor type of thin capitalization rule is equivalent to imposing the constraint $B \leq bk$ on the multinational, except when the amount of debt is immaterial, as it is when $t = 0$. After presenting our main results, we will discuss the implications of adopting an earnings stripping rule in Section 7.

For $t > 0$, the cheapest income shifting option for the multinational is to shift income out of the host country using only debt so that $rB = F - wl_m$. Because the subsidiary operates under decreasing returns to scale, this level of debt would have to be greater than or equal to k. Thus, for any $b \leq 1$ when $t > 0$, $B = bk$ and the subsidiary's debt-equity ratio equals $b/(1-b)$. Except in the limit case of $b = 1$ and constant returns to scale, the multinational will not be able to shift all of its host country income to the tax haven with just debt. Thus, it will use both its debt financing and transfer pricing options.

The multinational's problem then is to choose l_m, k, and R to maximize

$$\Pi = (1-t)\Pi_T + k(Rb - r - \alpha cb) - \phi \text{ subject to } \Pi_T = F - wl_m - Rbk \geq 0. \tag{4}$$

A multinational with sufficiently large entry costs may choose not to enter because the multinational can always guarantee itself zero global profit from its host country operations by not entering. By the Envelope Theorem, there exists $\hat{\phi} \in [\underline{\phi}, \bar{\phi}]$ such that multinationals with $\phi \leq \hat{\phi}$ will enter and those with $\phi > \hat{\phi}$ will not. Denote the measure of multinational firms that enter by $M = (\hat{\phi} - \underline{\phi})/(\bar{\phi} - \underline{\phi})$ and let $L_m(b,t)$ and $K(b,t)$ denote the quantities of labor and capital that maximize (4), conditional on entry. These quantities will be independent of ϕ so aggregate multinational labor demand equals ML_m and aggregate FDI equals MK. Let $R(b,t)$ denote a multinational's optimal

transfer price and let $\Pi^*(b, t, \phi)$ denote the indirect profit of a firm with entry cost ϕ prior to its entry decision.

Host country welfare is the weighted sum of labor income, after-tax domestic firm profit, and tax revenues. Let $\beta_w \geq 0$ denote the welfare weight on domestic labor income and let $0 \leq \beta_\pi \leq 1$ denote the welfare weight on after-tax domestic firm profit. We normalize the welfare weight on tax revenue to one. By assuming that $\beta_\pi \leq 1$, we eliminate the desirability of subsidizing firms with tax revenues. Thus, host country welfare is defined as

$$\Omega = \beta_w w + \beta_\pi(1-t)\pi + t\pi + t(F - wL_m - RbK)M. \tag{5}$$

The host country will choose its thin capitalization parameter b and its tax rate t to maximize its welfare. If $\beta_w < 1$ and $\beta_\pi < 1$ for a host country, then that country prefers a dollar of tax revenue over a dollar of wage gains or after-tax domestic profit (see footnote 3). Our formulation allows us to consider optimal tax policy for countries with a wide range of welfare functions including national income maximization when $\beta_w = \beta_\pi = 1$ and tax revenue maximization when $\beta_w = \beta_\pi = 0$.

4 A motivating example

Before presenting our analysis of this model, we use an example to highlight several aspects of the economic trade-offs in the model that we believe help explain the key empirical properties seen in Figure 1. Figure 2 graphs host country welfare as a function of the thin capitalization parameter, b, for two slightly different host countries. For this example, we assume $F(l_m, k) = k^{0.3} l_m^{0.5}$, so that the multinational sector generates rents. We also assume $r = 0.08$, $t = 0.45$, $\alpha = 3$, $c(R-r) = (R-r)^2$, $\phi \in [0.1, 10]$, $\beta_\pi = 0.3$, and $\beta_w = 1$. In the graph on the left, $G(L_d) = L_d^{0.85}$. In the graph on the right, $G(L_d) = L_d^{0.9}$, so that the domestic sector generates fewer rents than in the graph on the left. These values are not meant to reflect calibrated values but only to illustrate the range of possible welfare effects from different thin capitalization rules.

In both graphs, the observed welfare patterns due to changes in the thin capitalization limit are due to three different multinational responses to a host country's tax policy. First, the constant welfare region corresponds to low values of b at which the host country attracts no FDI. The limited

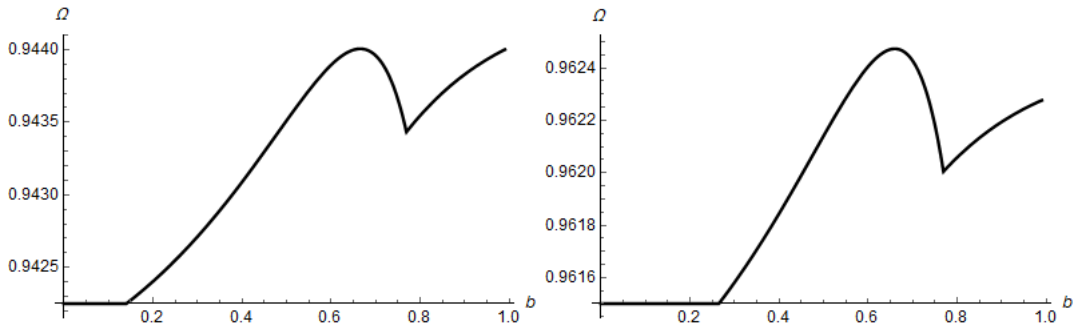

Figure 2: Host country welfare as a function of the thin capitalization parameter, b, when $F(l_m, k) = k^{0.3} l_m^{0.5}$, $r = 0.08$, $t = 0.45$, $\alpha = 3$, $c(R - r) = (R - r)^2$, $\phi \in [0.1, 10]$, $\beta_\pi = 0.3$, and $\beta_w = 1$. In the left graph, $G(L_d) = L_d^{0.85}$. In the right graph, $G(L_d) = L_d^{0.9}$.

amount of income shifting allowed via debt financing and transfer pricing is insufficient to permit any multinational to cover its fixed cost of entry. Second, the middle region in which welfare is quasi-concave in b corresponds to values of b at which the host country attracts strictly positive levels of FDI and the subsidiaries report strictly positive taxable income. The quasi-concave shape of the welfare function reflects a trade-off between the benefits of increased wage income from multinational employment and welfare losses from lower domestic sector profits and lower domestic and multinational tax revenues. Initially, increases in b attract enough FDI to generate a net increase in welfare through wage increases. At some point, the wage gains from further increases in b are not sufficient to outweigh the welfare losses, in part because of increases in marginal domestic employment losses.[16] Third, the strictly increasing region at high values b corresponds to tax policy at which the host country attracts FDI but none of the subsidiaries report taxable income. They are successful in shifting all of their income into the tax haven through a combination of transfer pricing and debt financing. Host welfare is increasing in b in this last region as the gains from higher wages dominate the truncated tax revenue losses from income shifting.[17] The different regions of multinational behavior result in two locally optimal values of b, at $b = 0.66$ and at $b = 1$. For the graph on the left, the global optimum occurs at $b = 1$ while, for the graph on the right, the global optimum occurs at $b = 0.66$.

In both graphs, the host country's preferences are non-convex in b.[18] Both an increase in b

[16] At low tax rates, one observes behavior consistent only with this region.

[17] At very high tax rates, one can observe no FDI for low values of b and positive FDI with no taxable income for high values of b. In this latter situation, welfare can be U-shaped.

[18] Recall that convex preferences differ from a function being convex.

above approximately 0.75 and a decrease in b below 0.75 increases host welfare. The non-convexity arises because of the limitation on receiving a tax benefit from subsidiary losses and not because of some technical assumption.[19] As a result, a small decrease in the rents generated by the domestic sector results in the optimal value of b jumping from 1 down to approximately 0.65.

5 Equilibrium firm choices

For each pair of policies (b,t), an equilibrium consists of an optimal labor, capital, and transfer price choice for each multinational that chooses to enter, the set of entering firms defined by $\hat{\phi}$, an optimal labor choice for the domestic firm, and a market-clearing wage rate. We will denote these equilibrium values by $L_m(b,t)$, $K(b,t)$, $R(b,t)$, $\hat{\phi}(b,t)$, $L_d(b,t)$, and $w(b,t)$. Since M is the measure of multinational firms that enter, we will show for each (b,t), that the resulting equilibrium must fall into one of three cases: (1) $M>0$ and $\Pi_T>0$, (2) $M>0$ and $\Pi_T=0$, and (3) $M=0$. We denote the sets of values of (b,t) associated with each of these cases by $\mathcal{M}_{++}$, $\mathcal{M}_{+0}$, and $\mathcal{M}_0$. For example, $\mathcal{M}_0=\{(b,t)|M=0\}$. In cases 1 and 2, some multinational firms enter so the amount of FDI is strictly positive. In case 1, the subsidiary pays a strictly positive host tax. In case 2, all taxable income is shifted out of the host country so the subsidiary pays no host tax. In case 3, no multinational firms enter so there is no FDI in equilibrium for any $(b,t)\in\mathcal{M}_0$.

We begin by solving multinational problem (4) by choosing L_m, K, R, and $\hat{\phi}$ to maximize aggregate multinational profit, in which case the associated Lagrangian is

$$\Lambda = M(\hat{\phi})\left[(1-t)\Pi_T + K(Rb-r-\alpha cb)\right] - \int_{\phi=\underline{\phi}}^{\hat{\phi}} \phi dM(\phi) + \mu M(\hat{\phi})\Pi_T. \tag{6}$$

The advantage of adopting this standard approach[20] of maximizing aggregate profit is that it transforms a discrete entry decision into a continuous optimization choice and makes it easier to sign the model's comparative statics.

The analysis of the multinational's problem differ when $t<1$ and when $t=1$ so we first analyze optimal equilibrium choices when $t<1$. With any positive-FDI equilibrium for which $t<1$, the

[19] The exact value at the kink in the welfare function is slightly different in the two graphs.

[20] See Mas-Colell, Whinston, and Green (1995), section 5.E.

first-order conditions associated with (6) imply

$$F_L(L_m, K) = w, \tag{7}$$

$$F_K(L_m, K) = \frac{(\mu - t)Rb + r + \alpha cb}{1 - t + \mu}, \tag{8}$$

$$1 - \alpha c' = 1 - t + \mu, \tag{9}$$

$$\hat{\phi} = (1 - t)\Pi_T + K(Rb - r - \alpha cb) + \mu\Pi_T, \tag{10}$$

and

$$\mu\Pi_T = 0 \tag{11}$$

where $\mu \geq 0$, F_K denotes the marginal product of capital, and F_L denotes the marginal product of labor. While (7) implies that each multinational will equate its marginal product of labor with the pre-tax wage rate, (8) implies that each multinational will equate its marginal product of capital with its after-tax cost of capital. When the subsidiary's taxable income is positive, (9) implies that each multinational would like to set its transfer price to equate its marginal tax savings, t, with its marginal cost of income shifting, $\alpha c'$. If this transfer price implies negative taxable income, each multinational will adjust its transfer price so that it is closer to r. In either situation, (9) shows that the profit gain from income shifting, net of income shifting costs per dollar of debt, $R - \alpha c$, is always positive. This net gain is equal to r when $R = r$ and is increasing in R as long as the marginal cost of transfer pricing, $\alpha c'$, is less than one. Eq. (10) implies that the marginal multinational to enter will earn zero after-tax global profit. Eq. (11) is the standard complementary slackness condition.

When $t = 1$, each multinational benefits only from income shifted to the tax haven. Its profit net of financing (r) and income shifting costs (αcb) equals $K(Rb - r - \alpha cb)$. Per unit of capital, this net income shifting profit is maximized when R solves $\alpha c' = 1$, which we denote by $R^*(1)$. In order for a multinational to be willing to invest in the host country, its optimal net income shifting profit must be greater than or equal to its fixed entry cost, ϕ. Define $\hat{b} = r/(R - \alpha c)$ at $R^*(1)$ as the value of $b \leq 1$ for which a multinational's optimal net income shifting profit is zero.

If $t = 1$ and $b \leq \hat{b}$, then $K = L_m = 0$ because the net profit from shifted income is non-

positive. While the optimal transfer price reduces a multinational's after-tax cost of capital below r, it does not shift enough net income, $Rb - \alpha cb$, to generate positive net income shifting profit. No multinational will enter because none will be able to cover the fixed cost of entry.[21] As the host country's institutional capacity improves to the point where it can detect any transfer price deviation, so that α goes to ∞, then $R^*(1)$ goes to r and $\hat{b}$ goes to 1. In this case, every multinational would set a transfer price equal to its cost of capital. For any b, optimal net income shifting profit when α tends to ∞ converges to $rK(b-1)$, which is non-positive and discourages any FDI at $t = 1$.

If $t = 1$ and $b > \hat{b}$, a multinational earns strictly positive net income shifting profit on each unit of capital. If it could, a multinational would invest an infinite amount of capital just to shift income out of the host country. However, for a large enough value of K, the subsidiary's taxable income is strictly negative, i.e., $\Pi_T < 0$. Thus, a multinational that enters would choose values of K, L_m, and R that imply $\Pi_T = 0$, $F_L = w$, and $\mu = 1 - \alpha c' > 0$. With a strictly positive multiplier on the non-negative taxable income constraint, the optimal transfer price will be strictly less than $R^*(1)$. As the host country's institutional capacity to detect transfer price deviations, α, goes to zero, $R^*(1)$ goes to ∞ and $\hat{b}$ goes to zero. In this case, with any positive value of b the host country is unable to deter transfer prices that shift all subsidiary income out of the host country. Even with shifting all taxable income out of the host country, a multinational may still not be able to earn sufficient net income shifting profit to cover its fixed entry cost. We will address this issue below.

For all t, the remaining equilibrium conditions imply that the domestic firm employs labor until the marginal product of labor equals the wage rate,

$$G_L(L_d) = w, \tag{12}$$

and that the labor market clears,

$$L_d + M(\hat{\phi})L_m = 1. \tag{13}$$

Thus, a positive-FDI equilibrium with $t < 1$ is defined by the solution to (7) - (13). A no-FDI equilibrium for $t < 1$ is defined by $L_m(b,t) = K(b,t) = 0$, $\hat{\phi}(b,t) = \underline{\phi}$, $L_d(b,t) = 1$ and

[21] If for some $b \leq \hat{b}$, $R^*(1)$ implies $\Pi_T < 0$, a firm would have to choose a smaller value of R. Any $R < R^*(1)$ would lower Π and still result in no entry.

$w(b,t) = G_L(1)$. The value of $R(b,t)$ is not relevant. For $t = 1$, the host tax is a pure profit tax in the absence of FDI. We assume that the domestic firm maximizes its pre-tax income, in this case so that the equilibrium is still defined by $L_d(b,t) = 1$ and $w(b,t) = G_L(1)$.

To ensure that each type of equilibrium arises for some tax policies, we make two assumptions:

$$\text{(A1) } F(L_m(0,0), K(0,0)) - w(0,0)L_m(0,0) - rK(0,0) > \underline{\phi} \text{ and}$$

$$\text{(A2) } (R(1,1) - r - \alpha c(R(1,1) - r))K(1,1) > \underline{\phi}.^{22}$$

Assumption (A1) requires that some multinationals enter when $b = t = 0$ and is sufficient for the existence of tax policies in which case 1 equilibria arise. It will be satisfied if $\underline{\phi}$ is small or if output is sufficiently large. Assumption (A2) requires that some multinationals enter when $b = t = 1$. Because $\hat{b} < 1$, subsidiary taxable income will be zero. Assumption (A2) is sufficient for the existence of tax policies in which case 2 equilibria arise as it ensures for b close to 1 that net income shifting profit is large enough to cover the fixed entry costs for firms with ϕ close to $\underline{\phi}$. It defines an upper bound on α because, as α goes to ∞, transfer price profit goes to 0 when $b = 1$. Thus, there exists $\bar{\alpha} < \infty$ such that for all $\alpha \geq \bar{\alpha}$, $\mathcal{M}_{+0}$ is empty. Together these two assumptions reduce the set of tax policies that support zero FDI and make it less likely that the optimal tax policies induce no FDI. Nevertheless, as we will show below, there always exist tax policies in which case 3 equilibria arise. Moreover, we are still able to identify environments in which attracting no FDI is optimal for a host country. We next describe properties of the multinational behavior for each type of equilibrium and summarize the tax policies that generate each type of equilibrium in Figure 3.

Case 1: Positive FDI and positive multinational tax revenues, $\mathcal{M}_{++}$

Assumption (A1) guarantees that this first type of equilibrium will exist for a positive measure of tax policy parameters, b and t, because at $t = 0$, no multinational has an incentive to use its transfer price to shift income, the amount of internal debt has no effect on multinational profit or market equilibria, and global multinational profit is more than sufficient to cover the entry costs when ϕ is close to $\underline{\phi}$. We have also shown above that this type of equilibrium cannot exist when $t = 1$ so the following analysis only applies when $t < 1$. To understand multinational behavior in

[22] This assumption is equivalent to $F(L_m(1,1), K(1,1)) - w(1,1)L_m(1,1) - (r + \alpha c(R(1,1) - r))K(1,1) \geq \underline{\phi}$ because $\Pi_T = 0$.

this region, we need to understand how Π_T varies with respect to b and t. It turns out that the response of firm behavior on $\mathcal{M}_{++}$ can differ when $b \leq \hat{b}$ and when $b > \hat{b}$. Thus, we will break our analysis for Case 1 into two parts.

When $\Pi_T > 0$, $\mu = 0$ so (8) implies that $(1-t)(F_K - Rb) = r - Rb + \alpha cb$. The left-hand side of the equation is the multinational's marginal after-tax subsidiary income from FDI and the right-hand side is the multinational's net cost of capital, its cost of capital reduced by its transfer pricing. For $b \leq \hat{b}$, each multinational's adjusted cost of capital remains positive so $F_K - Rb$ must be positive. In addition, decreasing returns to scale of the subsidiary production function implies that

$$\Pi_T > F_K K + F_L L_m - wL_m - RbK = (F_K - Rb)K. \tag{14}$$

If $F_K - Rb \geq 0$, then (14) implies that Π_T must be strictly positive. Conversely, if $\Pi_T = 0$, then $F_K - Rb$ must be strictly negative. Thus, for each fixed value of $b \leq \hat{b}$, Π_T must be strictly bounded away from zero.

For each $b > \hat{b}$, if $t = 0$, $R = r$ and $r - Rb + \alpha cb = r(1-b) \geq 0$. The adjusted cost of capital is non-negative. Alternatively, if t is close to one, then we must have $r - Rb + \alpha cb < 0$. Now the multinational's adjusted cost of capital is negative which means its tax haven affiliate reports strictly positive income (as opposed to just reducing the multinational's net cost of capital). Thus, for each $b > \hat{b}$, there exists a value of t, denoted by $t_1(b)$, at which $r - Rb + \alpha cb = 0$. At $t = t_1(b)$, $F_K - Rb = 0$. For $t < t_1(b)$, $r - Rb + \alpha cb > 0$ so $F_K - Rb > 0$. For $t > t_1(b)$, $F_K - Rb < 0$. As $b \to \hat{b}$, $t_1(b) \to 1$. This distinction is important for signing the comparative statics on M_{++}. We use t and b subscripts on $K, \hat{\phi}, w$ and R to denote the main comparative statics.

Proposition 1 *Assume (b,t) yields an equilibrium with strictly positive FDI and strictly positive taxable subsidiary income. Then $K_b > 0$, $\hat{\phi}_b > 0$, $w_b > 0$, $R_b = 0$, and $R_t > 0$. For $b \leq \hat{b}$, $w_t < 0$ and if Π_T is sufficiently close to zero, then $K_t < 0$ and $\hat{\phi}_t > 0$. For $b > \hat{b}$ and $t \geq t_1(b)$, $K_t > 0$ and $\hat{\phi}_t < 0$, and if Π_T is sufficiently close to zero, then $w_t > 0$.*

According to Proposition 1, weaker thin capitalization rules (larger values of b) attract more capital and more multinationals and raise the host wage. This happens because a larger value of b reduces the net cost of capital by allowing more income shifting. However, tax rate changes have

ambiguous effects.

For capital, the reason for the ambiguous effect can be seen by again focusing on (8) or $(1-t)(F_K - Rb) = r - Rb + \alpha cb$. The right-hand side is the net cost of capital. An increase in t increases the optimal transfer price and lowers this marginal cost. The left-hand side is marginal after-tax subsidiary income. An increase in t lowers this marginal benefit by reducing $1-t$ and by increasing the transfer price. Thus, an increase in t discourages a multinational's capital investment by reducing after-tax subsidiary profit but it encourages capital investment by increasing income shifting margins.

If b is small and taxable income, Π_T, is close to zero,[23] income shifting reduces a multinational's net cost of capital but the tax haven profit (and marginal profit) remains negative as $r-Rb+\alpha cb > 0$. If it enters, a multinational will choose its amount of capital so that its marginal subsidiary profit $F_K - Rb$ is positive. Although a higher tax rate decreases the after-tax cost of capital, (8) also implies that $F_K = (r - tRb + \alpha cb)/(1-t)$, where the expression on the right-hand side, the after-tax cost of capital, is increasing in t. Thus, the optimal amount of capital coincides with a larger marginal product of capital and is achieved by less capital investment.

If b is large, income shifting now generates strictly positive marginal tax haven profit and implies that a multinational will invest capital until its marginal taxable subsidiary income is negative. A higher tax rate now encourages a multinational to increase its capital investment in order to shift more aggregate income.

To understand the comparative statics results with respect to $\hat{\phi}$ and w, notice that differentiating (10) implies

$$\frac{d\hat{\phi}}{dt} = -\Pi_T - (1-t)L_m w_t.$$

An increase in t directly reduces global after-tax multinational profit at a rate proportional to the taxable income of subsidiaries and it generates a general equilibrium effect through the host wage. If taxable subsidiary income is close to zero, the equilibrium wage and equilibrium global after-tax profit will change in opposite directions. When b is small, so that in equilibrium $F_K - Rb > 0$, income shifting opportunities are limited so the decrease in K for the same measure of multinationals

[23] When Π_T is close to zero, the general equilibrium effects associated with income shifting will not dominate multinational capital choices.

implies a lower wage. If Π_T is close to zero, the lower wage then encourages more multinationals to enter. When b is large, so that in equilibrium $F_K - Rb < 0$, the income shifting incentives to increase capital investment increase global after-tax multinational profit. As long as Π_T is close to zero, the wage will increase and global after-tax profit will decrease.

The focus in Proposition 1 on equilibria with Π_T close to zero is helpful because Π_T will be close to zero near the boundary between $\mathcal{M}_{++}$ and $\mathcal{M}_{+0}$. We have already shown at $t = 0$ that $\Pi_T > 0$ and at $t = 1$ that a multinational would invest until $\Pi_T < 0$ if it could receive a tax benefit from running a loss at the subsidiary. Thus, there is a tax rate, $t_2(b)$ at which the non-negativity constraint on Π_T must bind for all $t > t_2(b)$. It is defined only for $b > \hat{b}$, and $t_2(b) \to 1$ as $b \to \hat{b}$. The function $t_2(b)$ defines the boundary between $\mathcal{M}_{++}$ and $\mathcal{M}_{+0}$ for all tax policies that attract strictly positive FDI. In Figure 3, $t_2(b)$ is represented by the solid curve in $\mathcal{M}_{++}$ and its dotted extension in $\mathcal{M}_0$. For tax rates just below $t_2(b)$, Π_T must be positive but close to zero. As a result, we can use the results in Proposition 1 for the case in which $b > \hat{b}$ to determine how t_2 varies with b. The following proposition summarizes the key properties of $t_2(b)$.

Proposition 2 *Assume (b, t) yields an equilibrium with strictly positive FDI and strictly positive taxable subsidiary income. For $b > \hat{b}$ and t just below $t_2(b)$, taxable subsidiary income is strictly decreasing in b and strictly decreasing in t.*

Proposition 2 reveals that $dt_2(b)/db < 0$. Along $t_2(b)$, an increase in b that permits more income shifting via internal debt will have no effect on taxable subsidiary income if the host government also decreases its tax rate, t. The lower tax rate decreases the firm's transfer price on the debt due to a smaller tax incentive.

Case 2: Positive FDI and zero multinational tax revenue, $\mathcal{M}_{+0}$

This second type of equilibrium will also exist for a positive measure of tax policies. From the above discussion of the case in which $t = 1$, the policy (b,1) results in positive K and $\Pi_T = 0$ for all $b > \hat{b}$, conditional on entry. Assumption (A2) guarantees that some multinationals will enter in equilibrium when (b, t) is close to (1,1). A multinational's optimal choices in this region no longer depend on t since each multinational sets its transfer price so that $\Pi_T = 0$. Thus,

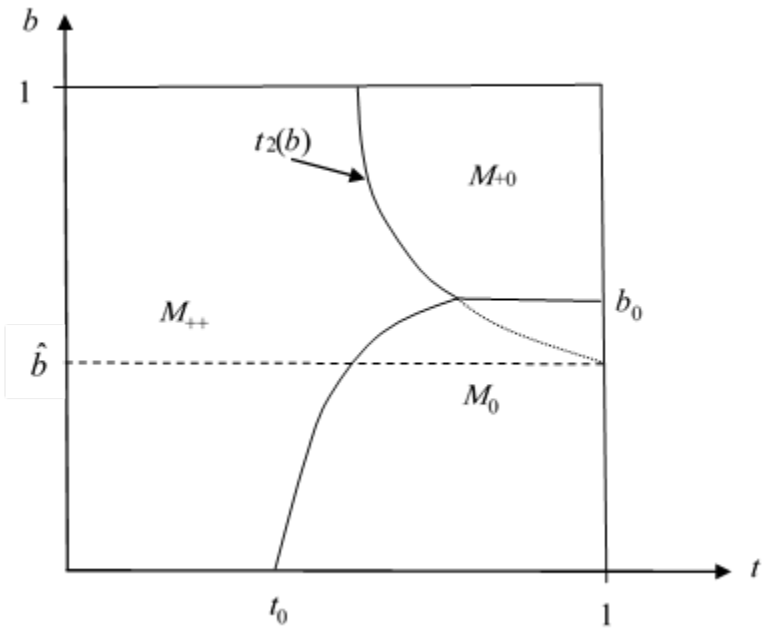

Figure 3: Equilibrium Regions

$K_t = R_t = \hat{\phi}_t = w_t = 0$ and $\Pi^*(b,t,\phi) = \Pi^*(b,t_2(b),\phi)$ for all $t \geq t_2(b)$. The next proposition summarizes the comparative statics on this region.

Proposition 3 *Assume (b,t) yields an equilibrium with strictly positive FDI and zero taxable subsidiary income. Then $w_b > 0$ if M is close to zero. K_b and R_b are ambiguous in sign but $\hat{\phi}_b > 0$, which means that multinational profit increases with b in this region.*

For policies that attract FDI but result in no taxable subsidiary income, the multinational's global profit is equal to $K(Rb - r - \alpha cb)$. While an increase in the thin capitalization limit, b, creates the incentive for multinationals to shift more income out of the host country per unit of capital for the same transfer price, the fact that subsidiaries were already generating zero taxable income means that, in order to increase income shifting profit, multinationals must adjust their capital investments and transfer prices to maintain zero taxable income. Holding the wage fixed, $d\Pi_T = 0$ if $(F_K - Rb)dK - bKdR - RKdb = 0$. Because $F_K - Rb < 0$ for this case, a multinational can maintain zero taxable income by increasing K, which reduces taxable income, and decreasing R, which increases taxable income, or vice versa. Even with general equilibrium wage effects, one

of these options will increase global after-tax profit. Thus, an increase in b will increase global after-tax profit and attract more multinationals.

Case 3: No FDI, $\mathcal{M}_0$

The above analyses of cases 1 and 2 were conditional on entry by multinational firms. In this subsection, we will identify tax policies that attract no FDI. Tax policies that attract no FDI do exist. At $b = 0$ and $t = 1$, $\Pi^* = -rK - \phi < 0$ so no firm will enter. This implies $\hat{\phi} = \underline{\phi}$ or $M = 0$. However, by (A1), multinational firms will enter at $b = t = 0$. Because Π^* is continuous in t, there exists $0 < t_0 < 1$ such that the host country attracts no FDI for all $t \geq t_0$ when $b = 0$ and it attracts positive FDI for all $t < t_0$, again when $b = 0$. The equilibrium analysis when $t = 1$ also implies $M = 0$ for each $b \leq \hat{b}$. Because Π^* is continuous in b, there exists a positive measure of policies for which the host country attracts no FDI. We now turn to a more explicit analysis to determine the boundaries of the set $\mathcal{M}_0$.

For all $b \leq \hat{b}$ and $t < 1$, the above analysis of case 1 shows any multinational that enters will earn $\Pi_T > 0$. Thus, for $b \leq \hat{b}$, the economy can only transition between equilibria with strictly positive FDI and strictly positive taxable subsidiary income to equilibria with no FDI. From the proof of Proposition 1, $\hat{\phi}_b > 0$ and, when M is close to zero, $\hat{\phi}_t < 0$. Thus, the boundary between $\mathcal{M}_{++}$ and $\mathcal{M}_0$ must be strictly increasing. It is represented by the upward sloping curve in Figure 3.

Intuitively, smaller values of b encourage less capital investment and less entry. If there is no FDI at (b, t), there should also be no FDI for all (b', t) with $b' < b$. Suppose that this result was not true. That is, for some $b' < b$, assume FDI is strictly positive. At (b, t), the lack of FDI means that $w(b, t) = G_L(1)$. With strictly positive FDI at (b', t), the equilibrium wage, $w(b', t)$ must exceed $G_L(1)$ as otherwise the labor market would exhibit excess demand. Formally then

$$\begin{aligned} \underline{\phi} \geq \Pi^*(b,t) &\geq \Pi(L_m(b',t), K(b',t), R(b',t), w(b,t), b, t) \\ &> \Pi(L_m(b',t), K(b',t), R(b',t), w(b',t), b, t) > \Pi(b',t). \end{aligned} \tag{15}$$

The second weak inequality in (15) follows from profit maximization. The first strict inequality in (15) arises because by assumption the reduction in b increases the equilibrium wage by attracting

FDI and the second strict inequality arises because a reduction in b holding the host wage and all multinational choices fixed reduces multinational profit by allowing a smaller tax deduction for interest payments. Together the chain of inequalities in (15) implies there will be no FDI at (b', t), which contradicts our initial assumption. A similar argument also applies to increases in t.

At $b = \hat{b}$ and for all $t < 1$, $\Pi_T > 0$, so in the limit as b converges to $\hat{b}$ from above, $t_2(\hat{b})$ converges to one. In addition, in the limit as t approaches one with $b = \hat{b}$, transfer price profits go to zero and after-tax subsidiary profit goes to zero. These two results imply that for t close to one, multinational profit will not be sufficient to cover the fixed cost of entry. Thus, the boundary between $\mathcal{M}_{++}$ and $\mathcal{M}_0$ at $\hat{b}$ must occur at some $t < 1$ and it must continue into the region for which $b > \hat{b}$.

Finally, because $t_2(b)$ is decreasing by Proposition 2, there exists $b_0 > \hat{b}$ for which no FDI arises at $(b_0, t_2(b_0))$. For $t > t_2(b_0)$, the host economy moves into $\mathcal{M}_{+0}$, and the equilibrium firm choices and the equilibrium wage become independent of t. With $\Pi_T = 0$, equilibrium multinational profit also does not vary with t. As a result, the boundary of $\mathcal{M}_0$ will extend into the region where $\Pi_T = 0$ and will be horizontal. By Proposition 3, M must be positive for $b > b_0$.

A special case arises when transfer pricing is costless because $\alpha = 0$. This is the case for which the host country's institutions are so weak that it cannot detect or chooses not to detect any transfer price deviation. With $\alpha = 0$, $\mathcal{M}_0 = \{(0, t) | t \geq t_0\}$ and $\mathcal{M}_{++} = \{(b, 0) | 0 \leq b \leq 1\} \cup \{(0, t) | t < t_0\}$. $\mathcal{M}_{+0}$ thus consists of all policies with $b > 0$ and $t > 0$. With no institutional capacity to limit transfer price deviations, the host country will attract strictly positive FDI with any strictly positive thin capitalization limit and any strictly positive tax rate but multinationals will shift all taxable income out of the host country.

6 Optimal tax policies

In this section, we analyze a host country's welfare maximization problem for each of the three cases identified in the equilibrium analysis. Because we begin by focusing on each region separately, our analysis will identify policies that are locally optimal. We will then compare host welfare among the locally optimal policies to identify the globally optimal policy.

For all three types of equilibria, totally differentiating (5) yields

$$\begin{aligned} d\Omega &= t\Pi_T dM - tMbKdR + tM(F_K - Rb)dK - ((t + (1-t)\beta_\pi)L_d - \beta_w + tML_m)dw \\ &- tMRKdb + ((1-\beta_\pi)\pi + \Pi_T M)dt. \end{aligned} \tag{16}$$

Eq. (16) reveals that host welfare is increasing in its tax rate and the measure of multinational firms that enter and decreasing in the transfer price and the debt-financing limit. The effect of a change in subsidiary capital and the host wage can be positive or negative.

Case 1: $FDI > 0$ **and** $\Pi_T > 0$

Denote the locally optimal tax policy on $\mathcal{M}_{++}$ by (b_{++}, t_{++}) and define $\Omega_{++} = \Omega(b_{++}, t_{++})$. Because this case is defined by strict inequalities, a locally optimal policy need not exist as the host country's incentives may be to move out of this region. One way to determine if a locally optimal policy on $\mathcal{M}_{++}$ exists is to study host country welfare on the boundaries of the region.

Near the boundary between $\mathcal{M}_{++}$ and $\mathcal{M}_0$, the measure of entrants is close to zero so (16) simplifies to

$$d\Omega = t\Pi_T dM - ((t + (1-t)\beta_\pi) - \beta_w)dw + (1-\beta_\pi)\pi dt \tag{17}$$

where $M_t < 0$ and $w_t < 0$ to the left of the boundary and $M_b > 0$ and $w_b > 0$ above the boundary. If the host country seeks to maximize national income ($\beta_w = \beta_\pi = 1$), then $\Omega_b > 0$ above the boundary and $\Omega_t < 0$ to the left so attracting FDI is locally optimal. For β_π just below one, positive FDI is still locally optimal but now $\Omega_t > 0$ to the right of the boundary. This means host preferences will be non-convex in t as both decreases and increases in t at this boundary increase host welfare. The non-convexity is important for understanding differences in host country policy choices because a small change in a host country characteristic could lead to a large change in the optimal policy. If the host country seeks to maximize tax revenues ($\beta_w = \beta_\pi = 0$), then countervailing effects arise. An increase in b increases host welfare by attracting more multinationals but decreases host welfare by decreasing domestic tax revenues due to a higher wage. A decrease in t increases host welfare due to more multinationals but decreases host welfare by decreasing domestic tax revenues, both directly via a lower tax rate and by lowering the domestic firm's income due to a higher wage.

Thus, we need to be aware that a host country that is focused largely on raising tax revenues may prefer not to attract FDI.

Near the boundary between $\mathcal{M}_{++}$ and $\mathcal{M}_{+0}$, taxable subsidiary income is close to zero so (16) simplifies to

$$d\Omega = tM(F_K - Rb)dK - tMbKdR - ((t+(1-t)\beta_\pi)L_d - \beta_w + tML_m)dw - tMKRdb + (1-\beta_\pi)\pi dt. \quad (18)$$

An alternative way to write $d\Omega$, by collecting together terms that affect Π_T, is

$$d\Omega = tMd\Pi_T + t\Pi_t dM + (\beta_w - (t + (1-t)\beta_\pi)L_d)dw + [(1-\beta_\pi)\pi + M\Pi_T]dt. \quad (19)$$

Just above the $\mathcal{M}_{++} - \mathcal{M}_{+0}$ boundary, that is at $t_2(b)^+$, $\Pi_T = 0$ and $d\Pi_T = 0$ so

$$d\Omega = (\beta_w - (t + (1-t)\beta_\pi)L_d)dw + (1-\beta_\pi)\pi dt. \quad (20)$$

Eq. (20) implies that $\Omega_b = (\beta_w - (t+(1-t)\beta_\pi)L_d)w_b$, which can be positive or negative depending on both the magnitude of M and the welfare weight values. However, since $w_t = 0$ on Ω_{+0}, the host country has a local incentive to increase its tax rate and adopt a tax policy strictly in M_{+0}. Below the boundary, $\Omega_b = (\beta_w - (t+(1-t)\beta_\pi)L_d)w_b + tMd\Pi_T/db$, where $w_b > 0$ and $d\Pi_T/db < 0$. If $\beta_w = \beta_\pi = 0$, $\Omega_b < 0$. Thus, a host country that wishes to maximize tax revenue has a local incentive to tighten the thin capitalization limit by lowering b. Doing so increases host welfare by reducing the incentive for multinationals to shift all taxable income out of the host country. As with the $M_{++} - M_0$ boundary, host preferences are non-convex.

Case 2: $FDI > 0$ **and** $\Pi_T = 0$

Denote the locally optimal tax policy on $\mathcal{M}_{+0}$ by (b_{+0}, t_{+0}) and define $\Omega_{+0} = \Omega(b_{+0}, t_{+0})$. On $\mathcal{M}_{+0}$, the equilibrium wage and all equilibrium firm choices are independent of t. Once multinationals are shifting all affiliate income out of the host country, further increases in t will have no effect on FDI decisions and will only increase tax revenues from the domestic sector. Thus,

Proposition 4 *For each $b > b_0$, host welfare on $\mathcal{M}_{+0}$, where equilibrium subsidiary taxable income*

is equal to 0, is maximized at $t = 1$.

Proof. By (16), $\Omega_t = (1 - \beta_\pi)\pi > 0$ for all $\beta_\pi < 1$ on $\mathcal{M}_{+0}$. For each $b > b_0$, $t = 1$ maximizes host welfare on $\mathcal{M}_{+0}$. If $\beta_\pi = 1$, then host welfare is independent of t on $\mathcal{M}_{+0}$ and $t = 1$ is still optimal. ■

In light of Proposition 4, the locally optimal policy on $\mathcal{M}_{+0}$ must take the form $(b, 1)$ for some $b > b_0$. Note however that the policy $(b_0, 1)$ attracts no FDI and is thus not an element of $\mathcal{M}_{+0}$.

With $t_{+0} = 1$, for any $b > b_0$,

$$\Omega_{+0}(b) \equiv \Omega(b, 1) = G(L_d) + (\beta_w - L_d)G_L(L_d) \tag{21}$$

and

$$\Omega_b = (\beta_w - L_d)w_b. \tag{22}$$

According to Proposition 3, $w_b > 0$ when M is close to zero. For b just above b_0, M is close to zero and $\Omega_b = (\beta_w - 1)w_b < 0$ for all $\beta_w < 1$. In this case, the local incentives on $\mathcal{M}_{+0}$ lead to the policy $(b_0, 1)$, which implies the host country prefers attracting no FDI in equilibrium to attracting a small amount of FDI. Among policies that attract FDI but generate no affiliate tax revenue, a necessary but not sufficient condition for no optimal policy to exist is $\beta_w < 1$. For example, this will be the case if the host country seeks to maximize tax revenues ($\beta_w = \beta_\pi = 0$).[24] Even with $\beta_w < 1$, an optimal policy on $\mathcal{M}_{+0}$ may exist if for large enough values of b the multinational employs enough labor so that $L_d < \beta_w$ as this would imply $\Omega_b \geq 0$. In our simulations presented later in this section, the sign of w_b does not change so the existence of a local optimum on $\mathcal{M}_{+0}$ occurs at $b = 1$.

Proposition 5 *The policy* $(b_0, 1)$*, which does not attract FDI, is locally optimal when the host country has a smaller welfare weight on wage income than on tax revenues.*

Proposition 5 highlights a welfare trade-off between wage income and tax revenues generated by the domestic sector. The policy $(b_0, 1)$ is the marginal policy between those policies with a

[24] Another example of a welfare function that puts less weight on wages than tax revenues is a Rawls welfare function for a host country with an unproductive group of residents who earn no wage income.

tax rate of one that attract FDI but generate no taxable income ($b > b_0$) and those policies that attract no FDI ($b \leq b_0$). A small increase in the thin capitalization limit above b_0 attracts a small amount of FDI and increases the equilibrium wage, which in turn reduces domestic taxable income and hence also tax revenues collected from domestic firms. For host countries that value an extra dollar of tax revenue even a little more than an extra dollar of wage income, the policy $(b_0, 1)$ is locally optimal. The discussion preceding Proposition 5 also points out that, for larger increases in the thin capitalization limit (such as to $b = 1$), if the more lax limit attracts enough multinational employment, the welfare gains from increased wages can more than offset welfare losses from reduced domestic tax revenues. In this case, a policy such as (1,1) can also be a local optimum. Figure 4 below provides an example of this possibility.

Case 3: $M = 0$

On $\mathcal{M}_0$, the equilibrium wage and all equilibrium firm choices are independent of b and t. By increasing t, the host country can increase tax revenues from the domestic firm. Thus,

Proposition 6 *For each b such that for some t the host country attracts no FDI, host welfare is maximized at $t = 1$.*

Proof. By (16), $\Omega_t = (1 - \beta_\pi)\pi > 0$ for all $\beta_\pi < 1$ when $(b, t) \in \mathcal{M}_0$. If $\beta_\pi = 1$, then host welfare is independent of t on $\mathcal{M}_0$. Thus, $t = 1$ is still optimal. ■

At $t = 1$, host welfare is independent of b on $\mathcal{M}_0$. Therefore, host welfare is maximized at $(b_0, 1)$ and maximal host welfare on $\mathcal{M}_0$ is $\Omega_0 \equiv \Omega(b_0, 1) = G(1) + (\beta_w - 1)G_L(1) > 0$.

Comparing optimal policies in each case

The above welfare analysis identifies three distinct tax policies that can be local optima for the host country. In this subsection, we proceed by showing that attracting no FDI can be globally optimal for a host country and by showing how the (globally) optimal host policy varies with the host country's institutional quality parameter, α.

Figure 4 illustrates an example in which it is optimal for the host country to adopt a tax policy that attracts no FDI. For this example, $F(l_m, k) = 1.5k^{0.3}l_m^{0.4}$, $G(L_d) = L_d^{0.9}$, $r = 0.08$, $\alpha = 3$, $c(R - r) = (R - r)^2$, $\phi \in [0.1, 10]$, $\beta_\pi = 0$, and $\beta_w = 0.8$. The values of λ, γ, δ and A are selected

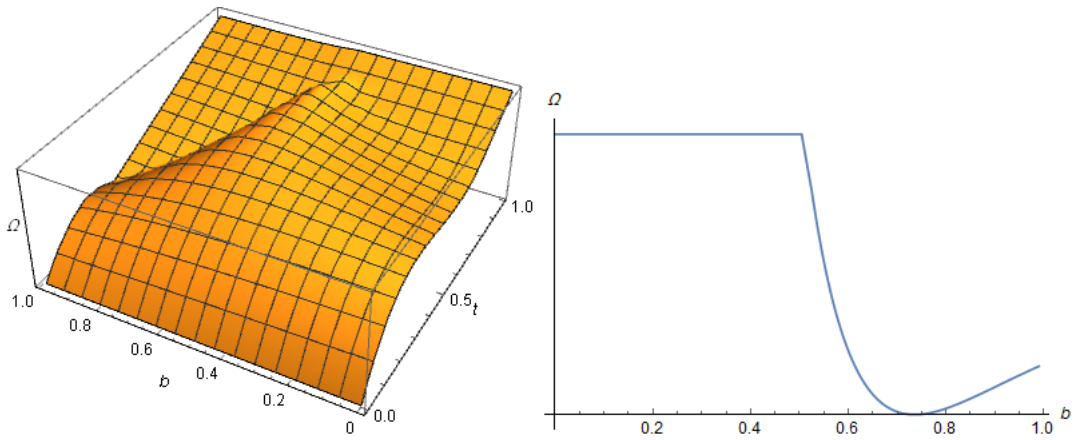

Figure 4: Host welfare as a function of b and t. No FDI is optimal when $F(l_m, k) = 1.5k^{0.3}l_m^{0.4}$, $G(L_d) = L_d^{0.9}$, $r = 0.08$, $\alpha = 3$, $c(R - r) = (R - r)^2$, $\phi \in [0.1, 10]$, $\beta_\pi = 0$, and $\beta_w = 0.8$. $t = 1$ in the right panel.

to be suggestive of a developing country as these values are indicative of low domestic rents, high subsidiary rent consistent with Karabarbounis and Nieman (2014), and a foreign sector that is larger than the domestic sector. The remaining parameter values define a baseline example in which it is optimal for the host country to attract no FDI. The left graph plots Ω against b and t. The right graph plots Ω as a function of b for $t = 1$. Both graphs reveal non-convexities in the host welfare function identified in the above welfare analysis. The right graph, in particular, shows that an increase in b just above $b_0 \approx 0.55$ attracts FDI but the welfare gain from a higher wage is smaller than the welfare loss from lower domestic firm tax revenues. For values of b closer to one, welfare is increasing in b. For these values of b, domestic employment has fallen to the point at which the marginal welfare gains from a higher wage now outweigh the marginal welfare losses from lower domestic firm tax revenues. Even though welfare is locally maximized at $(b, t) = (1, 1)$, the globally optimal tax policy occurs at $(b_0, 1)$. It attracts no FDI in equilibrium.

Figure 5 illustrates an example in which it is optimal for the host country to adopt a tax policy that does attract FDI. It is generated using the same parameter values used in Figure 4 except that $\alpha = 2.13$, $\beta_\pi = 0.3$, and $\beta_w = 0.85$. The main change is the reduction in α. We chose these specific parameter values to create an example in which the host country is close to indifferent between all three local optima. We focus on this 3-way indifference case as it allows us to show how a change in α can cause a host country's optimal tax policy to shift between the three possible

equilibrium cases and generate the discontinuous jump in safe harbor limits we observe in Figure 1. Before discussing Figure 5 in more detail, as it is presented solely for illustration purposes, we first compute and analyze two comparative statics with respect to changes in α that will help us establish general results about how a small change in α can lead to a discrete change in tax policy.

For policies that generate equilibria on $\mathcal{M}_{+0}$,

$$\frac{d\Omega_{+0}(b,1)}{d\alpha} = (\beta_w - L_d)w_\alpha \tag{23}$$

where L_d is the equilibrium level of labor at $t = 1$ and $b > b_0$. Eq. (23) allows us to understand how changes in a host country's institutional quality affects the welfare differences between attracting FDI that generates no taxable income and attracting no FDI. Recall that for b just above b_0, M is close to zero so L_d is close to one, and $w_\alpha < 0$. This means for any $\beta_w < 1$, there are values of b above b_0 for which an increase in α increases host welfare. More effective transfer price regulation, reflected by an increase in α, attracts fewer multinationals because each multinational earns less net income shifting profit. The multinationals that enter when $t = 1$ are only profiting from income shifting, so any change in the host country that reduces the net profit from income shifting will attract less FDI, and results in a lower wage. A lower wage increases the taxable income of domestic firms and results in larger taxes collected from domestic firms. With $\beta_w < 1$, the welfare gain from higher tax revenues more than offsets the welfare loss from a lower wage.

For b close to one, host welfare on $\mathcal{M}_{+0}$ can either increase or decrease depending on the sign of $\beta_w - L_d$. If $b = 1$ is a local optimum, and the policy attracts enough FDI, then L_d will be less than β_w as now the marginal tax loss from domestic firms is low enough that the marginal welfare gain from a higher wage dominates. This reversal in the sign of $\beta_w - L_d$ between the locally optimal no-FDI policy at $(b_0, 1)$ and the locally optimal policy that attracts FDI but generates no tax revenues from the FDI at (1,1) can be observed in the right panel in Figure 4. Since the co-existence of these two local optima requires that $\beta_w > L_d$ at (1,1), it will also be true that an increase in α lowers welfare from the policy (1,1).

That is, suppose there is a host country whose top two local optima generate very similar welfare at (1,1) and at $(b_0, 1)$. With a marginally higher institutional quality, the country would now prefer

to attract no FDI, while with a marginally lower institutional quality, the country would prefer to attract FDI and allow maximal income shifting with the policy (1,1). Thus, for host countries choosing between the locally optimal policies that attract no FDI and that attract FDI with no taxable income investing in marginally better institutional quality might not be advantageous.

Second, on M_{++}, the Envelope Theorem and the firm's first-order conditions (7) - (10) imply that

$$\frac{d\Omega_{++}(b_{++}, t_{++})}{d\alpha} = (\beta_w - t - (1-t)\beta_\pi L_d)w_\alpha + t\Pi_T M_\alpha - \frac{t(Rb - r - \alpha cb)}{1-t}K_\alpha - \frac{tMbK(1-\alpha c')}{1-t}R_\alpha. \tag{24}$$

Direct calculations show that the comparative statics K_α, R_α, M_α, and w_α are all negative. That is, an increase in α reduces capital investment per firm, the transfer price, the measure of multinational firms, and the host wage.

If b_{++}, the optimal thin capitalization level on M_{++}, satisfies $\partial\Omega_{++}/\partial b = 0$, (24) can be simplified by noticing that $w_\alpha = x \cdot w_b$, $M_\alpha = x \cdot M_b$, and $K_\alpha = x \cdot K_b$ for $x = cb/(\alpha(c - Rc'))$. Using the host country's first-order condition on b then implies that

$$\frac{d\Omega_{++}(b_{++}, t_{++})}{d\alpha} = tMbK\left(\frac{c'}{\alpha c''} - \frac{Rc}{\alpha(c - Rc')}\right) > 0, \tag{25}$$

due to the convexity of $c(\cdot)$. Thus, an increase in α increases host welfare from the locally optimal tax policy that attracts FDI and results in strictly positive taxable income. The reason is that better institutional quality in the tax authority encourages multinationals to shift less income out of the host country. We can use this comparative static to understand how changes in a host country's institutional quality affects the welfare differences between the locally optimal policy that attracts FDI and generates taxable income with the locally optimal policy that attracts no FDI or with the locally optimal policy that attracts FDI and generates no taxable income.

In order for a small difference in a host country's institutional quality to lead to a large change in its optimal tax policy as suggested by Figure 1, consider the situation in Figure 5 in which three distinct local optima exist (one of them at (1,1)) and yield identical host welfare. β_w must be less than one for this three-way tie scenario to exist. Welfare values are reported in Table 1.

The globally optimal tax policy attracts no FDI with b below approximately 0.4 and $t = 1$. If α increases to 2.14, the globally optimal tax policy attracts FDI and generates taxable income by setting $b = 0.47$ and $t = 0.56$.

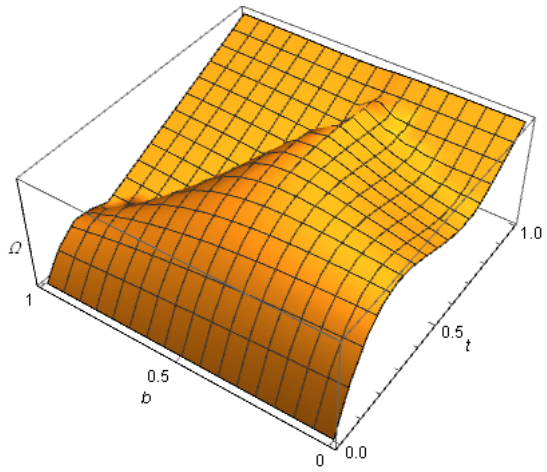

Figure 5: Comparable welfare from the optimal no-FDI policy, the optimal positive-FDI-with-positive-taxable-income policy, and the optimal positive-FDI-with-zero-taxable-income policy.

	$\alpha = 2.13$	$\alpha = 2.14$
FDI $= 0$	0.865	0.865
FDI > 0 and $\Pi_T > 0$	0.864989	0.865015
FDI > 0 and $\Pi_T = 0$ $b = 1$	0.864942	0.864940

Table 1: Host welfare at each local optima as a function of α.

According to comparative statics (23) and (25), if one begins with a host country whose value of α implies it is indifferent among three distinct local policy optima, a host country with a marginally larger value of α would choose a tax policy that attracts FDI and yields strictly positive taxable income while a host country with a marginally smaller value of α would choose a tax policy that attracts FDI with zero taxable income.[25] This difference in the optimal policy of two very similar countries is due to the fact that an increase in α changes welfare in opposite directions for the locally optimal policy that attracts FDI with no taxable income and the locally optimal policy that attracts FDI with taxable income. First, according to (23), an increase in α attracts less FDI with the policy (1,1). Even with a welfare weight on wage income less than one, with large enough multinational employment generated by setting $b = 1$ better transfer price enforcement attracts enough less FDI to more than offset the welfare gains from increased domestic tax revenue. An example of this change can be seen in the last row of Table 1. Second, according to (25), an increase in α increases multinational tax revenues collected under the locally optimal policy that

[25] Because of the slight difference in welfare in Table 1, countries with α between 1.54 and 2.13 would choose not to attract FDI while only countries with $\alpha < 1.54$ would choose to attract FDI with zero taxable income.

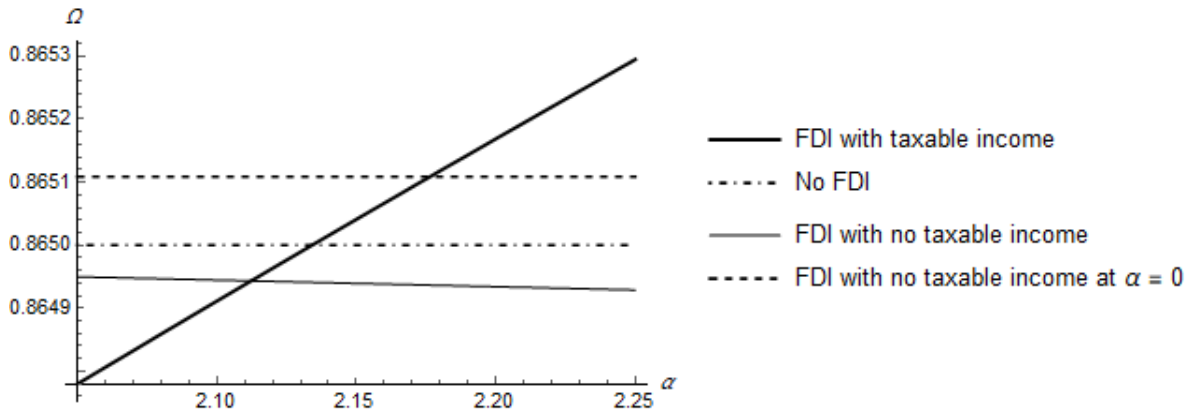

Figure 6: Host welfare as a function of α.

attracts FDI with taxable income and results in more welfare. An example of this change can be seen in the second row of Table 1. Since welfare under a locally optimal policy that attracts no FDI is unaffected by a change in α, combining the above two changes implies that with better institutional quality a host country now strictly prefers a policy that attracts FDI with taxable income. However, this conclusion implicitly assumes that a host country will always want to fully utilize its auditing capabilities.

Suppose instead that a host country can choose to audit in a way that does not fully utilize its institutional quality.[26] Because small changes in α can cause a country's optimal tax policy to change discontinuously, we need to determine how α affects welfare at each of the local optima separately. First, comparative static (23) implies that welfare from any policy that attracts FDI but yields no taxable income is decreasing in α if the quantity demanded of labor by multinationals is greater than β_w. Under these conditions, (1,1) is locally optimal. Using the same parameter values from Figure 5, this decreasing property of host welfare at (1,1) is illustrated in Figure 6 by the thin solid line. Host welfare at (1,1) is maximized when $\alpha = 0$ as no transfer price auditing attracts the most FDI. The value of host welfare at (1,1) with $\alpha = 0$ corresponds to the dashed line in Figure 6. The dot-dashed line in Figure 6 shows the value of welfare when the host country chooses a policy that attracts no FDI. This value is independent of α. Notice that, for the plotted values of α below 2.13, the optimal policy when the host country fully utilizes its institutional quality attracts no

[26]Introducing a marginal cost associated with changing α would not alter our conclusions. It would only add a second reason for a host country to under-utilize its institutional ability.

FDI but if it chooses to operate as though its value of α is close to zero it should instead adopt a policy that attracts FDI but yields no taxable income. That is, by choosing to audit in a manner consistent with lower institutional quality, a no-FDI policy is no longer globally optimal because less carefully audited multinationals would increase their labor demand sufficiently to offset lower tax revenues under the policy (1,1).[27] Second, comparative static (25) implies that welfare from the locally optimal policy that attracts FDI with taxable income is increasing in α. Welfare in this case is illustrated by the heavy solid line in Figure 6.

With under-utilization of institutional quality, countries with a value of α approximately less than 2.18 are better off acting as though their value of α was equal to zero. This group of host countries includes both those that with full utilization would have chosen to attract no FDI and those that would have chosen to attract FDI that generates positive taxable income. Instead, these countries will adopt policies that attract FDI and zero taxable income and are based on the countries under-utilizing their institutional quality. The reason why under-utilization benefits these countries is that under full utilization the optimal tax policy generates limited multinational tax revenues. Thus, it does not benefit the country to impose auditing costs on multinationals. In our model, the host country does not incur a cost to use any level of its institutional quality. If it did, potential audit cost savings would simply create a second reason for under-utilization. It is also the case that the auditing costs the multinational incurs are incurred outside the host country. Thus, social concealment costs are not driving our results. The main driver for choosing α low (zero in our examples) is larger FDI. It is only countries with values of α approximately greater than 2.18 that will fully utilize their institutional quality and adopt policies that attract FDI and positive taxable income. Thus, the strategic choice of auditing intensity results in more countries attracting FDI with zero taxable income. Moreover, comparing Figures 4 and 5, the scope for the strategic choice of auditing arises in countries that place sufficient welfare weight on after-tax domestic profit and wage income. Even in this case, the analysis still generates a discrete jump in the thin capitalization limit chosen by high-quality and low-quality countries as observed in Figure 1.

[27] In the example illustrated in Figure 4, in which tax revenue maximization is the dominant goal of the government, the ability for under-utilization to change the globally optimal policy does not arise because host welfare with a no-FDI policy is larger than with the locally optimal policy that yields positive FDI with no taxable income for any smaller value of α.

7 Earnings stripping rules

The main alternative to a safe harbor rule is an earnings stripping rule. Earnings stripping rules limit the tax deduction for interest payments to interest payments that do not exceed a specified fraction of pre-tax earnings (either EBIT or EBITDA). In our model, an earnings stripping rule corresponds to a constraint of the form $RB \leq b(F - wL_m)$ for $0 \leq b \leq 1$. A number of major economies including the United States and several EU countries now use earnings stripping rules instead of safe harbor rules. In the EU, the change from safe harbor to earnings stripping rules was prompted in 2008 by new attempts in Germany and Denmark to foster the equity base in firms and prevent international income shifting, and enforced in 2019 by the EU Anti Tax Avoidance Directive (EU-ATAD) that builds on the OECD Action Plan 4 (OECD, 2013).

For any $b < 1$, subsidiary taxable income will always be strictly positive. Thus, the set of policies that attract FDI and yield no taxable income is a line segment from $(1, t_2(1))$ to $(1, 1)$. The optimal policy on this segment is (1,1). Gresik, Schindler, and Schjelderup (2017) show that the optimal transfer price, R, equals r when there are no costs associated with debt financing, as in the current paper. Adding in financing costs to the current paper would not change the results in sections 5 and 6 but would imply $R > r$ for the case of earnings stripping. Thus, the case of no financing costs is the most extreme case that could arise.

With no financing costs, the adoption of an earnings stripping rule eliminates country characteristics for which no FDI is an optimal outcome. With larger financing costs, both the potential optimality of a no FDI policy and the discrete jump to optimal tax policies from small changes in a country's institutional quality can arise.

8 Conclusion

In this paper, we study whether it is beneficial or not for a country to attract FDI when multinationals can shift income to tax havens and countries differ in their institutional ability to curb income shifting. Our model allows us to show how optimal tax policies differ among developing, emerging, and developed countries. For example, countries that value tax revenue highly, but have a low ability to curb income shifting (i.e., low institutional quality), may suffer a loss in welfare

from attracting FDI. The reason is that welfare losses from lost tax revenue dominate the welfare gains from higher domestic wages. We also show that for some countries with intermediate levels of institutional quality, it can be welfare enhancing to under-utilize their institutional quality to generate a sufficient increase in FDI. Our analysis provides an explanation for the bifurcated pattern of thin capitalization limits observed in practice.

Going back at least to the era of the Washington Consensus (Williamson (1989)), there has been a presumption that attracting FDI is good for developing countries. Consistent with this view, economists have documented the ability of lower effective average and marginal tax rates in attracting FDI[28] and the link between lower tax rates and wages.[29] Recent policy studies that focus on developing country policies that can attract FDI, such as the World Bank study by Andersen, Bett, and von Uexkull (2018), also fail to acknowledge that attracting FDI may not be welfare-enhancing for a developing country nor do they take account of perhaps the most widespread tax incentive, a permissive thin capitalization rule with interest rate transfer pricing.

A policy implication of our findings is that what works well for developed economies need not work the same way nor be appropriate for developing economies. We have shown that for developing countries that rely heavily on corporate tax revenues and have weak tax administration capabilities, attracting FDI can make the country worse off. Offering other tax incentives such as tax holidays and investment tax credits only exacerbates the problem. Thus, in the context of corporate tax reform, our paper formalizes the idea in Bhagwati (2004) of "appropriate governance," and shows how a host country's level of actual governance affects how it should think about attracting FDI. For countries with low levels of tax administration capability, our analysis implies that improving the quality of tax administration is crucial if a country wants to reap the benefits of FDI. Some might argue that attracting FDI today provides the experience that can lead to higher quality tax administration tomorrow. This longer-term strategy hinges on sufficient public funding for tax administration as well as the ability to hire high quality workers that understand the behavior of multinationals. Neither condition may be met in poor countries. Hence, before opening up for FDI, a country needs to evaluate how long it would take to build sufficient tax administration quality. It

[28] For example, de Mooij and Ederveen (2008) report in a meta-analysis significant semi-elasticities of FDI with respect to both effective average and marginal tax rates in the range of -4 to -5.

[29] For example, see Fuest, Piechl, and Siegloch (2018).

should also recognize that the improved quality will not immediately translate into increased tax revenues.

Appendix: Proofs

Proof of Proposition 1. This case requires $t < 1$. When $t = 1$, either $\mathcal{M} = 0$ or $\Pi_T = 0$. Totally differentiating (7) - (10) and (12) - (13) with $\mu = 0$ yields

$$\begin{pmatrix} (1-t)F_{KK} & (1-t)F_{KL} & 0 & 0 & 0 & 0 \\ F_{KL} & F_{LL} & 0 & 0 & 0 & -1 \\ 0 & 0 & -\alpha c'' & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & -(1-t)L_m \\ 0 & 0 & 0 & 0 & G_{LL} & -1 \\ 0 & M & 0 & mL_m & 1 & 0 \end{pmatrix} \cdot \begin{pmatrix} dK \\ dL_m \\ dR \\ d\hat{\phi} \\ dL_d \\ dw \end{pmatrix} = \begin{pmatrix} a_1 \\ 0 \\ -dt \\ a_2 \\ 0 \\ 0 \end{pmatrix} \quad (26)$$

where $m = 1/(\bar{\phi} - \underline{\phi})$, $a_1 \equiv \alpha(c - Rc')db + (F_K - Rb)dt$ and $a_2 \equiv \alpha(c - Rc')Kdb + \Pi_T dt$. Denote the 6x6 matrice in (26) by Z. Direct calculation shows that $|Z| = \alpha c''[G_{LL}M(1-t)F_{KK} - G_{LL}(1-t)^2 mL_m^2 \nabla^2 F + (1-t)\nabla^2 F] > 0$. By the convexity of $c(\cdot)$, $c - Rc' \leq 0$. The homogeneity assumption on F implies that $KF_{KK} + L_m F_{KL} < 0$ and $L_m F_{LL} + KF_{KL} < 0$.

Additional direct calculations then show that

$K_b = \alpha^2(c - Rc')c''[MG_{LL} + F_{LL} - G_{LL}(1-t)mL_m(L_m F_{LL} + KF_{KL})]/|Z| > 0$,

$\hat{\phi}_b = -\alpha^2(c - Rc')c''[G_{LL}M(1-t)(F_{KL}L_m + KF_{KK}) + (1-t)K\nabla^2 F)]/|Z| > 0$,

$w_b = \alpha^2(c - Rc')c''G_{LL}(MF_{KL} + KmL_m(1-t)\nabla^2 F)/|Z| > 0$,

$K_t = \alpha c''[(F_K - Rb)(MG_{LL} - G_{LL}(1-t)mL_m^2 F_{LL} + F_{LL}) - G_{LL}mL_m(1-t)F_{KL}\Pi_T]/|Z|$,

$\hat{\phi}_t = -\alpha c''[(F_K - Rb)G_{LL}MF_{KL}(1-t)L_m + \Pi_T(G_{LL}M(1-t)F_{KK} + (1-t)\nabla^2 F)]/|Z|$, and

$w_t = \alpha c''G_{LL}[(F_K - Rb)MF_{KL} + \Pi_T mL_m(1-t)\nabla^2 F]/|Z|$.

While the comparative statics with respect to b are unambiguously signed, the comparative statics with respect to t for K, $\hat{\phi}$, and w have potentially countervailing terms that depend on the magnitude of $(1-t)\Pi_T$ and the sign of $F_K - Rb$.

When $\mu = 0$, (8) implies that $(1-t)(F_K - Rb) = -(Rb - r - \alpha cb)$. For $b \leq \hat{b}$, $Rb - r - \alpha cb < 0$

for all $t < 1$ because (9) implies that $R^*(\hat{b}, t) < R^*(1)$, which means a multinational loses money on its income shifting. In order for a multinational to enter the host market, its after-tax subsidiary profit must be positive, which it will be because $F_K - Rb > 0$ at the optimal capital, labor, and transfer price choices. Thus, for $b \leq \hat{b}$, $w_t < 0$ while $K_t < 0$ and $\hat{\phi}_t > 0$ if $(1-t)\Pi_T$ is sufficiently close to zero.

For $b > \hat{b}$, $F_K - Rb < 0$ for all $t > t_1(b)$. Thus, $K_t > 0$ and $\hat{\phi}_t < 0$. If $(1-t)\Pi_T$ is close to zero, then $w_t > 0$. Note: The comparative statics for the case in which there is no transfer pricing ($\alpha = \infty$) can be generated mechanically by setting $\alpha(c - Rc') = -rt$ and $\alpha c'' = -1$. In this case, $K_t > 0$ and $\hat{\phi}_t < 0$. The sign of w_t remains ambiguous.

Proof of Proposition 2. First, we can show that $d\Pi_T/db < 0$ on $\mathcal{M}_{++}$ when $\Pi_T \approx 0$. The multinational first order conditions imply

$$\frac{\partial \Pi_T}{\partial K} K_b + \frac{\partial \Pi_T}{\partial L_m}(L_m)_b + \frac{\partial \Pi_T}{\partial R} R_b = -(Rb - r - \alpha cb)K_b/(1-t) - bK(1 - \alpha c')R_b. \tag{27}$$

Note that

$$\frac{d\Pi_T}{db} = \frac{\partial \Pi_T}{\partial K} K_b + \frac{\partial \Pi_T}{\partial L_m}(L_m)_b + \frac{\partial \Pi_T}{\partial R} R_b + \frac{\partial \Pi_T}{\partial b}, \tag{28}$$

where $R_b = 0$ and $\partial \Pi_T/\partial b = -RK - L_m w_b$. With $w_b > 0$ and $K_b > 0$, $d\Pi_T/db < 0$ because $Rb - r - \alpha cb > 0$ for Π_T close to zero.

Second, we can show that $d\Pi_T/dt < 0$ when $\Pi_T \approx 0$. Now the multinational first order conditions imply

$$\frac{\partial \Pi_T}{\partial K} K_t + \frac{\partial \Pi_T}{\partial L_m}(L_m)_t + \frac{\partial \Pi_T}{\partial R} R_t = -(Rb - r - \alpha cb)K_t/(1-t) - bKR_t, \tag{29}$$

where $R_t > 0$. Then,

$$\frac{d\Pi_T}{dt} = -K_t(Rb - r - \alpha cb)/(1-t) - bKR_t - L_m w_t. \tag{30}$$

When $\mu = 0$, (8) implies that $(1-t)(F_K - Rb) = -(Rb - r - \alpha cb)$. For $b < \hat{b}$, the right-hand side is positive so Π_T must be strictly positive in order for the host country to attract FDI. In order

for $(b,t) \in \mathcal{M}_{++}$, as opposed to $\mathcal{M}_0$, Π_T must be bounded away from zero. Thus, this proposition does not apply when $b < \hat{b}$. For $b > \hat{b}$, the equilibrium marginal return on capital investment in the subsidiary is negative when $\Pi_T \approx 0$. From Proposition 1, an increase in the host tax rate encourages each multinational to invest more capital in the host country, set a larger transfer price, and the wage rate increases when Π_T is close to zero. Thus, $d\Pi_T/dt < 0$.

Proof of Proposition 3. We derive the comparative statics with respect to b when $t = 1$ as this will be the relevant tax rate to consider for the welfare analysis on $\mathcal{M}_{+0}$. The comparative statics for any $t < 1$ on $\mathcal{M}_{+0}$ can be generated by substituting $1 - t + \mu$ for μ in the expressions below. The signs of the comparative statics remain unchanged.

Totally differentiating (7) - (13) with $\mu > 0$ yields

$$\begin{pmatrix} & & & & & 0 & -L_m \\ & & & & & 0 & 0 \\ & & BH & & & 0 & -1 \\ & & & & & 0 & 0 \\ & & & & & 0 & -\mu L_m \\ 0 & 0 & 0 & 0 & 0 & G_{LL} & -1 \\ 0 & 0 & M & 0 & mL_m & 1 & 0 \end{pmatrix} \cdot \begin{pmatrix} d\mu \\ dK \\ dL_m \\ dR \\ d\hat{\phi} \\ dL_d \\ dw \end{pmatrix} = \begin{pmatrix} RKdb \\ \alpha(c - Rc')db \\ 0 \\ 0 \\ \alpha(c - Rc')Kdb \\ 0 \\ 0 \end{pmatrix} \tag{31}$$

where BH, the bordered Hessian for (6) is

$$\begin{pmatrix} 0 & F_K - Rb & 0 & -bK & 0 \\ F_K - Rb & \mu F_{KK} & \mu F_{KL} & 0 & 0 \\ 0 & F_{KL} & F_{LL} & 0 & 0 \\ -1 & 0 & 0 & -\alpha c'' & 0 \\ 0 & 0 & 0 & 0 & -1 \end{pmatrix} \tag{32}$$

and $|BH| > 0$. Denote the 7x7 matrice in (31) by X. Direct calculation shows that

$$\begin{aligned} |X| &= ML_mG_{LL}(F_K - Rb)\alpha c'' - MG_{LL}(-\mu F_{KK}bK + \alpha c''(F_K - Rb)^2) \\ &- m\mu^2 L_m^2 G_{LL} bK\nabla^2 F + \mu F_{KL}^2 + m\mu L_m^2 G_{LL}\alpha c'' F_{LL}(F_K - Rb)^2 + |BH| > 0. \end{aligned} \tag{33}$$

Solving (31) then yields

$$\begin{aligned} K_b &= [-\mu M F_{KL} RKG_{LL} + \alpha(c - Rc')bK(MG_{LL} + F_{LL} - \mu m L_m^2 F_{LL}G_{LL}) \\ &- \alpha c'' F_{LL} RK(F_K - Rb)mL_m - \mu m L_m \alpha(c - Rc')bK^2 F_{KL}G_{LL} \\ &- mL_m^2\alpha^2 c''(c - Rc')(F_K - Rb)F_{LL}G_{LL}K]/|X|, \end{aligned} \tag{34}$$

$$\begin{aligned} R_b &= [-MG_{LL}(\alpha(c - Rc')(L_m F_{KL} - (F_K - Rb)) + \mu F_{KK}RK) \\ &+ \mu m L_m G_{LL}\alpha(c - Rc')K(F_{KL}(F_K - Rb) + L_m\nabla^2 F) \\ &+ \mu m L_m^2 G_{LL}(\mu RK\nabla^2 F - \alpha(c - Rc')F_{LL}(F_K - Rb)) \\ &- (\mu RK\nabla^2 F - \alpha(c - Rc')F_{LL}(F_K - Rb))]/|X|, \end{aligned} \tag{35}$$

$$\begin{aligned} w_b &= [-\alpha^2 c''(c - Rc')(F_K - Rb)^2 G_{LL}F_{LL}mL_mK - \alpha c'' MR(F_K - Rb)G_{LL}F_{KL}K \\ &+ \alpha(c - Rc')MbG_{LL}F_{KL}K + \alpha(c - Rc')\mu\nabla^2 FmbL_mG_{LL}K^2]/|X|, \end{aligned} \tag{36}$$

and

$$\begin{aligned} \hat{\phi}_b &= [-\alpha(c - Rc')MbG_{LL}(KF_{KK} + L_mF_{KL})K + \alpha(c - Rc')K|BH|_4 \\ &+ \alpha c'' MG_{LL}(F_K - Rb)K(\alpha(c - Rc')(F_K - Rb) - \alpha(c - Rc')L_mF_{KL} + \mu L_m RF_{KL}]/|X| > 0. \end{aligned} \tag{37}$$

By the convexity of $c(\cdot)$ and noting that $F_K - Rb < 0$ on $\mathcal{M}_{+0}$, the first line of (34) is positive while the remaining terms in the numerator are negative. Thus, the sign of K_b is ambiguous. For R_b, the first, third, and fourth terms in the numerator of (35) are negative while the second term is ambiguous in sign. Similarly, the second term in the numerator of (36) is negative while the other

three terms are positive. For $M = 0^+$, the second term goes to zero and $w_b > 0$. Finally, $\hat{\phi}_b > 0$ because $|BH|_4$, the determinant of the upper 4x4 principal minor of $|BH|$, is non-positive, $c(\cdot)$ is convex, and the homogeneity of F implies that $KF_{KK} + L_m F_{KL} < 0$.

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