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Abstract

To prevent profit shifting by manipulation of transfer prices, tax authorities typically apply the arm's length principle in corporate taxation and use comparable market prices to 'correctly' assess the value of intracompany trade and royalty income of multinationals. We develop a model of heterogeneous firms subject to financing frictions and offshoring of intermediate inputs. We find that arm's length prices systematically differ from independent party prices. Application of the principle thus distorts multinational activity by reducing debt capacity and investment of foreign affiliates, and by distorting organizational choice between direct investment and outsourcing. Although it raises tax revenue and welfare in the headquarter country, welfare losses are larger in the subsidiary location, leading to a first order loss in world welfare.

Keywords

Corporate tax, transfer prices, arm's length principle, outsourcing, foreign direct investment, corporate finance

JEL Classification

D23, H25, F23

1 Introduction

With the increasing importance of multinational firms, collecting corporate taxes in high tax countries has become a challenging task. In contrast to local firms, multinational corporations can shift profits to lightly taxed foreign locations, leading to substantial losses in tax revenue. One important channel to reduce the global tax liability is the transfer pricing of intracompany trade. Multinational firms can shift profits and minimize the tax burden in high tax countries by overpricing imports from foreign subsidiaries, or underpricing exports. To protect their tax base, tax authorities have adopted arm's length pricing (ALP) as the central principle in the taxation of multinational companies. The principle is set out in Article 9 of the OECD Model Tax Convention and governs the prices at which transfers within a multinational company are set for the purposes of tax. Such transfers can be of intermediate goods, produced by one company within the multinational group and sold to another, or they can include a licence or royalty fee paid for the right to produce and to use intellectual property owned by another part of the group. The ALP is essentially the price at which the transaction would take place between two independent agents. In many cases, it is difficult in practice to identify a price for the same product actually transferred between two independent agents. This paper, however, is not concerned with the practical difficulties of implementing the ALP, but rather with the underlying rationale. The principle seems to be based on the implicit assumption that arm's length prices observed in trade between independent firms are the 'correct' ones when assessing the value of intracompany trade of multinational firms. The central point of this paper is that ALP might be an inappropriate benchmark and might therefore introduce new distortions in the taxation of multinational firms.

The paper analyzes the consequences of the ALP in a general equilibrium model with offshoring of the production of components for the assembly of final goods by the parent company in a high tax country ('North'). Final goods producers can choose to offshore components to the 'South' either by entering an outsourcing relationship or by establishing a wholly owned foreign subsidiary via foreign direct investment (FDI). The model endogenously explains arm's length prices paid in outsourcing relationships among independent firms and the prices used by multinational firms when importing the same components from foreign affiliates. In both organizational forms, the final goods producer chooses a profit maximizing contract in dealing either with an independent subcontractor or with an affiliate company. To induce an efficient organization of the total production chain, the contract specifies a licence fee for the right to produce and a component price. FDI is assumed to require a larger set-up cost compared to an outsourcing relationship with an independent firm. Once these costs are sunk, ownership of the foreign production unit is more profitable. Northern firms thus face a trade-off in choosing the organizational form with the larger net present value. The more profitable firms afford the higher set-up cost in FDI and can exploit the advantages of ownership. The less profitable ones prefer an outsourcing relationship.[1]

A key aspect of the model is that owning the foreign production unit is more valuable than outsourcing to an independent firm, once the higher set-up cost is sunk. We assume that all firms are endowed with limited own assets that allow for self-financing of initial set-up costs. However, remaining assets are insufficient to fully finance investment for component production. Firms therefore need to raise additional funds on the external capital market. External funding is subject to finance constraints as emphasized in the corporate finance literature. Subsidiaries of multinational companies find it easier to overcome finance constraints compared to independent subcontracting firms. Multinationals can shift profits to a subsidiary by paying higher prices for components, thereby strengthening pledgeable income and facilitating external financing of the subsidiary. Furthermore, ownership means that the parent firm does not need royalties to extract profits since it can always get profits by means of repatriated dividends. In reducing free cash-flow, royalty payments again impair the subsidiary's debt capacity and are, thus, optimally set to zero. Multinational firms thus choose rather high transfer prices and set low (zero) royalties,

[1] Our framework thus links to recent literature in international economics on firm heterogeneity, see Melitz (2003), Antras (2005), Grossman and Helpman (2002, 2004) and the survey by Helpman (2006). The present paper adopts a simpler probabilistic framework as in Keuschnigg and Ribi (2009).

extracting profits by means of dividend repatriation. The optimal outsourcing contract instead features lower component prices and higher royalties. Royalties are high because they are the only way to extract profits, and component prices are lower since the final goods producer has no interest in shifting profits to independent subcontractors. As a result, for purely economic reasons, and even in the absence of tax, optimal contracts specify higher component prices and lower (zero) royalty fees for trade within multinational firms compared to arm's length relationships. Profit shifting by multinational firms occurs for economic reasons, and is reinforced by corporate taxation.

In this situation, the ALP imposes a flawed benchmark in the taxation of multinational firms. Applying the ALP in taxation of multinational firms forces them, for the purposes of tax, to assess the value of intermediate imports at lower arm's length prices and to declare fictitious royalty income as observed in outsourcing relationships. Applying the ALP thus imposes a tax penalty on multinationals when stating higher transfer prices and not declaring royalty income. The results are the following: (i) the tax penalty leads to lower transfer prices and less profit shifting; (ii) it reduces, in turn, debt capacity and investment in the subsidiary; (iii) it pushes a margin of firms to choose outsourcing rather than foreign direct investment and thereby distorts the extensive margin of business organization; (iv) it strengthens tax revenue and raises national welfare in the North; (v) it strongly reduces tax revenue and welfare in the South; (vi) it leads to a world-wide welfare loss of first order magnitude. The last result is due to the fact that tax authorities, when observing arm's length prices, tend to misinterpret high transfer prices and low royalties as a result of tax induced profit shifting while, in fact, these choices reflect an efficient organization of worldwide production by multinational firms.

We believe that the central implications of the paper are well supported by empirical evidence. Our theory starts from the presumption that taxes induce international profit shifting, see Devereux (2006) for a survey. Some papers estimate the responsiveness of the corporate tax base to international differences in tax rates. Huizinga and Laeven (2008) find that profit shifting leads to substantial redistribution of national tax revenue. They estimate a semi-elasticity of reported profits with respect to the top statutory tax rate of 1.3 which is substantial. Bartelsman and Beetsma (2003) calculate that at the margin more than 60% of the additional revenue resulting from a unilateral tax increase is lost due to income shifting.[2] Other research more directly addresses the tax impact on transfer prices. Bernard and Weiner (1990) distinguish between imports from a third party and an affiliate and find systematic differences between transfer prices and ALPs but the impact of the corporate tax is weak. Swenson (2001) estimates significant but relatively small effects of tax rates on transfer prices but her data do not allow differentiation between intrafirm prices and ALPs. Clausing (2003) reports important differences in the behavior of intrafirm trade prices compared to ALPs which are consistent with tax-motivated income shifting. A 1% lower foreign tax rate is associated with 0.94% lower intrafirm export prices and 0.64% higher import prices, relative to the tax effects for non-intrafirm goods. The results are highly significant. Bernard, Jensen and Schott (2006) document that export prices of U.S. multinationals for intrafirm transactions are significantly lower than prices for the same good sent to an arm's length customer. On average, the ALP is 43 percent higher than the related-party price. A decrease in the corporate tax rate of one percentage point raises the gap between ALPs and related-party prices by 0.56 to 0.66 percent.

The empirical literature does not explain which part of the price gap is due to taxes and whether a substantial gap would remain for economic reasons in the absence of taxes. A substantial theoretical literature in accounting has studied the role of transfer prices in the governance of multinational firms. Harris and Sansing (1998) and Sansing (1999) study the determination of ALPs and transfer prices and the choice of a manufacturing firm in supplying the market either by staying vertically integrated or selling the product to an independent distributor. All firms are monopolies and the choice of organizational form

[2] See also Grubert and Mutti (1991) for earlier results. These papers do not distinguish different channels of profit shifting, either by transfer pricing or internal debt. The importance of the debt channel is documented in Desai, Foley and Hines (2004), Huizinga, Laeven and Nicodeme (2008), Mintz and Smart (2004) and Egger, Eggert, Keuschnigg and Winner (2009), among others.

thus trades off the costs of double marginalization and the greater local market knowledge of an independent seller. As in our paper, they show how the transfer pricing rules of the U.S. treasury (comparable uncontrolled price method) can distort organizational choice and production efficiency. Different from our paper, the analysis is partial equilibrium and abstracts from agency costs or incentive problems. Holmstrom and Tirole (1991) study the determination of transfer prices, the design of managerial incentives and the choice of organizational form in trading an intermediate good internally or externally. Taxes are not part of the analysis. Smith (2002) instead focusses on the use of transfer prices both for tax minimization and managerial incentives. While the main part of the literature considers the case of one set of books, Baldenius, Melumad and Reichelstein (2004) consider the role of internal transfer prices when there are two books, one used to guide incentives and the other for tax purposes. Hyde and Choe (2005) study the same issue. Their key insight is that the two prices are importantly related to each other. It seems that tax authorities can easily inspect economic books whenever there is a need to check transfer prices reported for tax purposes.[3] Our analysis is based on one book.

Much of the tax literature does not address the role of transfer prices for the internal organization of vertically integrated multinationals as compared to trade among independent firms, and mostly abstracts from the choice between these two organizational forms. The tax literature on transfer pricing either considers the ALP only in reduced form or not at all, focussing instead on tax induced profit shifting, see Haufler and Schjelderup (2000), for example. Nielsen, Raimondos-Moeller and Schjelderup (2008) or Gresik and Osmundsen (2008) discuss strategic considerations in choosing transfer prices, assuming

[3] Czechowicz, Choi and Bavishi (1982) report that 89% of U.S. multinationals use the same transfer price for both purposes. A survey by Ernst and Young (2003) indicates that over 80% of parent companies use a single set of transfer prices for management and tax purposes. The report mentions on p. 17 that "... alignment of transfer prices with management views of the business can enhance the defensibility of the transfer prices, ease the administrative burden, and add to the effectiveness of the transfer pricing program. In fact, in many countries management accounts are the primary starting point in the determination of tax liability and differences between tax and management accounts are closely scrutinized."

a well defined 'true' price for intracompany shipments. In Elizur and Mintz (1996), firms use the transfer price to minimize global tax liabilities and to control the decisions of a self-interested manager in a subsidiary company. There is no organizational choice and no comparable price from arm's length trade. Instead, their focus is on the interaction of transfer pricing and tax competition.

The present paper is unique and the most complete in integrating the analysis of managerial incentives, the determination of ALPs and internal transfer prices, and choice of organizational form. In particular, it considers the new distortions introduced by forcing multinationals to use ALPs in their tax report when, in fact, different prices are optimal for economic reasons. Another key innovation is to integrate the incentive problems studied in corporate finance theory in a general equilibrium model of multinational firm decisions. At the core of our model is a financing constraint due to capital market frictions, along the lines of Tirole (2001, 2006) and Holmstrom and Tirole (1997). This part replaces the incomplete contracting and bargaining framework of Antras (2005) who shows how residual control rights from ownership can affect firms' offshoring choice between outsourcing and FDI. Antras, Desai and Foley (2009) have recently derived theoretical predictions from a corporate finance model and tested them with firm-level data to explain how financing frictions and institutional country characteristics such as investor protection can affect FDI flows and the scale of multinational activity (see also Manova, 2008, who finds credit constraints to importantly affect international trade flows). Desai, Foley and Hines (2004) similarly found that multinational affiliates are financed with less external debt in countries with underdeveloped capital markets, reflecting significantly higher local borrowing costs.

The paper develops the basic model in Section 2. Section 3 analyses the consequences of imposing the arm's length principle on the scale of production, organizational choice as well as tax revenue and welfare in the world economy. Section 4 concludes.

2 An Agency Cost Model

2.1 Basic Assumptions

The world economy consists of two regions, North and South. Firms in the North assemble a final numeraire good $y_j = \beta x_j$ using intermediate inputs x_j where β is a fixed input output coefficient. Components $x_j = f(l_j) I_j$ are produced with capital I_j and labor l_j where f is a strictly concave and increasing function. The South is abundant in cheap labor which motivates offshoring of component production. The index $j \in \{o, i\}$ denotes the organizational form; firms can offshore either by outsourcing to independent subcontractors (index o) or by establishing an own subsidiary (index i). Production of final goods is subject to a risky production technology in three stages. The first stage consists of a fixed early stage investment k_j which is specific to the organizational form. It succeeds with probability q and fails with probability $1-q$ in which case the firm closes down. The second stage involves a risky expansion investment I_j to prepare component production which succeeds with probability p. If it fails with probability $1-p$, the firm again is closed down without any production. When both stages are successfully completed, components are produced and shipped to the North for assembly of the final good. Assembly of final goods y_j always occurs in the North where the early stage investment is sunk. This fixed cost might capture the costs of further product development, marketing and other skilled entrepreneurial tasks which cannot be offshored to the South. Agents are assumed risk-neutral with linearly separable preferences over income and effort.

Each firm is endowed with own assets A and is run by a single entrepreneur or manager who develop one risky project. Firms are heterogeneous in the success probability q of early stage investment, with distribution $G(q_i) = \int_0^{q_i} g(q)\, dq$, while the success probability p of the expansion stage is uniform.[4] The life-cycle of a firm involves the following sequence

[4]Firms could be heterogeneous in several dimensions. Following Keuschnigg (2008), we assume heterogeneous success probabilities. This approach is in the line of the credit market literature reviewed in DeMeza and Webb (1999). However, we avoid adverse selection in assuming self-financing of early

of events: (i) a mass one of firms is born, i.e. we abstract from endogenous entry; (ii) firms learn the type $q \in [0,1]$ of their project; (iii) they choose organizational form $j \in \{o, i\}$, conditional on type q, and invest k_j; (iv) When it survives the start-up phase, the firm chooses expansion invest I in the South which is partly financed with external funds; the manager of the subsidiary or the independent subcontractor chooses effort, leading to high or low success probability, $p > p_L$, in the expansion stage. Investment in component production is thus subject to moral hazard which introduces a financing constraint; (v) When expansion stage is successfully completed, firms in the South hire labor and produce components $x_j = f(l_j) I_j$, and the parent firms in the North produce final output $y_j = \beta x_j$. We solve by backward induction.

Given a wage rate w in the South, component production yields a gross cash-flow per unit of invested capital equal to

$$v_j \equiv v(z_j) = \max_{l_j} \; z_j f(l_j) - w l_j, \quad z_j f'(l_j) = w, \quad v'(z_j) = f(l_j). \tag{1}$$

where z_o is the arm's length price (ALP) chosen in an outsourcing relationship, and z_i is the internal transfer price chosen to control production decisions of a wholly owned subsidiary company in the South.

Depending on organizational form, the parent company in the North faces a tax liability T_j^n and earns an expected net of tax profit

$$\pi_j^n = (\beta - z_j) x_j p + r_j + \pi_j - T_j^n. \tag{2}$$

The first term is the expected profit of the final goods division. The parent earns an upfront royalty $r_o \geqslant 0$ if it outsources to an independent firm in the South. In this case, dividend income is zero, $\pi_o = 0$, since all profit after paying the royalty goes to the

stage investment. In Holmstrom and Tirole (1997), firms differ in terms of own equity A (free cash-flow, strong or weak balance sheets) and can, thus, leverage investment by a variable amount. The new trade literature reviewed in Helpman (2006) assumes firms to be heterogeneous in factor productivity, i.e. investment may result in high or low productivity. The present approach offers a major simplification by keeping firms symmetric when sharing the same organizational form.

Southern producer. Alternatively, the parent firm may choose foreign direct investment (FDI) and thereby turn into a multinational enterprise (MNE). In this case, it fully owns the subsidiary company in the South and can either choose to extract profit by means of a royalty $r_i \geqslant 0$ or a repatriated dividend $\pi_i \geqslant 0$.

The expected net present value of the firm of type q is

$$V_j(q) = q \cdot \pi_j^n - k_j. \tag{3}$$

Depending on its type, early stage investment succeeds with probability q and yields profit π_j^n, or fails with probability $1-q$, leaving nothing. Knowing its type, the firm chooses the organizational form yielding the highest net present value. Hence, a type q firm chooses FDI if $V_i(q) \geqslant V_o(q)$. Proposition 4 below will show that ownership yields a strictly larger expected profit, $\pi_i^n > \pi_o^n$. To exclude FDI dominating outsourcing for all firms, we assume that FDI is more expensive to set up, $k_i > k_o$, where we choose $k_o = 0$ as a convenient normalization. This parameterization introduces the key trade-off between ownership and arm's length transactions where ownership is more profitable but also more costly due to a higher required set-up cost. As Figure 1 illustrates, FDI is preferred if

$$V_i(q) \geqslant V_o(q) \quad \Leftrightarrow \quad q \geqslant q_i = k_i / (\pi_i^n - \pi_o^n). \tag{4}$$

When a firm is born, it expects with density $g(q)$ to be of type q. In choosing k_i or $k_o = 0$, it adopts an organizational form, outsourcing or FDI. At the start, a new firm chooses outsourcing if $q < q_i$, and expects to earn π_o^n with probability s_o,

$$s_o = \int_0^{q_i} q dG(q), \quad s_i = \int_{q_i}^1 q dG(q), \quad K_i = \int_{q_i}^1 k_i dG(q). \tag{5}$$

Due to early stage failure (at rates $1-q$), $s_o + s_i < 1$. Since $k_o = 0$ by normalization, aggregate early stage investment K_i stems from firms preparing for FDI only.

Prior to learning its type, the expected net present value of a new firm is

$$\bar{V} = \int_0^{q_i} V_o(q) dG(q) + \int_{q_i}^1 V_i(q) dG(q) = s_o \pi_o^n + s_i \pi_i^n - K_i \geqslant 0. \tag{6}$$

Since all final goods producers are located in the North, $\bar{V}$ is also aggregate profit income.

The key part of the analysis refers to investment, employment and production decisions in the South where components are produced with much lower labor cost. We focus on the case where investment is externally financed at the margin and is subject to finance constraints. We first turn to outsourcing relationships with independent subcontractors in the South. The price chosen in an outsourcing relationship where the Northern firm trades with an independent subcontractor, is the arm's length price (ALP).

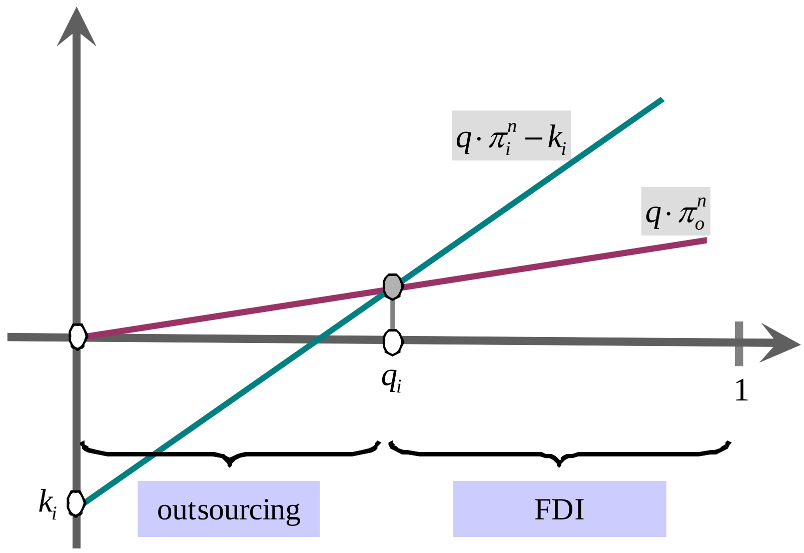

Figure 1: Choice of Organizational Form

2.2 Outsourcing

Investment and Financing: Independent subcontracting firms in the South earn a price z_o on their output and pay an upfront royalty r_o, as specified in the outsourcing contract. Firms have own wealth A. After paying the royalty, they are left with $A - r_o$ to self-finance part of expansion investment I_o. The remaining part $D_o = I_o - A + r_o$ is borrowed externally. To manage variable expansion investment, the entrepreneur incurs an effort cost cI_o. Investment succeeds with probability p which is the same across firms and statistically independent, and fails with probability $1 - p$. Depending on the level of investment, the firm generates a cash-flow $v_o I_o$ if successful. In the absence of depreciation, end of period value is $I_o + v_o I_o$. The tax liability T_o^e is specified below. When the firm is successful, it pays back debt plus interest as well as tax, and is left with V_o^e. The surplus of the firm, π_o^e, the bank, π_o^b, and the joint private surplus π_o are:

$$\begin{aligned} \pi_o^e &= pV_o^e - cI_o - A, \quad V_o^e = I_o + v_o I_o - (1+i) D_o - T_o^e, \\ \pi_o^b &= p(1+i) D_o - D_o, \quad D_o = I_o - A + r_o, \\ \pi_o &= [(1+v_o) p - c - 1] I_o - r_o - pT_o^e. \end{aligned} \tag{7}$$

Adding the expected net present value of tax $G_o^e = pT_o^e$ yields a social surplus $\pi_o^* = [(1+v_o) p - c - 1] I_o - r_o$. Since nothing is paid back by failed firms, banks must charge a loan rate $i > 0$ to cover losses from credit defaults. With perfect competition among banks, the zero profit loan rate is $(1+i) p = 1$. The deposit rate is normalized to zero. The loan rate reflects an intermediation margin which must cover the credit losses from defaulting firms.

The tax liability of the subcontractor is assumed to be $T^e = \tau^s [vI - i(D+A) - r]$, implying that the costs of both debt and equity finance are deductible.[5] We assume that upfront royalties are not immediately deductible but only when income is received in the success state. Using $D = I - A + r$, then

$$T_o^e = \tau^s [(v_o - i) I_o - (1+i) r_o].$$

Expected tax payment is $pT_o^e = p\tau^s (v_o - i) I_o - \tau^s r_o$ when banks are competitive and $(1+i) p = 1$.

[5]A more common tax code would be $T^e = \tau^s [vI - iD - r]$ which would introduce a constant iA in subsequent analysis. Although more complicated, the results remain qualitatively the same. Since the focus of the paper is not on the tax effects on investment, we adopt this major simplification. Note that in both formulations, investment is 100% debt financed *at the margin* since internal equity is a constant. The effective marginal tax rate (EMTR) would thus be zero in *both* formulations even if deduction of iA were excluded. To relate to neoclassical theory, replace vI by concave cash-flow $v(I)$ and set $c = 0$. Noting how D and T increase with I, maximizing V^e yields $v'(I) = i$. The user cost of capital is i and EMTR is zero in both cases.

Perfect competition among banks forces down the loan rate and allows them to perform no better than break-even, $\pi_o^b = 0$. Using $(1+i)\,p = 1$ and substituting for tax T_o^e yields a private surplus of

$$\pi_o^e = \pi_o = [(1-\tau^s)\,(v_o - i)\,p - c]\,I_o - (1-\tau^s)\,r_o. \tag{8}$$

To restrict attention to a finance-constrained equilibrium, we further assume

$$\frac{pc}{p-p_L} > p\,(1-\tau^s)\,(v_o - i) > c > p_L\,(1-\tau^s)\,(v_o - i)\,. \tag{A}$$

The second inequality implies that the net present value increases when firms expand investment, i.e. $d\pi_o/dI_o > 0$. The last inequality says that the marginal net present value is negative when the success probability is low.

When banks are competitive, subcontractors appropriate the entire surplus. Since the surplus rises with investment, firms want to invest as much as possible. However, loan size must also be incentive compatible to assure a high success probability since the project would not be profitable with a low success probability,

$$IC^e: \quad p \cdot V_o^e - cI_o \geqslant p_L \cdot V_o^e \quad \Leftrightarrow \quad V_o^e \geqslant \gamma I_o. \tag{9}$$

where $\gamma \equiv c/(p-p_L)$. The entrepreneur must keep a large enough stake for lending to be incentive compatible. Since V^e declines with debt, the firm's debt capacity is limited by

$$(1+i)\,D_o \leqslant [1+i+(1-\tau^s)\,(v_o-i)-\gamma]\,I_o + (1+i)\,\tau^s r_o. \tag{10}$$

Given $\gamma > (1-\tau^s)\,(v_o - i)$ by the first inequality of assumption (A), higher investment raises the required debt repayment faster than the firm's debt capacity on the right hand side. Investment is expanded until the inequality binds which determines the maximum incentive compatible investment level

$$I_o = m\,(z_o) \cdot [A - (1-\tau^s)\,r_o]\,, \quad m\,(z_o) \equiv \frac{1+i}{\gamma - (1-\tau^s)\,(v_o - i)}. \tag{11}$$

The ALP affects the multiplier via $v_o = v\,(z_o)$ as in (1). The multiplier is positive on account of the first inequality in (A).

We wish to focus on finance constrained equilibria. The first two inequalities in (A) importantly depend on c and p_L. A positive value of p_L is required to open an interval $[c, cp/(p - p_L)]$, which gets infinitely large when $p_L \to p$. If one sets v_o such that the term in the c-interval approaches the upper bound, the multiplier m gets infinitely large. A realistic equilibrium will have a multiplier moderately above one, implying that a marginal increase in own equity A by one unit raises investment by more than one, i.e. additional equity is positively leveraged with external debt. We thus consider a situation with a not too high value of p_L and an equilibrium value of v_o such that the multiplier exceeds one (the term $p(1 - \tau^s)(v_o - i)$ is close to the upper bound) and, simultaneously, the net present value of marginal investment is negative when the success probability is low (last inequality is satisfied).

Outsourcing Contract: With outsourcing, the innovator does not invest her own wealth but instead buys from an independent subcontractor by offering a contract z_o and r_o. To finance investment, the subcontractor injects her own assets and raises external funds. The parent firm in the North collects royalty income, earns profits from its final goods division, and pays tax $T_o^n = \tau[(\beta - z_o) x_o p + r_o]$. The expected net profit is π_o^n as in (2) since repatriated dividends are zero when outsourcing. Given that the parent's project is of type q, the net present value is

$$V_o(q) = q \cdot \pi_o^n, \quad \pi_o^n = (1 - \tau)[(\beta - z_o) x_o p + r_o]. \tag{12}$$

Adding initial wealth A yields the innovator's end of period utility $V_o + A = q\pi_o^n + A$.

When offering an outsourcing contract z_o and r_o, the parent firm fully anticipates the subcontractor's behavior resulting in a delivery $x_o = f(l_o) I_o$ which determines her own profits from final goods production. The contract must also fulfill the subcontractor's participation constraint, $V_o^e = \pi_o + A \geqslant A$, or $\pi_o \geqslant 0$.

Proposition 1 *The optimal outsourcing contract z_o, r_o satisfies*

$$z_o = \beta, \quad r_o = [(1 - \tau^s)(v_o - i)p - c] I_o / (1 - \tau^s). \tag{13}$$

Proof. The optimal contract z_o, r_o solves $\pounds = \pi_o^n + \mu_o \pi_o^e$, where $\pi_o^e = \pi_o$. Suppressing the index o for the moment, the Lagrangean is

$$\pounds = (1-\tau)\left[(\beta - z)\, px + r\right] + \mu \left\{\left[(1-\tau^s)(v(z) - i)\, p - c\right] I - (1-\tau^s)\, r\right\}.$$

Note the solutions $l(z)$, $I(z,r)$, $x(z,r) = f(l(z))\, I(z,r)$ as well as $v'(z) = f(l)$. In general, $\tau \neq \tau^s$. The optimality conditions for the contract are

$$z \;:\; \left[1-\tau-(1-\tau^s)\,\mu\right] px = (1-\tau)(\beta - z)\, p\frac{dx}{dz} + \mu\left[(1-\tau^s)(v-i)\, p - c\right]\frac{dI}{dz}, \quad \text{(i)}$$

$$r \;:\; \left[1-\tau-(1-\tau^s)\,\mu\right] = -(1-\tau)(\beta - z)\, p\frac{dx}{dr} - \mu\left[(1-\tau^s)(v-i)\, p - c\right]\frac{dI}{dr}. \quad \text{(ii)}$$

The royalty r does not affect l, $f(l)$ and v. Using $(1+i)\, p = 1$, we have

$$\frac{dm}{dv} = (1-\tau^s)\, m^2 p, \quad \frac{dI}{dz} = (1-\tau^s)\, mpx, \quad \frac{dI}{dr} = -(1-\tau^s)\, m. \quad \text{(iii)}$$

The effect on output of components, $x = f(l)\, I$ is more complicated. Using (iii),

$$\frac{dx}{dz} = (1-\tau^s)\, f(l)\, mpx + If'(l)\, l'(z), \quad \frac{dx}{dr} = -(1-\tau^s)\, mf(l). \quad \text{(iv)}$$

Evaluating the f.o.c.'s, and multiplying the second by px, yields

$$\frac{1-\tau-(1-\tau^s)}{(1-\tau)(1-\tau^s)}\mu - \mu\frac{\left[(1-\tau^s)(v-i)\, p - c\right] m}{1-\tau} = (\beta - z)\left[pmf + \frac{f'l'}{(1-\tau^s)\, f}\right], \quad \text{(v)}$$

$$\frac{1-\tau-(1-\tau^s)}{(1-\tau)(1-\tau^s)}\mu - \mu\frac{\left[(1-\tau^s)(v-i)\, p - c\right] m}{1-\tau} = (\beta - z)\, pmf.$$

The left hand side is the same in both equations. Since $f'l' > 0$, they can thus hold simultaneously only if both sides are zero, giving

$$z_o = \beta, \quad \mu_o = \frac{(1-\tau)/(1-\tau^s)}{1 + \left[(1-\tau^s)(v_o - i)\, p - c\right] m_o}. \quad \text{(vi)}$$

Given a positive shadow price, the participation constraint yields the royalty in (13). ■

Substituting the zero profit royalty in (13) into the investment condition (11), and using the definition of m_o and $(1+i)\, p = 1$ yields

$$I_o = \frac{m_o}{1 + \left[(1-\tau^s)(v_o - i)\, p - c\right] m_o} A = \frac{p - p_L}{cp_L} A. \quad (14)$$

With zero profits in the South, supplier investment is independent of the ALP and royalty.

Given the optimal ALP, the innovator's surplus from outsourcing amounts to

$$\pi_o^n = (1-\tau)\cdot r_o = \frac{1-\tau}{1-\tau^s}\cdot\left[(1-\tau^s)(v_o - i)\, p - c\right] I_o. \quad (15)$$

2.3 Direct Investment

When assessing a multinational, the government in the North observes arm's length market prices z_o and royalties r_o by outsourcing firms that are otherwise comparable. It will be shown below that MNE firms optimally choose different prices $z_i > z_o$ and $r_i < r_o$ for purely economic reasons of internal efficiency, even in the absence of taxes. These prices, however, also have the side effect of shifting profits to the South where investment must be financed. Profit shifting, in turn, may lead governments in the North to impose the arm's length principle to protect their tax base and secure more tax revenue.[6] Tax liability of the parent becomes

$$G_i^n = \tau \cdot \left[(\beta - \phi_z z_i) x_i p + \phi_r r_i + (1 - \phi_r) r_o \right], \quad \phi_z, \phi_r \leq 1. \tag{16}$$

If the ϕ-coefficients are set to unity, transfer prices and royalties of the MNE are not disputed, leaving $G_i^n = \tau \left[(\beta - z_i) x_i p + r_i \right]$. However, in reducing ϕ below unity, the government marginally applies the ALP by using observed market prices and royalties in outsourcing relationships to calculate the tax liability. In the extreme case, if $\phi_z = z_o/z_i$ and $\phi_r = 0$, the tax liability becomes $G_i^n = \tau \left[(\beta - z_o) x_i p + r_o \right]$, meaning that the ALP is fully imposed by recognizing only observed market prices rather than prices chosen by the MNE firm. We are concerned with marginally imposing ALPs by considering small deviations from $\phi_z = \phi_r = 1$.

An MNE's global net of tax profit amounts to $\pi_i^n = (\beta - z_i) x_i p + r_i + \pi_i^s - G_i^n$. Following practice in the vast majority of countries[7], repatriated dividends are assumed to be tax exempt. Using (16), global net of tax profits amount to

$$\pi_i^n = \pi_i^s + \left[(1 - \tau) \beta - (1 - \phi_z \tau) z_i \right] p x_i + (1 - \phi_r \tau) r_i - (1 - \phi_r) \tau r_o. \tag{17}$$

Subsidiary profits in the South (indexed by s) is paid back to the Northern parent either

[6] We henceforth use ALP to refer to both 'arm's length principle' and 'arm's length price', except when the meaning appears ambiguous.

[7] As of 2009, the USA and Japan are the only large countries to maintain taxation of worldwide income, instead of primarily exempting foreign source dividends.

as a tax exempt dividend π_i^s or as a royalty r_i which is subject to tax. The net present value of a type q firm choosing the FDI mode is $V_i(q) = q\pi_i^n - k_i$.

Subsidiary Investment: The subsidiary in the South earns a cash-flow $v_i(z_i)$ per unit of invested capital. The last term $(1-\phi_r)\tau r_o$ in (16) is like a lump-sum tax to be paid out of free cash-flow as well. After self-financing early stage investment and paying the upfront tax liability on royalties, the parent is left with free cash-flow A^n as defined in (18) below. Finally, the MNE may request its own subsidiary to pay royalties. This, however, raises the financing needs of the subsidiary to $I_i + r_i$ in total. A part A^n is self-financed by the parent while the remaining part is borrowed externally. The subsidiary's tax liability in the South amounts to $T_i^s = \tau^s[(v_i - i)I_i - (1+i)r_i]$, following the same approach as in the outsourcing case. In case of success, the subsidiary manager earns V_i^s, giving,

$$\begin{aligned}
\pi_i^s &= pV_i^s - cI_i - A^n, \quad V_i^s \equiv (1+v_i)I_i - (1+i)D_i - T_i^s, \\
\pi_i^b &= p(1+i)D_i - D_i, \quad D_i \equiv I_i + r_i - A^n, \quad A^n \equiv A - k_i - (1-\phi_r)\tau r_o, \qquad (18) \\
\pi_i &= [(1+v_i)p - c - 1]I_i - r_i - pT_i^s.
\end{aligned}$$

Adding the net present value of expected tax revenue $G_i^s = pT_i^s$ yields the social surplus $\pi_i^* = [(1+v_i)p - c - 1]I_i - r_i$. Again, the zero profit condition in banking fixes the loan rate, $(1+i)p = 1$, and the subsidiary repatriates dividends equal to the entire net of tax surplus $\pi_i^s = \pi_i$. By acquiring ownership in the foreign plant, the MNE firm can extract the surplus from component production either as ex post dividends or ex ante royalties, $\pi_i + r_i = [(1+v_i)p - c - 1]I_i - G_i^s$. If she had opted for outsourcing instead, her only instrument to extract profits would be to charge a high royalty.

Given an FDI contract with z_i and r_i, the manager's incentive constraint is $V_i^s \geqslant \gamma I_i$ as before. The incentive pay to the manager limits the subsidiary's pledgeable income to $(1+i)D_i \leqslant (1+v_i)I_i - T_i^s - \gamma I_i$. Borrowing is expanded until pledgeable income is exhausted and the financing constraint holds with equality. Substituting debt and tax liability yields

$$I_i = m(z_i) \cdot [A^n - (1-\tau^s) r_i], \quad m(z_i) \equiv \frac{1+i}{\gamma - (1-\tau^s)(v_i - i)}. \tag{19}$$

Investment is now controlled by the FDI contract specifying z_i and r_i.

FDI Contract: The parent sets a transfer price and a royalty to maximize global profit net of tax. The firm fully anticipates how it thereby controls subsidiary behavior. Note also that the firm must give up dividend income when it requests a higher royalty.

Proposition 2 *In a neighborhood of $\phi_z = \phi_r = 1$ and given the assumption $\tau \geqslant \tau^s$, the optimal FDI contract satisfies*

$$z_i > z_o = \beta, \quad r_i = 0 < r_o. \tag{20}$$

Proof. Given z_i and r_i, the subsidiary chooses $l(z_i)$, $I(z_i, r_i)$, $x(z_i, r_i) = f(l_i) I_i$ and earns $\pi_i^s = [(1-\tau^s)(v_i - i)p - c] I_i - (1-\tau^s) r_i$. Further, $v'(z_i) = f(l_i)$. Suppressing index i for the moment, a variation in contract terms changes global profits in (17) by

$$\begin{aligned} \frac{d\pi_i^n}{dz_i} &= (\phi_z \tau - \tau^s) px + [(1-\tau)\beta - (1-\phi_z\tau) z] p \frac{dx}{dz} + [(1-\tau^s)(v-i)p - c] \frac{dI}{dz}, & \text{(i)} \\ \frac{d\pi_i^n}{dr_i} &= -(\phi_r \tau - \tau^s) + [(1-\tau)\beta - (1-\phi_z\tau) z] p \frac{dx}{dr} + [(1-\tau^s)(v-i)p - c] \frac{dI}{dr}. & \text{(ii)} \end{aligned}$$

The first terms reflect gains from direct profit shifting. The royalty r does not affect l, $f(l)$ and v, because it is paid upfront. We note $dm/dv = (1-\tau^s) pm^2$, leading to

$$\frac{dI}{dr} = -(1-\tau^s) m, \quad \frac{dI}{dz} = (1-\tau^s) mpx. \tag{iii}$$

The effect on component output $x = f(l) I$ is

$$\frac{dx}{dr} = -(1-\tau^s) mf, \quad \frac{dx}{dz} = (1-\tau^s) f(l) mpx + I f'(l) l'(z). \tag{iv}$$

Evaluating $d\pi_i^n / dz_i = 0$ by substituting the derivatives in (iii-iv), the optimal transfer price in the FDI mode satisfies

$$(1-\phi_z\tau) z - (1-\tau)\beta = \frac{(\phi_z\tau - \tau^s) + [(1-\tau^s)(v-i)p - c](1-\tau^s) m}{(1-\tau^s) fpm + f'l'/f}. \tag{v}$$

Noting that all terms on the right hand side are positive yields $z_i > \beta$ if ϕ_z is near unity.

Evaluating $d\pi_i^n/dr_i$ and using (iii-iv) as well as (v) yields, after some manipulations,

$$\frac{d\pi^n}{dr} = (\phi_z - \phi_r)\,\tau - [(1-\phi_z\tau)\,z - (1-\tau)\,\beta]\,f'l'/f < 0 \quad \Rightarrow \quad r = 0. \qquad \text{(vi)}$$

The square bracket is strictly positive by (v). With ϕ_z, ϕ_r close to unity, the derivative is negative, giving a corner solution. Since royalties reduce investment and output $x = fI$, they also reduce global profit and are thus optimally set to zero. ■

Clearly, the above results hold in the absence of taxes. Intuitively, an upfront royalty would only raise the need for external financing. Given a fixed borrowing capacity, demanding a royalty payment upfront crowds out investment while ex post dividends avoid this. Consequently, the parent firm optimally sets the royalty to zero, and instead obtains the subsidiary's profit as an ex post, risky dividend. This option is not open with an outsourcing relationship since the final goods firm has no ownership in this case. The only way to extract profits from independent subcontracting firms is to pay a low ALP and charge a high royalty. The outsourcing contract reflects the optimal way to do so.

The optimal transfer price chosen by MNE firms is higher than the ALP in outsourcing relationships, $z_i > \beta$. In shifting profits, the parent can boost the subsidiary's pledgeable income and relax the borrowing constraint. To see this, consider the tax parameters as mentioned in the Proposition. The direct effect of a higher transfer price is to shift taxable profit which corresponds to the first term in (20.i). If $\phi_z = 1$ and $\tau > \tau^s$, MNE firms find it optimal to raise the transfer price for tax reasons in order to shift profits to the low tax country and thereby reduce the global tax bill. According to this standard argument in the tax literature, imposing the ALP by reducing ϕ_z would contain profit shifting and protect the tax base. This tax induced profit shifting incentive is eliminated when tax rates are equal, making the ALP redundant. However, transfer prices serve important economic functions. Imposing the ALP impairs internal efficiency of MNEs. A first behavioral effect is that paying a higher transfer price induces subsidiaries to supply a larger quantity. Starting from $z_i = \beta$, the firm incurs a zero loss to the first order in her final goods division when tax rates are symmetric.

A second behavioral effect is that the transfer price boosts pledgeable income of the subsidiary company and thereby allows for more borrowing and investment. Since the firm is credit constrained in the first place, the relaxation of the financing constraint yields a first order increase in subsidiary profits equal to $(1-\tau^s)\,vp-1-c$ per unit of capital as in the third term of (20.i). This gain is related to the fact that more investment is socially profitable (see assumption A) but the firm can leverage its own funds only to a limited extent. By shifting profits from the final goods division to the subsidiary where investment needs to be financed, the parent can relax a financing constraint and thereby boost global profits. It is thus optimal to raise the transfer price above the marginal product β. However, as the transfer price is raised further, it increasingly distorts the optimal use of components in final goods assembly which cuts into worldwide profits. As the losses in the final goods division become large, a further increase in the transfer price eventually becomes undesirable.

Consider now how MNE firms reduce the transfer price when the government in the North imposes the ALP. To analyze policy shocks, as in section 3 below, we log-linearize the model. The hat notation indicates percentage changes relative to the initial situation, e.g. $\hat{x} \equiv dx/x$. Exceptions to the rule will be specially noted.

Proposition 3 *In a neighborhood of $\phi_z = \phi_r = 1$, the transfer price under FDI falls when the tax authority applies the ALP in assessing the value of components ($\hat{\phi}_z < 0$),*

$$\hat{z}_i = \varepsilon_\phi \cdot \hat{\phi}_z, \quad \varepsilon_\phi > 0. \tag{21}$$

Applying the ALP in assessing royalty income ($\hat{\phi}_r < 0$) has no impact on transfer prices.

Proof. The optimality condition in (20.i) is $d\pi_i^n/dz_i \equiv \zeta(z_i;\phi_z) = 0$. Applying the implicit function theorem yields comparative statics in ϕ_z. The second order condition $d^2\pi_i^n/dz_i^2 = d\zeta/dz_i \equiv \zeta_z < 0$ pins down the sign of the effects. Using (20.i,iii,iv) yields

$$\begin{aligned} \zeta(z_i;\phi_z) &= (\phi_z\tau - \tau^s)\,px_i + [(1-\tau^s)(v_i - i)\,p - c]\,(1-\tau^s)\,m_i p x_i \qquad \text{(i)} \\ &: \; +[(1-\tau)\,\beta - (1-\phi_z\tau)\,z_i]\,[(1-\tau^s)\,f_i m_i p + f_i' l_i'/f_i]\,px_i = 0. \end{aligned}$$

The condition depends on ϕ_r only via its impact on investment I_i and, in turn, on x_i. Since x_i cancels from (i), ϕ_r has no effect on x_i, i.e. $d\zeta/d\phi_r = 0$. The transfer price is independent of ϕ_r. Since x_i, I_i and m_i depend only on foreign taxes, the impact of ϕ_z is

$$\frac{d\zeta}{d\phi_z} \equiv \zeta_\phi = \tau p x_i \cdot [1 + z_i \cdot ((1-\tau^s) f_i p m_i + f_i' l_i'/f_i)] > 0. \tag{ii}$$

The implicit function theorem thus implies $dz_i/d\phi_z = -\zeta_\phi/\zeta_z$, which yields (21) with the elasticity defined as $\varepsilon_\phi \equiv -\phi_z\zeta_\phi/(z_i\zeta_z) > 0$. ■

Relative Profits: To choose the value maximizing organizational form, the parent firm must compare global profits under outsourcing and FDI.

Proposition 4 *In a neighborhood of $\phi_z = \phi_r = 1$ and $\tau = \tau^s$, and with k_i not too large, global expected profits with FDI are strictly larger than with outsourcing, $\pi_i^n > \pi_o^n$.*

Proof. Setting tax parameters as mentioned, (11-13) give the parent's global profit with outsourcing while (17), π_i^s as noted after (20), and (19) together with $r_i = 0$ and $A^n = A - k_i$ yield global profits with FDI,

$$\pi_o^n = (1-\tau)(\beta - z_o) p x_o + [(1-\tau)(v_o - i) p - c] m_o [A - (1-\tau) r_o], \tag{i}$$
$$\pi_i^n = (1-\tau)(\beta - z_i) p x_i + [(1-\tau)(v_i - i) p - c] m_i (A - k_i). \tag{ii}$$

Start with a situation of $k_i = (1-\tau) r_o$ and $z_i = z_o = \beta$, implying $v_i = v_o$ and $m_i = m_o$. This leads to $\pi_i^n = \pi_o^n$ since all terms are identical. Consider first the effect of having a smaller start-up cost ($k_i < (1-\tau) r_o$ 'not too large'). This has no impact on v_i (since it does not depend on k_i) but raises free cash-flow which, in turn, boosts investment in (19) and global profits under FDI. The first step thus raises π_i^n relative to π_o^n. Second, optimally raise the transfer price to a level $z_i > \beta$ as in (20) while the firm sets $z_o = \beta$ under outsourcing. Since z_i is chosen to maximize global profits, moving towards the higher optimal price again raises profits from FDI relative to outsourcing. By continuity, the same arguments also hold for small deviations from symmetric tax parameters. ■

2.4 Equilibrium and Welfare

The firm in the North chooses FDI if it yields the largest end of period wealth. The net present value of going multinational is $V_i(q) = q\pi_i^n - k_i$, while outsourcing yields a value $V_o(q) = q\pi_o^n$. Once the start-up phase is successfully completed, FDI is more profitable, $\pi_i^n > \pi_o^n$. However, FDI requires a larger early stage investment, $k_i > 0$. Figure 1 in section 2.1 illustrates the decomposition of Northern firms by organizational form. Only the best firms, those with the highest probability q of surviving the start-up phase, prefer FDI while the less profitable ones with a smaller expected profit prefer outsourcing. Equation (5) computes the shares of multinational and outsourcing companies among all new firms, and (6) states the expected net present value of a new firm before it has learned the type q of its project.

The model is recursive. Labor earns a fixed wage w in the South where there is free mobility between a Ricardian sector and the component industry serving Northern final goods producers. The fiscal budget closes the model. Given our focus on efficiency rather than distribution, we assume that tax revenue is rebated lump-sum. Hence, $G^n = s_o G_o^n + s_i G_i^n$ is the transfer per capita, and similarly in the South:

$$\begin{aligned} G^n &= \tau\left[(\beta - z_o)\, px_o + r_o\right]\cdot s_o + \tau\left[(\beta - \phi_z z_i)\, px_i + (1-\phi_r)\, r_o\right]\cdot s_i, \qquad (22) \\ G^s &= \tau^s\left[p\,(v_o - i)\, I_o - r_o\right]\cdot s_o + \tau^s p\,(v_i - i)\, I_i \cdot s_i, \end{aligned}$$

where $A^n = A - k_i - \tau(1-\phi_r)\, r_o$. Note $z_i > z_o = \beta$ and $r_o > r_i = 0$ in equilibrium. Assuming the exemption principle in place, repatriated dividends from foreign subsidiaries are not taxed in the North. The government in the South is, of course, not concerned with the ALP since profit shifting anyway works in its favor. The Appendix shows Walras' Law to illustrate the market structure and trade balances.

Welfare equals income minus effort costs. Since V_j is net of effort cost and represents a surplus over initial assets, expected utility and aggregate welfare in the North are

$$\Omega^n = A + G^n + \bar{V}, \quad \bar{V} = s_o\pi_o^n + s_i\pi_i^n - K_i. \qquad (23)$$

Since asset endowment is fixed, welfare changes along with $G^n + \bar{V}$.

3 Implications of the Arm's Length Principle

Offshoring occurs either at arm's length with independent suppliers or in a vertically integrated multinational firm with a wholly owned foreign subsidiary. These organizations set entirely different component prices and royalties. To investigate the ALP, we start from a situation of $\phi_z = \phi_r = 1$, where tax authorities do not dispute private tax reports, and then consider marginal reductions of ϕ_z, ϕ_r. Tax rates are kept constant throughout. To simplify, we mostly consider symmetric tax rates $\tau = \tau^s$.

3.1 Investment and Profit

Applying the ALP is not relevant for outsourcing relationships. Given constant tax rates, the policy has no effect on investment of subcontractors and neither on profits, royalties and tax payments in both locations, see (14-15). By way of contrast, the ALP directly affects multinationals and their relations to foreign subsidiaries. The tax penalty on the higher transfer price of multinationals leads them to set a lower price, see (21), which erodes the subsidiary's cash-flow by $v'(z_i) = f_i$:

$$\hat{z}_i = \varepsilon_\phi \hat{\phi}_z, \quad \hat{v}_i = (z_i f_i / v_i) \cdot \hat{z}_i. \tag{24}$$

Obviously, the lower transfer price reduces profit shifting, not only because firms charge and report a lower price but also because firms produce and import less.

A smaller cash-flow diminishes the subsidiary's borrowing capacity, leading to lower investment. The parent sets the optimal royalty to zero, earning all surplus with dividends, so that (19) gives $I_i = m_i A^n$ with $A^n = A - k_i - (1 - \phi_r) \tau r_o$. Evaluating at $\phi_r = 1$, the investment response is $\hat{I}_i = \hat{m}_i + (\tau r_o / A^n) \hat{\phi}_r$. Since $\hat{m}_i = (1 - \tau^s) m_i v_i p \cdot \hat{v}_i$,

$$\hat{I}_i = (1 - \tau^s) m_i p z_i f_i \cdot \hat{z}_i + (\tau r_o / A^n) \cdot \hat{\phi}_r. \tag{25}$$

Forcing the investor to pay tax on fictitious royalty income reduces the MNE's free cash-flow and, thereby, self-financing. Investment declines since it is a constant leverage of own equity. When tax liability is based on a lower ALP for components, the resulting tax penalty leads the parent firm to set a lower transfer price. Investment again falls on account of lower pledgeable income which limits external leverage.

Subsidiary profits are $\pi_i^s = [(1-\tau^s)(v_i - i)p - c] I_i$, as noted below (20) with $r_i = 0$. Taking the differential yields $d\pi_i^s = [(1-\tau^s)(v_i - i)p - c] I_i \cdot \hat{I}_i + (1-\tau^s) p I_i z_i f_i \cdot \hat{z}_i$. Substitute (25) and use $1 + [(1-\tau^s)(v_i - i)p - c] m_i = m_i \gamma p_L$,

$$d\pi_i^s = m_i \gamma p_L \cdot (1-\tau^s) p z_i x_i \cdot \hat{z}_i + \tau r_o (\pi_i^s / A^n) \cdot \hat{\phi}_r. \quad (26)$$

Imposing the ALP erodes subsidiary profits, leading to smaller dividend repatriations. First, the tax penalty leads the parent firm to set a lower transfer price which cuts subsidiary earnings from component production. Second, imposing the ALP discourages investment which again subtracts from subsidiary profit.

By the envelope theorem, a variation of z_i has no impact on consolidated MNE profit. We need to consider only the direct derivatives of (17-18). Note that m_i and l_i depend only on z_i but not on domestic tax parameters while investment I_i and, thus, $x_i = f(l_i) I_i$, additionally reflect the tax penalty of applying the ALP on royalties, see (25). Given optimal $r_i = 0$, using (26), and evaluating at $\phi_z = \phi_r = 1$ so that $\hat{\phi}_j = d\phi_j$, yields[8]

$$d\pi_i^n = \tau p x_i z_i \cdot \hat{\phi}_z + \tau r_o (1 + \pi_i^n / A^n) \cdot \hat{\phi}_r. \quad (27)$$

Imposing the ALP directly raises the tax liability. Global net profit of the MNE firm further declines because it squeezes subsidiary investment which is already finance constrained even in the absence of tax.

3.2 Firm Decomposition

Imposing the ALP reduces global profits in the FDI mode. Figure 1 illustrates how this change in relative profits discourages FDI and pushes firms into the outsourcing

[8] We get $d\pi_i^n = \tau p x_i z_i \cdot \hat{\phi}_z + \tau r_o [1 + \pi_i^s / A^n + (1-\tau)(\beta - z_i) p x_i / A^n] \cdot \hat{\phi}_r$. The result obtains by noting that $(1-\tau)(\beta - z_i) p x_i = \pi_i^n - \pi_i^s$ holds in the initial equilibrium.

mode. Analytically, tax policy changes the outsourcing versus FDI margin in (4) by $\hat{q}_i = -d\pi_i^n / (\pi_i^n - \pi_o^n)$, giving

$$\hat{q}_i = -\frac{\tau p x_i z_i}{\pi_i^n - \pi_o^n} \cdot \hat{\phi}_z - \frac{\tau r_o (1 + \pi_i^n / A^n)}{\pi_i^n - \pi_o^n} \cdot \hat{\phi}_r. \tag{28}$$

Tax policy thus changes the composition of the business sector by organizational form. Using $g_i = g(q_i)$, the differential of (5) yields

$$\hat{s}_o = \frac{q_i^2 g_i}{s_o} \cdot \hat{q}_i, \quad \hat{s}_i = -\frac{q_i^2 g_i}{s_i} \cdot \hat{q}_i, \quad \hat{K}_i = -k_i \frac{q_i g_i}{K_i} \cdot \hat{q}_i. \tag{29}$$

Obviously, the change in shares satisfies $ds_o + ds_i = 0$. Since individual start-up cost is fixed, and normalized to zero for outsourcing firms, the impact on aggregate early stage investment only reflects changes in group size.

3.3 Tax Revenue

North: Welfare partly depends on tax revenue. Revenues reflect intensive (tax per firm) and extensive responses (composition effects). Tax liability of an MNE partly reflects subsidiary output: $x_i = f(l_i) I_i$ and $\hat{x}_i = \hat{f}_i + \hat{I}_i$. Specifying $f(l) = l^{1-\alpha}$, the employment condition $z f'(l) = w$ yields $\hat{l} = \hat{z}/\alpha$. Output changes by $\hat{f}_i = (1-\alpha)\hat{l}_i = \hat{z}_i \cdot (1-\alpha)/\alpha$. Also note $l' f'/f = (1-\alpha)/(\alpha z_i)$ for later reference. Substituting (25) gives

$$\hat{x}_i = \xi_i \cdot \hat{z}_i + (\tau r_o / A^n) \cdot \hat{\phi}_r, \quad \xi_i \equiv \frac{1-\alpha}{\alpha} + (1-\tau^s) m_i p z_i f_i > 0, \tag{30}$$

where $\hat{z}_i = \varepsilon_\phi \hat{\phi}_z$ by (24). Applying the ALP on transfer prices and royalty income leads to lower investment and subsidiary output which limits profit shifting and reduces the loss of the home division.

Repatriated dividends are assumed tax exempt. Tax liability per MNE firm in the North is $G_i^n = \tau [(\beta - \phi_z z_i) p x_i + (1 - \phi_r) r_o]$, where r_o is invariant to the policy change and $r_i = 0$. Tax revenue thus changes by $dG_i^n = \tau p x_i \left[(\beta - z_i)\hat{x}_i - z_i \hat{z}_i - z_i \hat{\phi}_z \right] - \tau r_o \hat{\phi}_r$. Substituting the output response above yields

$$dG_i^n = -[(z_i - \beta)\xi_i \varepsilon_\phi + (1 + \varepsilon_\phi) z_i] \tau p x_i \hat{\phi}_z - [1 + (z_i - \beta)\tau p x_i / A^n] \tau r_o \hat{\phi}_r. \tag{31}$$

Imposition of the ALP thus raises tax revenue extracted from MNEs in the North. Reflecting intensive and extensive responses, total revenue collected from all firms in the North changes by (note $G_o^n = \tau r_o > 0 > G_i^n = -\tau (z_i - \beta) p x_i$)

$$G^n = s_o G_o^n + s_i G_i^n, \quad dG^n = (G_o^n - G_i^n) q_i g_i dq_i + s_i dG_i^n. \tag{32}$$

South: Tax from subcontracting firms is fixed, $G_o^s = \tau^s (v_o - i) p I_o - \tau^s r_o$. Since it pays no royalty, tax liability of a foreign subsidiary is $G_i^s = \tau^s (v_i - i) p I_i > G_o^s$. The inequality holds since $v_i > v_o$ due to a higher price z_i, and $I_i > I_o$ on account of the arguments given in Proposition 4. Since outsourcing firms are not affected, $dG_o^s = 0$, total revenue from the source tax is

$$G^s = s_o G_o^s + s_i G_i^s, \quad dG^s = (G_o^s - G_i^s) q_i g_i dq_i + s_i dG_i^s. \tag{33}$$

Source tax revenue depends on Northern policy towards ALPs. The tax liability of subsidiaries changes by $dG_i^s = \tau^s p \left[v_i I_i \hat{v}_i + (v_i - i) I_i \hat{I}_i \right]$. Substituting earlier results yields

$$dG_i^s = [1 + (1 - \tau^s)(v_i - i) p m_i] \tau^s p z_i x_i \cdot \hat{z}_i + (v_i - i) \tau^s p m_i \cdot \tau r_o \cdot \hat{\phi}_r. \tag{34}$$

A higher transfer price inflates taxable subsidiary profits since it boosts cash-flow and also stimulates investment in the South. Imposing the ALP on royalties reduces free-cash flow of parent companies, leading them to cut back on borrowing and investment.

World: Tax policy in the North changes worldwide tax revenue by $dG = dG^n + dG^s$ or, using (32-33), $dG = (G_o - G_i) q_i g_i dq_i + s_i (dG_i^n + dG_i^s)$, where $G_o = G_o^n + G_o^s$ and similarly for G_i. Substitute earlier results and recall that the initial equilibrium is assumed symmetric, $\tau = \tau^s$. The optimality condition (20.v), if evaluated with symmetric tax parameters, and the coefficient ξ_i defined in (30) imply $(z_i - \beta) \xi_i = [(1 - \tau)(v_i - i) p - c] m_i z_i$. Also use $v_i = z_i f_i - w l_i$. Worldwide tax revenue is found to change by

$$\begin{aligned} dG &= (G_o - G_i) q_i g_i dq_i + (c m_i \varepsilon_\phi - 1) \tau p z_i x_i s_i \hat{\phi}_z \\ &: \quad + [(\beta f_i - w l_i - i) \tau p m_i - 1] \tau r_o s_i \hat{\phi}_r. \end{aligned} \tag{35}$$

To sign the compositional effect, we need to rank worldwide tax collected from firms in the outsourcing and FDI mode. Adding $G_o^n = \tau r_o$ and $G_o^s = \tau \left[(v_o - i) pI_o - r_o \right]$ yields world tax revenue G_o and, similarly for $G_i = G_i^n + G_i^s$,

$$G_i = \tau (\beta f_i - wl_i - i) pI_i > G_o = \tau (\beta f_o - wl_o - i) pI_o, \tag{36}$$

where $I_i = m_i (A - k_i)$ and $I_o = m_o (A - (1 - \tau) r_o)$. To show this, note that G_o is a constant. We restrict attention only to equilibria with an interior solution of organizational choice, $\pi_i^n > \pi_o^n$. Proposition 4 shows that this requires $z_i > \beta$ or $k_i < (1 - \tau) r_o$. The last condition implies $I_i > I_o$ and, thus, $G_i > G_o$ at $z_i = \beta$. To compute how $G_i = G_i^n + G_i^s$ rises with z_i, substitute (34) and $dG_i^n = -\left[(z_i - \beta) \xi_i + z_i \right] \tau p x_i \hat{z}$ from (31), and get $dG_i = \tau p x_i \left[(1 - \tau) (v_i - i) p m_i z_i - (z_i - \beta) \xi_i \right] \hat{z}_i$. Clearly, $dG_i > 0$ at $z_i = \beta$ since $v_i > i$. As was noted prior to (35), the optimal z_i fulfills $(z_i - \beta) \xi_i = \left[(1 - \tau) (v_i - i) p - c \right] m_i z_i$, so that $dG_i|_{z_i^*} = \tau p m_i z_i x_i c \hat{z}_i$. Since global tax revenue still increases with z_i at the optimal value z_i^*, we have shown that $G_i > G_o$ must hold in equilibrium.

3.4 National Welfare

Tax policy affects welfare by $d\Omega^n = dG^n + d\bar{V}$ as in (23). Using $ds_o = q_i g_i dq_i = -ds_i$ as well as $dK_i = -k_i g_i dq_i$, the change in expected firm value follows from the differential $d\bar{V} = -\left[(\pi_i^n - \pi_o^n) q_i - k_i \right] g_i dq_i + s_o d\pi_o^n + s_i d\pi_i^n$. The square bracket is zero by organizational choice. Profits from outsourcing are not affected. Substituting (27) yields

$$d\bar{V} = \tau p x_i z_i s_i \cdot \hat{\phi}_z + (1 + \pi_i^n / A^n) \tau r_o s_i \cdot \hat{\phi}_r. \tag{37}$$

The total welfare effect obtains by substituting (31-32) and (37) into $d\Omega^n = dG^n + d\bar{V}$. Canceling mechanical effects and using $I_i = m_i A^n$ yields

$$\begin{aligned} d\Omega^n &= (G_o^n - G_i^n) q_i g_i dq_i - \left[(z_i - \beta) \xi_i + z_i \right] \tau p x_i s_i \varepsilon_\phi \hat{\phi}_z \\ &: + \left[\pi_i^n - \tau (z_i - \beta) p x_i \right] (\tau r_o s_i / A^n) \hat{\phi}_r. \end{aligned} \tag{38}$$

The last term reflects the impact of forcing MNEs to declare fictitious royalty income. There are two opposing effects. First, imposing the ALP on royalties boosts national tax revenue and welfare. Apart from the direct gain in tax revenue collected from the MNE operation at home, it also reduces the scale of production x_i and thereby cuts the losses in the domestic final goods division which further boosts tax revenue. Second, the policy reduces national welfare on account of a lower expected firm value $\bar{V}$, reflecting a lower global profit π_i^n in the MNE mode. Again, this lower profit reflects the direct tax effect and, in addition, the lower dividend repatriations because it reduces subsidiary investment in the South. The net effect in (38) is negative, implying lower national welfare in the North, as long as global MNE profits before domestic tax are positive.[9]

Consider now the total welfare consequences of marginally imposing the ALP by only partially recognizing transfer prices reported by multinational firms, $\hat{\phi}_z < 0$. The scenario similarly distorts the extensive and intensive margins. It pushes a margin of firms from FDI into outsourcing mode, $dq_i > 0$ in (28). Now, the North reaps a welfare gain equal to $(G_o^n - G_i^n)\, q_i g_i dq_i$ since outsourcing firms pay more tax than MNEs. As a further behavioral effect, the tax penalty leads firms to reduce the transfer price z_i. In the MNE optimum, global profits are unaffected at the margin since the increased loss at home is just offset by an increased profit abroad. However, for any given transfer price z_i, the policy directly raises tax revenue since only a smaller part of the total cost $z_i x_i$ for components can be deducted from tax. The increase in tax liability corresponds to the term involving z_i in the first line of 38). The revenue gain is further magnified by the fact that the lower transfer price reduces component production by $\hat{x}_i = \xi_i \hat{z}_i$ which limits the losses in the home division and thus boosts tax revenue (the term proportional to $z_i - \beta$).

Proposition 5 *Imposing the ALP on component pricing ($\hat{\phi}_z < 0$) reduces transfer prices and pushes firms from FDI into outsourcing. National welfare in the North increases.*

A tax on fictitious royalty income directly redistributes from multinationals to the government. Although the policy does not distort component prices, it does discriminate

[9] Substitute $\pi_i^n = \pi_i^s - (1-\tau)(z_i - \beta) p x_i$ from (17) and get pre tax profit $[\pi_i^n - \tau (z_i - \beta) p x_i] = \pi_i^s - (z_i - \beta) p x_i$ which necessarily must be positive in an equilibrium without taxes.

against subsidiary investment. MNEs optimally do not claim royalty income but rather prefer ex post dividends in order to relax the external financing constraint of their subsidiaries. The tax penalty on royalties does the opposite. It reduces free cash-flow and thereby impairs the MNE's borrowing capacity and investment in the subsidiary. There are thus again two behavioral responses. First, the investment response at the intensive margin reduces national welfare. Although lower investment cuts losses in the home division and thereby strengthens tax revenue, it also reduces repatriated dividends as a source of national income and welfare. These two effects offset each other. Since investment is finance constrained, a further reduction of investment strictly reduces global profits before domestic taxes. The last square bracket in (38) indicates that national welfare falls on this account as long as MNEs record positive global profits gross of tax. Second, a margin of firms is again pushed from FDI into outsourcing, $dq_i > 0$. The impact on organizational form leads to a welfare gain due to the higher tax payment of outsourcing firms compared to MNEs. The net effect is ambiguous.

Proposition 6 *Imposing the ALP on royalty income of MNEs ($\hat{\phi}_r < 0$) pushes firms from FDI into outsourcing which boosts national tax revenue and welfare. The policy also reduces free cash-flow, further distorts MNE investment and lowers welfare. The net impact on welfare in the North is ambiguous.*

3.5 Global Welfare

We have shown that the imposition of ALP on transfer prices for intracompany trade helps to contain profit shifting and thereby raises welfare in the North. Profit shifting creates a fiscal spillover. We now show that imposing the ALP leads to a welfare loss in the South and, more importantly, that this loss exceeds the Northern gain. The ALP thus results in a net loss of global welfare.

Welfare South: Welfare in the South is equal to the sum of wages, assets and refunded tax revenue, $\Omega^s = wL + A + G^s$. It does not depend on profit income since profits of subcontractors are extracted by royalties and profits of foreign subsidiaries are repatriated. The South collects revenue from the source tax as in (33) and (34). The source tax from MNE subsidiaries much depends on Northern tax policy via its impact on transfer prices, $\hat{z}_i = \varepsilon_\phi \hat{\phi}_z$. Welfare in the South thus changes by

$$\begin{aligned} d\Omega^s &= -\left(G_i^s - G_o^s\right) q_i g_i dq_i + \tau^s \left(v_i - i\right) p m_i \cdot \tau r_o s_i \hat{\phi}_r \\ &: \quad +\tau^s \left[1 + \left(1 - \tau^s\right) \left(v_i - i\right) p m_i\right] p z_i x_i \cdot s_i \varepsilon_\phi \hat{\phi}_z. \end{aligned} \tag{39}$$

Note that subsidiaries pay more tax per firm in the South compared to subcontractors, $G_i^s > G_o^s$, since the higher transfer price $z_i > \beta$ and the reliance of MNEs on dividends instead of royalties strengthen both cash-flow and investment under FDI. MNEs are better able to cope with financing constraints and raise more external funds than local firms. Imposing the ALP on transfer prices induces a margin of firms to shift from FDI to outsourcing, imposing a loss of tax revenue on the South, $-\left(G_i^s - G_o^s\right) q_i g_i dq_i < 0$. This loss in revenue and welfare is reinforced by the induced cut in the transfer price and the consequent investment reduction so that less profit gets shifted to the South. By enforcing the ALP, the North creates a strong negative fiscal spillover on the South. Imposing the ALP on royalties ($\hat{\phi}_r < 0$) has a similar effect. It pushes firms from FDI into outsourcing which means less tax to the source country. By reducing subsidiary investment, the North also narrows the tax base of the source country which further erodes tax revenue. The South looses on both fronts.

Proposition 7 *When the North imposes the ALP on transfer prices and royalties ($\hat{\phi}_z < 0$ and $\hat{\phi}_r < 0$), welfare in the South declines.*

Global Welfare: Global welfare is $\Omega^* = \Omega^n + \Omega^s$. The change in world welfare reflects the policy impact on world tax revenue and on aggregate profit income in the North stemming from royalties and repatriated dividends. Note the assumption of symmetric tax rates, use the optimality condition $(z_i - \beta)\,\xi_i = \left[(1-\tau)(v_i - i)\,p - c\right] m_i z_i$, the definition of cash-flow $v_i = z_i f_i - w l_i$, the MNE's global tax liability G_i in (36), and get

$$d\Omega^* = -\left(G_i - G_o\right) q_i g_i dq_i + \left(\pi_i^n + G_i\right) \left(\tau r_o s_i / A^n\right) \hat{\phi}_r + \tau c m_i z_i p x_i s_i \varepsilon_\phi \hat{\phi}_z. \qquad (40)$$

where the coefficient of $\hat{\phi}_z$ is proportional to the global increase in tax liability of a multinational, as shown after (36).

Again, the impact on global welfare is explained by the intensive and extensive responses in the business sector. The welfare effect on the extensive margin hinges on the fact that MNEs globally pay more tax than outsourcing firms, $G_i > G_o$ as shown in (36). The welfare effects on the intensive margins relate to transfer pricing and investment for component production in the South, and are given by the second and third terms above. Obviously, a pure redistribution of profits and tax payments between regions, and between firms and governments, must cancel out in a worldwide perspective.

Applying the ALP means $\hat{\phi}_z < 0$. The following results are qualitatively the same if the Northern government applies the ALP on royalty income, $\hat{\phi}_r < 0$. The tax penalty on MNEs raises q_i, meaning that it pushes a margin of firms from FDI into outsourcing. The reduced share of MNEs among all firms leads to a loss in global tax revenue and welfare since MNEs globally pay more tax compared to outsourcing firm. On the intensive margin, both policies reduce subsidiary investment in (25), either due to firms choosing a lower transfer price, or by reducing free cash-flow. Since subsidiary investment is finance constrained, a further reduction of investment leads to lower global pretax income which erodes the global tax base of MNEs and results in a net loss in worldwide tax revenue. Global welfare declines.

Proposition 8 *Imposing the ALP on transfer prices and royalty income of MNEs reduces global welfare.*

4 Conclusions

With the international fragmentation of production in a globalized world, collecting corporate tax from multinational firms has become a difficult task in high tax countries. Unlike national firms, multinational companies can minimize the global tax liability by shifting profits to low tax locations, leading to substantial revenue losses in high tax countries. One important channel for profit shifting is transfer pricing for intracompany trade. A parent company in a high tax country might overpay for components imported from lightly taxed foreign subsidiaries, thereby shifting profit from high to low tax countries. Following the OECD Model Tax Convention, the standard approach of tax authorities is to invoke the arm's length principle and assess the value of intracompany trade based on prices in comparable arm's length relationships. The implicit assumption is that these prices are the 'correct' ones since trade between independent firms is free from any profit shifting motive. The main argument of the present paper is, however, that arm's length prices might well introduce a wrong benchmark in assessing the tax liability of multinational firms. Multinational companies set transfer prices to efficiently coordinate production units in different countries. Transfer prices thus serve an important economic function and are not merely a tool for tax minimization.

The paper is unique in the literature in studying the implications of the arm's length principle in a model where firms can explicitly choose to trade with independent firms (outsourcing) or with wholly owned subsidiaries (foreign direct investment). In both cases, we start from the premise that firms 'in the North' choose to offshore production of components 'to the South' but may do so in alternative organizational forms. Component production requires capital and labor. Importantly, independent subcontractors and subsidiary companies need to raise external funds on top of own equity to finance investment. External funding is subject to finance constraints as emphasized in the corporate finance literature. To coordinate production, final goods producers offer contracts consisting of a component price and a royalty payment for the right to produce. These contracts, in turn, determine the firms' debt capacity for external financing. In this framework, multinationals find it easier to overcome finance constraints compared to local subcontracting firms. Multinationals can shift profits to a subsidiary by paying higher prices for components, thereby strengthening pledgeable income and facilitating external financing of the subsidiary. Furthermore, ownership means that the parent firm does not need royalties to extract profits since it can always get profits by means of repatriated dividends. In reducing free cash-flow, royalty payments again impair the subsidiary's debt capacity. For both reasons, multinational firms pay rather high transfer prices and set royalties to zero, instead collecting profits by dividend repatriation. The optimal outsourcing contract instead features lower component prices and higher royalties. Royalties are high because they are the only way to extract profits, and component prices are lower since the final goods producer has no interest in shifting profits to independent subcontractors. As a result, for purely economic reasons, and even in the absence of tax, optimal contracts specify higher component prices and lower (zero) royalty fees for trade within multinational firms compared to arm's length relationships.

In this situation, the arm's length principle imposes a flawed benchmark in the taxation of multinational firms. Forcing them to assess the value of intermediate imports at lower arm's length prices and to declare fictitious royalty income as observed in outsourcing relationships imposes a tax penalty on multinational firms. In our framework, the consequences are the following: (i) the tax penalty leads to lower transfer prices and less profit shifting; (ii) it reduces, in turn, external debt capacity and investment in the subsidiary; (iii) it pushes a margin of firms to choose outsourcing rather than foreign direct investment and thereby distorts the extensive margin of business organization; (iv) it strengthens tax revenue and raises national welfare in the North; (v) it strongly reduces tax revenue and welfare in the South; (vi) it leads to a world-wide welfare loss of first order magnitude. The last result is due to the fact that tax authorities, when observing arm's length prices, tend to misinterpret high transfer prices and low royalties as a result of tax induced profit shifting while, in fact, these choices reflect an efficient organization of worldwide production by multinational firms.

Appendix: The World Economy

North: We state Walras' Law to illustrate the market structure. Welfare is income minus effort cost. Therefore, the income related to surplus π_j is $\pi_j + cI_j$. Welfare in the North amounts to $\Omega^n = A + G^n + \pi_o^n s_o + \pi_i^n s_i - K_i$. In case of outsourcing, effort is expended in the South, so that π_o^n is actual income. The FDI mode yields global profit net of effort costs equal to π_i^n. Since managerial effort is incurred by the Northern innovator, actual profit is $\pi_i^n + cI_i$. Disposable income equal to consumption thus amounts to $C^n = \Omega^n + cI_i s_i$. Substituting the welfare expression, tax revenue G^n, and profits π_o^n and π_i^n eventually yields

$$\begin{aligned} C^n &= A - K_i + (\beta - z_o)\, p x_o s_o + (\beta - z_i)\, p x_i s_i + B, \qquad \text{(A.1)} \\ B &\equiv r_o s_o + r_i s_i + (\pi_i^s + cI_i)\, s_i. \end{aligned}$$

International factor income B consists of royalties and repatriated dividends. In equilibrium, $r_i = 0$. A simple rearrangement yields

$$Y^n = A + \beta\,(x_o s_o + x_i s_i)\, p + B = C^n + K_i + (z_o x_o s_o + z_i x_i s_i)\, p. \qquad \text{(A.2)}$$

National income Y^n consists of endowments, manufacturing output and net factor income B from abroad (royalties plus dividends), and is spent on private consumption C^n, aggregate start-up investment K_i, and intermediate imports due to offshoring.

South: Suppose that labor endowment in the South is L, and there is a mass one of entrepreneurs with initial wealth A per capita. A share $1 - s_o$ remains passive and simply consumes the endowment A. The other share s_o, equal to the number of firms in the North choosing outsourcing, enters the subcontracting business and earns end of period wealth $\pi_o + A$. Perfect competition reduces the surplus to zero, $\pi_o = 0$. Aggregate welfare is income minus effort cost, $\Omega^s = C^s - cI_o s_o$, giving

$$C^s = wL + A + G^s + (1 - \tau^s)\,[(v_o - i)\, pI_o - r_o]\, s_o. \qquad \text{(A.3)}$$

The last term reflects the break even condition $\pi_o = 0$ so that the monetary profit must just compensates for effort cost cI_o.

To obtain the income identity in the South, substitute G^s, use B to eliminate $r_o s_o$, insert the definition of π_i^s and finally use the cash-flow per firm, $v_j I_j = z_j x_j - w l_j I_j$:

$$\begin{aligned} Y^s &= A + (z_o x_o s_o + z_i x_i s_i)\, p + w\,[L - (l_o I_o s_o + l_i I_i s_i)\, p] - B \qquad \text{(A.4)} \\ &= C^s + (1-p)\,(I_o s_o + I_i s_i)\,. \end{aligned}$$

GNP is spent on private consumption plus depreciated (failed) expansion investment of foreign owned subsidiaries and local subcontractors. All start-up investment is incurred in the North. GNP consists of (i) output of the entrepreneurial sector consisting of initial assets and the value of component production, plus (ii) output of a Ricardian sector which absorbs all labor not used in component manufacturing (the square bracket), minus (iii) factor payments B to the North (royalties and repatriated dividends).

Finally, we add up (A.2) and (A.4) to obtain world output market equilibrium:

$$2A + \beta\,(x_o s_o + x_i s_i)\, p + w\,[L - (l_o I_o s_o + l_i I_i s_i)\, p] = C^n + C^s + K_i + (1-p)\,(I_o s_o + I_i s_i)\,.$$

Northern imports, $(z_o x_o s_o + z_i x_i s_i)\, p$, cancel with Southern exports, as do capital income flows B. Aggregate world output of the homogeneous good equals world endowments $2A$, plus the aggregate final output of the industrial sector in the North, plus output of the Ricardian sector in the South. World demand is for consumption and for aggregate net investment (start-up in North, plus depreciated expansion investment in the South).

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