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Foreign Direct Investment, Endogenous Tariffs, and Preferential Trade Agreements*

Emily J. Blanchard

Abstract

This paper examines the complementarity between international trade and investment policies, and argues that preferential trade agreements may be a particularly effective means for harnessing the tariff liberalizing potential of foreign direct investment. A simple two country model demonstrates that export-platform foreign investment induces unilateral tariff liberalization by the investment-source country, suggesting that international capital mobility may substitute partially for multilateral forums such as the WTO in achieving efficient tariffs. A multi-country extension of the model in which countries can compete for foreign investors via subsidies then develops an efficiency argument in favor of discriminatory tariff allowances such as Article XXIV of the GATT or the Generalized System of Preferences. When small countries can earn preferential tariff treatment from a large trading counterpart by encouraging local export-platform investment (or by discouraging import competing investment), the equilibrium tariff level will be lower when discriminatory tariffs are possible rather than when they are not.

KEYWORDS: FDI, MFN, preferential trade agreements, optimal tariffs

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1 Overview

This paper argues that preferential trading arrangements may arise as an endogenous response to outward foreign investment; to the extent that a country's nationals hold a substantial interest in a trading partner's export sector, their government will be inclined to offer special treatment to those imports. Although this idea is intuitive, current research largely overlooks the role of overseas investments in determining tariff policies. Though several literatures investigate the effect of inbound foreign investment on the host government's policy choices, relatively little attention has been afforded to the policy implications of outward capital flows. This omission is particularly puzzling given the historical and contemporary evidence suggesting a close link between tariffs and outward foreign investment.

With the rise of large scale international trade in the 17th century, European powers, notably Britain and France, developed systems of colonial preferences to manage commerce within their empires. Curiously, the prevailing mercantilist dogma that discouraged imports did not always extend to trade with colonies. Colonial exports to the mother country were often exempt from the high tariffs imposed on goods from outside the empire. It seems that many trade policies were designed as much to determine the source of imports as to regulate the overall volume and balance of trade.

The British Acts of Trade (1651-1696) created a series of regulations that severely limited trade between British colonies and non-members of Imperial Britain. Though many provisions were designed simply to extract rent from colonists or to exclude Dutch merchant ships from colonial ports, a few others point to ulterior motives. A particularly suggestive example is tobacco; Britain offered preferential tariff treatment for tobacco imports from her American colonies while banning domestic production and levying nearly prohibitive duties on Spanish tobacco. This peculiar policy seems to have served little purpose but to enrich southeastern Atlantic tobacco plantations, which were effectively given monopoly rights in Britain. It seems more than coincidence that southern tobacco planters were primarily British residents or loyalists, many with close ties to the crown.[1]

This paper develops a model which suggests that imperial commercial interests overseas may have been partly responsible for colonial trade preferences, and thus that it should come as no surprise that London granted

[1]Royalist ties were not subtle; in the years following his ascension to the British throne in the 1660, King Charles II gave "nearly all" of the soil of Virginia to two court favorites, the Earl of Arlington and Lord Culpeper (Elson (1917), p.70).

colonial exporters preferential access to British consumers when the profits of those exports accrued primarily to British enterprises such as those in American tobacco, British West Indian sugar, and Indian textiles shipped by the British East India Company. The findings extend well beyond historical application. Current preferential tariff agreements, whether an outgrowth of colonial legacy[2] or more recent initiatives for regional integration, may be understood as an endogenous and reenforcing response to international capital flows. Indeed, the model suggests that the recent "offshoring" phenomenon, whereby vertically integrated multinational firms (e.g. Nike, Dell, Apple Computers, etc.) establish overseas manufacturing operations in low wage countries to produce goods for reexport, will afford additional momentum to bilateral trade negotiations between multinationals' production and headquarters countries.[3]

The first half of this paper presents a two country general equilibrium model with simultaneously and endogenously determined tariffs and international capital flows. The model demonstrates that when part of the foreign export sector is held by its own constituents, a government has less incentive to shift costs onto foreign exporters via an import tariff. As a consequence, export-platform investment (*FDI*, for short)[4] induces the investment-source country to liberalize its tariffs unilaterally. This result is reminiscent of the well known finding by Mundell (1957) that free movement in goods can substitute for free movement in factors; this model shows that free movement in factors can induce free movement in goods via endogenous trade policy. This

[2]For example, the Lomé Conventions (1975-1990) provide special access to European markets for African-Caribbean-Pacific (ACP) countries which are former colonies of European Economic Community (EEC) members. The precursor to Lomé, the Yaounde Conventions (1963, 1967), were made legal by the "Enabling Clause" (1968) of the General Agreement on Tariffs and Trade (GATT), which preserved and expanded pre-existing colonial preference systems under the Generalized Systems of Preferences (GSP). See Trebilcock and Howse (1995) chapter 12.

[3]Savvy readers may note that many multinationals' offshore production is sourced from arms-length foreign affiliates. The model will demonstrate, however, that the FDI-tariff mechanism depends only on the sensitivity of the multinational companies' profits to changes in the world price of goods produced abroad, but in no other way on the specific contractual relationship between the multinational and its production facility.

[4]A note on terminology: *FDI* is used as notational shorthand for "foreign investment" (for the analysis in this paper, investment need not be "direct" in the sense that operational control is maintained by the investor). The term *export-platform* investment is used in this paper to refer to all investment in the local export-oriented sector, regardless of the final destination of the exported production; this definition is consistent with Ekholm, Forslid, and Markusen (2007) who use "third country EP" to refer to investment undertaken to access third markets.

phenomenon, coined the *FDI-terms of trade effect* (FDI-TOT), provides a market access benefit to investment-host countries from attracting investors from abroad. In addition to conventionally cited gains from capital accumulation, technology transfer, employment, and economic growth, local export-platform investment by foreigners can reduce the overseas tariff barriers faced by an investment-host country's export sector. At the same time, the model demonstrates that import competing investment exacerbates a large investment-source country's terms of trade cost-shifting motive. Tariff-jumping investment therefore may prove detrimental to the investment-host country's terms of trade, providing a potential explanation for why some countries seem reticent to allow foreign investment in import competing (particularly service sector) industries.

The tariff liberalizing potential of export-platform investment carries the implication that opening capital markets may substitute, at least partially, for negotiated tariff liberalization in achieving efficient tariffs. As countries become increasingly invested in export-oriented sectors overseas, their optimal unilateral import tariffs decline. Thus, though multilateral tariff reductions achieved under forums such as the World Trade Organization (WTO) are still a first best solution if negotiations are costless, freeing international capital flows may serve as a passable substitute if reaching consensus is costly. Indeed, it is theoretically possible that sufficiently large vertical FDI stocks relative to trade flows could push unilateral tariffs all the way to internationally efficient levels (or even lower), such that the role of a multilateral agreement in facilitating reciprocal reduction of trade barriers through negotiation could be eliminated (or even reversed). Yet it is equally clear that the same cycle could work in reverse: higher levels of import competing investment leading to higher tariffs, which in turn increase further the level of import competing FDI. Either way, the clear implication is that the increasing importance of investment relative to trade during the last several decades could alter significantly the role of the WTO in the world trading system and the design features that best allow it to serve this role.[5]

The second half of the paper shifts to a multi-country version of the model to explore the implications of the FDI-terms of trade effect for preferential tariff arrangements. In the expanded version of the model, small investment-seeking countries use investment subsidies (or taxes) to compete for (or discourage) foreign investment, which may influence their market access to the investing country via the FDI-TOT effect. Two versions of a tariff-subsidy game are

[5] See Bagwell and Staiger (1999) (2002) for the fundamental economic theory of the GATT/WTO.

compared, one in which the investment-source country is required to set a single tariff against every country (for instance because of the Most Favored Nation (MFN) principle of non-discrimination), and a second in which the investment-source country is free to set discriminatory tariffs.

When the investment-source country is restricted to a non-discriminatory tariff, small investment-receiving countries are powerless to influence the MFN tariff unilaterally. Hence the optimal investment policy of every investment--host country is one of non-intervention, regardless of the sectoral orientation of local FDI. Introducing the possibility of discriminatory tariffs via a Generalized System of Preferences (GSP) or Article XXIV-style exemption to MFN changes the result markedly. When small countries can earn preferential tariff treatment, their optimal policy is to subsidize foreign investment in the local export sector, and to tax investment in the local import competing sector. The equilibrium tariff level is therefore lower, and the aggregate level of export-platform (import competing) investment higher (lower) when discriminatory tariffs are possible than when they are not. This result obtains even in a symmetric equilibrium, which by definition needs not invoke an MFN exemption.

A short final section of the paper offers anecdotal evidence in support of the paper's theoretical findings. Although formal econometric testing of the model lies outside the scope of this paper, several case studies and a simple back of the envelope exercise suggest the practical plausibility and potential economic relevance of pecuniary channels linking the pattern of international investment and the structure of preferential tariff agreements.

The paper's theoretical findings complement a body of recent work in the trade literature. First, in focusing on foreign investment as a critical element in policy formation, the paper follows Ethier (1998) who argues that regionalism, essentially a system of preferential trading arrangements, is perhaps better understood as an endogenous response to international economic integration than as a cause. But while Ethier's model focuses on the role of foreign investment as a signal of "reform" under domestic political pressure, the focus here is on the effect of FDI on the investing country's optimal tariff structure.

This paper's initial result, that by encouraging FDI in its local export sector a country can induce its trading partner (the investment-source country) to liberalize unilaterally, is a variant of Krishna and Mitra (2005). In their paper, unilateral tariff liberalization by a large country can induce that country's trading counterpart to reduce its tariffs in return. When a large country decreases its tariff, its foreign trading partner's terms of trade improve, which increases the benefit to foreign exporters from forming a political lobby. The foreign export lobby then pressures the foreign government to reduce its import tariffs "reciprocally." This model arrives at a similar result through a different mechanism. Here even a small country can induce a large trading counterpart to reduce its tariffs (unilaterally and preferentially) by liberalizing its local investment policies.[6] And whereas Krishna and Mitra's model focuses on the role of special interest groups in liberalizing tariffs, the results here obtain in the presence of national income maximizing governments (though as observed later in the paper, the results also would apply generally to models with politically motivated governments). Thus, this paper offers a mechanically different but qualitatively complementary argument to Krishna and Mitra's, that unilateral liberalization may be reciprocated endogenously, that reform begets reform, and thus that there are reenforcing cycles in global economic integration.

The finding that export-platform investment may reduce the potential role for negotiated trade liberalization in achieving efficient tariff regimes parallels Devereux and Lee (1999). Devereux and Lee reach a similar conclusion using a parameterized two country model of optimal financial risk sharing. They show that if tariffs are determined optimally by national income maximizing governments, free trade is an equilibrium of a Nash tariff game between governments when international financial markets are fully diversified. Intuitively, they argue that complete international equity integration breaks the link between a country's terms of trade and its welfare, so that free trade can be a unilaterally optimal tariff policy for both governments. Notably, the Devereux and Lee framework does not permit consideration of import competing investment, and so cannot address the role of the trade-orientation of investment as emphasized here.

The policy game put forward in Section 3 is reminiscent of Goh and Olivier (2002), who examine the potential complementarity between trade liberalization and patent protection in a multilateral setting. Although Goh and Olivier's model is quite different (the authors develop a dynamic general equilibrium framework for evaluating the impact of tariffs and intellectual property rights protection on innovation), their focus on the potential strategic policy interactions between governments with multiple instruments is similar in spirit to the tariff-investment subsidy game developed here.

[6] Indeed, this paper's finding that small countries may influence their large trading partners' optimal tariff strategies is similar to Raimondos-Moller and Woodland (2000), who demonstrate that small countries may influence large countries' trade policies (and thus the terms of trade) by acting as Stackelberg leaders in a tariff setting game.

This paper's suggestion that discriminatory tariff exemptions from MFN may have efficiency implications is similar to that of Choi (1995). Contrary to this paper, however, Choi finds that MFN may improve competition and efficiency. In Choi's model, two foreign exporters, each from a different country, compete Cournot-style for market access into a third country. He shows that MFN solves a time-inconsistency problem by allowing the importing country to commit against introducing a competition-dampening discriminatory tariff regime in the future. Thus, an ex-ante commitment to MFN by the importing country can increase cost competition among the two foreigners, and thereby improve efficiency.

Finally, these results parallel earlier findings under models of tax competition. In studying the interplay between optimal tariffs and optimal tax policy, the first half of this paper is reminiscent of Kemp (1966) and Jones (1967), who first identified the relationship between the twin terms-of-trade for goods and investment movements using a "neo-Heckscher-Ohlin" approach to determine the optimal tariff structure.[7] The second half of this paper implies among other things, that competition among potential investment-host countries may yield welfare gains. This result is similar to Rogoff (1985), which demonstrates that non-cooperative tax policies among investment-seeking countries may provide efficiency gains by strengthening governments' ability to commit credibly not to overtax foreign capital.

The remainder of the paper consists of four sections. The next section develops a two-country two-good Ricardo-Viner general equilibrium model with endogenous foreign direct investment and examines the mechanism through which an outward flow of FDI influences the investing country's optimal tariff via the *FDI terms of trade effect*. Section 3 extends the analysis to a multi-country setting by dividing the single foreign country of Section 2 into an infinite number of identical countries that compete for FDI from the single large investor country via an investment subsidy. Comparing two policy environments, one in which the investing country's tariff policy is bound by the MFN principle and one in which it is not (e.g. under an Article XXIV exemption), reveals that the tariff-investment equilibrium prediction depends crucially on whether the MFN principle is imposed; specifically, the subgame perfect equilibrium tariff level will be lower when discriminatory tariffs are permitted. Section 4 offers a brief account of anecdotal evidence in support of the theory, and Section 5 concludes.

[7]Neither of these authors consider the potential implications of foreign investment for preferential trade agreements or the strategic use of investment subsidies, however, which are of course the primary thrust of this paper.

2 Foreign Investment and the Optimal Tariff

This section develops a two country model of endogenous tariff determination with atomistic capitalists who invest locally or abroad to maximize their returns. The model is kept as simple as possible by assuming that governments are apolitical national income maximizers, and that only the investing country may impose a tariff. Introducing political economy to the model would make an interesting and relatively straightforward extension, but the arguments presented in this paper are, I believe, more compelling under the assumption of apolitical governments. The asymmetry of the policy instruments is not ideal, but offers a considerably simpler framework for analysis. Moreover, the tariff-availability assumption is justified in the multi-country version of the model in Section 3 since the small investment-host countries would optimally elect not to use a positive tariff in equilibrium.

The model is tailored to address the increasingly prevalent offshoring-type FDI that comprises much of the firm level investment from industrialized to developing countries; investment can flow in only one direction in one sector in equilibrium. As such, the model is more appropriate for analysis of vertical FDI flows to developing countries than for investment among OECD countries, which is predominantly the horizontal tariff-jumping variety. The analysis focuses on the benchmark case of export-platform investment, but comparison results for the case of import competing FDI are offered briefly at the end of each section.[8] For a generalized study of the interaction between international investment and bilateral trade negotiations in which both countries set tariffs simultaneously and foreign investment may exist in any sector and any direction, see the companion paper to this one, Blanchard (2006).

2.1 Model Preliminaries

The model builds on a standard two-good three-factor general equilibrium framework. Two countries with identical and homothetic preferences, *Home* and *Foreign*, produce and trade two goods, x and y, with internationally identical constant returns to scale technologies. Each production technology employs a common factor of production – labor (L) – and a specific factor of production – capital (K) for x and land (T) for y.[9] The wage to labor is set

[8] The parallel results for the case of import competing investment are sufficiently straightforward given the symmetry of the model that they are not derived explicitly in this paper. Details are available by request to the author.

[9] This Ricardo-Viner framework eliminates the indeterminacy of goods and factor movements found by Mundell (1957) and avoids the less interesting production specialization

competitively by factor markets and each specific factor is paid its sector's residual profit. Capital is internationally mobile but land and labor are not.

International investment (FDI) takes the form of physical capital flows, and is therefore new (or "greenfield") investment rather than the acquisition of existing assets by overseas interests. I assume, critically, that the natural flow of capital is from Home's import sector to the Foreign export sector. This requires that in capital and goods market autarky (i) the return to capital is less in Home than in Foreign, and (ii) the price of x relative to y is higher in Home than in Foreign. There are a number of scenarios under which this might arise; I adopt a case in which Home and Foreign are initially endowed with equal quantities of capital and land but Foreign has a greater endowment of labor. By then assuming technologies are such that in capital market autarky Foreign has a comparative advantage in good x, I ensure that Home's natural import good is x and the natural (and globally income maximizing) flow of capital is from Home's import sector to the Foreign export sector.[10] The aggregate level of Home to Foreign FDI is denoted by $\hat{K}$. Using an asterisk (*) to denote Foreign variables, and given initial factor endowments $\bar{K}$ and $\bar{K}^*$, the levels of capital available for x production at Home and abroad are then $K = \bar{K} - \hat{K}$ and $K^* = \bar{K}^* + \hat{K}$, respectively. Note that FDI cannot be greater than Home's total capital endowment so that $\hat{K} \in [0, \bar{K}]$.

Good y acts as numeraire, such that $p \equiv \frac{p_x}{p_y}$ ($p^* \equiv \frac{p_x^*}{p_y^*}$) represents the Home (Foreign) local price ratio. Since Home's natural import good is x, the world price ratio is $p^w \equiv \frac{p_x^*}{p_y}$ and the Home (Foreign) terms of trade is $\frac{1}{p^w}$ (p^w). Let t denote Home's ad-valorem tariff on good x and define $\tau \equiv (1 + t)$. Home's domestic price ratio then may be written as a function of the world price and the tariff, $p(\tau, p^w) \equiv \tau p^w$. Since the Foreign tariff is not central to the analysis, I set it to zero.[11] This assumption simplifies the model considerably, since the foreign local price is then simply the world price, i.e. $p^* = p^w$.

outcomes that follow from Heckscher-Ohlin models with greater factor movement dimensionality. See Neary (1995) for an articulate explanation of the model's merits in this context.

[10]Formally, a sufficient condition is that the slope of the Rybczynski schedule for labor is less than 1, so that along any ray from the origin the Foreign production possibilities frontier is flatter than Home's (assuming x on the horizontal axis); See Wong (1995) pp. 54-59.

[11]The assumption that Foreign practices free trade is vindicated later in the paper by assuming that Foreign is composed of an infinite number of identical independent countries, since then each foreign country's optimal tariff is zero. The concerned reader can verify easily that the analysis in this section is identical under the many symmetric small foreign country framework.

Assuming that tariff revenue is redistributed to Home residents, Home's income measured in units of good y, $I \equiv I(p, p^w; \hat{K})$, is given implicitly by:[12]

$$I = pq_x(p, \hat{K}) + q_y(p, \hat{K}) + r^*(p^w, \hat{K})\hat{K} + (p - p^w)[d_x(p, I) - q_x(p, \hat{K})], \quad (2.1)$$

where $q_x(p, \hat{K})$ $(q_y(p, \hat{K}))$ is the output of good $x(y)$ as a function of the local price and the FDI level, $r^* \equiv r^*(p^w, \hat{K})$ is the per-unit return to capital in Foreign measured in units of good y so that $r^*\hat{K}$ is the value of FDI remittances from Foreign to Home, and $d_x(p, I)$ is domestic quantity demand for good x as a function of the local price and income. Notice that Home income describes gross national product (GNP) rather than gross domestic product (GDP), since it includes remittances from investments abroad.

It proves useful later in the paper to have a ready definition of Home tariff revenue. Measured in units of good y, this is given by:

$$R(p, p^w; \hat{K}) \equiv (p - p^w)[d_x(p, I(p, p^w; \hat{K})) - q_x(p, \hat{K})]. \quad (2.2)$$

Home imports of x are given by $M_x(p, p^w; \hat{K}) \equiv d_x(p, I(p, p^w; \hat{K})) - q_x(p, \hat{K})$ and Home exports of y by $E_y(p, p^w; \hat{K}) \equiv q_y(p, \hat{K}) - d_y(p, I(p, p^w; \hat{K}))$. Similarly, Foreign exports of x are $E_x^*(p^w; \hat{K}) \equiv q_x^*(p^w, \hat{K}) - d_x^*(p^w, I^*(p^w; \hat{K}))$ and Foreign imports of y are $M_y^*(p^w; \hat{K}) \equiv d_y^*(p^w, I^*(p^w; \hat{K})) - q_y^*(p^w, \hat{K})$, where Foreign income is defined $I^*(p^w; \hat{K}) = p^w q_x^*(p^w, \hat{K}) + q_y^*(p^w, \hat{K}) - r^*(p^w, \hat{K})\hat{K}$. Both countries are assumed to satisfy their balance of payments conditions:

$$p^w M_x(p, p^w; \hat{K}) = E_y(p, p^w; \hat{K}) + r^*(p^w, \hat{K})\hat{K} \quad (2.3)$$

$$M_y^*(p^w; \hat{K}) = p^w E_x^*(p^w; \hat{K}) - r^*(p^w, \hat{K})\hat{K}. \quad (2.4)$$

Global market clearing determines implicitly the market clearing world price, $\tilde{p}^w$, according to:

$$E_x^*(\tilde{p}^w; \hat{K}) = M_x(p(\tau, \tilde{p}^w), \tilde{p}^w; \hat{K}). \quad (2.5)$$

By Walras' law the market for y must also clear if the preceding holds and countries obey their budget constraints, (2.3) and (2.4). Note from (2.5) that the market clearing world price depends on both the tariff and the FDI level;

[12] The assumption that Foreign sets no tariff is notationally helpful here; otherwise Home's income would also be a function of the foreign local price via the returns to overseas investments.

i.e. $\tilde{p}^w \equiv \tilde{p}^w(\tau, \hat{K})$. Finally, I assume that the Metzler and Lerner paradoxes are absent such that:[13]

$$\frac{\partial \tilde{p}^w(\tau, \hat{K})}{\partial \tau} < 0 < \frac{dp(\tau, \tilde{p}^w(\tau, \hat{K}))}{d\tau}. \tag{2.6}$$

2.2 The Optimal Tariff as a Function of FDI

The Home government chooses its tariff to maximize the indirect utility of a representative home-country consumer, where indirect utility, $v(\cdot)$, is a function of the domestic price at which goods may be purchased and income, itself a function of domestic and world prices and FDI. I assume that the Home country cannot commit to a tariff regime before investment decisions are made, so that Home's optimal tariff is determined non-strategically taking $\hat{K}$ as fixed.[14] The Home government chooses the tariff according to:

$$\tau^R(\hat{K}) = \arg\max_{\tau} \quad V(p, \tilde{p}^w; \hat{K}) \tag{2.7}$$

where,

$$V(p, \tilde{p}^w; \hat{K}) \equiv v(p(\tau, \tilde{p}^w), I(p(\tau, \tilde{p}^w), \tilde{p}^w; \hat{K})) \tag{2.8}$$

and income is given by (2.1).[15]

One way of writing the associated first order condition of the government's maximization problem in (2.7) is particularly helpful for understanding how FDI affects the optimal tariff. Paralleling the characterization of the optimal tariff problem by Bagwell and Staiger (1999), the first order condition for (2.7) may be expressed as:

$$V_\tau = V_p + \lambda V_{\tilde{p}^w} = 0, \tag{2.9}$$

where $\lambda \equiv \frac{\frac{\partial \tilde{p}^w}{\partial \tau}}{\frac{dp}{d\tau}} < 0$ by (2.6) and subscripts on $V(\cdot)$ denote partial derivatives. Bagwell and Staiger argue that written this way, the Home government's terms of trade cost-shifting motive is captured completely by $V_{\tilde{p}^w}$. In a standard (no FDI) model with national income maximizing governments, $V_{\tilde{p}^w}$ is less than

[13]In this specific factors framework with international capital movements, the conditions under which the Metzler and Lerner paradoxes can occur must be modified to incorporate the potential income effects that travel through $\hat{K}$. Neary (1995) formally characterizes the necessary and sufficient conditions for each paradox in footnote 18, page S19.

[14]Changing the timing to a Stackelberg game in which the government commits to a tariff regime before capitalists make their investment decisions introduces several interesting additional aspects that merit independent attention in another paper.

[15]Note that Home's objective function is defined for any $\hat{K}$, which implies, importantly, that the capital market clearing condition (defined in Section 2.3) is not imposed on $\tau^R(\cdot)$.

zero, reflecting that Home's welfare improves from a marginal increase in its terms of trade, holding the local price fixed.[16] Since the product of λ and $V_{\tilde{p}^w}$ is positive, V_p must be negative at the optimal Home tariff to satisfy the first order condition. This yields the familiar result that a large country's national income maximizing tariff is strictly positive.[17]

It is trivial to confirm that the same result obtains under this model when $\hat{K}$ is set to zero, since of course the model then collapses to the standard (no-FDI) framework. In capital market autarky this model yields:

$$V_{\tilde{p}^w}(p, \tilde{p}^w; \hat{K} = 0) \;\; = \;\; v_I \frac{\partial R(p, \tilde{p}^w)}{\partial p^w} < 0, \tag{2.10}$$

since $v_I \equiv \frac{\partial v(p,I)}{\partial I} > 0$ and goods are normal under the assumption of homothetic preferences so that Home tariff revenue is decreasing in p^w. In the absence of FDI, then, $V_{\tilde{p}^w} < 0$ and Home's optimal tariff follows the standard Johnson (1951-52) cost-shifting rule $\tau^R(\hat{K} = 0) = 1 + \frac{1}{\epsilon_x^*}$, where $\epsilon_x^* \equiv \frac{dE_x^*}{dp^w}\frac{p^w}{E_x^*} > 0$ is Foreign export supply elasticity.[18]

Allowing transnational asset ownership via FDI changes the components of $V_{\tilde{p}^w}$ relative to standard (no-FDI) trade models. When Home constituents hold an interest in the Foreign export sector, a decline in the world price causes Home's overseas investors to suffer alongside their Foreign counterparts. The sign of $V_{\tilde{p}^w}$ therefore depends on the magnitude of $\hat{K}$:

$$V_{\tilde{p}^w}(p, \tilde{p}^w; \hat{K}) = v_I \Bigg\{ \underbrace{\overset{(-)}{\frac{\partial R(p, \tilde{p}^w)}{\partial p^w}}}_{\text{TOT Motive}} + \underbrace{\overset{(+)}{\frac{\partial r^*(\tilde{p}^w, \hat{K})}{\partial p^w}\hat{K}}}_{\text{FDI Effect}} \Bigg\}. \tag{2.11}$$

That is, holding its local price fixed, Home benefits from a terms of trade improvement only if the implied increase in tariff revenue outweighs the losses incurred by its foreign investors. In the presence of FDI, therefore, the national income maximizing tariff is not necessarily positive. Indeed, there could be some levels of FDI that eliminate- or even reverse- Home's terms of trade

[16] Indeed, Bagwell and Staiger (1999,2002) argue that a large country's welfare improves with its terms of trade for virtually any political economy model, though none incorporates international investment.

[17] See Bagwell and Staiger (2002), p.18 footnote 3, for the proof that $V_p < 0$ implies $\tau > 1$.

[18] $V_\tau(\hat{K} = 0) = \left[v_p + v_I \frac{\partial I(p, \tilde{p}^w)}{\partial p}\right]\frac{dp}{d\tau} + v_I \frac{\partial I(p,\tilde{p}^w)}{\partial p^w}\frac{\partial \tilde{p}^w}{\partial \tau} = v_I \Big\{ \Big[-d_x + q_x + M_x + t\tilde{p}^w \frac{\partial M_x(p,p^w)}{\partial p}\Big] \frac{dp}{d\tau} + \Big[-M_x + t\tilde{p}^w \frac{\partial M_x(p,p^w)}{\partial p^w}\Big]\frac{\partial p^w}{\partial \tau}\Big\}$ by Roy's identity and the envelope theorem. Thus, $V_\tau = v_I(E_x^* \cdot (t\epsilon_x^* - 1)) = 0 \rightarrow t^R = \frac{1}{\epsilon_x^*}$.

cost-shifting motive. Setting $V_{\tilde{p}^w} \geq 0$ from (2.11) and evaluating at free trade reveals that Home's terms of trade motive to set a positive tariff is fully offset when FDI profit to changes in the world price is sufficiently large relative to the volume of trade:

$$\frac{\partial \pi_x^*}{\partial p^w}\frac{\hat{K}}{K^*} \geq M_x, \tag{2.12}$$

where $\pi_x^* \equiv r^* K^*$ is the standard Ricardo-Viner residual profit in sector x measured in units of good y.[19]

At equality (2.12) implicitly defines $\hat{K}^{ft}$, a level of FDI that exactly eliminates Home's motive to manipulate the terms of trade.[20] Since a deterioration of Foreign export sector profit following a decline in the world price, $\frac{\partial \pi_x^*}{\partial p^w}$, is typically shared by both capitalists and laborers, it proves useful to expand (2.12) using Hotelling's lemma. $\hat{K}^{ft}$ then may be expressed implicitly as the solution to:

$$\left[q_x^* - \frac{dw^*}{dp^w}L_x^*\right]\frac{\hat{K}^{ft}}{K^*} = M_x\bigg|_{\tau=1}, \tag{2.13}$$

where $\frac{dw^*}{dp^w} \in [0, \frac{w^*}{p^w}]$ is the change in the Foreign wage to labor that follows a marginal change in the world price. To better understand the free trade condition in (2.13), consider the following two boundary scenarios. First suppose that a decline in the world price is suffered entirely by capitalists so that $\frac{dw^*}{dp^w} = 0$. In this case, Home's terms of trade cost-shifting motive is eliminated (or reversed) when its share of Foreign export sector *revenue* is equal to (or greater than) the value of its imports of x (i.e. when $\tilde{p}^w q_x^* \frac{\hat{K}}{K^*} \geq \tilde{p}^w M_x$). Conversely, in the opposite extreme in which a decline in the world price is suffered entirely by laborers so that $\frac{dw^*}{dp^w} = \frac{w^*}{p^w}$, the condition in (2.13) implies that $V_{\tilde{p}^w} \geq 0$ when Home's foreign export sector *profit* is weakly greater than the value of its imports (i.e. $r^*\hat{K} \geq \tilde{p}^w M_x$). Notice that this second condition is sufficient (but not necessary) for the general condition in (2.12) to hold, since $r^*\hat{K}$ is the smallest possible value of $\tilde{p}^w \frac{\partial \pi_x^*}{\partial p^w}$.

A sufficient condition to ensure that a free trade inducing FDI level is *feasible* (i.e. $\hat{K}^{ft}$ is less than Home's initial endowment of capital, $\bar{K}$) is that there exists some $\hat{K}^s \leq \bar{K}$ such that $r^*\hat{K}^s = \tilde{p}^w M_x$ evaluated at free trade. That is, $\hat{K}^{ft}$ is feasible if *the potential FDI income to trade ratio* is sufficiently large. The balanced budget condition in (2.3) provides a formalization of this

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[19] $\frac{R(p,\tilde{p}^w)}{\partial p^w}|_{\tau=1} = -M_x$, and $\frac{\partial r^*(\tilde{p}^w,\hat{K})}{\partial p^w} = \frac{\partial \pi_x^*}{\partial p^w}\frac{1}{K^*}$ where $\pi_x^* \equiv r^*K^* = p^w q_x^* - w^* L_x^*$, w^* is the Foreign wage to labor, and L_x^* is the labor employed in the Foreign x sector.

[20] $V_{\tilde{p}^w}|_{\tau=1} = 0$ implies that free trade is optimal, since $V_p = t\tilde{p}^w \frac{\partial M_x(p^w,p)}{\partial p} = 0 \rightarrow \tau^R = 1$.

statement; assuming that Home spends all of its income, it must be true at free trade that $E_y(p(\tau = 1, \tilde{p}^w), \tilde{p}^w; \hat{K}^s) = 0$ so that Home is in effect exporting only capital. Figure 1 demonstrates that $\hat{K}^s$ is implicitly defined by a value of FDI remittances ($r^*\hat{K}^s$) that allows Home to consume just far enough outside its local production possibilities frontier that $E_y(p(\tau = 1, \tilde{p}^w), \tilde{p}^w; \hat{K}^s) = 0$ given the implied market clearing world price $\tilde{p}^w(\tau = 1, \hat{K}^s)$.

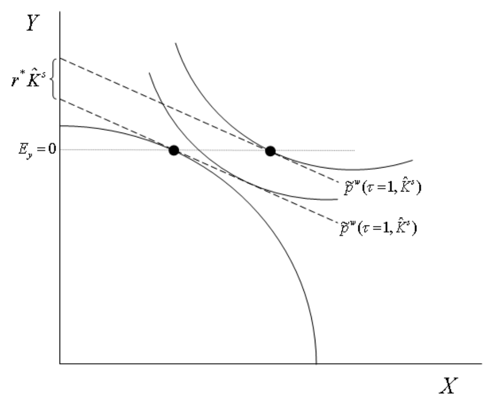

Figure 1: A Graphical Interpretation of $\hat{K}^s$.

The figure illustrates that $\hat{K}^s$ approaches zero as the underlying no-FDI/free trade volume $E_y(p(1, \tilde{p}^w), \tilde{p}^w; \hat{K} = 0)$ approaches zero; thus, if the "potential trade" (for $\tau = 1, \hat{K} = 0$) is sufficiently small, $\hat{K}^s < \bar{K}$ (and hence $\hat{K}^{ft} < \bar{K}$) is certain to exist. It is equally clear that $\hat{K}^s < \bar{K}$ will exist if $r^*(\tilde{p}^w, \bar{K})\bar{K}$ is big enough – that is, if the "potential FDI income" is sufficiently large. Combining these two observations yields the statement that $\hat{K}^{ft}$ is feasible provided that the potential FDI income to trade ratio is sufficiently large. Hereafter I assume this to hold, so that $\hat{K}^{ft} < \bar{K}$ exists.

Together the observations that $\tau^R(\hat{K} = 0) > 1$ and $\tau^R(\hat{K}^{ft} > 0) = 1$ imply that the Home country's optimal import tariff is a decreasing function of its export-platform investment over at least some regions of $\hat{K} \in [0, \bar{K}]$. Solving for the general characterization of the optimal tariff function formalizes this. From the first order condition in (2.9), the implicit solution to the Home government's optimal tariff problem is given by:

$$\tau^R(\hat{K}) = 1 + \frac{1}{\epsilon_x^*}\left(1 - \underbrace{r_{p^w}^* \frac{\hat{K}}{E_x^*}}_{\text{FDI-TOT}}\right), \tag{2.14}$$

where $r_{p^w}^* \equiv \frac{\partial r^*(\tilde{p}^w,\hat{K})}{\partial p^w} > 0$. The *FDI terms-of-trade effect* labeled above captures the erosion of Home's motive to manipulate its terms of trade when its constituents hold equity interests in the Foreign export sector. Just as implied by (2.10) and (2.11), (2.14) confirms that $\tau^R(\hat{K} = 0) = 1 + \frac{1}{\epsilon_x^*}$, $\tau^R(\hat{K}^{ft}) = 1$, and more generally the degree to which the standard cost-shifting tariff $\left(\frac{1}{\epsilon_x^*}\right)$ is influenced by export-platform foreign investment depends on the sensitivity of FDI profits to changes in the export price relative to the volume of trade.[21]

It is clear from (2.14) that Home's optimal tariff depends on the level of FDI both directly via Home's "internalization" of part of the losses to foreign export sector profit, and indirectly through the response of the return to capital, the trade volume, and the foreign export supply elasticity to international capital flows. The optimal tariff function is monotonically decreasing in $\hat{K}$ as long as the direct effect of FDI – how $\hat{K}$ enters (2.14) explicitly – everywhere outweighs any indirect effects of FDI (which are ambiguous in sign) – how a change in $\hat{K}$ affects $r_{p^w}^*$, E_x^*, and ϵ_x^*.[22] For the remainder of the paper, I assume this to be the case. (The formal condition is derived in the first appendix.)

An intriguing implication of the FDI-TOT effect is that a country can induce its trading partner to reduce its import tariffs unilaterally by welcoming export-platform investment from overseas. This tariff liberalizing effect of FDI provides an additional benefit of attracting foreign investment above and beyond conventionally cited potential gains from capital accumulation, technology transfer, employment, and economic growth. This suggests a potential role for strategic government subsidies to encourage local export-platform investment, which is developed formally in Section 3.

[21]Note that since the FDI-TOT effect operates via the effect of the world price on overseas investment profits, the final destination of the (export sector) goods produced by FDI is irrelevant. This observation is useful for empirical testing, since it implies that to test for the FDI-TOT effect one does not need to know the markets into which foreign affiliates sell their products.

[22]A change in FDI causes a shift in (rather than just movement along) the Home and Foreign offer curves; standard simplifying assumptions such as the adoption of iso-elastic offer curves are therefore of little use in this context. The net effect of a change in FDI on the elasticities of the offer curves, import demand, and export supply therefore is generally ambiguous in both sign and magnitude unless specific parametric assumptions are imposed on the model.

Finally, although this paper's focus is offshoring-type export-platform investment, it is important to note that import competing FDI – for instance the tariff-jumping variety studied in the "quid-pro-quo" line of research – would only exacerbate Home's terms of trade cost-shifting motive.[23] This finding suggests that FDI receiving governments should temper high expectations of traditionally recognized benefits of import competing FDI with an awareness that such investments could reduce their exporters' market access overseas. Curiously, this potential adverse term of trade effect seems to justify the frequently observed policies that impose maximum foreign ownership regulations in import competing industries or discourage import-platform FDI via minimum export requirements. And indeed, to the extent that the GATT Trade-Related Investment Measures (TRIMS) ban such minimum export requirements the provisions may reduce (or even reverse) the tariff liberalizing effect of foreign investment. Notably, this potential reverse effect of import competing investment does not obtain in models with sectorally-balanced investment (for instance through portfolio diversification as in Devereux and Lee (1999)). For more complete analysis of the potential *composition effects* of sectoral bias in the pattern of international investment, see Blanchard (2006).

2.3 Endogenous FDI as a Function of the Tariff

Following Neary (1995), I assume that international investment follows a simple arbitrage condition. Atomistic capitalists invest abroad until the return to capital at Home, $r(\cdot)$, equals the return to capital overseas, $r^*(\cdot)$:

$$r(p(\tau,\tilde{p}^w(\tau,\hat{K})),\hat{K}) - r^*(\tilde{p}^w(\tau,\hat{K}),\hat{K}) = 0. \tag{2.15}$$

The return functions $r(\cdot)$ and $r^*(\cdot)$ are defined here as functions of FDI rather than the local capital stock. Since an increase in FDI depletes the Home capital stock and thus raises the local marginal product of capital: $r_{\hat{K}}(p,\hat{K}) > 0$, where subscripts denote partial derivatives.[24] By a parallel

[23] If FDI entered the Foreign y sector the optimal tariff would increase with FDI: i.e. Let $\hat{T} = \bar{T} - T = T^* - \bar{T}^*$, and $\hat{K} \equiv 0$. Then $\tau^R(\hat{T}) = 1 + \frac{1}{\epsilon_x^*}\left[1 - \frac{\partial \pi_y^*}{\partial p^w}\frac{\hat{T}}{T^*}\frac{1}{E_x^*}\right]$ where π_y^* is residual profit in Foreign sector y. The direct effect of FDI is to raise the optimal tariff, since $\frac{\partial \pi_y^*}{\partial p^w} = -\frac{\partial w^*}{\partial p^w}L_y^* < 0$ where L_y^* is the labor employed in Foreign sector y.

[24] Recall that the competitive rate of return is equal to the value marginal product of capital, and thus the increase in GDP caused by a marginal addition to the local capital stock: i.e. $r = g_K(p,K,L) \equiv \frac{\partial g(\cdot)}{\partial K}$ where $g(p,K,L,T) \equiv pq_x + q_y$ is GDP measured in units of good y. By concavity of the production function, $r_{\hat{K}}(p,\hat{K}) = r_K(p,\bar{K}-\hat{K})\frac{dK}{d\hat{K}} = -g_{KK} > 0$.

argument, the Foreign capital stock increases with FDI so that the Foreign marginal product of capital declines with $\hat{K}$: $r^*_{\hat{K}}(p^w, \hat{K}) < 0$. Because FDI is used in the production of x only, the return to capital increases with the local price in both countries, so that $r_p(p, \hat{K}) > 0, r^*_{p^w}(p^w, \hat{K}) > 0$.

Taking the total derivative of the arbitrage condition in (2.15) and rearranging yields the slope expression for the capital market clearing locus:[25]

$$\frac{d\hat{K}}{d\tau} = \frac{\left[r_p \frac{dp}{d\tau} - r^*_{p^w} \frac{\partial \tilde{p}^w}{\partial \tau}\right]}{-(r_{\hat{K}} - r^*_{\hat{K}}) - (\tau r_p - r^*_{p^w})\frac{\partial \tilde{p}^w}{\partial K}} < 0. \tag{2.16}$$

The expression in (2.16) indicates that higher Home tariffs discourage (export-platform) foreign direct investment in Foreign, while a liberal Home tariff regime would induce greater capital flows to Foreign.[26] Intuitively, raising the Home tariff increases the return to capital at Home via an increase in p and simultaneously decreases the return to capital abroad through the decline in $\tilde{p}^w$. Hence, an increase in the Home tariff, which causes p to rise relative to $\tilde{p}^w$, makes overseas investments relatively less attractive to capital owners, causing the FDI level to fall. The locus of FDI-tariff pairs that clear the capital market (labeled the KK locus) is therefore everywhere downward sloping as shown by the KK locus in Figure 2. Note that the free movement of goods and factors maximizes global income, since at a zero tariff the free movement of capital equalizes the marginal physical product of capital across countries. This world income maximizing level tariff-FDI pair, marked by $(\tau = 1, \hat{K}^o)$ in Figures 3a-c, provides a useful benchmark for efficiency throughout the paper.[27]

It is again worthwhile to consider briefly the alternative case of import competing investment. Since an increase in Home's tariff would cause the price of Foreign's import good to rise, and thereby increase the return to investment in the Foreign import competing sector, higher tariffs imposed by Home would lead to *greater* tariff jumping investment in Foreign and an upward sloping investment-market-clearing locus.

[25] See the second appendix for the proof that $\frac{d\hat{K}}{d\tau} < 0$.

[26] This finding is consistent with Proposition 3 (p. S19) of Neary (1995).

[27] Note that this is only one point on a locus of Pareto efficient tariff-FDI pairs in $(\tau, \hat{K})$ space. Focusing on global income maximization as the socially preferred outcome effectively assumes that there is some (unmodeled) lump sum transfer instrument available to governments.

2.4 The Equilibrium Tariff-FDI Pair

An equilibrium tariff-FDI pair is one for which the tariff is optimal given the FDI level and the capital market clears at the given tariff. Equilibrium may be characterized graphically as the intersection of the optimal tariff function $\tau^R(\hat{K})$ with the capital market clearing (KK) locus, as shown in Figure 2.

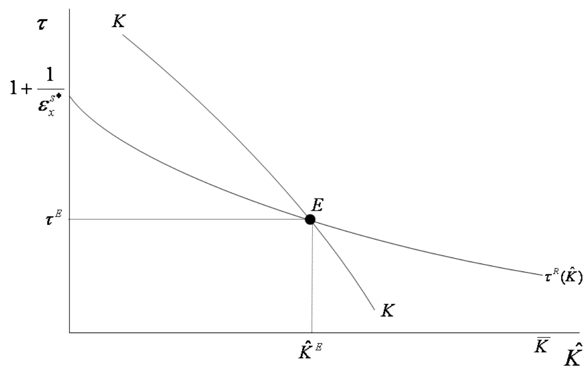

Figure 2: Tariff-FDI Equilibrium.

The requirement for a "nice" case (an unique, stable[28] equilibrium) is that the KK locus intersects Home's tariff reaction curve only once from above. The assumptions that make this possible include technical conditions on the foreign export supply elasticity governing the slopes of the two loci, as well as a few more obvious and economically meaningful requirements. First, at the no-FDI optimal tariff, at least a small positive capital flow from Home to Foreign must be profitable. Second, at some point FDI must be unprofitable even if accompanied by the implied decline in the optimal Home tariff. The first requirement holds under the model's assumptions because the endowment and preference assumptions ensure that under capital and goods market autarky, the rate of return to capital in Foreign exceeds the return to capital at Home, so that a positive flow of Home to Foreign FDI is implied under even a prohibitive tariff. I assume that the second condition holds.

[28]Stability implies that the equilibrium is robust to small tariff policy or capital market perturbations.

It is important to note that the equilibrium level of FDI, $\hat{K}^E$, may be greater or less than the level of FDI required to induce a zero tariff, $\hat{K}^{ft}$. Indeed, there is no reason to believe that the equilibrium FDI level coincides with the free trade inducing level of FDI; the conditions under which $\hat{K}^E = \hat{K}^{ft}$ are apparently devoid of a meaningful economic interpretation. The case in which the equilibrium results in free trade is therefore just a lucky razor's-edge scenario. Figures 3a-c depict three types of interior equilibria, characterized by whether the equilibrium level of FDI is less than, equal to, or greater than the global income maximizing level. Figure 3a illustrates a case in which the equilibrium tariff is positive and the equilibrium FDI level falls short of both the global income maximizing and free trade inducing levels. Figure 3b shows the razor's-edge case in which equilibrium is efficient and global income is maximized. The third possibility is illustrated in Figure 3c; in this case, the equilibrium level of FDI overshoots the efficient level, resulting in an import subsidy in equilibrium.

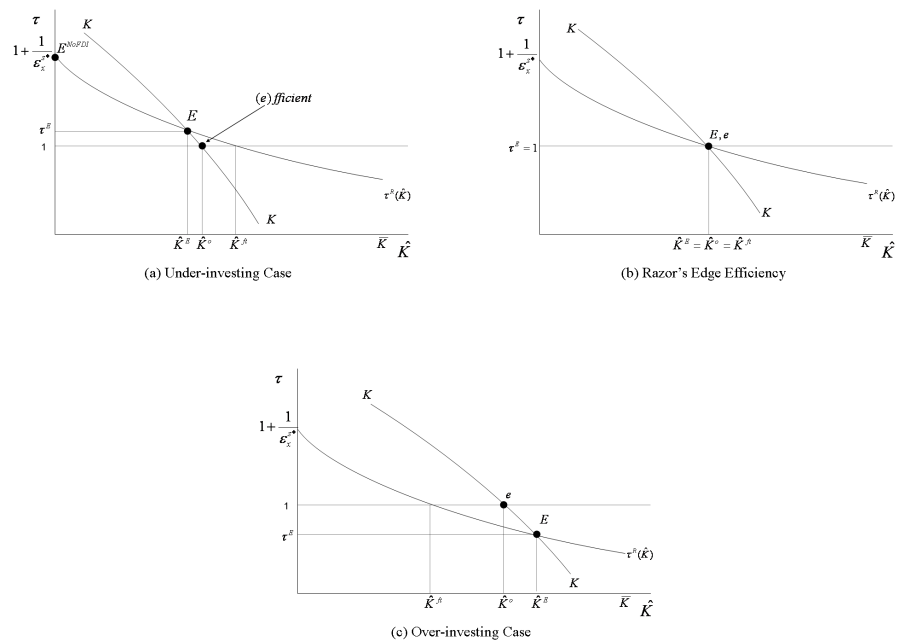

Figure 3: Three Types of Interior Equilibria.

Together the panels in Figure 3 suggest that beginning from capital market autarky, an exogenous rightward shift in the KK locus (for instance due to reduced restrictions on international capital flows, declining international transportation costs, or lower risk premia to international investments) would be efficiency enhancing initially, but not indefinitely.[29] Starting from the Figure 3a case in which the tariff is inefficiently high and the volume of trade inefficiently low, a rightward shift of the capital market clearing locus pushes the equilibrium tariff lower, expanding the volume of trade and increasing global income. Moving the KK locus beyond the point at which equilibrium FDI coincides with the efficient level in Figure 3b, however, would lead Home to subsidize imports, resulting in an inefficiently high level of FDI and too much trade.[30]

This result carries the intriguing suggestion that under some circumstances international capital mobility may substitute for multilateralism in achieving more liberal tariff regimes.[31] If we interpret the role of negotiated trade agreements such as the GATT/WTO as helping governments move from the typically inefficient unilaterally optimal trade policy at E to the efficient point at e, then the panels in Figure 3 illustrate in broad terms the potential importance of FDI in determining the magnitude, and possibly even the nature, of the task before multilateral trade forums. Moreover, the case depicted in panel (c) introduces the provocative notion that under sufficiently large flows of export-platform foreign investment, the role of multilateral trade organizations could evolve from one of expanding international market access to one that helps governments cooperatively restrict international trade.

Once again, it is clear that the results would be reversed under the alternative scenario of import competing investment. As noted at the end of each of the previous sections, if Home invested instead in the Foreign import competing sector, Home's tariff would be increasing in its overseas investment level and the market clearing level of (import competing) investment in Foreign likewise would be increasing in Home's tariff. With both the optimal tariff and FDI market clearing schedules sloping upward from the same vertical (zero investment) intercept as in Figure 2, it is clear that the equilibrium tariff

[29] This is apart from any additional efficiency effects due directly to the cause of the shift in the capital market clearing locus (i.e. the shift in the KK locus could itself embody (unmodeled) efficiency gains).

[30] Introducing political economy considerations to this model re-scales the efficient tariff such that $\hat{K} > \hat{K}^{ft}$ does not necessarily imply an import subsidy, but rather just an politically suboptimal level of protection.

[31] Devereux and Lee (1999) reach a similar conclusion, that complete international financial markets can substitute for international coordination in trade policy by eliminating countries' terms of trade cost-shifting motives. Their policy prediction is not unconditional, however, since in their model free trade is only one of a continuum of possible equilibria.

would be unambiguously higher in the presence of import competing investment than it would be under either capital market autarky or the benchmark case of export-platform investment. In this case, the current role of the WTO to assist governments in increasing market access by cooperatively liberalizing tariffs would be even more crucial.

The preceding analysis demonstrates how endogenously determined tariffs and foreign direct investment interact to determine the equilibrium pattern of trade and investment. A logical pursuant question is then whether governments have an incentive to influence the tariff-FDI equilibrium in their favor. The next section explores a scenario in which foreign governments can offer subsidies to export-platform FDI (or tax import competing investment) in an effort to influence relations with a large trading and investing partner via the FDI-TOT effect. One can envision a multiplicity of strategic policy games, but the strategic use of explicit investment subsidies seems particularly relevant given current trends among developing and newly industrialized countries.

3 Strategic FDI Policy and MFN

Until now the Foreign government has been assumed to be politically passive throughout the process of tariff-setting and international investment. This section relaxes the restriction by introducing a policy tool with which the Foreign government can influence the equilibrium outcome, a specific subsidy to (or tax on) the returns to foreign direct investment. The per-unit investment subsidy is a deliberately simple instrument, designed so that starting from zero, a marginal increase in the subsidy influences the capital market clearing condition while leaving Home's optimal tariff function, $\tau^R(\hat{K})$, unchanged.[32] Intuitively, a subsidy to FDI shifts the capital market clearing locus to the right in $(\tau, \hat{K})$ space by increasing the return to FDI for any tariff level, which in the benchmark case of export-platform investment, causes the equilibrium tariff to decline and the equilibrium FDI level to rise.

To explore the interplay between investment subsidies and preferential tariff arrangements, I now assume that Home has multiple trading counterparts. The model is modified by dividing Foreign into N autonomous identical countries. To eliminate the possible indeterminacy of the goods and capital markets effects that obtain when N is finite, I evaluate the equilibrium conditions of the model in the limit as $N \to \infty$, such that each foreign country is

[32] In contrast, an ad-valorem investment subsidy would magnify the impact of a world price change on FDI remittances, and thereby enter Home's optimal tariff function.

vanishingly small in both goods and capital markets. Note that this limiting framework vindicates the earlier assumption that the aggregate foreign tariff is zero, since the optimal tariff policy for each small country is free trade.[33]

Each small foreign country's optimal investment policy depends on whether it can earn more favorable tariff treatment from the Home country by attracting additional export-platform FDI. Intuitively, if the Home country is restricted to a non-discriminatory tariff policy, for instance because it is bound by the Most Favored Nation (MFN) clause of the GATT, each foreign country is powerless to influence the MFN tariff. If, however, discriminatory tariffs are possible because of an MFN exemption under GATT Article XXIV or the Generalized System of Preferences, Home's optimal tariff against an individual foreign country declines with the level of local export-platform FDI, so that even a vanishingly small foreign country can exploit a localized FDI-TOT effect to earn a more favorable tariff from Home.

A two stage game presents this idea formally. In the first stage, the foreign countries simultaneously and non-cooperatively compete for Home country investment by setting a subsidy to local FDI. In the second stage, the Home tariff and aggregate FDI level are determined simultaneously, just as in Section 2.4, but where the capital market clearing condition depends on the foreign countries' Stage 1 investment policies. Attention is restricted to symmetric subgame perfect Nash equilibria (SPNE). I compare two versions of the game: one in which the Home government is bound by an MFN restriction that requires it to set a single tariff against all foreign countries, and a second version of the game which allows the Home country to employ discriminatory tariffs. The analysis again adopts the case of export-platform investment; discussion of the alternative case of import competing investment is reserved for the end.

3.1 The N Country Model with Investment Subsidies

A familiar problem arises under the many-country framework; when N is finite, a marginal change in one country's investment subsidy may generate indeterminate global capital movements and price changes that ultimately lead to ambiguous results regarding the optimal investment subsidy. I use a two stage procedure to pin down definitive results: first, I develop the model with an arbitrary finite number of foreign countries, N, and then I evaluate the equi-

[33]Although a small country could expropriate rents from overseas investors in its export sector via a (second-best) export tax, the available investment tax/subsidy instrument is first best and thus the only mechanism that would be used for expropriation.

librium conditions as $N \to \infty$, so that each foreign country thus is vanishingly small in capital and goods markets in the limit. This two step method of exposition is particularly useful because it makes explicit the simplifying effects of the limiting framework.

Foreign is divided into N identical countries, indexed by $i \in \mathcal{N} \equiv \{1, N\}$, all of which share the same technology and preferences. The total Foreign endowment of each factor $\bar{L}^*, \bar{T}^*$, and $\bar{K}^*$ is divided equally among the N foreign countries, so that each foreign country has $\frac{1}{N}^{th}$, of the initial Foreign endowment. Note that constant returns to scale technology and homothetic preferences ensure that any symmetric equilibrium is invariant to the number of partitions, N. Each foreign country $i \in \mathcal{N}$ may offer a per-unit subsidy to local FDI (tax if negative), s^i, which is measured in units of good y. Denote the set of investment subsidies by the vector, $\boldsymbol{s} \equiv (s^1, \ldots, s^N)$. When symmetric, the uniform subsidy level is denoted by $\bar{s} \equiv s^i = s^j \ \forall i, j \in \mathcal{N}$. Letting the distribution of FDI across the N countries be given by $\hat{\boldsymbol{K}} \equiv (\hat{K}^1, \ldots, \hat{K}^N)$, the aggregate FDI level is then simply the sum: $\hat{K} = \sum_{i=1}^{N} \hat{K}^i$.

The foreign local price may differ across countries due to the possibility of discriminatory Home-country tariffs. Adjusting the notation accordingly, the local price in each foreign country i is $p^{wi} \equiv p^{wi}(\tau^i, p) \equiv \frac{p}{\tau^i}$, where p denotes the Home price of x relative to y and $\tau^i \equiv (1 + t^i)$ where t^i represents Home's ad-valorem tariff against imports from country i. The vector of foreign prices is then $\boldsymbol{p^w} \equiv (p^{w1}, \ldots, p^{wN})$, and the vector of tariffs is $\boldsymbol{\tau} \equiv (\tau^1, \ldots \tau^N)$. When imposed, the MFN (non-discrimination) restriction on the Home tariff will imply that $\tau^i = \tau^j \equiv \tau^{MFN} \ \forall i, j \in \mathcal{N}$, so that under MFN, $p^{w1} = \ldots = p^{wN} \equiv p^w$.

Capital market clearing requires that the net-of-subsidy return to capital is the same in every country. Thus, for a given set of investment subsidies and tariffs, capital market clearing determines the distribution and aggregate level of FDI according to the set of N arbitrage conditions:

$$r(p, \hat{K}) = r^{*i}(p^{wi}(\tau^i, p), \hat{K}^i) + s^i \qquad \forall i \in \mathcal{N}. \tag{3.1}$$

Note that under any symmetric set of investment subsidies and tariffs, the distribution of FDI must be uniform according to (3.1), with $\hat{K}^i = \frac{\hat{K}}{N}, \forall i \in \mathcal{N}$.

I assume that discriminatory tariffs do not alter the pattern of trade, so that every foreign country is an exporter of x.[34] Each foreign country $i \in \mathcal{N}$

[34]This effectively assumes that there are prohibitive trade costs among foreign countries so that preferential access to the Home market cannot induce trade for reexport.

must obey a local balance of payments condition:

$$M_y^{*i}(p^{wi}(\tau^i,p);\hat{K}^i,s^i) = p^{wi}E_x^{*i}(p^{wi}(\tau^i,p);\hat{K}^i,s^i) - [r^{*i}(p^{wi}(\tau^i,p),\hat{K}^i) + s^i]\hat{K}^i, \tag{3.2}$$

where $[r^{*i}+s^i]\hat{K}^i$ is country i's gross FDI remittances to Home (investment returns plus subsidy cost), $E_x^{*i}(p^{wi};\hat{K}^i,s^i) \equiv q_x^{*i}(p^{wi};\hat{K}^i)-d_x^{*i}(p^{wi},I^{*i}(p^{wi};\hat{K}^i,s^i))$ is country i's exports of good x, and $M_y^{*i}(p^{wi};\hat{K}^i,s^i) \equiv d_y^{*i}(p^{wi},I^{*i}(p^{wi};\hat{K}^i,s^i))-q_y^{*i}(p^{wi};\hat{K}^i)$ is country i's imports of y. Note that a foreign country's export supply and import demand depend on the local subsidy to FDI, s^i, via income.[35]

Writing the multi-country version of Home income and the Home balance of payments condition requires additional notation, since Home tariff revenue depends not only on the aggregate import volume, but also on the distribution of import volumes across the foreign countries. Define the bilateral trade share between Home and each foreign country $i \in \mathcal{N}$:[36]

$$\delta_x^i(\boldsymbol{p^w};\hat{K}^i,s^i) = \frac{E_x^{*i}(p^{wi};\hat{K}^i,s^i)}{\sum_{j=1}^N E_x^{*j}(p^{wj};\hat{K}^j,s^j)}. \tag{3.3}$$

Home income, $I \equiv I(p,\boldsymbol{p^w};\boldsymbol{\hat{K}},\boldsymbol{s})$, may now be defined implicitly by:

$$I = pq_x(p;\hat{K}) + q_y(p;\hat{K}) \quad + \sum_{i=1}^N \Big[[r^{*i}(p^{wi}(\tau^i,p),\hat{K}^i) + s^{*i}]\hat{K}^i + (p-p^{wi})\delta_x^i[d_x(p,I) - q_x(p;\boldsymbol{\hat{K}})]\Big], \tag{3.4}$$

where δ_x^i is the fraction of the total Home import volume sourced from country i; i.e. $M_x^i(p,\boldsymbol{p^w};\boldsymbol{\hat{K}},\boldsymbol{s}) \equiv \delta_x^i M_x(p,\boldsymbol{p^w};\boldsymbol{\hat{K}},\boldsymbol{s})$, where $M_x(p,\boldsymbol{p^w};\boldsymbol{\hat{K}},\boldsymbol{s}) \equiv d_x(p,I(p,\boldsymbol{p^w};\boldsymbol{\hat{K}},\boldsymbol{s}))-q_x(p;\boldsymbol{\hat{K}})$ is aggregate Home import demand. The multi-country version of Home's balanced budget condition in (2.3) is now:

$$\sum_{i=1}^N p^{wi}M_x^i(p,\boldsymbol{p^w}(\boldsymbol{\tau},p);\boldsymbol{\hat{K}},\boldsymbol{s}) = \quad E_y(p,\boldsymbol{p^w}(\boldsymbol{\tau},p);\boldsymbol{\hat{K}},\boldsymbol{s}) + \sum_{i=1}^N [r^{*i}(p^{wi}(\tau^i,p),\hat{K}^i) + s^i]\hat{K}^i, \tag{3.5}$$

[35] $I^{*i}(p^{wi};\hat{K}^i,s^i) = p^{wi}q_x^{*i}(p^{wi};\hat{K}^i) + q_y^{*i}(p^{wi};\hat{K}^i) - [s^i + r^{*i}(p^{wi};\hat{K}^i)]\hat{K}^i$.

[36] See Bagwell and Staiger (1999).

Finally, the equilibrium Home price, $\tilde{p}$, is determined by the goods market clearing condition, which requires that aggregate foreign export supply ($E_x^* \equiv \sum_{i=1}^N E_x^{*i}$) equals aggregate home import demand ($M_x \equiv \sum_{i=1}^N M_x^i$).

$$\sum_{i=1}^{N} E_x^{*i}(p^{wi}(\tau^i, \tilde{p}); \hat{K}^i, s^i) = M_x(\tilde{p}, \boldsymbol{p^w}(\boldsymbol{\tau}, \tilde{p}); \hat{\boldsymbol{K}}, \boldsymbol{s}). \tag{3.6}$$

If the balanced budget conditions in (3.2) and (3.5) hold and the market for x clears according to (3.6), the market for y must also clear.

3.1.1 Stage 1: The Optimal Investment Subsidy

Though the tariff-subsidy game is ultimately solved by backwards induction, it proves pedagogically useful to begin by deriving a small foreign country's optimal Stage 1 investment subsidy, using placeholders for the effect of the subsidy on its Stage 2 terms of trade and local FDI level. By identifying the channels through which the Stage 2 Tariff-FDI equilibrium influences the subgame perfect optimal investment subsidy, this first stage develops intuition and offers a helpful preview of the remaining analysis.

When setting its subsidy to FDI, each foreign country recognizes that increasing its subsidy may influence its Stage 2 FDI level or local price. Taking the investment policies of the other N foreign countries as fixed, country i chooses its optimal subsidy to maximize indirect utility, $v(\cdot)$, which is a function of the local price and income:

$$s^{io} = \arg\max_{s^i} \qquad V^{*i} \equiv v(p^{wi}, I^{*i}(p^{wi}; \hat{K}^i, s^i)) \tag{3.7}$$

where,

$$I^{*i} = p^{wi} q_x^{*i}(p^{wi}; \hat{K}^i) + q_y^{*i}(p^{wi}; \hat{K}^i) - [s^i + r^{*i}(p^{wi}, \hat{K}^i)]\hat{K}^i. \tag{3.8}$$

The derivative of the objective function is,[37]

$$V_{s^i}^{*i} = v_{p^{wi}} \frac{dp^{wi}}{ds^i} + v_I \left\{ \frac{\partial I^{*i}}{\partial p^{wi}} \frac{dp^{wi}}{ds^i} + \frac{\partial I^{*i}}{\partial \hat{K}^i} \frac{d\hat{K}^i}{ds^i} + \frac{\partial I^{*i}}{\partial s^i} \right\}. \tag{3.9}$$

[37]Note that $\frac{\partial I^{*i}}{\partial \hat{K}^i}\big|_{s^i=0} = -r_{\hat{K}^i}^{*i} > 0$; when the foreign capital stock increases, the factor payments to pre-existing FDI decline and these gains are captured by foreign local labor. See Brecher and Findlay (1983) for a thorough analysis of the income effects of an (exogenous) capital inflow to a small open economy in the specific factors model.

Recall that $p^{wi} = p^{wi}(\tau^i, \tilde{p})$, so that a change in country i's subsidy affects its local price both through change in the Stage 2 market clearing price, $\tilde{p}$, and through the endogenously determined Stage 2 equilibrium tariff, τ^i:

$$\frac{dp^{wi}}{ds^i} = \frac{\partial p^{wi}}{\partial p}\frac{d\tilde{p}}{ds^i} + \frac{\partial p^{wi}}{\partial \tau^i}\frac{d\tau^i}{ds^i}. \tag{3.10}$$

Similarly, the net effect of a marginal change in s^i on the local FDI level, $\hat{K}^i$, may be written in terms of the Stage 2 equilibrium effects. The capital market clearing condition in (3.1) implies that country i's local FDI level is determined by equilibrium prices, the aggregate FDI level, and the local subsidy to FDI; i.e. $\hat{K}^i(\tilde{p}, p^{wi}(\tau^i, \tilde{p}), \hat{K}, s^i)$. Taking the total derivative of (3.1) and solving yields:

$$\frac{d\hat{K}^i}{ds^i} = -\frac{1}{r^{*i}_{\hat{K}^i}} - \frac{r^{*i}_{p^{wi}}}{r^{*i}_{\hat{K}^i}}\frac{dp^{wi}}{ds^i} + \frac{r_p}{r^{*i}_{\hat{K}^i}}\frac{d\tilde{p}}{ds^i} + \frac{r_{\hat{K}}}{r^{*i}_{\hat{K}^i}}\frac{d\hat{K}}{ds^i}. \tag{3.11}$$

Substituting (3.11) and (3.10) into (3.9) and manipulating yields the derivative of the objective function:

$$V^{*i}_{s^i} = v_I\Bigg\{\left(E^{*i}_x + \frac{s^i r^{*i}_{p^{wi}}}{r^{*i}_{\hat{K}^i}}\right)\frac{\partial p^{wi}}{\partial \tau^i}\frac{d\tau^i}{ds^i} + \left(E^{*i}_x - r^{*i}_{p^{wi}}\hat{K}^i\right)\frac{\partial p^{wi}}{\partial p}\frac{d\tilde{p}}{ds^i} - r_{\hat{K}}\left(\hat{K}^i + \frac{s^i}{r^{*i}_{\hat{K}^i}}\right)\frac{d\hat{K}}{ds^i} + \frac{s^i}{r^{*i}_{\hat{K}^i}}\Bigg\}. \tag{3.12}$$

Evaluated at a zero subsidy, this expression reduces to:

$$V^{*i}_{s^i}\Big|_{s^i=0} = v_I\Bigg\{\underbrace{E^{*i}_x\frac{\partial p^{wi}}{\partial \tau^i}\frac{d\tau^i}{ds^i}}_{\text{tariff effect}} + \underbrace{\left(E^{*i}_x - r^{*i}_{p^{wi}}\hat{K}^i\right)\frac{\partial p^{wi}}{\partial p}\frac{d\tilde{p}}{ds^i}}_{\text{market clearing price effect}} - \underbrace{r_{\hat{K}}\hat{K}^i\frac{d\hat{K}}{ds^i}}_{\text{hurdle effect}}\Bigg\}. \tag{3.13}$$

Starting from a policy of non-intervention, a foreign country thus will benefit from a marginal increase in its subsidy to FDI if the sum of the tariff effect (that country i may earn a lower tariff from Home via the FDI-TOT effect), market clearing price effect (that a change in the market clearing price affects the local terms of trade, holding the tariff fixed), and "hurdle" effect (that an increase in aggregate FDI causes the cost (hurdle rate) of attracting FDI to rise) is positive.

The net impact of these three effects is generally ambiguous in sign when N is finite, since in general a change in one country's investment subsidy will have a non-negligible impact on world capital and goods markets. For this reason, I focus on the limiting case in which the foreign countries are each vanishingly small to generate unambiguous equilibrium predictions. In the next section, I show that starting from any symmetric Stage 2 equilibrium, a small change in one foreign country's subsidy leaves the market clearing price and aggregate FDI level unchanged in the limit as $N \to \infty$, so that the *only* reason a vanishingly small country would want to offer an investment subsidy is as an effort to earn preferential tariff treatment from its large investment-source trading partner.

3.2 The MFN Game

This section shows that when foreign countries are too small to affect the optimal MFN tariff unilaterally, there is no incentive for them to subsidize or tax FDI. Solving by backward induction, I first establish that starting from any symmetric foreign investment policy, the Stage 2 MFN tariff-FDI equilibrium is unaffected by a marginal change in the subsidy level of a single foreign country in the limit as $N \to \infty$. Then returning to Stage 1, it is simply a matter of substituting into the foreign government's first order condition to show that in the limit as $N \to \infty$, the unique symmetric subgame perfect foreign investment subsidy is zero.

3.2.1 The Effect of an Investment Subsidy Under MFN

The Stage 2 equilibrium for any symmetric $\bar{s}$ is defined by a single MFN tariff-FDI pair. Recall that Section 2 characterizes equilibrium using two equations: the optimal Home tariff as a function of the FDI level and the market clearing FDI level as a function of the tariff – both of which incorporate the goods market clearing condition. In this section it proves analytically convenient to use a system of three equations instead: the optimal MFN tariff as a function of FDI given that the goods market clears; market clearing FDI as a function of the MFN tariff and the Home price; and the market clearing Home price as a function of the MFN tariff and FDI. Restricting attention to symmetric equilibria simplifies exposition considerably; given a symmetric Stage 1 investment subsidy, the distribution of FDI is necessarily uniform across foreign countries for any MFN tariff choice. Any symmetric equilibrium is therefore characterized fully by the tariff, market clearing price, and *aggregate* level of FDI. Formally, for any N and symmetric investment subsidy policy, $\bar{s}$, Stage

2 equilibrium is characterized by the system:

$$\tau^{MFN}(\hat{K}, \bar{s})$$
$$\tilde{p}(\tau^{MFN}, \hat{K}, \bar{s})$$
$$\hat{K}(\tau^{MFN}, \tilde{p}, \bar{s})$$

To show that any symmetric Stage 2 equilibrium is unaffected by a marginal change in a single foreign country's investment subsidy, it is sufficient to demonstrate that neither the capital market clearing aggregate FDI level, market clearing price, or optimal MFN tariff function shift in response to a change in one country's investment subsidy, s^i. The next few pages establish that (i) $\lim_{N\to\infty} \frac{\partial \hat{K}(\tau,\tilde{p},\bar{s})}{\partial s^i} = 0$, (ii) $\lim_{N\to\infty} \frac{\partial \tilde{p}(\tau,\hat{K},\bar{s})}{\partial s^i} = 0$, and (iii) $\lim_{N\to\infty} \frac{\partial \tau^{MFN}(\hat{K},\bar{s})}{\partial s^i} = 0$ through a series of lemmas.

Capital Market Clearing. The N capital market clearing conditions in (3.1) implicitly define the aggregate level and distribution of FDI that clear the capital market given the investment subsidies, tariffs, and the market clearing Home price. Given a symmetric Stage 1 subsidy choice and the associated equilibrium tariff and uniform distribution of FDI, a marginal increase in one foreign country i's investment subsidy causes that country to become a relatively more attractive location for investment, *ceteris paribus*. The immediate impact is a marginal inflow of FDI into i, matched by a net capital outflow from Home and every other foreign country. In the limit as $N \to \infty$ this reallocation of capital towards i is negligible, so that the marginal increase in s^i leaves the aggregate FDI level unchanged. Formally,

Lemma 3.1 *(Proof in appendix.) Every foreign country $i \in \mathcal{N}$ becomes vanishingly small in the world capital market in the limit as $N \to \infty$. Starting from any symmetric equilibrium,*

$$\lim_{N\to\infty} \frac{\partial \hat{K}(\tau, \tilde{p}, \bar{s})}{\partial s^i} = 0. \tag{3.14}$$

Goods Market Clearing. The market clearing price, $\tilde{p}$, is determined by the goods market clearing condition in (3.6). That the market clearing price is invariant to a change in a vanishingly small foreign country's investment subsidy (holding all else fixed) is intuitive. When the foreign countries are each vanishingly small, each represents a negligible fraction of aggregate export supply and – via its contributions to Home income through FDI remittances and tariff revenue – Home import demand. Thus, in the limit as $N \rightarrow \infty$ a marginal change in one country's investment subsidy has a negligible impact on the world goods market, holding tariffs and FDI fixed. Restating,

Lemma 3.2 *(Proof in appendix.) Starting from any symmetric equilibrium, the market clearing price is invariant to changes in a single foreign country's subsidy to FDI in the limit as $N \rightarrow \infty$; i.e. $\forall i \in \mathcal{N}$,*

$$\lim_{N\rightarrow\infty} \quad \frac{\partial \tilde{p}(\tau, \hat{K}, \bar{s})}{\partial s^i} = 0. \tag{3.15}$$

The Optimal MFN Tariff. Under the MFN restriction, Home must set the same tariff against every country, so that $\tau^1 = \tau^2 = \ldots = \tau^N \equiv \tau$. The local price in every foreign country is therefore the same: $p^{wi} = p^w = \frac{\tilde{p}}{\tau}, \forall i \in \mathcal{N}$. For arbitrary finite N and taking as given any (possibly asymmetric) distribution of FDI and investment subsidies, the Home government chooses its MFN tariff according to:

$$\tau^{R^{MFN}} = \arg\max_{\tau} \qquad V(\tilde{p}, p^w; \hat{\boldsymbol{K}}, \boldsymbol{s}) \equiv v(\tilde{p}, I(\tilde{p}, p^w(\tau, \tilde{p}); \hat{\boldsymbol{K}}, \boldsymbol{s})), \tag{3.16}$$

where income is given in (3.4). The corresponding first order condition is:

$$V_\tau = v_p \frac{\partial \tilde{p}}{\partial \tau} + v_I \left\{ \frac{\partial I(\tilde{p}, p^w)}{\partial p} \frac{\partial \tilde{p}}{\partial \tau} + \frac{\partial I(\tilde{p}, p^w)}{\partial p^w} \frac{dp^w}{d\tau} \right\} = 0. \tag{3.17}$$

Solving reveals that the optimal tariff expression is a straightforward multi-country extension of the single foreign country ($N \equiv 1$) version in (2.14):

$$\tau^{R^{MFN}} = 1 + \frac{1}{\epsilon_x^*} \left(1 - \bar{r}^*_{p^w} \frac{\hat{K}}{E_x^*} \right), \tag{3.18}$$

where $\epsilon_x^* \equiv \frac{dE_x^*}{dp^w} \frac{p^w}{E_x^*}$ is the elasticity of aggregate export supply under MFN and $\bar{r}^*_{p^w} \equiv \sum_{i=1}^N r^{*i}_{p^w} \frac{\hat{K}^i}{\hat{K}}$. Note that $\epsilon_x^*, \bar{r}^*_{p^w}$, and E_x^* depend on both the distribution and aggregate level of FDI, so that (3.18) implicitly defines $\tau^{R^{MFN}}(\hat{\boldsymbol{K}}, \boldsymbol{s})$.

Holding the distribution of FDI fixed, the optimal MFN tariff in (3.18) is unaffected by a change in s^i in the limit as $N \rightarrow \infty$ if the market clearing price, $\tilde{p}$, and the functions $\bar{r}^*_{p^w}$, E_x^*, and ϵ_x^*, are left unchanged by a marginal change in one country's investment subsidy. Under symmetry the distribution of FDI is uniform, so that the components of the optimal tariff function are a function of the aggregate FDI level only; i.e. $\tau^{R^{MFN}} \equiv \tau^{R^{MFN}}(\hat{K}, \bar{s})$. Again using the argument that in the limit any country i comprises a negligible fraction of the aggregate world economy yields:

Lemma 3.3 *(Proof in appendix.) Starting from any symmetric equilibrium, Home's optimal MFN tariff function is invariant to changes in a vanishingly small foreign country's subsidy to FDI;* $\forall i \in \mathcal{N}$,

$$\lim_{N\to\infty} \frac{\partial \tau^{R^{MFN}}(\hat{K}, \bar{s})}{\partial s^i} = 0. \tag{3.19}$$

Lemmas 3.1-3.3 establish that beginning from any symmetric investment subsidy, the Stage 2 equilibrium, $(\tau^{MFN}, \hat{K}, \tilde{p})$, is unaffected by a marginal change in the investment subsidy of a vanishingly small foreign country so that under MFN:[38]

$$\lim_{N\to\infty} \frac{d\tau^{MFN}}{ds^i} = 0, \qquad \lim_{N\to\infty} \frac{d\tilde{p}}{ds^i} = 0, \text{ and} \qquad \lim_{N\to\infty} \frac{d\hat{K}}{ds^i} = 0. \tag{3.20}$$

3.2.2 The Subgame Perfect Investment Subsidy under MFN

Substituting the limiting value of the Stage 2 equilibrium effects of the subsidy from (3.20) into the derivative of foreign country's objective function with respect to its FDI choice in (3.12), yields the first order condition:

$$\lim_{N\to\infty} V^{*i}_{s^i}\Big|_{s^i=0} = v_I \frac{s^i}{r^{*i}_{\hat{K}^i}}\Big|_{s^i=0} = 0, \tag{3.21}$$

which implies that when foreign countries are vanishingly small in both capital and goods markets and Home is restricted to a non-discriminatory (MFN) tariff, the cost of a small subsidy to induce additional FDI exactly outweighs the benefit of FDI (starting from a policy of non-intervention). Therefore,

Proposition 3.1 *Under an MFN tariff restriction, the optimal unilateral FDI policy for a foreign country that is vanishingly small in both capital and goods markets is one of non-intervention; i.e.* $\forall i \in \mathcal{N}$,

$$\lim_{N\to\infty} s^{io} = 0.$$

That a small national income maximizing government cannot optimally distort its capital inflow is not surprising. Since each foreign country is a net

[38] In the absence of the symmetry assumption, this is somewhat more complicated since one then needs to demonstrate additionally that in the limit as $N \to \infty$ the optimal MFN tariff and the market clearing price are invariant to a zero-mass change in the distribution of FDI.

importer of capital and small in the international capital market, one would expect the optimal levy on imported capital to be zero.

Proposition 3.1 implies that if Home is restricted to a non-discriminatory tariff, small foreign countries cannot profitably manipulate the equilibrium FDI-tariff outcome from an initial symmetric foreign investment policy of non-intervention. Moreover, from any symmetric non-zero investment subsidy policy, each foreign country could improve its welfare by deviating to a zero-investment subsidy. Consequently,

Corollary 3.2 *In the unique symmetric SPNE of the MFN game, every foreign country sets a zero-subsidy to FDI in the limit as $N \to \infty$.*

Under MFN, the unique symmetric SPNE is therefore exactly the equilibrium derived in Section 2.4; the Home tariff, aggregate FDI level, and market clearing price are the same as they would be if the foreign countries did not have access to the investment instrument. Intuitively, the MFN restriction eliminates each vanishingly small foreign country's incentive to compete for FDI by removing the possibility that increasing the local FDI level will lead to preferential tariff treatment by Home and the concomitant terms of trade gain. Moreover, it is clear that Proposition 3.1 will hold regardless of the sectoral orientation of foreign investment. Thus, in the presence of MFN, the optimal unilateral policy for a vanishingly small country hosting investment in *either* sector – import competing or export-platform – is non-intervention.

3.3 The Discriminatory Tariff Game

Introducing the possibility of discriminatory tariffs significantly alters the nature of the trade tax-investment subsidy game. This section demonstrates that even a vanishingly small foreign country can influence the discriminatory tariff imposed by Home, and thus that each foreign country's subgame perfect investment policy is to subsidize local FDI. The model is again solved by backward induction, beginning with Stage 2 and working in reverse order to find the subgame perfect investment subsidy.

3.3.1 The Effect of an Investment Subsidy in the Absence of MFN

The Stage 2 equilibrium analysis in this version of the game parallels that in the previous section and most of the intermediate results are the same. Just as in the MFN version of the game, a marginal change in a vanishingly small foreign country's investment subsidy cannot affect the market clearing price or market clearing aggregate FDI level starting from any symmetric Stage 2 equilibrium.[39] This section must argue additionally that this holds even if a foreign country successfully influences Home's discriminatory tariff against it.

First notice that Lemmas 3.1 and 3.2 from the previous section apply equally to the discriminatory tariff version of the game. Starting from any symmetric equilibrium and for symmetric fixed tariffs, each foreign country is too small to affect the goods or capital market clearing conditions with a change in its local investment subsidy in the limit as $N \to \infty$. Further, under discriminatory tariffs the goods market clearing price, $\tilde{p}$, is invariant to a marginal change in the tariff levied against a vanishingly small foreign country starting from any symmetric equilibrium. The argument is by now familiar; a given foreign country i represents a vanishingly small proportion of total foreign export supply and Home tariff revenue as $N \to \infty$. A change in its local economy (in this case the via the home-imposed tariff, τ^i) therefore leaves the aggregate export supply and Home import demand functions, and therefore the market clearing price, unchanged. Formally,

Lemma 3.4 *(Proof in appendix.) Starting from any symmetric equilibrium, the market clearing price and aggregate FDI level are invariant to changes in the discriminatory Home tariff against a single foreign country in the limit as* $N \to \infty$*; i.e.* $\forall i \in \mathcal{N}$

$$\lim_{N\to\infty} \frac{\partial \tilde{p}(\tau, \hat{K}, \bar{s})}{\partial \tau^i} = 0, \text{ and} \tag{3.22}$$

$$\lim_{N\to\infty} \frac{\partial \hat{K}(\tau, \tilde{p}, \bar{s})}{\partial \tau^i} = 0. \tag{3.23}$$

Since the aggregate FDI level and market clearing price are invariant to changes in the investment subsidy in (or discriminatory tariff against) a vanishingly small foreign country i, the discriminatory tariffs against all other $j \neq i \in \mathcal{N}$ are also invariant to changes in the investment subsidy in (or discriminatory tariff against) country i.[40] Lemmas 3.1, 3.2 and 3.4 together

[39]Note that for a Stage 2 equilibrium to be symmetric, every foreign country $i \in \mathcal{N}$ must set the same subsidy to FDI *and* face the same tariff from Home. Under MFN, the tariff policy must be symmetric so that the necessary and sufficient condition for symmetry is simply a symmetric investment subsidy across the foreign countries. It is possible that under discriminatory tariffs, however, that an asymmetric Stage 2 equilibrium could follow from a symmetric investment subsidy policy; thus, I restrict attention to initially symmetric equilibria by imposing $\tau^i = \tau^j, \forall i, j \in \mathcal{N}$ in any (initially) symmetric Stage 2 equilibrium.

[40]This is verified by examining the optimal discriminatory tariff expression in (3.28); in the limit as $N \to \infty$ Home's discriminatory tariff against any country $j \neq i \in \mathcal{N}$ is a

imply that beginning from any symmetric equilibrium the Stage 2 equilibrium, the market clearing price and aggregate FDI level are unaffected by a marginal change in the local investment subsidy in a vanishingly small foreign country;

$$\lim_{N\to\infty} \frac{d\tilde{p}}{ds^i} = 0 \qquad \text{and} \qquad \lim_{N\to\infty} \frac{d\hat{K}}{ds^i} = 0. \tag{3.24}$$

Optimal Discriminatory Tariffs. For arbitrary N and any distribution of FDI and investment subsidies, Home chooses its (possibly discriminatory) tariff against country i according to:

$$\tau^{R^i} = \arg\max_{\tau^i} \qquad V(\tilde{p}, \boldsymbol{p^w}(\boldsymbol{\tau}, \tilde{p}); \hat{\boldsymbol{K}}, \boldsymbol{s})) \equiv v(\tilde{p}, I(\tilde{p}, \boldsymbol{p^w}(\boldsymbol{\tau}, \tilde{p}); \hat{\boldsymbol{K}}, \boldsymbol{s})) \tag{3.25}$$

where income is given by (3.4). When N is finite, a change in Home's tariff against foreign country i is transmitted to the local price of every other foreign country $j \neq i$ via a change in the Home price since $p^{wj} \equiv \frac{\tilde{p}}{\tau^j}, \forall j \in \mathcal{N}$. The first order condition for (3.25) is therefore:

$$V_{\tau^i} = v_p \frac{\partial \tilde{p}}{\partial \tau^i} + v_I \left\{ \frac{\partial I(\tilde{p}, \boldsymbol{p^w})}{\partial p} \frac{\partial \tilde{p}}{\partial \tau^i} + \frac{\partial I(\tilde{p}, \boldsymbol{p^w})}{\partial p^{wi}} \frac{dp^{wi}}{d\tau^i} + \sum_{j\neq i}^{N} \frac{\partial I(\tilde{p}, \boldsymbol{p^w})}{\partial p^{wj}} \frac{dp^{wj}}{d\tau^i} \right\} = 0 \tag{3.26}$$

where, $\frac{dp^{wj}}{d\tau^i} = \frac{1}{\tau^j}\frac{\partial \tilde{p}}{\partial \tau^i} \forall j \neq i$. A marginal change in τ^i affects Home's income from the $N-1$ other ($j \neq i$) foreign countries in two ways: through the tariff revenue impact of trade diversion (the pattern of imports from the foreign countries may shift, causing tariff revenue to change) and rent dissipation (any change in the foreign local prices impacts the profitability of FDI in those countries). These price ripple effects are captured by Ω in the expanded version of the first order condition:

$$\begin{aligned} V_{\tau^i} = \quad & v_I \Bigg\{ \left(t^i p^{wi} \frac{dE_x^{*i}}{dp^{wi}} - E_x^{*i} + r_{p^{wi}}^{*i} \hat{K}^i \right) \frac{dp^{wi}}{d\tau^i} \\ & + \underbrace{\left[\sum_{j\neq i} \left(t^j p^{wj} \frac{dE_x^{*j}}{dp^{wj}} - E_x^{*j} + r_{p^{wj}}^{*j} \hat{K}^j \right) \frac{1}{\tau^j} \right] \frac{\partial \tilde{p}}{\partial \tau^i}}_{\equiv \Omega} \Bigg\} = 0. \end{aligned} \tag{3.27}$$

function of country j variables only. But holding $\hat{K}$, $\tilde{p}$, and τ^j for all $j \neq i \in \mathcal{N}$ fixed, the capital market clearing condition in (3.1) implies that $\hat{K}^j$ in all $j \neq i \in \mathcal{N}$ countries cannot change in response to s^i. This in turn implies that $r_{p^{wi}}^{*i}$, the export volume E_x^{*i}, and the export supply elasticity ϵ_x^{*i}, cannot be affected by s^i in the limit.

In the limit as $N \to \infty$, these trade diversion and rent dissipation effects become negligible; as foreign country i becomes vanishingly small, a marginal change in Home's optimal tariff against it does not affect the market clearing price, $\tilde{p}$, by Lemma 3.4. Thus,

Lemma 3.5 *(Proof in appendix.) In the limit as $N \to \infty$ Home's discriminatory tariff against country i is, $\forall i \in \mathcal{N}$:*

$$\lim_{N\to\infty} \tau^{R^i} = 1 + \frac{1}{\epsilon_x^{*i}}\left(1 - r^{*i}_{p^{wi}}\frac{\hat{K}^i}{E_x^{*i}}\right). \tag{3.28}$$

Though country i becomes vanishingly small in the limit, Home's optimal discriminatory tariff against it does not.[41] Moreover, Home's optimal tariff against country i is monotonically decreasing in the local FDI level, $\hat{K}^i$, under conditions parallel to those in the single country case. Assuming monotonicity, Home's optimal tariff against country i is everywhere decreasing with its level of investment in i's export sector even in the limit; $\lim_{N\to\infty} \frac{\partial \tau^{R^i}(\hat{K}^i, s^i)}{\partial \hat{K}^i} < 0 \ \forall i \in \mathcal{N}$.

The effect of a marginal change in s^i on the optimal discriminatory tariff function in (3.28) depends on how the local export volume and export supply elasticity change with s^i, holding all else fixed.[42] Holding FDI constant, the only effect of a marginal change in s^i is through a local income effect in the limit; i.e. $\lim_{N\to\infty} \frac{\partial E_x^{*i}(p^{wi}, \hat{K}^i, s^i)}{\partial s^i} = \frac{dE_x^{*i}}{dI^{*i}} \frac{\partial I^{*i}(p^{wi}, \hat{K}^i, s^i)}{\partial s^i}$. Starting from a zero subsidy, a marginal change in s^i has no effect on country i's income, and thus no effect on E_x^{*i}. The key result is that evaluated at $s^i = 0$, a marginal change in s^i leaves the optimal tariff function unchanged:

Lemma 3.6 *Starting from a policy of non-intervention, a marginal increase in a vanishingly small foreign country's investment subsidy leaves Home's optimal discriminatory tariff function against it unchanged; i.e. $\forall i \in \mathcal{N}$*

$$\lim_{N\to\infty} \left.\frac{\partial \tau^{R^i}(\hat{K}^i, s^i)}{\partial s^i}\right|_{s^i=0} = 0. \tag{3.29}$$

[41] McLaren (1997) finds a similar result, showing explicitly that a large country's optimal tariff against a vanishingly small trading partner can be non-zero in two-country Ricardian model.

[42] Formally, $\lim_{N\to\infty} \frac{\partial \tau^{R^i}(\hat{K}^i, s^i)}{\partial s^i} = -\frac{(\tau^i - 1)}{\epsilon_x^{*i}} \frac{\partial \epsilon_x^{*i}}{\partial s^i} - \frac{1}{\epsilon_x^{*i}} r^{*i}_{p^{wi}} \frac{\hat{K}^i}{E_x^{*i2}} \frac{dE_x^{*i}}{dI^{*i}} \frac{\partial I^{*i}(p^{wi}, \hat{K}^i, s^i)}{\partial s^i}$.

The Foreign Local Tariff-FDI Equilibrium. Figure 4 sketches the capital market clearing locus in $(\tau^i, \hat{K}^i)$ space for a vanishingly small foreign country. The negative slope is found by taking the total derivative of the arbitrage condition in (3.1) and following the methodology used to find the slope expression in the first half of the paper. When s^i changes, the country i capital market clearing locus shifts according to the arbitrage condition in (3.1). Holding the market clearing price and aggregate FDI level fixed according to (3.24), the derivative of the capital market clearing condition for foreign country i in (3.11) reveals that,

Lemma 3.7 *A marginal increase in a vanishingly small foreign country's investment subsidy causes the local capital market clearing locus to shift right in* $(\tau^i, \hat{K}^i)$ *space.* $\forall i \in \mathcal{N}$,

$$\lim_{N\to\infty} \frac{\partial \hat{K}^i(\tau^i, s^i)}{\partial s^i} = -\frac{1}{r^{*i}_{\hat{K}^i}} > 0. \qquad (3.30)$$

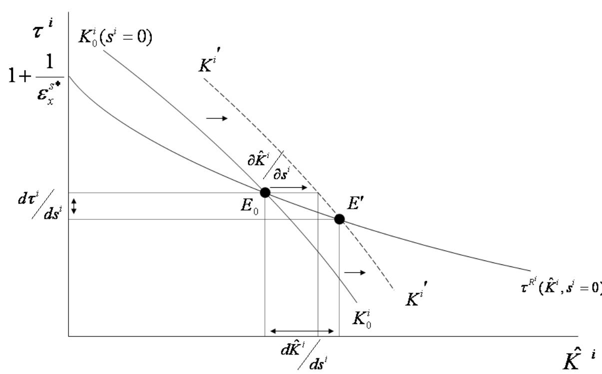

Figure 4: The Effect of a Small Investment Subsidy.

Figure 4 shows that starting from $s^i = 0$, a marginal increase in vanishingly small foreign country i's subsidy leaves the optimal discriminatory tariff function unchanged by Lemma 3.6, but causes the local capital market clearing FDI locus to shift right by Lemma 3.7. This leads to an unambiguous increase in the Stage 2 local FDI level which is accompanied by a decline in the tariff imposed by Home. Thus, even when the foreign countries are each vanishingly small in goods and capital markets, they can gain preferential tariff treatment by exploiting a localized FDI-TOT effect. Starting from a symmetric Stage 2 equilibrium of non-intervention, a vanishingly small foreign country i can earn preferential tariff treatment from Home by offering a small positive subsidy to local FDI. Formally,

$$\lim_{N\to\infty} \frac{d\tau^i}{ds^i}\bigg|_{s^i=0} < 0. \qquad (3.31)$$

3.3.2 The Subgame Perfect investment subsidy in the Absence of MFN

Substituting the Stage 2 equilibrium effect of a marginal change in s^i from equations (3.24) and (3.31) into the derivative of the foreign government's welfare function in (3.13) yields:

$$\lim_{N\to\infty} V^{*i}_{s^i}\bigg|_{s^i=0} = v_I E^{*i}_x \frac{\partial p^{wi}}{\partial \tau^i}\frac{d\tau^i}{ds^i} > 0. \qquad (3.32)$$

That is, starting from a symmetric investment policy of non-intervention, every foreign country $i \in \mathcal{N}$ has an incentive to deviate to a strictly positive investment subsidy (in the limit as $N \to \infty$). Consequently, the unique subgame perfect outcome of the MFN game cannot be reproduced in any equilibrium of the discriminatory tariff game.

Moreover, in any symmetric subgame perfect equilibrium under discriminatory tariffs, it must be the case that each foreign country offers at least a small positive investment subsidy to Home investors. From the derivative of a foreign government's welfare function with respect to s^i evaluated at *any* symmetric $\bar{s}$, the first order condition is:

$$V^{*i}_{s^i} = v_I \left\{ \left(E^{*i}_x + \frac{s^i r^{*i}_{p^{wi}}}{r^{*i}_{\hat{K}^i}} \right) \frac{\partial p^{wi}}{\partial \tau^i}\frac{d\tau^i}{ds^i} + \frac{s^i}{r^{*i}_{\hat{K}^i}} \right\} = 0. \qquad (3.33)$$

When solved, this yields the optimal subsidy expression in the next proposition.

Proposition 3.3 *When Home may employ discriminatory tariffs, the optimal investment policy for every vanishingly small foreign country* $i \in \mathcal{N}$ *is to offer at least a small positive investment subsidy according to:*

$$\lim_{N\to\infty} s^{io} = \frac{-r^{*i}_{\hat{K}^i} E^{*i}_x \frac{\partial p^{wi}}{\partial \tau^i}\frac{d\tau^i}{ds^i}}{r^{*i}_{p^{wi}} E^{*i}_x \frac{\partial p^{wi}}{\partial \tau^i}\frac{d\tau^i}{ds^i} + 1} > 0. \qquad (3.34)$$

Given that the foreign countries are *ex ante* identical, it is natural to focus on symmetric equilibria. Corollary 3.4 summarizes.

Corollary 3.4 *In any symmetric SPNE of the discriminatory tariff game, foreign countries offer a strictly positive subsidy to FDI in the limit as $N \to \infty$; this subsidy generates a higher aggregate FDI level and lower tariff level than would obtain under MFN.*

Tautologically, the MFN exemption is never actually imposed in the symmetric equilibrium of the discriminatory tariff game. It is therefore simply the possibility of gaining preferential treatment that induces foreign countries to subsidize export-platform FDI, which in turn increases aggregate international capital flows, causing Home to liberalize its tariff regime unilaterally.

Remarkably, the bottom line is the same under the alternative case of import competing investment: allowing discriminatory use of tariffs yields lower equilibrium tariff levels than would obtain under strict enforcement of MFN. Intuitively, since Home's optimal discriminatory tariff is increasing with the level of import competing FDI, Foreign countries can earn lower tariffs by discouraging investment in their local import sector. Starting from a symmetric policy of non-intervention (again the unique SPNE of the MFN game, by Corollary 3.2), each investment-host country would have an incentive to impose a strictly positive investment *tax* (i.e. $s_y^{io} < 0$) when discriminatory tariffs are possible.[43] Thus, in the limit as $N \to \infty$, any symmetric outcome of the discriminatory tariff game would again lead to lower tariffs (but now also a lower level of investment) than would be reached under the MFN game. As in the benchmark case, MFN need not be violated in equilibrium to yield the tariff-liberalizing potential of preferential allowances.

By Corollary 3.4, starting from an equilibrium case in which tariffs are inefficiently high and the aggregate FDI level and trade volume inefficiently low, an Article XXIV or GSP type exemption to MFN would be efficiency enhancing as long as the induced tariff liberalization did not overshoot the

[43] Formally, in the case of import competing investment the home tariff is *increasing* with the Foreign investment subsidy to import competing (y-sector) investment; i.e. $\frac{d\tau^i}{ds_y^i} > 0$. The parallel elements used in the derivation of 3.31 for the case of import competing investment are $\frac{\partial \hat{T}^i(\tau^i, s_y^i)}{\partial s_y^i} > 0$ and $\frac{\partial \tau^{Ri}(\hat{T}^i, s_y^i)}{\partial \hat{T}^i} > 0$.) The corresponding expression for 3.34 is then: $\lim_{N\to\infty} s_y^{io} = -\frac{\frac{\partial \pi_y^{*i}}{\partial \hat{T}^i} E_x^{*i} \frac{\partial p^{wi}}{\partial \tau^i} \frac{d\tau^i}{ds_y^i}}{\frac{\partial \pi_y^{*i}}{\partial p^{wi}} E_x^{*i} \frac{\partial p^{wi}}{\partial \tau^i} \frac{d\tau^i}{ds_y^i} + 1} < 0$, where $\frac{d\tau^i}{ds_y^i} > 0$, $\frac{\partial \pi_y^{*i}}{\partial p^{wi}} < 0$, $\frac{\partial \pi_y^{*i}}{\partial \hat{T}^i} > 0$, and all remaining elements are the same (and thus of the same sign) as in the case of export-platform FDI.

efficient tariff level.[44] Conversely, if conditions are such that the MFN (no-subsidy) equilibrium is of the razor's-edge or over-investing type, MFN exemptions would induce a further decline in the equilibrium tariff level and thereby reduce global income. This suggests that the Article XXIV exemption to MFN, Generalized Systems of Preferences, or other forms of preferential trading arrangements may have played a more important efficiency role in the last century – when global capital markets were less developed such that the tariff-FDI equilibrium was more likely of the under-investing type – than they do today. Indeed, if ours is a world in which there is already too much offshoring-type foreign investment and trade, the model indicates that preferential trading arrangements that permit discriminatory tariffs could magnify existing inefficiencies.

4 Anecdotal Support

The model's clear theoretical predictions notwithstanding, one is naturally led to ask whether evidence of the posited link between trade policy and the pattern of international investment exists in the real world. This section briefly discusses anecdotal support found in related empirical work, several short case studies, and a simple but suggestive back of the envelope exercise.

Formal empirical study of the relationship between international investment and trade policy remains a largely untapped area of research. This said, the one clearly relevant study, Amiti and Wakelin (2003), does find empirical support for both the complementarity of trade and investment liberalization, and (albeit somewhat indirectly) the importance of the sectoral orientation of investment. In a careful empirical analysis that controls for endogeneity of trade and investment flows, the authors demonstrate that liberalization of a potential investment-host country's investment policies leads to an increase in its exports if the two countries differ in their relative factor endowments *and trade costs are low*, and decreases exports otherwise. That is, if host and source countries are different in their relative factor endowments – so that investment is *ex-ante* more likely to be of the vertical, export-platform type – and if trade costs are low – which further increases the return to export-platform investment – then trade and investment flows (and hence policies) seem to be complementary. Conversely, when countries are similar or trade costs high – so that investment is more likely to be of the horizontal import

[44]Of course, in the special case of import competing investment, it would be impossible to overshoot efficiency since the lowest possible equilibrium tariff (under zero-investment) is the (positive) standard large country tariff.

competing variety – then more liberal investment policies lead to less trade. Although trade policy is treated as exogenous in their empirical strategy, the Amiti and Wakelin (2003) study nonetheless offers evidence consistent with the theoretical channels suggested here.

The recent proliferation in preferential free trade agreements (FTAs) offers additional evidence of the practical relevance of the relationship between international investment and trade policy. Consider the case of the North American Free Trade Agreement (NAFTA) between Mexico, Canada, and the United States, which entered into force in 1994. It is widely held that the presence of U.S. multinational corporations in Mexico's export sector played a major role in pushing the NAFTA legislation through the U.S. legislative process. In the mid-1960s, Mexico and the U.S. developed the "Maquiladora" program, effectively a set of preferential trade and investment arrangements designed to attract export-platform firms serving the U.S. market, as a means to boost Mexican employment in manufacturing.[45] Over the next three decades, the number and size of maquiladoras grew, as did pressure to sign a free trade agreement from U.S. multinationals (both those associated with the maquiladora program and others). Gruben (2001) argues that while the NAFTA (and expectation of its signing) certainly led to an increase in export-platform investment through the maquiladora program, so too did existing U.S. investments spur NAFTA itself:

> This globalization process was not a creature of NAFTA. If anything NAFTA was a creature of this globalization process. If the reductions in transportation and communications costs that motivated globalization had not taken place, the political pressures that permitted NAFTA would not have been so strong. (p.6)

Similar evidence of the practical relevance of the link between investment in trade agreements – and particularly the differing roles played by export-platform and import competing investment – can be found in the case of the Asian Free Trade Area (AFTA). In describing (and lauding) the motives for creating a free trade agreement among the charter members,[46] Athukorala and Menon (1997) emphasize the importance of an "investment-trade nexus" in reducing tariffs for industries with "efficiency-seeking" export-platform FDI without simultaneously increasing the incentives for import competing investment:

[45]The political expediency for the program stemmed from the (arguably exogenous) 1964 cancellation of a U.S. immigration program that had previously allowed Mexican *braceros* to work in the U.S. under temporary permits. See Gruben (2001).

[46]Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand.

> Many regional firms are adopting international production strategies benefitting from complementarity in resource endowments across countries in the region. In this context, the AFTA scheme has considerable potential for providing further impetus to this internationalization process. (p.173)
>
> To the extent that there is tariff-jumping investment, it is likely to be concentrated in sensitive industries such as motor vehicles, where external protection...is likely to remain high. (p.170) Thus the importance of tariff jumping FDI in total FDI flows in the region is unlikely to grow. (p.173)

The AFTA was signed by its charter members in 1992 and has since expanded to include Vietnam, Laos, Myanmar, and Cambodia.

A final simple exercise uses data on majority owned foreign affiliates of US multinationals (MOFAs) to compare the pattern of affiliate sales (total sales to all destinations versus sales "back" to the US) for a number of geographic regions.[47] The theory predicts that countries whose US-owned foreign affiliates export a higher proportion of total sales back to the US (the investment-source country) should be more likely to have (or to form) a preferential trade agreement with the US. Conversely, regions with a low ratio of MOFA-sales-to-the-US relative to total-MOFA-sales are more likely import competing, and thus may be viewed as less likely to have (or to form) preferential agreements with the US.[48]

The data reveal a systematic pattern consistent with the model. Although US MOFAs located in Europe accounted for over 50% of total US MOFA sales worldwide in 2004, they comprised only 23% of US imports from MOFAs; just 3.2% of European MOFA sales were destined for the US market. Compare this with also-wealthy Canada, which accounts for only 13% of the total US MOFA sales activity worldwide but over 36% of US MOFA imports; over 20% of Canadian MOFA sales are destined for the US. Similarly, Latin American MOFAs accounted for just 11% of total US MOFA sales, but nearly 23% of total US imports from MOFAs; the ratio of US imports from Latin American MOFAs to total Latin American MOFA sales was nearly five times higher

[47]Data are for all industries and are from the Bureau of Economic Analysis 2004 Direct Investment Abroad database, publicly available from www.bea.gov/international. Restricting data to manufacturing industries strengthens the patterns reported here.

[48]It is important to keep in mind that these back of the envelope calculations demonstrate correlation only, and certainly reflect the inherent endogeneity (the bi-directional causality clearly outlined in the model) between tariffs and investment. This exercise is for illustrative purpose only; rigorous empirical analysis remains an important task for future work.

(at 15%) than for Europe but slightly below the same measure for Canada. Consistent with the theory, Canada is a longstanding free trade partner of the US, while Latin America has a number of more recent and tentative agreements; there are no serious talks of a US-European Union preferential trade agreement.[49]

Direct country comparisons offer additional evidence. Within the western hemisphere, one can compare Mexico and Caribbean nations (which have FTAs with the US under NAFTA and the CBI, respectively) with Brazil and Argentina (among the few Latin American countries without preferential access to the US): the US-to-total MOFA sales ratio for Mexico and the Caribbean versus Brazil and Argentina are respectively .36 and .37 versus .03 and .07.[50] Asia Pacific comes out in between with just over a fifth (21.1%) of worldwide MOFA sales, 16% of US MOFA imports, and US-to-total sales ratio of .054. The trend holds at a disaggregated level, with Malaysia and Singapore – the only two countries in east Asia currently with bilateral FTAs with the US – reporting above average US-sales to total-sales ratios of .29 and .094 respectively. Though certainly not conclusive by any rigorous standard, these empirical regularities nonetheless suggest a positive correlation between export-platform FDI and the formation of preferential trade arrangements, consistent with the theoretical predictions pursuant to the model presented herein.

5 Closing Remarks

This paper offers a series of policy implications stemming from the interaction of endogenously determined tariffs and foreign direct investment. I show how export-platform investment induces unilateral tariff liberalization by the investment-source country via the *FDI terms-of-trade effect*, and argue that under some circumstances FDI may substitute partially (or in a razor's-edge case, fully) for multilateral trade liberalization. Though forums such as the WTO remain a first best option if negotiation is costless, the impetus for multilateral tariff agreements may be lessened considerably by international

[49]The Canada-US FTA (CUFTA) was signed in 1988 and NAFTA enacted in 1994. Latin American agreements include NAFTA, the Central American Free Trade Agreement (CAFTA-DR) signed in 2005, the Caribbean Basin Initiative (CBI) of 1984, and the potential (but presumably late coming) Free Trade Agreement of the Americas (FTAA).

[50]Data for the Caribbean, Argentina, Malaysia, and Singapore are from preliminary 2004 numbers; revised numbers were not yet available at the time of final submission.

capital mobility, since the unilateralist tariff outcome with FDI may be more efficient than existing (no-FDI) models of endogenous tariff choice suggest.

A multi-country extension of the model with strategic investment subsidies demonstrates that when investment-host countries are vanishingly small in capital and goods markets, the aggregate export-platform FDI level will be higher (or the import competing investment level lower) and the equilibrium tariff level lower when the investment-source country is free to use discriminatory tariff policies than when it is not. Interestingly, this result obtains even in symmetric equilibria, suggesting that simply the *possibility* of discriminatory tariffs may lead to unilateral tariff liberalization. These findings present a new efficiency argument against the MFN principle of non-discrimination; if our's is a world with inefficiently high tariffs and too little trade, then by proscribing discriminatory tariffs we may forgo the possibility of further efficiency gains through investment-induced unilateral tariff liberalization.

These results suggest several directions for future research. First, although this paper examines one extension of the basic FDI-tariff framework – how the MFN principle may affect competition for FDI and ultimately the tariff level – there are a number of other potential avenues of pursuit. For example, an extension of the basic model to incorporate enforcement constraints in international trade agreements could lead naturally to a model of gradualism in negotiated tariff liberalization. Intuitively, by committing to an initial round of tariff reductions that is constrained by the incentives for cheating that arise as countries are moved below their unilateral best response tariffs, countries can increase the level of FDI; this increase in FDI could then reduce countries' unilateral best response tariff levels, thereby relaxing governments' incentive constraints and permitting another round of tariff liberalization. Such a model would provide a qualitatively new explanation for incremental negotiated tariff liberalization, complementing previous work in the area.[51]

Another possible extension of this paper might formalize the policy design features that facilitate the tariff liberalizing effect of foreign investment. Several real world issues suggest that the FDI-TOT effect will be relevant in practice only in the presence of complementary policy measures. For instance, the optimistic prediction that export-platform investment will induce unilateral tariff liberalization cannot persist under the threat of expropriation. If political instability prevents potential investment-host governments from committing against the appropriation of foreign owned assets, foreign investors will

[51]See, for example, Staiger (1995), Devereux (1997), Furusawa and Lai (1999), Chisik (2003), or Bond and Park (2002).

stay out of the local market and concomitant cost-shifting tariffs must ensue.[52] A similar qualification arises at the firm level; export-platform investment reduces the investing country's unilaterally optimal tariff only to the extent that foreign and domestically owned exporters are subject to the same tariff treatment. If an investment-source country could levy tariffs on imports from foreign-owned firms while offering tariff exemptions to enterprises owned by its own constituents, for instance through selective use of anti-dumping duties or via "outward processing clauses", the FDI-TOT effect would vanish. Given the model's implication that import competing FDI may exacerbate a investment source country's terms of trade cost-shifting motive, then to the extent that the GATT Trade-Related Investment Measures (TRIMS) ban the use of the minimum export requirements that discourage import competing FDI, these provisions may reduce or reverse the tariff liberalizing effect of foreign investment.

The preceding suggestions notwithstanding, empirical testing remains the most important task for future work. At its most basic level, the model delivers a simple test of the importance of FDI as it relates to tariff policy: that by comparing a country's import volume with its FDI income in a given sector, one can gauge the extent to which that country has an incentive to set an inefficiently high (cost-shifting) tariff. Beyond this, the model also suggests a possible causal link between export-platform investment and the formation of preferential trade agreements. The econometric strategy developed recently by Baier and Bergstrand (2004) shows how a number of simple economic determinants can help predict the formation of free trade agreements; the results of this model suggest that measures of foreign investment might further enhance predictive power in this setting.

6 Appendices

6.1 Regularity Condition for the FDI-TOT Effect.

This appendix derives the formal condition under which Home's optimal tariff is everywhere decreasing with the level of FDI; i.e. $\tau^{R\prime}(\hat{K}) < 0$. The derivative

[52]Indeed, Chapter 11 of the North American Free Trade Agreement, which legislates against appropriative measures by host country governments, appears to have been tailored precisely to address this difficulty.

of Home's tariff reaction function with respect to $\hat{K}$ is:

$$\tau^{R\prime}(\hat{K}) = - \underbrace{\left(\frac{\partial \epsilon_x^*}{\partial \hat{K}} + \frac{\partial \epsilon_x^*}{\partial p^w}\frac{\partial \tilde{p}^w}{\partial \hat{K}}\right)}_{\equiv \Delta\epsilon_x^*}\left[\frac{1}{\epsilon_x^{*2}}\left(1 - r_{p^w}^*\frac{\hat{K}}{E_x^*}\right)\right] + \frac{1}{\epsilon_x^*}\left[-r_{p^w}^*\frac{1}{E_x^*}\right.$$
$$\left. - \underbrace{\left(r_{p^w\hat{K}}^* + r_{p^w p^w}^*\frac{\partial \tilde{p}^w}{\partial \hat{K}}\right)}_{\equiv \Delta r_{p^w}^*}\frac{\hat{K}}{E_x^*} + r_{p^w}^*\frac{\hat{K}}{E_x^{*2}}\underbrace{\left(\frac{\partial E_x^*}{\partial \hat{K}} + \frac{\partial E_x^*}{\partial p^w}\frac{\partial \tilde{p}^w}{\partial \hat{K}}\right)}_{\equiv \Delta E_x^*}\right],$$

or:

$$\tau^{R\prime}(\hat{K}) = \frac{1}{E_x^*\epsilon_x^*}\left\{-\frac{\Delta\epsilon_x^*}{\epsilon_x^*}\left(E_x^* - r_{p^w}^*\hat{K}\right) - \Delta r_{p^w}^*\hat{K} - r_{p^w}^*\left(1 - \hat{K}\frac{\Delta E_x^*}{E_x^*}\right)\right\}. \quad (6.1)$$

The technical assumption that ensures monotonicity ($\tau^{R\prime}(\hat{K}) < 0$) is then:

$$\underbrace{-\frac{\Delta\epsilon_x^*}{\epsilon_x^*}\left(E_x^* - r_{p^w}^*\hat{K}\right) - \Delta r_{p^w}^*\hat{K} + r_{p^w}^*\hat{K}\frac{\Delta E_x^*}{E_x^*}}_{\text{indirect effects of FDI}} < \underbrace{r_{p^w}^*}_{\text{direct effect}} \quad ; \quad (6.2)$$

i.e. that the net effect of a marginal change in FDI on the trade volume, foreign export supply elasticity, and the world price (notably ambiguous in sign) is less than the direct "internalization" effect of the increase in Home ownership of the Foreign export sector.

6.2 Slope of the KK Locus

Proof that $\frac{\mathbf{d\hat{K}}}{\mathbf{d\tau}} < \mathbf{0}$. First notice that $-(r_{\hat{K}} - r_{\hat{K}}^*) < 0$ by the definition of the return functions $r(\cdot)$ and $r^*(\cdot)$, and similarly that $r_p\frac{dp}{d\tau} - r_{p^w}^*\frac{\partial \tilde{p}^w}{\partial \tau} > 0$, since the Metzler and Lerner paradoxes are assumed absent. Thus, from (2.16) a sufficient condition for the capital market clearing (KK) locus to be everywhere downward sloping is:

$$(r_p\tau - r_{p^w}^*)\frac{\partial \tilde{p}^w}{\partial \hat{K}} \geq 0. \quad (6.3)$$

Now note that $\tau r_p = r_{p^w} = g_{Kp^w} = g_{p^wK} = \frac{dq_x}{dK}$ and similarly, $r_{p^w}^* = g_{K^*p^w}^* = g_{p^wK^*}^* = \frac{dq_x^*}{dK^*}$, where $g(p^w, K, L, T) \equiv p^w q_x + q_y$ ($g^*(p^w, K^*, L^*, T^*) \equiv p^w q_x^* + q_y^*$)

is Home (Foreign) GDP measured in units of good y. Substituting shows that the necessary condition in (6.3) may be rewritten:

$$\left(\frac{dq_x}{dK} - \frac{dq_x^*}{dK^*}\right)\frac{\partial \tilde{p}^w}{\partial \hat{K}} \geq 0. \tag{6.4}$$

The sign of the world price effect of a marginal change in the FDI level (for a given tariff), $\frac{\partial \tilde{p}^w(\tau,\hat{K})}{\partial \hat{K}}$, is found from the total derivative of the market clearing condition in (2.5):

$$\frac{\partial E_x^*(p^w,\hat{K})}{\partial \hat{K}}dK + \frac{\partial E_x^*(p^w,\hat{K})}{\partial p^w}d\tilde{p}^w = \frac{\partial M_x(p^w,\hat{K})}{\partial \hat{K}}dK + \frac{\partial M_x(p^w,\hat{K})}{\partial p^w}d\tilde{p}^w. \tag{6.5}$$

Rearranging reveals that:

$$\frac{\partial \tilde{p}^w(\tau,\hat{K})}{\partial \hat{K}} = \frac{\frac{\partial E_x^*}{\partial \hat{K}} - \frac{\partial M_x}{\partial \hat{K}}}{\frac{\partial M_x}{\partial p^w} - \frac{\partial E_x^*}{\partial p^w}} \geq 0 \iff \frac{\partial E_x^*}{\partial \hat{K}} - \frac{\partial M_x}{\partial \hat{K}} \leq 0, \tag{6.6}$$

since the denominator is everywhere negative (export supply of x is upward sloping and import demand is downward sloping). Evaluated along the capital market clearing locus where $r^* = r$, a marginal change in $\hat{K}$ has no income effect, and therefore no effect on demand (holding the world price fixed). Thus, $\left(\frac{\partial E_x^*}{\partial \hat{K}} - \frac{\partial M_x}{\partial \hat{K}}\right)\Big|_{r=r^*} = \frac{dq_x^*}{d\hat{K}} + \frac{dq_x}{d\hat{K}} = \frac{dq_x^*}{dK^*} - \frac{dq_x}{dK}$. Substituting into (6.6) reveals that:

$$\frac{\partial \tilde{p}^w(\tau,\hat{K})}{\partial \hat{K}} \geq 0 \iff \frac{dq_x}{dK} - \frac{dq_x^*}{dK^*} \geq 0, \tag{6.7}$$

which implies that the sufficient condition in (6.4) for the KK locus to be everywhere downward sloping is always satisfied. $\diamond$

6.3 Limiting Arguments

Notes: (1) Lemmas 3.1-3.2 hold for both versions of the game, since attention is restricted to equilibria that are initially symmetric in tariffs. (2) Recall that N is defined as the number of identical countries into which the single Foreign country from the first half of the paper is divided. Thus, the assumptions of constant returns to scale (CRS) technologies and homothetic preferences ensure that under symmetry, aggregate foreign country variables are independent of N.

Proof of Lemma 3.1. Starting from a symmetric equilibrium, the N capital market clearing conditions from (3.1) are symmetric and given by:

$$r(p,\hat{K}) - [r^*(p^w(\tau,p),\frac{\hat{K}}{N}) + \bar{s}] = 0. \tag{6.8}$$

Allowing a single foreign country i to change its investment subsidy, but holding tariffs, the Home price, and every other investment subsidy fixed, the total derivative of (6.8) for country i and all countries $j \neq i \in \mathcal{N}$ are, respectively:

$$r_{\hat{K}} d\hat{K} - r^{*i}_{\hat{K}^i} d\hat{K}^i = ds^i \tag{6.9}$$

$$r_{\hat{K}} d\hat{K} - r^{*j}_{\hat{K}^j} d\hat{K}^j = 0, \forall j \neq i \in \mathcal{N}. \tag{6.10}$$

From (6.10) the distribution of FDI across all foreign countries $j \neq i$ must remain uniform. Thus, we know that $\hat{K}^j = \frac{\hat{K}-\hat{K}^i}{N-1} \forall j \neq i$, which implies $d\hat{K}^j = \frac{d\hat{K}}{N-1} - \frac{d\hat{K}^i}{N-1} \forall j \neq i$. Substituting this into (6.10) and rearranging yields:

$$r^{*j}_{\hat{K}^j} d\hat{K}^j = -[(N-1)r_{\hat{K}} - r^{*j}_{\hat{K}^j}]d\hat{K} \tag{6.11}$$

But starting from a symmetric equilibrium, the marginal physical product of capital must be equal across the foreign countries initially, such that $r^{*i}_{\hat{K}^i} = r^{*j}_{\hat{K}^j}, \forall i,j \in \mathcal{N}$. Using this to substitute (6.11) into (6.9) establishes (after manipulations) that:

$$\frac{d\hat{K}}{ds^i} = \frac{1}{N r_{\hat{K}} - r^{*j}_{\hat{K}^j}}. \tag{6.12}$$

Finally, note that $r^{*j}_{\hat{K}^j}$ is independent of N since:

$$r^{*j}_{\hat{K}^j} \equiv p^w f_{\hat{K}^j}(\hat{K}^j, L^{*j}_x) = \frac{1}{N} f_{\hat{K}}(\hat{K}, L^*_x)\frac{d\hat{K}}{d\hat{K}^j} = p^w f_{\hat{K}}(\hat{K}, L^*_x), \tag{6.13}$$

which depends on aggregate foreign variables only and is therefore independent of N. (See note (2) above.) Taking the limit of (6.12) as $N \to \infty$ completes the proof. ⋄

Proof of Lemma 3.2. Starting from a symmetric equilibrium, the goods market clearing condition in (3.6) determines the market clearing price as a function, $\tilde{p} \equiv \tilde{p}(\tau, \hat{K}, \bar{s})$. It proves helpful to rewrite the import demand as a function of the local price and income to highlight the effect of a change in one country's subsidy to FDI, s^i.

$$M_x(\tilde{p}, I(\tilde{p}, \boldsymbol{s})) = E^*_x(p^w(\tau,\tilde{p}), \boldsymbol{s})) \equiv \sum_{j=1}^{N} E^{*j}_x(p^w(\tau,\tilde{p}), s^j). \tag{6.14}$$

Holding fixed the investment subsidies of all foreign countries $j \neq i$ and the symmetric tariff and distribution of FDI, the total derivative is:

$$\frac{dM_x}{dp}d\tilde{p} + \frac{\partial M_x}{\partial I}\frac{\partial I}{\partial s^i}ds^i = \frac{1}{\tau}\frac{dE_x^*}{dp^w}d\tilde{p} + \frac{dE_x^*}{dI^*}\frac{\partial I^*(p^w, \hat{K}, s^i)}{\partial s^i}ds^i, \tag{6.15}$$

since holding prices fixed the only effect of a change in s^i on the foreign export supply function is via aggregate foreign income. From the income definitions in (3.4) and (3.8), under a symmetric distribution of FDI:

$$\frac{\partial I}{\partial s^i} = \frac{\hat{K}}{N} \qquad \text{and} \qquad \frac{\partial I^*}{\partial s^i} = -\frac{\hat{K}}{N}. \tag{6.16}$$

Substituting into the total derivative in (6.15) and solving yields:

$$\frac{d\tilde{p}}{ds^i} = -\left(\frac{\frac{dE_x^*}{dI^*} + \frac{\partial M_x}{\partial I}}{\frac{dM_x}{dp} - \frac{1}{\tau}\frac{dE_x^*}{dp^w}}\right)\frac{\hat{K}}{N}, \tag{6.17}$$

Thus, (6.17) approaches zero in the limit as $N \to \infty$. $\diamond$

Proof of Lemma 3.3. In any symmetric equilibrium, the partial derivative of (3.18) with respect to s^i is:

$$\begin{aligned}\frac{\partial \tau^{RMFN}(\hat{K}, \bar{s})}{\partial s^i} &= -\frac{1}{\epsilon_x^*}\frac{\hat{K}}{E_x^*}\frac{\partial \bar{r}_{p^w}^*}{\partial p^w}\frac{\partial p^w(\tilde{p}, \tau)}{\partial p}\frac{\partial \tilde{p}(\hat{K}, \tau, \bar{s})}{\partial s^i} \\ &+\frac{1}{\epsilon_x^*}\bar{r}_{p^w}^*\frac{\hat{K}}{E_x^{*2}}\left[\frac{\partial E_x^*(p^w, \hat{K}, \bar{s})}{\partial s^i} + \frac{\partial E_x^*(p^w, \hat{K}, \bar{s})}{\partial p^w}\frac{\partial p^w(\tilde{p}, \tau)}{\partial p}\frac{\partial \tilde{p}(\hat{K}, \tau, \bar{s})}{\partial s^i}\right] \\ &-\frac{(\tau - 1)}{\epsilon_x^*}\left[\frac{\partial \epsilon_x^*(p^w, \hat{K}, \bar{s})}{\partial s^i} + \frac{\partial \epsilon_x^*(p^w, \hat{K}, \bar{s})}{\partial p^w}\frac{\partial p^w(\tilde{p}, \tau)}{\partial p}\frac{\partial \tilde{p}(\hat{K}, \tau, \bar{s})}{\partial s^i}\right].\end{aligned}$$

But by Lemma 3.2, $\lim_{N\to\infty}\frac{\partial \tilde{p}(\hat{K}, \tau, \bar{s})}{\partial s^i} = 0$, so that:

$$\lim_{N\to\infty}\frac{\partial \tau^{RMFN}(\hat{K}, \bar{s})}{\partial s^i} = -\frac{(\tau - 1)}{\epsilon_x^*}\frac{\partial \epsilon_x^*(p^w, \hat{K}, \bar{s})}{\partial s^i} + \frac{1}{\epsilon_x^*}\bar{r}_{p^w}^*\frac{\hat{K}}{E_x^{*2}}\frac{\partial E_x^*(p^w, \hat{K}, \bar{s})}{\partial s^i}. \tag{6.18}$$

Recall from the proof of Lemma 3.2 that under symmetry:

$$\frac{\partial E_x^*(p^w, \hat{K}, \bar{s})}{\partial s^i} = \frac{dE_x^*}{dI^*}\frac{dI^*}{ds^i} = \frac{dE_x^*}{dI^*}\frac{\hat{K}}{N}, \tag{6.19}$$

so that,

$$\lim_{N\to\infty}\frac{\partial E_x^*(p^w, \hat{K}, \bar{s})}{\partial s^i} = 0. \tag{6.20}$$

Further, since $\epsilon_x^* \equiv \frac{dE_x^*}{dp^w}\frac{p^w}{E_x^*}$ and $p^w = p^w(\tau, \tilde{p})$ (such that holding constant τ and $\tilde{p}$, fixes p^w):

$$\frac{\partial \epsilon_x^*(p^w, \hat{K}, \bar{s})}{\partial s^i} = \frac{p^w}{E_x^*}\frac{d}{ds^i}\left(\frac{dE_x^*}{dp^w}\right) - \frac{dE_x^*}{dp^w}\frac{p^w}{E_x^{*2}}\underbrace{\left(\frac{\partial E_x^*(p^w, \hat{K}, \bar{s})}{\partial s^i}\right)}_{\to 0 \text{ by } 6.20}. \tag{6.21}$$

But since the aggregate foreign export supply *function* is unchanged by a marginal change in s^i, the its derivative with respect to p^w must also be left unchanged by a change in s^i; i.e. $\lim_{N\to\infty} \frac{d}{ds^i}\left(\frac{dE_x^*}{dp^w}\right) = 0$. Thus,

$$\lim_{N\to\infty} \frac{\partial \epsilon_x^*(p^w, \hat{K}, \bar{s})}{\partial s^i} = 0. \tag{6.22}$$

Substituting (6.20) and (6.22) into (6.18) completes the proof. $\diamond$

Proof of Lemma 3.4. Just as in the proof of Lemma 3.2, I rewrite the market clearing condition in (3.6) – this time to highlight the effect of a change in the tariff against a single country i. Starting from a symmetric equilibrium,

$$M_x(\tilde{p}, I(\tilde{p}, \boldsymbol{\tau})) = E_x^* \equiv \sum_{j=1}^{N} E_x^{*j}(p^{wj}(\tau^j, \tilde{p})) \tag{6.23}$$

$$\frac{dM_x}{dp}d\tilde{p} + \frac{\partial M_x}{\partial I}\frac{\partial I}{\partial \tau^i}d\tau^i = \frac{1}{\tau}\frac{dE_x^*}{dp^w}d\tilde{p} + \frac{dE_x^{*i}}{dp^{wi}}\frac{\partial p^{wi}}{\partial \tau^i}d\tau^i. \tag{6.24}$$

But from the definition of Home income and foreign export supply (under symmetry):

$$\frac{\partial I}{\partial \tau^i} = tp^{wi}\frac{M_x}{N} \qquad \text{and} \qquad \frac{dE_x^{*i}}{dp^{wi}} = \frac{1}{N}\frac{dE_x^*}{dp^w}. \tag{6.25}$$

Substitute and solve to yield:

$$\frac{d\tilde{p}}{d\tau^i} = \left(\frac{\frac{dE_x^*}{dp^w}\frac{\partial p^{wi}}{\partial \tau^i} - \frac{\partial M_x}{\partial I}tp^w M_x}{\frac{dM_x}{dp} - \frac{1}{\tau}\frac{dE_x^*}{dp^w}}\right)\frac{1}{N}, \tag{6.26}$$

which approaches zero in the limit. $\diamond$

For the second half of the proof, take the derivative of the capital market clearing condition in (3.1). For country i and all countries $j \neq i \in \mathcal{N}$, respectively:

$$r_{\hat{K}}d\hat{K} - r^{*i}_{\hat{K}^i}d\hat{K}^i - r^{*i}_{p^{wi}}\frac{\partial p^{wi}}{\partial \tau^i}d\tau^i = 0 \tag{6.27}$$

$$r_{\hat{K}}d\hat{K} - r^{*j}_{\hat{K}^j}d\hat{K}^j = 0, \forall j \neq i \in \mathcal{N}. \tag{6.28}$$

Just as in the proof of Lemma 3.1, note that the distribution of FDI across all foreign countries $j \neq i$ remains uniform so that $\hat{K}^j = \frac{\hat{K}-\hat{K}^i}{N-1} \forall j \neq i \rightarrow d\hat{K}^j = \frac{d\hat{K}}{N-1} - \frac{d\hat{K}^i}{N-1} \forall j \neq i$. Substituting this into (6.28) and rearranging yields:

$$r^{*j}_{\hat{K}^j} d\hat{K}^j = -[(N-1) r_{\hat{K}} - r^{*j}_{\hat{K}^j}] d\hat{K} \tag{6.29}$$

But again, starting from a symmetric equilibrium the marginal product of capital is equal across the foreign countries initially, so that $r^{*i}_{\hat{K}^i} = r^{*j}_{\hat{K}^j}, \forall i, j \in \mathcal{N}$. Substituting (6.29) into (6.27) establishes (after manipulations) that:

$$\frac{d\hat{K}}{d\tau^i} = \frac{r^{*i}_{p^{wi}} \frac{\partial p^{wi}}{\partial \tau^i}}{N r_{\hat{K}} - r^{*j}_{\hat{K}^j}}. \tag{6.30}$$

Since $r^{*i}_{\hat{K}^i} = r^{*j}_{\hat{K}^j}$ is independent of N by (6.13), (6.27) converges to zero as $N \rightarrow \infty$. $\diamond$

Proof of Lemma 3.5. The proof requires that I show $\lim_{N\rightarrow\infty} \Omega = 0$. To do this it is sufficient to demonstrate that $\lim_{N\rightarrow\infty} \frac{dp^{wj}}{d\tau^i} \equiv \frac{1}{\tau^j} \frac{\partial \tilde{p}(\boldsymbol{\tau}, \hat{K}, \bar{s})}{\partial \tau^i} = 0, \forall j \neq i$, since:

$$\Omega \equiv \left[\sum_{j \neq i} \left(t^j p^{wj} \frac{dE^{*j}_x}{dp^{wj}} - E^{*j}_x + r^{*j}_{p^{wj}} \hat{K}^j \right) \frac{1}{\tau^j} \right] \frac{\partial \tilde{p}}{\partial \tau^i}. \tag{6.31}$$

But $\lim_{N\rightarrow\infty} \frac{\partial \tilde{p}(\boldsymbol{\tau}, \hat{K}, \bar{s})}{\partial \tau^i} = 0$ by equation (3.22) in Lemma 3.4. $\diamond$

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