

Gresik, Thomas; Schindler, Dirk; Schjelderup, Guttorm

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Thomas A. Gresik
Dirk Schindler
Guttorm Schjelderup

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Abstract

Multinational corporations can shift income into low-tax countries through transfer pricing and debt financing. While most developed countries use thin capitalization rules to limit the extent to which a subsidiary can be financed with internal debt, a number of developing countries do not. In this paper, we analyze the effect on FDI and host country welfare of thin capitalization rules when multinationals can also shift income via transfer prices. We show that while permissive thin capitalization limits may be needed in developing countries to attract FDI, the amount of debt financing allowed by the permissive limits facilitates more aggressive transfer pricing and results in lower host country welfare.

JEL-Code: D690.

Keywords: multinationals, profit shifting, foreign direct investments, welfare.

Thomas A. Gresik
Department of Economics
University of Notre Dame
720 Flanner Hall
USA – Notre Dame, IN 46556
tgresik@nd.edu

Dirk Schindler
Dept. of Accounting, Auditing and Law
Norwegian School of Economics
Helleveien 30
Norway - 5045 Bergen
Dirk.Schindler@nhh.no

Guttorm Schjelderup
Dept. of Business and Management Science
Norwegian School of Economics
Helleveien 30
Norway - 5045 Bergen
Guttorm.Schjelderup@nhh.no

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1. Introduction.

Over the last few decades major industrialized countries have made considerable reforms to their corporate income tax policies in order to attract investment. Statutory rates in the OECD, for example, have fallen from an average of 50 % in the early 1980s to 25% in 2014. Despite falling tax rates, multinationals have come under fire for siphoning off profits into tax havens. Corporations have responded by saying that their objective is to reduce their worldwide taxes consistent with national laws in order to maximize post-tax global profit. This has prompted governments around the world to overhaul their tax systems and the OECD to launch its BEPS project (OECD, 2013). The latter points to transfer pricing and the use of conduit companies in tax havens as the main culprits of tax base erosion.

In this paper we investigate whether attracting foreign direct investment (FDI) from multinationals is a bane or a boon for a host country. Our analysis differs from previous contributions in that we model the interplay between tax havens, transfer pricing, thin capitalization, and host country policies. We allow the host country to decide on the corporate tax rate and thin capitalization rules that may limit profit shifting by excessive interest deductions. A multinational firm has a financing subsidiary located in a tax haven and an operational subsidiary in a high-tax country. The multinational can shift profit to the tax haven affiliate by the level of internal debt and the interest rate (transfer price) it charges on its internal debt to the affiliate in the high-tax country.

We show that while permissive thin capitalization limits may be needed in developing countries to attract FDI, the amount of debt financing allowed by such permissive rules may facilitate aggressive transfer pricing that can result in lower welfare. Which countries benefit or lose from attracting FDI depends in general on country characteristics. We categorize countries as being developed, emerging, or developing. Developed countries have better institutional quality than emerging or developing countries in the sense that their tax system makes it more costly for multinationals to engage in aggressive tax-induced transfer pricing. They also have a low cost of capital, high rents for domestic entrepreneurs, and a moderate to high capital share in multinational production relative to emerging and developing countries.

We find that developed countries can benefit from FDI and that a welfare maximum exists with an optimal corporate tax rate and a thin capitalization rule that are largely in line with average current tax rates and thin capitalization rules in the OECD. Emerging countries can also

benefit from FDI but that they also may need to select among two locally welfare optimal policies as welfare need not be globally concave. The existence of multiple locally optimal tax policies means that two similar countries can have very different optimal policies – a feature that we observe among the tax policies of emerging economies. Multiple local optima can also result in a country getting stuck in a local but not global optimum. Developing countries, however, do not stand to benefit from policies that attract positive FDI.

The reason for these results is that developing countries are less able to prevent aggressive transfer pricing due to low institutional quality in the tax administration (i.e., the multinational has more discretion in setting its transfer price). Because of this multinationals are able to shift most of their profits to the tax haven affiliates and at the same time erode the tax base in developing countries thereby negating the benefits of FDI. The optimal tax policy for developing countries is to effectively eliminate the tax benefits of debt financing and only tax domestic firms. In contrast, developed countries can better curb aggressive transfer pricing while attracting welfare-enhancing FDI with a combination of moderate thin capitalization limits and moderate tax rates. Emerging countries face a combination of the incentives associated with developed and developing countries. At high tax rates, multinationals will have an incentive to engage in aggressive transfer pricing, which creates local incentives for the host country to proscribe debt financing by multinationals and only tax domestic firms. At lower tax rates, the incentive for multinationals to engage in aggressive transfer pricing is muted to the extent that the host country faces local incentives to allow enough debt financing to attract some FDI. As we will show, which of these two tax policies is optimal for an emerging country will depend on a number of characteristics of the emerging country's economy.

Our result, that some countries can be harmed by multinationals' profit shifting activities to the extent that they should not adopt policies that attract any FDI, stands in contrast to the predominant views in the literature on tax base competition. For example, 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. 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 partly or wholly and reduce the adverse effects of inefficient policies.

Hong and Smart (2010) also show that providing a tax deduction for interest payments on subsidiary debt allows host countries to maintain or even increase high business 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-tax country. Increased investment increases the demand for labor which in turn increases the host wage rate and host welfare.

Slemrod and Wilson (2009) argue against these positive views by showing that the net welfare advantage to debt financing disappears when the host country can charge domestic investors and foreign investors different tax rates. One way a host country could do this is to levy a withholding tax on outbound interest payments. However, Johannesen (2012) shows that tax competition among several host countries will, in equilibrium, eliminate any incentive for a host country to impose a withholding tax on interest payments.

In practice host countries most often limit the tax deductibility of debt financing by adopting a safe harbor rule that allows a multinational to deduct interest payments to affiliates only if its debt to equity ratio is not too large. Table 1 (see appendix) lists the 2004 thin capitalization (safe harbor) limits and statutory tax rates for the 54 countries used by Blouin, Huizinga, Laeven, and Nicodème (2014).¹ More than half of the countries in the sample, including the largest national economies, have explicit safe harbor limits strictly less than one. In contrast, Hong and Smart show that host welfare is always increasing in its safe harbor limit which implies that it is always in a host country's interest to allow the full tax deductibility of debt financing.

The tax rate information in Table 1 reveals even more nuanced patterns between tax rates and thin capitalization limits than implied by Hong and Smart. Figure 1 plots average 2004 tax

¹ 2013 data shows the same general relationships among the safe harbor limits and statutory tax rates for the same 54 countries. More countries adopted thin capitalization limits in 2013 and several countries adopted earnings stripping limitations (which limit the tax deduction for interest payments by setting a maximum ratio of interest payments to the subsidiary's EBITDA), some in conjunction with a safe harbor limit. We study the interaction between safe harbor limits and earnings stripping limits in an upcoming sequel.

rates² and 2004 safe harbor limits for the top twenty countries in terms of GDP per capita. Figure 2 plots the same information for the remaining 34 countries whose safe harbor limits are reported in Blouin, Huizinga, Laeven, and Nicodème (2014).³ The portion of Figure 2 corresponding to countries with safe harbor limits less than one suggests a possible negative relationship between tax rates and safe harbor limits.⁴ Both figures also suggest that host countries can fall into two distinct policy regimes: a regime with a safe harbor limit of one and a regime with a safe harbor limit around 0.5 to 0.8.

In this paper we are able to qualitatively match this data to allow a multinational firm to shift income with transfer prices as well as debt financing. Transfer pricing incentives will be moderated through host country auditing while the amount of interest payments that are tax deductible are restricted by a safe harbor limit. While many tax haven papers focus on the role such countries play with regard to debt financing, the reality is that transfer pricing is still considered the major cause of income shifting, and hence of base erosion. Our analysis will

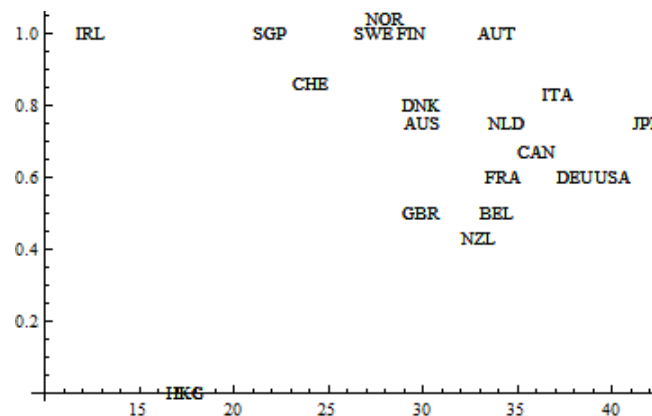


Figure 1: Average tax rates and thin capitalization limits for countries with top twenty per capita GDP

² Tax rate data comes from KPMG (2004) and Spengel, Elschner, and Endres (2012).

³ The countries listed at the top of each figure have thin capitalization limits equal to 1 but their positions have been adjusted in order to see each country's position in the graph.

⁴ The correlation between the safe harbor limits and the average tax rates for the countries with limits less than one is -0.16 in Figure 1 and -0.38 in Figure 2. Although neither correlation is precisely estimated, the difference suggests that safe harbor limits are more sensitive to average tax rates among emerging countries than among developed countries.

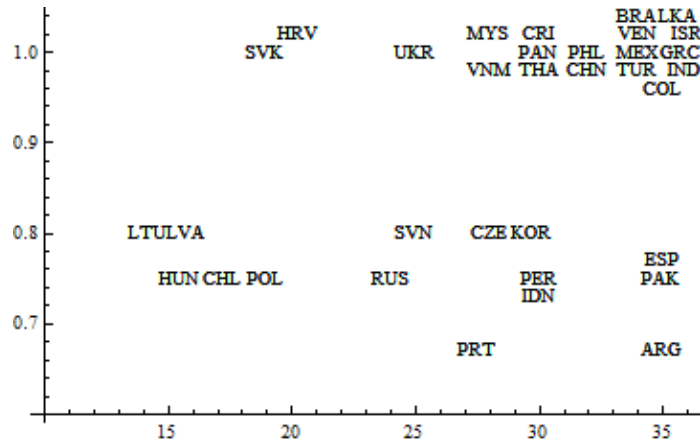


Figure 2: Average tax rates and thin capitalization limits for 34 emerging economies

show that both policies jointly determine the total amount of income a multinational will shift out of a host country and we will be able to generate tax rate and safe harbor patterns similar to those in Figures 1 and 2. Furthermore, because our model includes both debt financing and transfer pricing, we will identify host tax policies that are sufficiently permissive to create a money pump for multinationals to extract host country wealth and undermine host welfare and host tax policies that are so restrictive that the host country may not be able to attract any FDI. The optimality of this latter possibility for developing countries suggests that without strong enough transfer price regulation, a host country will be better off choosing a thin capitalization rule which results in zero FDI.⁵

Section 2 presents the model we analyze. In section 3, we derive conditions on host country tax policies that admit either an equilibrium with zero FDI or one with a strictly positive level of FDI. In section 4, we study optimal host country tax policy. We consider several extensions of our model in section 5. Concluding remarks are offered in section 6.

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

Our point of departure is the model by Hong and Smart (2010) – hereafter HS - where

⁵ This finding is consistent with the results in Abbas et al (2012) which reports the results of an empirical analysis of the effects of tax rate cuts in emerging and developing countries from 1996 to 2007. They find that, contrary to the effects experienced by larger host economies, African countries experience a drop in tax revenues even though they do attract more FDI.

FDI is issued by a subsidiary of the multinational located in a tax haven country. We expand their analysis in several aspects. First, we include transfer pricing and auditing costs. Second, we analyze the interplay between government regulation on profit shifting and corporate taxation. Finally, we study host country welfare of attracting FDI.

We model a multinational firm that can invest capital, either equity or debt, in a single host country. The host country economy consists of workers, who inelastically supply one unit of labor, and entrepreneurs, who own domestic firms. Domestic firms can employ L_d units of labor at a wage rate w to produce $G(L_d)$ units of output that are sold in a competitive market. The output price is normalized to one. The production function, $G(\cdot)$, is strictly increasing and strictly concave in L_d . The pre-tax profit of a domestic firm is

$$\pi = G(L_d) - wL_d. \quad (2.1)$$

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

The multinational firm operates 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 its host country subsidiary. $F(\cdot, \cdot)$ is strictly increasing, strictly concave, and homogeneous of degree 1 in both inputs. The multinational faces the same competitive wage rate, w , and sells its output in a competitive market whose price is also normalized to one. Denote the multinational's constant economic cost of capital by r .

The multinational can choose to finance its capital investment with equity, E , and/or debt, B , so that $K = E + B$. We assume that the multinational's economic cost of capital reflects, in part, a country-specific risk of the investment so that r need not simply equal a worldwide interest rate. The idiosyncratic cost of capital allows the multinational to charge its host country subsidiary an interest rate, σ , that can differ from r . That is, σ is the transfer price of internal debt. Allowing the multinational to use its transfer price on debt to shift income out of the host country is the simplest and most direct way to see the linkages between debt-shifting and transfer pricing.⁶

⁶ While the norm in the tax competition literature is to assume all multinationals can finance

The multinational incurs transfer pricing costs of $C(\sigma - r, B; \alpha) = \alpha c(\sigma - r)B$ to reflect any transfer price auditing the host country may conduct. These transfer pricing costs consist of three components. First, the cost function, $c(\cdot)$, is increasing and convex in the difference between σ and r , which we take to be the arm's-length interest rate. Second, the multinational's transfer pricing costs are proportional to the amount of debt as the total amount of shifted profit will equal $(\sigma - r)B$. Third, we use the non-negative parameter, α , to capture different levels of transfer price auditing intensity by the host country.

A key reason for financing a subsidiary with debt instead of equity is that interest payments on debt are tax deductible expenses while dividend payments to equity holders are not.⁷ As long as the subsidiary faces the same tax rate on host country profit as do domestic firms, the multinational's after-tax profit is defined as

$$\Pi = (1 - t)(F(L_m, K) - wL_m - \sigma B) + \sigma B - rK - C(\sigma - r, B; \alpha). \quad (2.2)$$

Many countries impose thin capitalization requirements on multinationals to prevent them from financing foreign operations entirely with debt. As in HS we model thin capitalization rules as the maximum proportion, b , of a multinational's capital investment for which interest expenses can be tax deductible. If a multinational finances its host country subsidiary with the maximum amount of debt, the subsidiary's debt-equity ratio would be $b/(1 - b)$. Assuming that the multinational does indeed use the maximum amount of debt allowed by the host country, $B = bK$, its after-tax multinational profit can be written as

$$\begin{aligned} \Pi &= (1 - t)(F(L_m, K) - wL_m - \sigma bK + \frac{\sigma b - r}{1 - t} K) - \alpha c(\sigma - r)bK \\ &= (1 - t)(F(L_m, K) - wL_m - \rho K) \end{aligned} \quad (2.3)$$

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 . We discuss an extension in which the multinational sets a transfer price on an intermediate third input (other than capital or labor) in section 5.

⁷Davies and Gresik (2003) study the role of debt borrowed from host country investors.

where $\rho = (r - \sigma bt + \alpha c(\sigma - r)b) / (1 - t)$ is the effective (pre-tax) cost of capital.

The host country seeks to maximize a weighted sum of worker and entrepreneur consumption, $C_W + \beta C_E$, where $\beta \in [0, 1)$. Aggregate worker consumption equals wage income, w , plus taxes, T . Since ρ is independent of K , if the multinational elects to invest in the host country it will employ labor and capital so that $F_L = w$ and $F_K = \rho$. Thus, host tax revenues equal

$$\begin{aligned} T &= t\pi + t(F - wL_m - \sigma bK) = t\pi + t(F_K K + F_L L_m - wL_m - \sigma bK) \\ &= t\pi + t(\rho - \sigma b)K. \end{aligned} \quad (2.4)$$

If one defines host country income as $Y = F - rK - \alpha cbK + G$, then

$$Y = wL_m + \rho K - rK - \alpha cbK + \pi + wL_d = (\rho - r - \alpha cb)K + w + \pi. \quad (2.5)$$

Using (2.4), worker consumption is $C_W = w + T = w + t\pi + t(\rho - \sigma b)K$. Note that

$Y - C_W = (1 - t)\pi + K((1 - t)\rho - r - \alpha cb + \sigma bt) = (1 - t)\pi = C_E$, where the second equality follows

from the definition of ρ . So as in HS, maximizing $C_W + \beta C_E$ is equivalent to maximizing

$$\Omega \equiv Y - (1 - \beta)(1 - t)\pi.$$

3. No-FDI and positive-FDI equilibria.

There are two possible types of equilibria: no-FDI equilibria and positive-FDI equilibria. The first type of equilibrium occurs when $K = 0$ and the second occurs when $K > 0$. The first type of equilibria was not considered in HS but will turn out to be important in our model due to the combination of debt shifting and transfer pricing.

Using the multinational's after-tax profit function in (2.3), the first-order conditions for a positive-FDI equilibrium are

$$\begin{aligned}
(i) F_K &= \rho, \\
(ii) F_L &= w, \\
(iii) G_L &= w, \text{ and} \\
(iv) \alpha c'(\sigma - r)bK &= tbK.
\end{aligned} \tag{3.1}$$

Since the optimal value of σ is independent of L_m and K and $F(\cdot, \cdot)$ and $G(\cdot)$ are strictly concave, (3.1) defines the profit-maximizing choices of a multinational when $K > 0$ is optimal.

Eq. (3.1.iv) implies that the profit-maximizing transfer price solves

$$c'(\sigma - r) = t / \alpha \tag{3.2}$$

for any $K > 0$ and $b > 0$. Denote the solution to (3.2) by $\sigma^*(t, \alpha)$. The multinational's transfer price is decreasing in α for $t > 0$ ($\sigma_\alpha^* = -t / (\alpha^2 c'') < 0$), independent of b , and increasing in t ($\sigma_t^* = 1 / (\alpha c'') > 0$). Define the multinational's indirect cost of capital, $\rho^*(b, t, \alpha)$, as ρ evaluated at σ^* . Eq. (3.2) implies that

$$\rho^*(b, t, \alpha) = \frac{r(1 - bt)}{1 - t} - \frac{b[t(c')^{-1}(t / \alpha) - \alpha c((c')^{-1}(t / \alpha))]}{1 - t} \tag{3.3}$$

so that with the strict convexity of $c(\cdot)$, $\rho^* \leq r(1 - bt) / (1 - t)$ and $\sigma^* t \geq \alpha c(\sigma^* - r)$.⁸ The multinational's indirect cost of capital is increasing in α for $b > 0$ and $t > 0$ ($\rho_\alpha^* = cb / (1 - t) > 0$), decreasing in b for $t > 0$ ($\rho_b^* = -(\sigma^* t - \alpha c) / (1 - t) < 0$), and can be increasing or decreasing in t ($\rho_t^* = (\rho^* - \sigma^* b) / (1 - t)$). For t sufficiently close to zero, ρ^* will be increasing in t , while for t and b sufficiently large, ρ^* can be decreasing in t since the multinational can now shift a significant amount of income out of the host country via its transfer price.

Eqs. (3.1) plus the labor market clearing condition, $L_d + L_m = 1$, define a positive-FDI

⁸ Define $x = (c')^{-1}(t / \alpha)$. Then one can write the term in square brackets in (3.3) as $\alpha(xc'(x) - c(x))$ which is non-negative by the strict convexity of $c(\cdot)$.

equilibrium if they admit a solution with $K > 0$. Denote such an equilibrium by $K(b, t, \alpha)$, $L_m(b, t, \alpha)$, $L_d(b, t, \alpha)$, $\sigma^*(t, \alpha)$, and $w^*(b, t, \alpha)$ and denote equilibrium host welfare by $\Omega^*(b, t, \alpha)$.

3.1 Equilibrium existence.

No equilibrium with $K = 0$ or $K > 0$ will exist if the multinational's profit function is unbounded. For each $b > 0$, this situation will arise if $t \leq 1$ and $\rho^* < 0$ or if $t < 1$ and $\rho^* = 0$ due to the multinational's ability to set σ . To identify the host country policies for which no equilibrium exists note that $\rho^* = 0$ only if the numerator of ρ^* , $r - \sigma^*bt + \alpha cb$, equals zero.⁹ For α fixed, b and t imply $\rho^* = 0$ if, and only if, $b = r / (\sigma^*t - \alpha c(\sigma^* - r))$. If for some t this value of b is greater than one, then ρ^* is always positive. This equation defines an iso- ρ^* curve in (b, t) space. Denote this curve by $b_\infty(t, \alpha)$. Comparative statics calculations imply that $\partial b_\infty / \partial t < 0$ and $\partial^2 b_\infty / \partial t^2 > 0$. The strict convexity of $c(\cdot)$ also implies that $0 < b_\infty(1, \alpha) < 1$ and $b_\infty(t, \alpha) = 1$ for t strictly between 0 and 1.

Proposition 1. *For each α , no equilibrium exists due to unbounded multinational profit for all $b \geq b_\infty(t, \alpha)$ when $t \in [0, 1)$ and for all $b > b_\infty(1, \alpha)$.*

Proposition 1 indicates that for each t and α , sufficiently high values of b will allow the multinational to earn infinite profits through its ability to charge its host country subsidiary a sufficiently high interest rate so that its after-tax cost of capital is negative. Furthermore, this issue cannot be avoided by appealing to Inada-type conditions as it is not the result of production function properties but rather of the multinational's response to the host country's tax policies. In addition at $\rho^* = 0$, $\rho_t^* = (\rho^* - \sigma^*b) / (1 - t)$ is strictly negative for all $b > 0$. Thus, the set of values of b for which no equilibrium exists is increasing with t . That is, large values of b permit

⁹ ρ^* is undefined at $t = 1$. In this case, $\Pi = -(r - \sigma b + \alpha cb)K$ so the multinational's profit will continue to be unbounded when $r - \sigma^*bt + \alpha cb < 0$. When $r - \sigma^*bt + \alpha cb = 0$ at $t = 1$, L'hospital's Rule implies that $\lim_{t \rightarrow 1} \rho^* = \sigma^*b$. Otherwise the limit is either ∞ or $-\infty$.

the multinational to shift a substantial amount of income to the tax haven by financing a large proportion of investment via debt while a high tax rate encourages a higher transfer price. The thick solid curve in Figure 3 represents the set of values of b and t for which $\rho^* = 0$.

Higher values of α ameliorate this existence problem by increasing the multinational's indirect cost of capital for each $b > 0$. In the limit as $\alpha \rightarrow \infty$, $\rho^* = r$ only for $b = t = 1$. Thus, when any deviations from the arm's-length interest rate, r , are infinitely expensive, an equilibrium exists for all b and t .

3.2 No-FDI equilibrium.

Another possibility is that the host factor markets equilibrate only when there is no FDI, that is, $K = 0$. This situation can occur when the host wage rate without FDI is too high relative to the multinational's cost of capital. Without any FDI, the equilibrium wage is $w_0 = G_L(1)$.

Because F is homogeneous of degree 1 in both inputs, one can write

$$F(L_m, K) = L_m \cdot F(1, K / L_m) = K \cdot F(L_m / K, 1). \quad (3.4)$$

Eq. (3.4) then implies that $F_K(L_m, K) = F_K(1, K / L_m)$ and $F_L(L_m, K) = F_L(L_m / K, 1)$. Since F_K is monotonic in K , (3.1.i) implies that if there exists a positive-FDI equilibrium, then

$K / L_m = F_K^{-1}(\rho^*)$. Substituting this expression into (3.1.ii) implies

$$F_L(1 / F_K^{-1}(\rho^*), 1) = w^*. \quad (3.5)$$

Because a positive amount of FDI will increase the demand for host labor, a necessary condition for a positive equilibrium to exist is $w^* > w_0$ or

$$F_L(1 / F_K^{-1}(\rho^*), 1) > G_L(1).$$

Denote the value of ρ^* for which $w^* = w_0$ by ρ_0 . The associated iso- ρ^* curve is a function,

$b_0(t, \alpha)$.¹⁰ Since $\rho_b^* < 0$, for all $b \leq b_0(t, \alpha)$ only equilibria with zero FDI exist.

Proposition 2. *For each α , the multinational invests no capital in the host country in equilibrium for all $b \leq b_0(t, \alpha)$ when $t \in [0, 1)$ and for all $b < b_0(1, \alpha)$ when $t = 1$.*

Proposition 2 implies that there is a minimum value of b needed to support a positive amount of FDI in equilibrium. The following example illustrates this idea.

Example 1. Assume that $G(L_d) = L_d^\lambda$ for $\lambda \in (0, 1)$ and $F(L_m, K) = K^\gamma L_m^{1-\gamma}$ for $\gamma \in (0, 1)$. A positive-FDI equilibrium will exist if, and only if, $w^* > \lambda$. This condition is equivalent to $\rho^* < \gamma((1-\gamma)/\lambda)^{(1-\gamma)/\gamma}$. If $\lambda + \gamma = 1$, then ρ^* must be less than γ . For $c(\sigma - r) = (\sigma - r)^2$, $r = .15$, $t = .3$, $\lambda = .9$, $\alpha = .1$, and $\gamma = .1$, positive-FDI equilibria will exist only if $b > .29$.

For all ρ^* that can arise in a positive-FDI equilibrium, differentiating (3.5) with respect to ρ^* implies

$$dw^*/d\rho^* = F_{LL}(1/F_K^{-1}(\rho^*)) \cdot (-1/F_K^{-1}(\rho^*)^2) \cdot dF_K^{-1}(\rho^*)/d\rho^* < 0 \quad (3.6)$$

because $K/L_m = F_K^{-1}(\rho^*)$ implies that $dF_K^{-1}/d\rho^* = 1/F_{KK}$. Ineq. (3.6) thus shows that the multinational's indirect cost of capital and the equilibrium host country wage are negatively correlated. Host country policies that lower ρ^* encourage FDI and increase w^* .

Note the tension between Propositions 1 and 2. By Proposition 1, if b is too large, then the multinational's profit is unbounded and no equilibrium will exist. By Proposition 2, if b is too small, the only equilibrium may be one with zero FDI. Moreover, increases in α increase the set of values of b and t that imply zero FDI in equilibrium.

This tension is further illustrated in Figure 3 in which several iso- ρ^* curves are graphed. The thickest solid curve is the iso- ρ^* curve for $\rho^* = 0$. As ρ^* increases, the corresponding iso-

¹⁰ If a positive-FDI equilibrium exists when $b = 0$, define $b_0(t, \alpha)$ to be strictly negative.

ρ^* curve shifts down and to the left, as indicated by the other solid curves. For $\rho^* \leq r$, the iso- ρ^* curves will be downward sloping for all t as when $\rho^* = 0$. For $\rho^* > r$, the iso- ρ^* curves begin at $b = 0$ and are initially increasing in t and then decreasing in t . At low tax rates, the dominant effect from an increase in t is a reduction in the multinational's after-tax return to capital. At high tax rates, the dominant effect from an increase in t is an increase in the multinational's ability to shift profits out of the host country through its transfer price. This second effect however is moderated by reducing the amount of debt financing to which the transfer price in this model applies. The lower solid curve (with intermediate thickness) is the iso- ρ^* curve for ρ_0 . Note that all the iso- ρ^* curves converge at $t = 1$. Above this point of convergence (the open circle) $\rho^* = -\infty$, while below it $\rho^* = \infty$. Footnote 6 reports that, for b fixed, ρ^* converges to $\sigma^* b$. However, any other limiting value can be achieved by converging along the appropriate iso- ρ^* curve. As a result, at the point of convergence multiple equilibria exist with K ranging from 0 to ∞ . For $t < 1$, positive-FDI equilibria will exist only for values of b and t that fall in between the two thick solid lines. The dashed lines correspond to the iso- ρ^* curves for $\rho^* = 0$ and $\rho^* = \rho_0$ due to an increase in α . They show that higher transfer price costs imply there are fewer combinations of b and t for which no equilibrium exists and more combinations of b and t for which there is a no-FDI equilibrium.

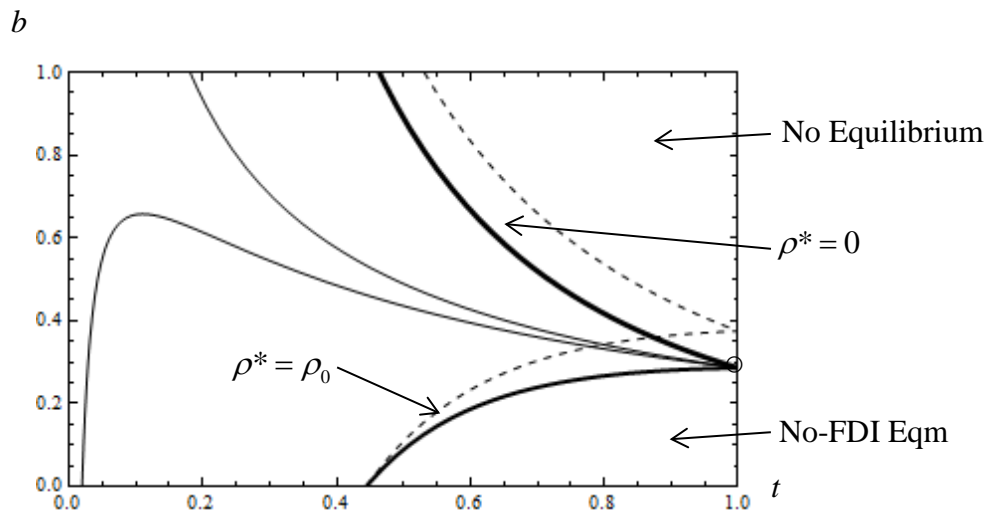


Figure 3: Iso- ρ^* curves

Corollary 1. *If $\rho_0 < r$, then for all t the minimum value of b for which a positive-FDI equilibrium exists is strictly greater than zero. That is, $b_0(t, \alpha) > 0$ for all t .*

Corollary 1 addresses the case in which the multinational would not invest in the host country without some tax incentive. In this case, the host country would not only need to allow for some tax-preferred debt financing but would also need to set a strictly positive tax rate in order to create an incentive for income shifting via transfer pricing.

4. Host country welfare maximization.

In any positive-FDI equilibrium, K , L_m , L_d , and w^* are uniquely determined by ρ^* . The tax policy variables b and t indirectly influence the factor market equilibria through their effect on ρ^* . Thus, totally differentiating equations (3.1(i)-(iii)) with respect to ρ^* and using the fact that $dL_d = -dL_m$ implies that

$$\begin{pmatrix} F_{KK} & F_{KL} & 0 \\ F_{KL} & F_{LL} & -1 \\ 0 & -G_{LL} & -1 \end{pmatrix} \cdot \begin{pmatrix} dK \\ dL_m \\ dw^* \end{pmatrix} = \begin{pmatrix} d\rho^* \\ 0 \\ 0 \end{pmatrix} \quad (4.1)$$

where $d\rho^* = \rho_b^* db + \rho_t^* dt$. Also define

$$H = \begin{pmatrix} F_{KK} & F_{KL} & 0 \\ F_{KL} & F_{LL} & -1 \\ 0 & -G_{LL} & -1 \end{pmatrix}$$

and note that $|H| = -F_{KK}G_{LL} < 0$. Solving (4.1) then implies

$$dK / d\rho^* = (F_{LL} + G_{LL}) / F_{KK}G_{LL} < 0, \quad (4.2)$$

$$dL_m / d\rho^* = -F_{LK} / F_{KK}G_{LL} < 0, \quad (4.3)$$

and

$$dw^*/d\rho^* = F_{LK} / F_{KK} < 0. \quad (4.4)$$

Thus, higher effective costs of capital imply lower equilibrium levels of FDI, host employment by multinationals, and a lower host country wage.

Totally differentiating equilibrium host country welfare with respect to b and t then implies

$$d\Omega^* = ((\rho_b^* - \alpha c)db + \rho_t^* dt - tbd\sigma^*)K + (\rho^* - r - \alpha cb)dK + (1 - \beta)\pi dt + [1 - (1 - (1 - \beta)(1 - t))L_d]dw^*. \quad (4.5)$$

Substituting (4.2) - (4.4), $\sigma_b^* = 0$, and $\sigma_t^* = 1 / \alpha c''$ into (4.5) yields

$$d\Omega^* = \left\{ \frac{\partial \Omega^*}{\partial \rho^*} \cdot \rho_b^* - \alpha c K \right\} db + \left\{ \frac{\partial \Omega^*}{\partial \rho^*} \cdot \rho_t^* - \frac{btK}{\alpha c''} + (1 - \beta)\pi \right\} dt \quad (4.6)$$

where

$$\begin{aligned} \partial \Omega^* / \partial \rho^* &= K - (\rho^* - r - \alpha cb) \frac{F_{LL} + G_{LL}}{|H|} + \frac{F_{LK}}{F_{KK}} \cdot [1 - (1 - (1 - t)(1 - \beta))L_d] \\ &= K - (\rho^* - r - \alpha cb) \frac{F_{LL} + G_{LL}}{|H|} - \frac{K}{L_m} \cdot [1 - (1 - (1 - t)(1 - \beta))L_d] \\ &= -(\rho^* - r - \alpha cb) \frac{F_{LL} + G_{LL}}{|H|} - (1 - t)(1 - \beta)KL_d / L_m. \end{aligned} \quad (4.7)$$

The second line of (4.7) is due to the CRS assumption on F . The last line of (4.7) is due to the fact that $L_m + L_d = 1$ in equilibrium. If the marginal welfare return to FDI, $\rho^* - r - \alpha cb$, is non-negative, then an increase in ρ^* must reduce host welfare ($\partial \Omega^* / \partial \rho^* < 0$). However, if the marginal welfare return to FDI is sufficiently negative, it can be that $\partial \Omega^* / \partial \rho^* \geq 0$. Because $\rho_b^* < 0$, (4.6) implies that host welfare must be decreasing in b when $\partial \Omega^* / \partial \rho^* \geq 0$.

4.1 A benchmark case: The HS model.

In order to study the welfare effects of debt shifting and transfer pricing, we start out with internal debt as the only profit shifting mechanism as in the HS model. Taking the limit of our

model as α goes to infinity approximates the HS model. The multinational's optimal transfer price, σ^* , converges to r and one can use L'Hopital's Rule to show that αc converges to zero.¹¹ $\rho^* - r - \alpha cb \rightarrow rt(1-b)/(1-t) > 0$ for all $b < 1$ so $\partial\Omega^*/\partial\rho^* < 0$ in the limit. Consistent with Proposition 4 in HS, (4.6) implies that for positive-FDI equilibria,

$$\frac{\partial\Omega^*}{\partial b} = -\frac{\partial\Omega^*}{\partial\rho^*} \cdot \frac{rt}{(1-t)} > 0.$$

Thus, increasing the amount of income the multinational can shift out of the host country via debt financing increases host country welfare for all b . An implication of this result, not made in HS, is that the optimal value of b is one for all $t > 0$. Furthermore, setting $b = 1$ implies that $\rho^* = r$ so t is now a pure-profit tax for both domestic and foreign firms. Because the tax rate does not distort the firm's factor demands, a positive-FDI equilibrium will exist for every t (with $b = 1$). As a result, $\partial\Omega^*/\partial t = (1 - \beta)\pi$. Thus, the optimal host country policy is one in which the host government allows the multinational to deduct all of its capital costs (financed with debt), appropriates all of the profits from domestic and foreign firms by imposing a tax rate of 100%, and then redistributes the tax revenues it to workers. Equilibrium multinational profit is zero. This equilibrium allocation is first-best. The implication of this benchmark analysis is that the ability of the host country to completely shut down the transfer pricing channel creates a strong incentive for the host country to allow full debt-shifting as all the rents from this activity can be completely taxed away.

4.2 Optimal host country policy with debt financing and transfer pricing.

For any finite value of α , the host country policy of setting $b = t = 1$ is no longer optimal. As shown in section 3.1, this policy would give the multinational the means to shift an arbitrarily large amount of profit out of the host country before it is taxed. Linking our model to previous research, note that the quantity demanded of host labor by the multinational would be effectively zero so the welfare gain in the HS model attributable to a higher wage rate would not materialize.

¹¹ However, even in the limit, $\alpha c' = t$, so a marginal effect of transfer pricing still persists as long as a positive-FDI equilibrium survives in the limit.

Given the possibility of an equilibrium with zero FDI, deriving the optimal host country tax policy in the presence of debt financing and transfer pricing now requires that one compare host welfare under the best no-FDI equilibrium to host welfare under the best positive-FDI equilibrium. Among host country policies that result in zero FDI, the optimal policy is a tax rate of one, since it allows the government to extract all the rents from domestic firms, and any b consistent with zero FDI.

The optimal positive-FDI policy can be derived using (4.6). Treating α as an exogenous parameter and using the formulas for ρ_b^* and ρ_t^* , (4.6) shows that the host country's first-order conditions with respect to b and t for an interior optimum are

$$\frac{\partial \Omega^*}{\partial b} = -\frac{(\sigma^* t - \alpha c)}{(1-t)} \cdot \frac{\partial \Omega^*}{\partial \rho^*} - \alpha c K = 0 \quad (4.8)$$

and

$$\frac{\partial \Omega^*}{\partial t} = \frac{(\rho^* - r - \alpha c b)}{t(1-t)} \cdot \frac{\partial \Omega^*}{\partial \rho^*} - \frac{btK}{\alpha c''} + (1-\beta)\pi = 0. \quad (4.9)$$

The first term on the right-hand side of (4.8) is the indirect welfare effect due to the effect on K , L_m , L_d , and w^* from a change in ρ^* induced by a change in b . Its sign is negatively correlated with the sign of $\partial \Omega^* / \partial \rho^*$. The second term is the direct effect on welfare from a change in b . It is negative because an increase in b , holding all factor market variables fixed, increases the multinational's total transfer price costs since it is using more debt financing. The first term in (4.9) is the indirect welfare effect associated with a change in the factor market equilibrium from a change in t . Its sign depends on the sign of $\partial \Omega^* / \partial \rho^*$ and the sign of the host country's marginal return to FDI. The second term is the indirect welfare effect from a change in the firm's transfer price generated by a change in t . It is negative because a larger tax rate causes the multinational to increase its transfer price and hence shift more profit out of the host country. The last term is the direct effect of a change in t associated with domestic firm rents. It is positive because an increase in t allows the host country to extract more domestic rent.

Holding t fixed, (4.8) reveals that the host country has a strict preference for setting $b > 0$ to attract FDI if $\partial \Omega^* / \partial \rho^* < 0$ at the value of b for which $\rho^* = \rho_0$. Recall that $K = 0$ when

$\rho^* = \rho_0$. Thus if $\partial\Omega^* / \partial\rho^* < 0$ at $\rho^* = \rho_0^-$, it must be the case that $\partial\Omega^* / \partial b > 0$.

Proposition 3. *Fix $t > 0$. If the limit of $\partial\Omega^* / \partial\rho^*$ as ρ^* converges to ρ_0 from below is strictly negative, then the host country will prefer a positive-FDI equilibrium to any no-FDI equilibrium.*

Note the relationship between the multinational's marginal cost of FDI, ρ^* , and the host country's marginal welfare return to FDI, $\rho^* - r - \alpha cb$, reflected in Proposition 3. According to Proposition 2, the multinational will invest in the host country only if b is sufficiently large as ρ^* is decreasing in b . However, $\rho^* - r - \alpha cb$ is also decreasing in b and $b > r / (\sigma^* - \alpha c)$ implies that $\rho^* - r - \alpha cb < 0$. Thus, if a sufficiently large value of b is needed to attract FDI, any FDI that a country does attract could reduce host welfare.

With the host tax rate fixed, Proposition 3 provides a sufficient condition for the host country to prefer an equilibrium in which it allows enough debt financing to attract a positive amount of FDI.¹² A stronger sufficient condition that implies $\partial\Omega^* / \partial\rho^* < 0$ is $\rho_0 - r - \alpha c \geq 0$. In other words, the host country will prefer choosing a strictly positive b to induce positive FDI if the marginal welfare return to FDI is positive at the effective cost of capital that shuts down FDI. This condition is only sufficient and not necessary. If at $\rho^* = \rho_0^-$, $\partial\Omega^* / \partial\rho^* \geq 0$, then $\partial\Omega^* / \partial b < 0$, which means the host government will locally prefer a no-FDI equilibrium to positive-FDI equilibria with K close to zero. Since Ω^* need not be globally concave in b , $\partial\Omega^* / \partial\rho^* \geq 0$ at $\rho^* = \rho_0^-$ is only a necessary condition for the host country to prefer attracting no FDI.

A further analysis of the economy described in Example 1 can help us better understand the conditions under which a host country would prefer zero FDI to a positive level of FDI. For the production functions in Example 1, an increase in b can never cause the sign of $\partial\Omega^* / \partial\rho^*$ to switch from positive to negative. Thus, if for a fixed t , $\partial\Omega^* / \partial\rho^* \geq 0$ at $\rho^* = \rho_0^-$, then the host

¹² If for a given value of t , $\rho^* > \rho_0$ for all b , then Proposition 3 holds trivially since there exists no zero-FDI equilibria.

country prefers a no-FDI equilibrium to any positive-FDI equilibrium, holding t fixed. In addition, ρ_0 is decreasing in the home production function parameter, λ , which also equals the host country autarky wage, and it is convex in the host capital-share parameter, γ . Thus, host countries with a lower autarky wage can attract FDI with lower values of b for each tax rate than can host countries with a higher autarky wage as the equilibrium wage with FDI, w^* , must exceed the autarky wage. However, $dw^*/d\gamma < 0$ for $\gamma < 1 - \lambda$ so it is harder for host countries to attract FDI from a multinational with a more capital-intensive technology unless $\gamma > 1 - \lambda$, that is, unless the multinational is extremely capital-intensive. Since estimates of γ tend not to exceed .4 (Karabarbounis and Neiman, 2014), it is more likely that low-wage host countries need to allow more permissive thin-capitalization limits than do high-wage host countries. This observation is consistent with the pattern observed in Table 1. It does not address the issue of whether it is in a host country's interest to attract FDI as we have not yet allowed the host country to choose the optimal tax rate.

To address this welfare question in the context of Example 1, note that $\rho^* = \rho_0$ implies that

$$b = \frac{r - (1-t)\rho_0}{\sigma^*t - \alpha c} . \quad (4.10)$$

Thus at ρ_0 , the host country's marginal return to FDI, $\rho^* - r - \alpha cb$, equals

$$\frac{t[\sigma^*(\rho_0 - r) - \alpha c\rho_0]}{\sigma^*t - \alpha c} . \quad (4.11)$$

Recall that a necessary condition for $\partial\Omega^*/\partial\rho^* \geq 0$ is that $\rho^* - r - \alpha cb < 0$. Since $\partial\sigma^*/\partial r = 1$ and auditing costs are quadratic, (4.11) implies that, for a fixed value of ρ_0 , the host country's marginal return to FDI is decreasing in r . Thus, host countries in which multinationals have higher pre-tax costs of capital are less likely to benefit from attracting FDI with a low thin capitalization limit.

Consider the case in which the multinational would not invest in the host country without

some tax benefit. This case corresponds to $\rho_0 < r$. At $\rho_0, L_d = 1$ and

$$\frac{\partial \Omega^*}{\partial \rho^*} = \frac{K}{L_m} \left\{ \frac{-\gamma(\rho_0 - r - \alpha cb)}{(1-\gamma)(1-\lambda)\rho_0} - (1-t)(1-\beta) \right\}.^{13} \quad (4.12)$$

$\partial \Omega^* / \partial \rho^*$ is strictly positive at $t = 1$ when $\rho_0 < r$ and the term in braces in (4.12) is increasing in t . Thus, for sufficiently high host tax rates, host country welfare is higher with zero FDI.

Figure 4 (which is also based on Example 1 and uses $\beta = .1$) shows that it is indeed possible with t fixed for the host country to prefer zero FDI to one with a positive amount. In this example, the host country must set b above .29 in order to attract any FDI. As b increases above .29, host welfare decreases due to a combination of a high interest rate, a low capital-intensive foreign production function, a high autarky wage, and very low transfer price costs. However, this example is merely suggestive as it assumes the tax rate is fixed at .3 while in the general model the tax rate is endogenous. To verify the robustness of this example, we must consider the host country's tax rate preferences as well as its thin capitalization limit preferences.

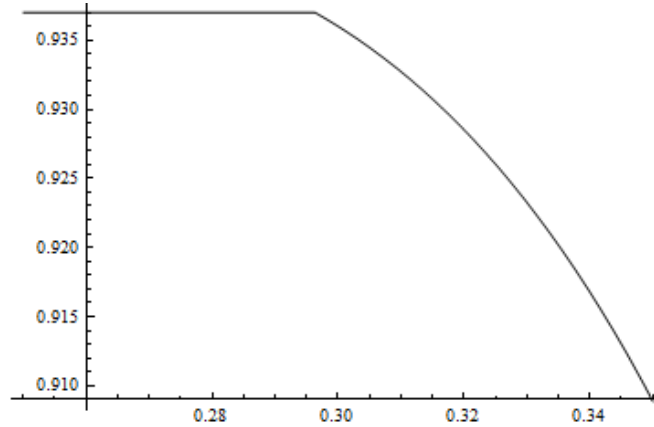


Figure 4: Host welfare as a function of b .

4.3 Different optimal policies for developed, emerging, and developing countries.

The above discussion suggests that the optimal host policy can differ with characteristics of the country. In order to solve for the equilibrium tax rate and thin capitalization limit and to

¹³ Although $K = L_m = 0$ at ρ_0 , the limit as $\rho^* \rightarrow \rho_0$ from below of K / L_m is strictly positive.

study how these equilibrium choices vary with the model's key parameters, we now focus on the more specific functional forms used in Example 1: $G(L_d) = L_d^\lambda$ for $\lambda \in (0,1)$, $F(L_m, K) = K^\gamma L_m^{1-\gamma}$ for $\gamma \in (0,1)$, and $c(\sigma - r) = (\sigma - r)^2$. Figure 5 graphs host welfare as a function of the host tax rate, t , evaluated at the optimal b for each t . Each graph corresponds to one of three general cases: Developed Host Country, Emerging Host Country, and Developing Host Country, and variation in one of the five model parameters: β , γ , λ , α , and r . The solid curve in all the graphs represents a baseline set of parameter values that is the same for each type of country. As one reads down a column, the baseline curves are the same (but may look different due to scaling differences on the vertical axis). Across columns, the baseline curves will differ. Each row illustrates variation in one of the parameters. For all of the graphs associated with the Developed Host Country and Emerging Host Country cases, the dash-dot-dot curve corresponds to a parameter value greater than the baseline value and the dashed curve corresponds to a parameter value less than the baseline value. The legend for the Developing Host Country graphs will be described below but, as one will see, the very low values of α dominate this case and result in zero FDI in equilibrium.

We define a developed host country as one for which multinationals have a low cost of capital ($r = .05$), rents for domestic entrepreneurs are high ($\lambda = .6$), a moderate to high capital share in multinational production ($\gamma = .25$), and transfer price manipulation is very costly ($\alpha = 6$). The baseline welfare weight on domestic firm profit is set at $\beta = .1$. The concave shape to the curves reflects the fact that the standard elasticity trade-off is the dominant effect. At low tax rates, an increase in the tax rate increases host welfare since FDI is inelastically supplied. At high tax rates, an increase in the tax rate decreases host welfare since FDI is elastically supplied.

Table 2 reports the equilibrium values of t , b , and K for the parameter values associated with the graphs in the first column of Figure 5. For the baseline case, the optimal tax rate is .32 and the optimal value of b is about .66. (The median values of t and b among the 20 countries with the largest GDP per capita are .26 and .75.) Increasing β , the welfare weight on domestic firm profit, γ , the capital share, or λ , the domestic rent parameter implies a lower optimal tax rate, a higher optimal thin cap limit, and more FDI. Increasing α , the transfer price cost parameter, implies a higher tax rate, a higher thin cap limit, and less FDI. Finally, increasing r , the

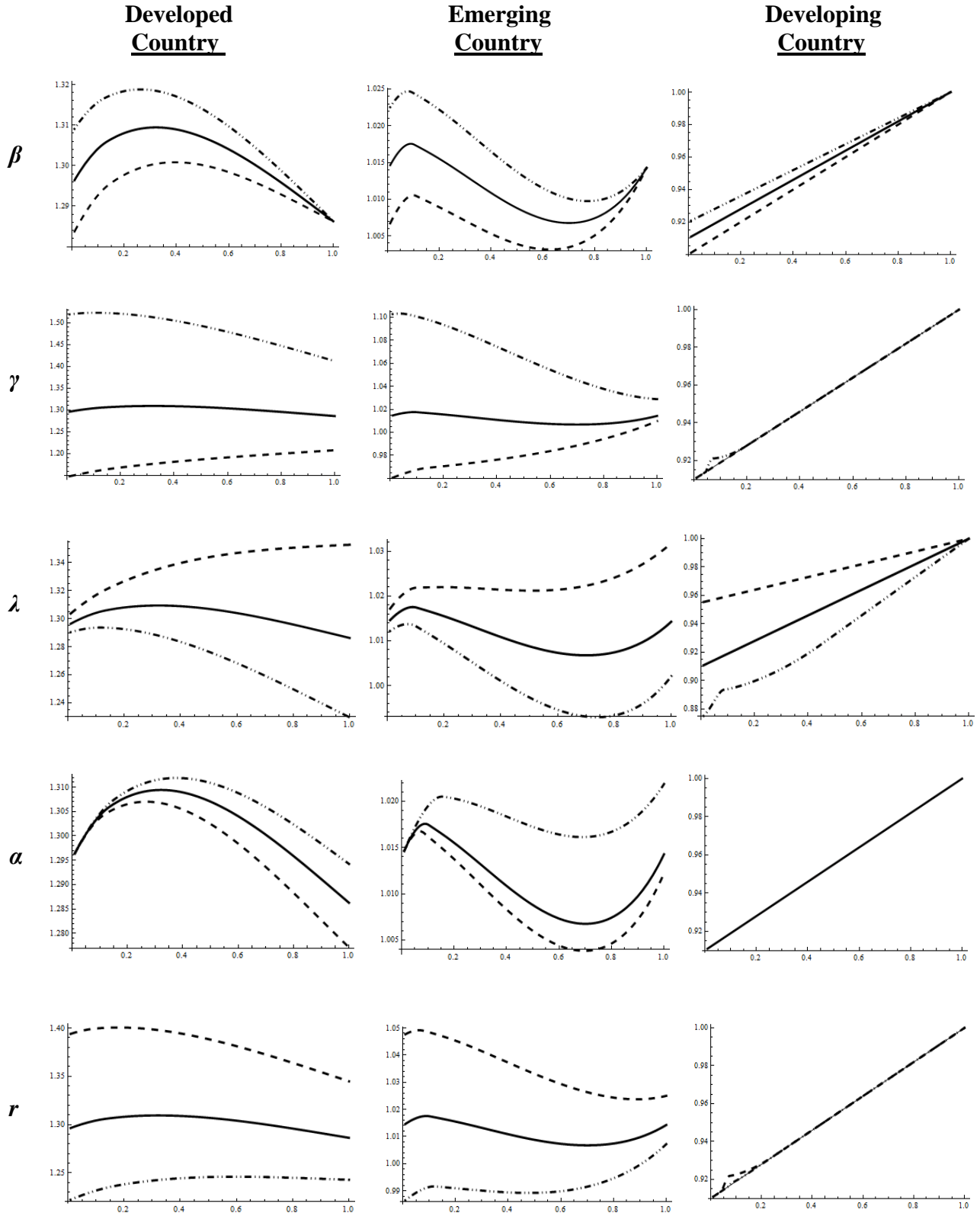
multinational's cost of capital, implies a higher tax rate, a lower thin cap limit, and less FDI. Thus, depending on the variation in parameter values across developed host countries one can observe either a positive or negative relationship between the countries' tax rates and thin capitalization limits. This is consistent with the variation in tax policies observed in Figure 1.

We define an emerging host country as one for which multinationals have a moderate cost of capital ($r = .08$), moderate rents for domestic entrepreneurs ($\lambda = .8$), a low capital share ($\gamma = .2$), and moderate transfer price manipulation costs ($\alpha = 1$). Table 3 reports the optimal values of t , b , and K for the parameter values associated with the graphs in the second column of Figure 5. For the baseline case (with $\beta = .1$), the optimal tax rate is .09 and the optimal thin cap limit is 1. The graphs now reveal that there can be two local maxima: One with a tax rate of one and another with a low tax rate. The convex regions of the curves at high tax rates arise because the lower cost of transfer pricing reduces the elasticity of FDI supply. The existence of multiple local optima suggests that an emerging host country government could get stuck at a local but not global maximum. More importantly, modest changes in parameter values can cause the optimal policy to jump from a low tax rate and a high thin cap limit to a high tax rate and a low thin cap limit and can explain the bifurcation in tax policies observed in Figure 2. All of the results in Table 3 support a negative relationship between the equilibrium tax rate and the equilibrium thin capitalization limit, which is consistent with the data in Figure 2.

We define a developing host country as one for which multinationals have a high cost of capital ($r = .15$), low rents for domestic entrepreneurs ($\lambda = .9$), a low capital share ($\gamma = .2$), and very low transfer price manipulation costs ($\alpha = .1$). The optimal tax rate in each graph is equal to one and the thin cap limit is very low, ranging from .049 to .13. In all cases, the equilibrium FDI is zero.¹⁴ This case provides a full equilibrium example in which the host country must set a strictly positive value of b in order to attract FDI but any FDI it attracts reduces host welfare. Thus, the host country is best off setting its thin cap limit too low to attract FDI and taxing its domestic rents at a rate of 100%.

¹⁴ Since FDI is zero in equilibrium, any value of b from the reported values to zero would be optimal. The reporting convention used above is to report the maximum value of b consistent with zero FDI.

Figure 5: Host welfare evaluated at optimal b for each t .
 Parameter change by row: Baseline (solid), increase (dash-dot-dot), decrease (dash).



5. Extensions.

We now consider three extensions of the main model by introducing (i) a third-factor for which the multinational can transfer price, (ii) a commensurate-with-income constraint that prohibits multinationals from receiving a tax deduction for losses, and (iii) decreasing returns in multinational production.

5.1 Transfer prices associated with a third factor.

In the main model, we assumed that the multinational could set the interest rate on internal debt different from its true cost of capital. This assumption was motivated by noting that in practice firms face different costs of capital due to heterogeneity in risk characteristics, which can be identified by a firm's CAPM beta. The norm in most tax competition models is to assume that all firms can borrow at a world interest rate, in which case the multinational cannot charge its host subsidiary a higher rate without being detected by the host government.

To create an alternative transfer-pricing channel, assume that the subsidiary requires a software license from the tax haven subsidiary for each unit of capital it uses. Denote the multinational's marginal economic cost of the license by q and denote the royalty paid by the host subsidiary by σ . After-tax multinational profit is now equal to

$$\Pi = (1-t)(F(K, L_m) - wL_m - rB - \sigma K) - rB - rK + (\sigma - q)K - \alpha c(\sigma - q)K. \quad (5.1)$$

It remains profit-maximizing for the multinational to finance the host subsidiary with the maximum amount of debt allowed ($B = bK$) and to set its transfer price so that $\alpha c' = t$. Introducing this third-factor implies that the multinational's effective cost of capital is

$$\rho^* = ((1-tb)r + q + \alpha c - \sigma^* t) / (1-t) \quad (5.2)$$

and the marginal welfare benefit of FDI is $\rho^* - r - q - \alpha c$. If $c(\sigma - q) = (\sigma - q)^2$, then

$$\Omega_\rho^* = -\frac{t}{1-t} \cdot ((1-b)r - t(2-t) / (4\alpha)) \frac{F_{LL} + G_{LL}}{|H|} - (1-t)(1-\beta)KL_d / L_m. \quad (5.3)$$

The thin capitalization limit, b , no longer affects the welfare return to transfer pricing since the license transfer price applies to the host subsidiary's total capital whereas, in the main model, the interest rate transfer price applies to the host subsidiary's internal debt. Thus,

$$\partial \Omega^* / \partial b = \frac{\partial \Omega^*}{\partial \rho^*} \cdot \rho_b^* \quad (5.4)$$

and

$$\partial \Omega^* / \partial t = \frac{\partial \Omega^*}{\partial \rho^*} \cdot \rho_t^* - \frac{tK}{\alpha c''} + (1 - \beta)\pi \quad (5.5)$$

where $\rho_b^* = -rt / (1 - t)$ and $\rho_t^* = (\rho^* - rb - \sigma^*) / (1 - t)$.

When α is close to zero, (5.3) implies that $\Omega_\rho^* > 0$, $\partial \Omega^* / \partial b < 0$, and $\rho_t^* < 0$. In this case, the optimal value of b implied by (5.4) is either zero or any value of b consistent with $K^* = 0$. This is consistent with our results for developing countries. When α is sufficiently large, (5.3) implies that $\Omega_\rho^* < 0$ in which case the optimal value of b implied by (5.4) is one and the optimal value of t is one. Thus, we are back to the benchmark result when the multinational firm only can use debt to shift profit (confer section 4.1). For intermediate values, the same qualitative properties of the optimal host tax policy can be generated, including the discontinuous response of the optimal policy to small parameter changes we observed for emerging host countries.

5.2 No tax deduction for losses.

Most of the countries listed in Table 1 do not allow a tax deduction for subsidiary losses. Losses can be carried forward to offset taxable income in future years or eventually repatriated to the parent company but these options have no effect in a single period model. To analyze the role of tax losses in our model, define taxable host income as $\Pi_T = F - wL_m - \sigma B$ and define after-tax multinational profit as

$$\Pi = \begin{cases} (1 - t)\Pi_T + \sigma B - rK - \alpha cB & \text{if } \Pi_T \geq 0 \\ F - wL_m - rK - \alpha cB & \text{if } \Pi_T < 0. \end{cases} \quad (5.6)$$

It is never profit-maximizing for the multinational to choose σ and B that imply $\Pi_T < 0$ and it is never profit-maximizing to set $B < bK$. Thus, the multinational's problem is to maximize Π subject to $B = bK$ and $\Pi_T \geq 0$. The solution to the multinational's problem satisfies $F_K = \rho(\mu)$, $F_L = w$, $\alpha c' = t - \mu$, and $\mu > 0$ implies $\Pi_T = 0$, where μ is the multiplier on the constraint $\Pi_T \geq 0$ and

$$\rho(\mu) = (r - (t - \mu)\sigma b + \alpha cb) / (1 - t + \mu). \quad (5.7)$$

If $\Pi_T \geq 0$ at $\mu = 0$, then the solution to the multinational's problem with no deduction for tax losses is identical to the multinational's problem with a deduction for tax losses. In this case, $\sigma = \sigma^*$ and $\rho(0) = \rho^*$ as defined in section 3. If $\Pi_T < 0$ at $\mu = 0$, then the solution to the multinational's problem with no deduction for tax losses implies $\Pi_T = 0$ which by constant returns to scale implies $\rho(\mu) = \sigma b$ or $\sigma b = r + \alpha cb$. Recall from section 3 that, with a deduction for losses, the profit-maximizing transfer price depends only on t while the effective cost of capital depends on b and t . Prohibiting a deduction for losses now implies, when this constraint binds, that the multinational's profit-maximizing transfer price and effective cost of capital depend only on b and not t !

Figure 6 illustrates the effect of eliminating a tax deduction for losses on the multinational's effective cost of capital. At $\mu = 0$, $\Pi_T \geq 0$ if, and only if, $\rho_t^* \geq 0$, so that a larger tax rate implies a weakly larger effective cost of capital. Analogous to Figure 3, Figure 6 shows the (unconstrained) iso- ρ^* curves as a function of b and t . The heavy solid lines are the iso-cost curves at which FDI is zero (upward-sloping curve) and at which $\rho^* = 0$ (downward-sloping curve). The thin solid lines are two intermediate iso-cost curves. The dashed curve identifies the combinations of b and t at which $\Pi_T = 0$ in the unconstrained problem. For each b , the (constrained) iso-cost curves are horizontal for all values of t to the right of the dashed curve. Since this region consists of the policies that imply downward-sloping iso-cost curves, not allowing a tax deduction for losses curtails the FDI enhancing incentives associated with higher

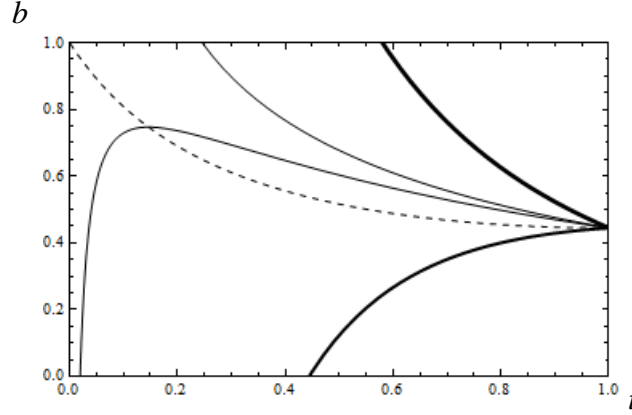


Figure 6: Iso- ρ^* curves (solid) and $\Pi_T = 0$ curve (dashed)

levels of debt financing and profit shifting via transfer prices. It also means t no longer distorts the multinational's transfer price or its choice of capital and labor. Thus, the host country's optimal policy is to tax profits at a rate of 100% and let the firm be financed entirely by debt.

5.3 Decreasing returns to scale in multinational production and no tax deduction for losses.

In this section, we modify the model in section 5.2 by assuming the multinational's production function used in the host country exhibits decreasing returns to scale. This assumption implies that the multinational can earn positive rents in equilibrium and allow for positive taxable income in the host country and positive tax haven profit. Without the knife-edge properties associated with constant returns to scale, the profit-maximizing level of FDI for the multinational is always finite and positive. While the equilibrium existence problem no longer exists so too does the possibility of zero FDI in equilibrium. To allow for the possibility of zero FDI in equilibrium with decreasing returns to scale, one needs to also introduce a fixed cost of entry, ϕ . Now the multinational's after-tax profit equals

$$\Pi = \begin{cases} (1-t)\Pi_T + \sigma B - rK - \alpha C - \phi & \text{if } \Pi_T \geq 0 \\ F - wL_m - rK - \alpha C - \phi & \text{if } \Pi_T < 0 \end{cases} \quad (5.8)$$

if the multinational opens a subsidiary in the host country and after-tax profit equals zero if it does not open a subsidiary. Our simulations assuming that $F(L_m, K) = K^\gamma L_m^\delta$ with $\gamma + \delta < 1$

generate the same qualitative results as our main model. They also reveal much more complex welfare effects associated with the extensive entry margin and the intensive margin related to the non-deductibility of tax losses. Thus, our main model, not only is the first to generate theoretical predictions consistent with observed tax policies, its results are also consistent with more complicated models that incorporate more real-world features of multinational tax policy.

6. Conclusion.

This analysis demonstrates that allowing multinationals to shift income out of a host country using debt financing and transfer pricing introduces novel equilibrium behavior. First, it is now possible for a multinational's after-tax cost of capital to be negative. The combination of a sufficiently high corporate income tax rate and a sufficiently high limit on tax deductible interest expenses can create a money pump that allows a multinational to shift arbitrarily large amounts of income out of the host country. Second, if the host country does not allow the multinational to deduct enough of its interest expenses on internal debt, the host country will not be able to attract any FDI. The combination of these first two results implies that the optimal tax rate is strictly less than the optimal rate that arises with debt financing as the sole channel for income shifting. Third, if the host country must allow for very thinly capitalized subsidiaries (by setting b high) in order to attract FDI, the host country may be made worse off adopting policies that attract FDI than with policies that attract no FDI.

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Appendix

Proposition 1. *For each α , no equilibrium exists due to unbounded multinational profit for all $b \geq b_\infty(t, \alpha)$ when $t \in [0, 1)$ and for all $b > b_\infty(1, \alpha)$.*

Proof of Proposition 1.

For $t < 1$, if $b = b_\infty(t, \alpha) \equiv r / (\sigma^* t - \alpha c)$, then $\rho^* = 0$. Because $\rho_b^* < 0$, $\rho^* \leq 0$ and the multinational's profit is unbounded for all $b \geq b_\infty(t, \alpha)$. For $t = 1$, $\Pi = -(r - \sigma^* b + \alpha c b)K$.

Thus, the multinational's profit is unbounded for all $b > b_\infty(t, \alpha)$. For $b = b_\infty(t, \alpha)$, $\Pi \equiv 0$ so any amount of capital and labor is profit-maximizing.

Given (3.2), $b_\infty(1, \alpha) = r / (\sigma^* - \alpha c) = r / (r + (c')^{-1}(1/\alpha) - \alpha c((c')^{-1}(1/\alpha))) > 0$. By the strict convexity of $c(\cdot)$, $b_\infty(1, \alpha)$ is also strictly less than one. Next note that as $\partial b_\infty / \partial t < 0$, $b_\infty(t, \alpha) < 1$ for all t . Finally note that $b = 1$ and $t = 0$ imply $r = 0$ in order for $\rho^* = 0$. Thus, $b_\infty(t, \alpha) = 1$ for some $t \in (0, 1)$. ***Q.E.D.***

Table 1: Thin capitalization debt to equity limits in 2004^{15,16}

Country	Debt to Equity	Tax Rate	Country	Debt to Equity	Tax Rate	Country	Debt to Equity	Tax Rate
Argentina	2	35	Hungary	3	16	Poland	3	19
Australia	3	30	India	no	35.9	Portugal	2	27.5
Austria	no*	34	Indonesia	no	30	Russia	3	24
Belgium	1	34	Ireland	no*	12.5	Singapore	no	22
Brazil	no	34	Israel	no	36	Slovenia	4	25
Canada	2	36.1	Italy	5	37.3	Slovakia	no	19
Chile	3	17	Japan	3	42	South Korea	4	29.7
China	no	33	Latvia	4	15	Spain	3	35
Columbia	no	35	Lithuania	4	15	Sri Lanka	no	35
Costa Rica	no	30	Malaysia	no	28	Switzerland	6	24.1
Croatia	no	20.3	Mexico	no	34	Sweden	no	28
Czech Rep.	4	28	Netherlands	3	34.5	Taiwan	no	25
Denmark	4	30	New Zealand	.75	33	Thailand	no	30
Finland	no*	29	Norway	no	28	Turkey	no	33
France	1.5	34.3	Pakistan	3	35	Ukraine	no	25
Germany	1.5	38.3	Panama	no	30	United Kingdom	1	30
Greece	no	35	Peru	3	30	United States	1.5	40
Hong Kong	0* ¹⁷	17.5	Philippines	no	32	Venezuela	no	34
						Vietnam	no	28

* Country has other anti-abuse regulations

¹⁵ The list of countries matches that in Blouin, Huizinga, Laeven, and Nicodème (2014).

Büttner, Overesch, Schreiber, and Wamser (2012) provide similar data for earlier years.

¹⁶ By 2013, China, Columbia, Croatia, Greece, Malaysia, Mexico, Sri Lanka, Taiwan, Turkey, and Venezuela adopted safe harbor limits between 1 and 4. These discrete changes are consistent with our theory applied to emerging economies. Belgium and New Zealand adopted higher (weaker) limits, while Canada, Italy, and South Korea adopted lower (stronger) limits.

¹⁷ We treat Hong Kong as having a safe harbor limit of zero because Blouin, Huizinga, Laeven, and Nicodème (2014) report that Hong Kong had a general rule in 2004 making all interest payments to foreign companies a non-deductible expense.

Developed Country Baseline										
$\beta = .1, \gamma = .25, \lambda = .6, \alpha = 6, r = .05$										
$t^* = .32, b^* = .66, K^* = 6.51$										
	$\beta (-)$		$\gamma (-)$		$\lambda (-)$		$\alpha (+)$		$r (-)$	
	0	.2	.2	.3	.5	.7	5	7	.04	.06
t^*	.40	.26	1	.11	1	.12	.27	.38	.19	.60
b^*	.63	.69	.55	.94	.55	1	.64	.67	.69	.62
K^*	6.26	6.70	2.62	11.68	4.18	7.55	6.58	6.41	9.51	4.33

Table 2: Equilibrium tax rates, thin capitalization limits, and FDI for developed countries. "(-)" denotes a negative relationship between the optimal tax rate and the optimal thin capitalization limit. "(+)" denotes a positive relationship.

Emerging Country Baseline										
$\beta = .1, \gamma = .2, \lambda = .8, \alpha = 1, r = .08$										
$t^* = .09, b^* = 1, K^* = 2.26$										
	$\beta (-)$		$\gamma (-)$		$\lambda (-)$		$\alpha (-)$		$r (-)$	
	0	.2	.15	.25	.75	.85	.75	2	.07	.09
t^*	1	.08	1	.04	1	.08	.07	1	.06	1
b^*	.24	1	.24	1	.24	1	1	.39	1	.26
K^*	.55	2.33	.33	3.65	.71	2.21	2.23	.73	2.80	.36

Table 3: Equilibrium tax rates, thin capitalization limits, and FDI for emerging countries. "(-)" denotes a negative relationship between the optimal tax rate and the optimal thin capitalization limit. "(+)" denotes a positive relationship.

Referee Appendix

Derivation of First-best Allocation.

The economy in the model is equivalent to one with 3 agents: a worker (W) endowed with one unit of labor, a domestic entrepreneur (E) who can produce with production function, G , and a foreign-owned subsidiary (S) with production function, F . Let $q_G = (q_{GW}, q_{GE}, q_{GS})$ and $q_F = (q_{FW}, q_{FE}, q_{FS})$ denote the allocation of each firm's output among the agents. These output allocations are feasible if $q_{FW} + q_{FE} + q_{FS} = F(L_m, K) - rK$, $q_{GW} + q_{GE} + q_{GS} = G(L_d)$, and $L_m + L_d \leq 1$. The agents' utility functions are $U_W = q_{GW} + q_{FW}$, $U_E = q_{GE}$, and $U_S = q_{FS} - rK$. The host country's welfare problem is

$$\begin{aligned} \max \quad & q_{GW} + q_{FW} + \beta q_{GE} \quad \text{s.t.} \quad (i) \quad q_{GW} + q_{GE} + q_{GS} = G \\ & \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad (ii) \quad q_{FW} + q_{FE} + q_{FS} = F - rK \\ & \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad (iii) \quad L_m + L_d = 1. \end{aligned}$$

Substituting (i) and (ii) into the objective function yields the optimization problem

$$\max F + G - rK - (1 - \beta)q_{GE} - q_{GS} - q_{FS} \quad \text{s.t.} \quad L_m + L_d = 1.$$

This problem is solved by allocating capital and labor so that $F_K = r$ and $F_L = G_L$ (when an interior labor allocation exists) and then giving all the net output to the worker and nothing to the entrepreneur or the subsidiary. This is the same allocation that results from $b = t = 1$ and $\alpha = \infty$.