Tax Policies in Open Economies

by

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TABLE OF CONTENTS

LIST OF APPENDICES

APPENDIX

Chapter I

Introduction

This dissertation consists of three papers that use economic theory to study tax policies in open economies. The first two papers study fiscal policies towards inbound foreign direct investment (FDI), while the third studies international trade policy. These papers together contribute to our understanding of government incentives to use fiscal instruments to improve domestic welfare in open economy settings.

Chapter II studies a small country's incentives to tax foreign investors. A central result in the theory of international taxation argues that small countries should not impose taxes on inbound FDI (Gordon, 1986). The existing literature suggests that this result will hold as long as there are no market imperfections or entry restrictions. Contrary to this literature, the analysis in Chapter II shows that small countries can have incentives to tax inbound FDI even in a setting with perfect competition and free entry. While investors make no aggregate profits worldwide due to free entry, they make taxable profits in foreign production locations because their investment costs are partly incurred in their home country. These profits are not perfectly mobile because a firm's productivity varies across locations. Consequently, the host country does not bear the entire burden of a tax on foreign investors and this gives rise to an incentive to impose taxes. The standard zero optimal tax result from the literature can be recovered in this model under a cost-apportionment system that ensures zero economic profits in each location.

Chapter III starts by noting that most countries impose taxes on foreign investors while also having in place targeted subsidies and tax incentives designed to attract them. This essay shows that such a policy can be optimal from the standpoint of a host country. The government has an incentive to tax inframarginal firms because they are relatively immobile. It also has an incentive to subsidize marginal firms because the economic activity generated by such a subsidy can increase domestic wages in excess of the fiscal cost of the subsidy. The benefits from the subsidy ultimately arise from an improvement in the host country's terms-of-trade. These tax and subsidy policies improve host country welfare but are distortionary from a global standpoint. This analysis is thus

able to provide an explanation for why tax coordination efforts can simultaneously entail reduced taxes and reduced subsidies on foreign firms.

Chapter IV shows that the presence of inframarginal exporters is an independent reason for a positive optimal tariff. To demonstrate this clearly, I develop a perfectly competitive model of international trade where due to fixed costs of exporting and firm heterogeneity, some firms are inframarginal in their decision to export to a market. In this setting, despite the fact that there are no pre-existing distortions, even a small importing country that has no world market power has an incentive to impose tariffs. Tariffs are optimal because they allow the importing country to indirectly tax a portion of the exporting rents earned by inframarginal foreign firms.

Chapter II

Incentives to Tax Foreign Investors

1 Introduction

A central result in the theory of international taxation suggests that small countries should not impose taxes on inbound FDI (Gordon, 1986).[1] This is because a small country faces a perfectly elastic supply of capital and so the burden of any tax on foreign investors falls entirely on domestic immobile factors. It would therefore be preferable to tax the immobile factors directly instead of unnecessarily reducing inbound investment. The existing literature has interpreted this result to be an implication of the Diamond-Mirlees (1971) framework, where firms are competitive and households receive no profits. The literature suggests that incentives to tax foreign investors arise only in settings that depart from the Diamond-Mirlees framework, which entails introducing market imperfections, entry restrictions or policy instrument limitations.

The current paper explains why it can be optimal for small countries to tax foreign investors even in a perfectly competitive setting with free entry. Free entry into production implies that investors from each country make no aggregate profits worldwide and so there are no economic profits that accrue to households.[2] Nevertheless, investors can make positive taxable profits in foreign production locations because the initial investment costs that enable production globally are incured in the investor's home country. These profits are not perfectly mobile because owing to productivity differences arising from uncertainty associated with entry, some investors find it more profitable to produce in a particular country than they would elsewhere in the world. When a host country taxes foreign investors, it taxes away a portion of the profits of these inframarginal investors. While this will affect business creation incentives in the rest of the world, a small country does not internalize this effect. As a result of this externality, domestic agents do not bear the entire

[1] See also Dixit (1985), Razin and Sadka (1991), and Gordon and Hines (2002) for alternative forms of this argument.

[2] This is as in Hopenhayn (1992) and Melitz (2003). The production structure is especially similar to Dharmapala et al. (2011).

burden of the tax and the host country therefore has an incentive to tax foreign investors.

The benchmark zero tax result can be recovered in this model under a specific system of cost apportionment. If the initial investment costs were apportioned to each country proportionately to the profits made in the location, investors would earn no aggregate economic profits location by location, just as in Gordon (1986). With such an apportionment system, the host country would no longer have an incentive to tax foreign investors. It is natural, therefore, to interpret the optimal zero tax results as implicitly assuming an apportionment regime that guarantees zero profits in each location. Note, however, that while such a regime would be efficient from a global standpoint, it would not be incentive-compatible: the host country has a unilateral incentive to not allow the apportioned investment costs to be deductible.[3]

In addition to the benchmark zero tax result, this paper is connected to a literature that studies business taxation in the presence of location rents.[4] This literature shows that countries can have incentives to impose taxes on foreign investors if a portion of the profits earned by foreign firms in a location could not be earned elsewhere in the world. The key contribution of the current paper is to explain how location rents from the standpoint of the host country can exist even in a setting where free entry guarantees that there are no true rents that accrue to any households. This distinction is substantively important because it illustrates how a rent-like motive for taxing foreign investors can exist in an open economy setting even when firms are fully subjected to competitive pressures.

This paper also makes a contribution to a growing literature on interjurisdictional taxation with heterogeneous firms. Burbidge et al. (2006) and Davies and Eckel (2010) study settings where firm heterogeneity gives rise to location rents. These models depart from the Diamond-Mirlees framework by allowing for positive aggregate profits and/or imperfect competition. Since these features are themselves capable of breaking the zero optimal tax result in settings without firm heterogeneity, the role of firm heterogeneity per se becomes more difficult to interpret. The current paper introduces producer heterogeneity without introducing other factors that could independently break the zero tax result and highlights the key role of the implicit apportionment system in generating location rents from the standpoint of the host country.

The rest of the paper is structured as follows. Section 2 presents the model. Section 3 studies optimal taxation. Section 4 discusses some additional implications of the model. Section 5 concludes.

[3] See Huizinga (1992) for a related point in the context of the R&D expenditures of multinational enterprises.

[4] See for example, Mintz and Tulkens (1996), Huizinga and Nielsen (1997) and Devereux and Hubbard (2003).

2 Model

2.1 Households

I study a setting with two countries: a small country and the rest of the world. The representative household in each country consumes a single final good that will be the numeraire, and is endowed with labor and capital. Labor is internationally immobile with the wage in country i given by w_i, and capital is mobile with rental rate r. Given that there is a single final good and this good is the numeraire, welfare in country i is given by the income of the representative households:

$$V_i = w_i L_i + rK_i + T_i,$$

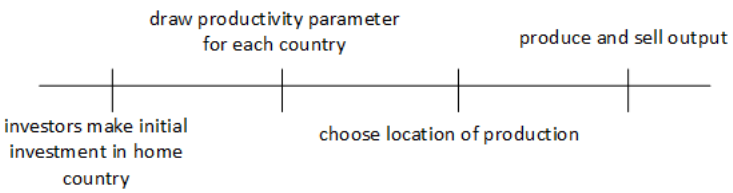
where L_i and K_i are the inelastic supplies of labor and capital, respectively; and T_i is government revenue rebated lump sum to the household. Note that there are no profits that enter into the household's budget because free entry will guarantee zero aggregate profits in equilibrium.

There are two points to note here in connection with Diamond and Mirlees (1971). First, the presence of a lump sum transfer indicates that I am studying a first-best setting instead of a second-best one unlike in much of the public finance literature. This is not an important difference in the context of the current paper because my main result is that the optimal tax rate on inbound FDI income is positive. If such a tax is optimal even in a first-best setting, it will be optimal a fortiori in a second-best context. Second, the Diamond-Mirlees framework requires that households receive no pure profits, either because there are no pure profits or because pure profits can taxed away at 100%. In this paper, the requirement that households receive no pure profits will be satisfied directly without a 100% tax on profits. This means that there are no pure profits in this model in the sense relevant for the production efficiency theorem, even though individual firms produce under decreasing returns to scale and do make variable profits. Put differently, as Dharmapala et al. (2011) point out, this type of setup essentially features constant returns to scale at the industry level.

2.2 Overview of Production

Figure 2.1 shows the logical timing of the events in the model. Ex-ante identical and risk-neutral investors in each country may pay fixed costs in their home country in order to engage in production. By doing so, they draw a productivity parameter for each country from a bivariate distribution. The investors then choose where to produce on the basis of their productivity draws. Finally, they will engage in production and sell their output at the world market price.

Figure 1: Timing of Events



A free entry condition guarantees that the investors make no profits in expectation net of the initial fixed costs they incur. Since there are a continuum of firms, zero expected profits will imply that there are no aggregate profits. This in turn means that the representative household in each country receives no pure profits from the activities of the firms that it owns. An individual firm, however, can make positive or negative ex-post profits. The entry process here is very similar to Melitz (2003) but with perfect competition instead of monopolistic competition as in Dharmapala et al. (2011).

Firms with different levels of productivity can co-exist in equilibrium despite perfect competition because each firm has a decreasing returns to scale production function. The decreasing returns to scale can be interpreted as reflecting the presence of an implicit firm-specific factor. The initial investment that enables production is the process by which this firm-specific factor is brought into existence. Given that the implicit firm-specific factor essentially determines each firm's productivity across the world, we could also interpret this initial entry process as an R&D investment with an uncertain return.

An alternative to the current setup would be a model with monopolistically competitive firms, such as Helpman et al. (2004). While assuming a decreasing returns to scale production function at the firm level is similar in many respects to a framework with firm-level product differentiation, there are a few important differences for the purposes of the current paper. First, imperfect competition generally introduces a pre-existing distortion that complicates the interpretation of an optimal tax problem. Second, in a monopolistically competitive setting, goods are differentiated at the firm level and so even small countries have terms-of-trade effects.[5] Finally, a perfectly competitive ensures that the current analysis remains within the Diamond-Mirlees framework.

[5]See Helpman and Krugman (1989) for more discussion of the complications that can arise when interpreting optimal trade policy questions in imperfectly competitive models.

2.3 Firm Problem

With this basic setup in mind, we can solve the model starting with the firm's problem. A firm will be indexed by a vector of productivity parameters $(\tilde{z}_1, \tilde{z}_2)$, where $\tilde{z}_i$ is the productivity parameter in country i. A firm with productivity parameter $\tilde{z}_i$ that has chosen to produce in country i whose home country is j solves the following problem:

$$\max_{l,k} \quad \left(1-\tau_{ij}\right)\left[\tilde{z}_i F_{ij}\left(l,k\right) - w_i l - rk\right], \tag{1}$$

where the choice variables l and k are the quantities of labor and capital, respectively, used by the firm; τ_{ij} is the tax rate faced by an investor in country i that is from country j. I will assume that $\tau_{ij} = \tau_i$ for $i \neq j$ and $\tau_{ii} = 0$: all foreign investors face the same tax rate while domestic investors are untaxed.[6]

$F(.)$ exhibits decreasing returns to scale and is assumed to be homogeneous of degree $\lambda < 1$. Under this homogeneity assumption, the pre-tax variable profit function $\pi_{ij}(w_i, r, \tilde{z}_i)$ can be written as ${\tilde{z}_i}^{1/(1-\lambda)}\pi_{ij}\left(w,r\right)$ (see Appendix A.1 for the proof). For notational simplicity, I will define $z_i \equiv {\tilde{z}_i}^{1/(1-\lambda)}$ and work with z_i instead of $\tilde{z}_i$ henceforth. The pre-tax variable profit function is then $z_i\pi_{ij}\left(w_i,r\right)$. We can also define the supply and factor demand functions that arise from the firm's problem: $x_{ij}\left(w_i,r,z_i\right)$, $l_{ij}\left(w_i,r,z_i\right)$ and $k_{ij}\left(w_i,r,z_i\right)$.

The tax system here allows for the deduction of all variable capital expenses and so is essentially a cash-flow tax. Such a tax does not distort the firm's intensive margin decision regarding how much labor and capital to use in production. However, the tax will still be distortionary because it will affect a firm's extensive margin decision concerning which country to produce in. Due to this extensive margin distortion, this assumption does not qualitatively alter the main argument made in this paper. Even if the tax base included the regular return to capital, part of the tax burden would still fall upon foreigners. A consideration that I have ignored here is that of potential royalty payments from the foreign affiliate to its parent for the use of the parent's technology. This is an important question that I postpone to subsection 4.1.

An investor chooses which country to produce in by comparing the profits it would make in each. It will locate in country i if it makes more profits by producing in i than in it would in the alternative country[7]:

$$\left(1-\tau_{ij}\right) z_i \pi_{ij}\left(w_i,r\right) \geq \left(1-\tau_{-ij}\right) z_{-i} \pi_{-ij}\left(w_{-i},r\right),$$

[6]Domestic firms being untaxed is not essential to the central point of this paper. This assumption allows us to clearly see that the incentives to tax foreign investors do not arise from the presence of fiscal externalities of any kind.

[7]For clarity of exposition, this setup assumes that the firm knows with certainty its productivity in each country before making its location choice. The main result will hold as long as the firm has a signal of its productivity in each location.

where the notation $-i$ refers to the country that is not i. We can define the set of firms from j that locate in i as follows:

$$\Theta_{ij} = \left\{ z : \left(1-\tau_{ij}\right) z_i \pi_{ij}\left(w_i, r\right) \geq \left(1-\tau_{-ij}\right) z_{-i} \pi_{-ij}\left(w_{-i}, r\right) \right\} \tag{2}$$

Further, I define the boundary set of Θ_{ij} – where the condition defining the set holds with equality – as $\partial\Theta_{ij}$.

2.4 Free Entry and Market Clearing

So far, I have discussed the problem solved by investors that have already drawn their productivities. I now turn to the entry process. An investor can choose to pay a fixed cost and thereby draw a productivity vector z from a joint distribution $G(z)$ with joint density $g(z)$. Across investors, the draws are independently and identically distributed. I assume that the components of z are not perfectly correlated and that z is bounded below at zero and has a finite upper-bound. These assumptions guarantee an interior solution where both potential production locations are always chosen by some investors from each country.

In equilibrium, a potential entrant makes zero expected profits net of the initial fixed costs. The required fixed costs in terms of labor and capital and will be denoted f_i and ϕ_i, respectively. The free entry condition in country j is then:

$$\sum_i \int_{\Theta_{ij}} \left(1-\tau_{ij}\right) z_i \pi_{ij}\left(w_i, r\right) g(z) dz \leq f_j w_j + \phi_j r \tag{3}$$

The left-hand side of (3) gives us the expected profits of a potential entrant. We need to sum over i because a firm could choose either country as the location of production. The term dz is a two-dimensional volume differential. If there is entry in equilibrium, the free entry condition will hold with equality. Note that this setup assumes investors are risk-neutral. Since there are a continuum of firms, the free entry condition implies that aggregate profits net of the fixed costs are equal to zero. This ensures that the fundamentals of the current model are consistent with Diamond and Mirlees (1971) since households will receive no pure profits. The presence of a continuum of firms also implies that there is no aggregate uncertainty in this model.

The model is closed by market clearing conditions for the final good and for the factors of production. For the final good, the condition is:

$$\sum_i \left(w_i L_i + r K_i + T_i\right) = \sum_i \sum_j m_j \int_{\Theta_{ij}} x_{ij}\left(w_i, r, z_i\right) g(z) dz, \tag{4}$$

where m_j is the measure of entrants from country j. Note that since there is a single final good

and this good is the numeraire, the demand for the good – the left-hand side – is equal to world income. The term on the right hand side of (4) is the world supply of the good. We sum over j to take into account the production of firms from each country and sum over i to aggregate across both locations of production. The market clearing conditions for labor and capital are:

$$L_i = \sum_j m_j \int_{\Theta_{ij}} l_{ij}(w_i, r, z_i)\, g(z) dz + m_i f_i \tag{5}$$

$$\sum_i K_i = \sum_i \sum_j m_j \int_{\Theta_{ij}} k_{ij}(w_i, r, z_i)\, g(z) dz + \sum_i m_i \phi_i \tag{6}$$

The two terms on the right-hand side of the factor market clearing conditions capture the fact that each factor is used to pay the fixed costs as well as being a direct input into production. Note that we sum over i for capital but not labor because capital is internationally mobile and so this market clears worldwide rather than country-by-country.

3 Optimal Taxation

3.1 Preliminaries

This section will study the optimal taxation of foreign firms from the standpoint of a small host country that will be denoted as country 1. The small country takes r and w_2 as given. Since it has a negligible effect on the aggregate profits of foreign firms, it also takes the mass of entrants in the rest of the world as given.[8] The variables that are endogenous from the point of view of the small country are its domestic wage, the set of firms that choose to site in the country and the mass of domestic firms. These variables are determined by country 1's labor market clearing condition, the location choice problem of firms, and by country 1's free entry condition.

Before turning to the government's problem, it will be useful to define several terms. The total after-tax profits made by foreign firms in country 1 is given by:

$$(1-\tau_1)\,\Pi_{12} = m_2 \int_{\Theta_{12}} (1-\tau_1)\, z_1 \pi_{12}(w_1, r)\, g(z) dz$$

Next, we can define the inframarginal profits earned by foreign firms in country 1 as:

[8] See Flam and Helpman (1987), Demidova and Rodriguez-Clare (2009) and Bauer et al. (2014) for similar small country assumptions in monopolistically competitive settings.

$$R_{12} = m_2 \int_{\Theta_{12}} \left[(1-\tau_1) z_1 \pi_{12}(w_1, r) - z_2 \pi_{22}(w_2, r) \right] g(z) dz$$

These inframarginal profits are defined as the difference between the after-tax profits made by foreign affiliates in country 1 and the counterfactual profits they would make in country 2. This expression captures the profits made by foreign affiliates in excess of what they would require in order to site in the host country. These inframarginal profits are location rents from the standpoint of the host country. They are not true rents in a global sense, however, because these profits enter into the foreign free-entry condition rather than accruing to foreign households. In Appendix A.2, I derive the derivatives of $(1-\tau_1)\Pi_{12}$ and R_{12} for later use.

3.2 Taxes, Welfare and the Optimal Tax Rate

We can now study the welfare effects of host-country taxation. I will focus on an equilibrium where there are no domestically owned firms and leave the simpler case with domestic firms to Appendix A.3. Given that there is a single final good and this good is the numeraire, welfare is simply given by the representative household's income:

$$V_1 = w_1 L_1 + r K_1 + \tau_1 \Pi_{12}$$

The effect of the tax on welfare is:

$$\frac{dV_1}{d\tau_1} = \frac{dw_1}{d\tau_1} L_1 + \Pi_{12} + \tau_1 \frac{d\Pi_{12}}{d\tau}$$

Noting that we are considering the case without domestic firms (i.e. $L_1 = L_{12}$) and evaluating this expression at $\tau_1 = 0$, we obtain:

$$\begin{aligned} \left.\frac{dV_1}{d\tau_1}\right|_{\tau_1=0} &= \frac{dw_1}{d\tau_1} L_{12} + \Pi_{12} \\ &= -\left.\frac{dR_{12}}{d\tau_1}\right|_{\tau=0}, \end{aligned}$$

where the second equality follows from an expression derived in Appendix A.2. To interpret the above result, note that $dR_{12}/d\tau_1$ is the effect of taxes on the inframarginal profits of foreign affiliates. This term captures the portion of the tax incidence that is not borne by domestic agents, since a reduction in the inframarginal profits of foreign affiliates does not affect incentives to

invest in country 1. Unsurprisingly, host country taxation will reduce these inframarginal profits (see Appendix A.3 for the formal proof) and so the small country will necessarily benefit from a sufficiently small tax:

$$\left.\frac{dV_1}{d\tau_1}\right|_{\tau_1=0} = -\left.\frac{dR_{12}}{d\tau_1}\right|_{\tau=0} > 0$$

In addition to showing that a small tax will improve welfare, we can also derive a formula for the optimal tax rate (see Appendix A.4 for the derivation):

$$\tau_1 * = \frac{dR_{12}/d\tau_1}{\frac{d}{d\tau_i}(1-\tau_1)\Pi_{12}} \tag{7}$$

This formula shows that the optimal tax rate depends on two key expressions. The numerator, as discussed earlier, captures the effect of the tax that is not borne by domestic agents. To the extent the tax is borne by foreigners, the optimal tax rate will be larger. The denominator captures the overall responsiveness of after-tax profits to host-country taxation. If profits are very responsive to taxes, we expect a greater behavioral distortion, and so the optimal tax rate will be smaller.

An important point to note throughout this analysis is that all of the derivations here would be the same whether the total mass of entrants in the rest of the world is determined by free entry or just fixed at some exogenous value. This is because either way, it is fixed from the standpoint of the small country which has a negligible effect on the aggregate worldwide profits of foreign firms. As a result, even though there are no rents that accrue to foreign households, from the standpoint of the small country, the situation is no different from one where the foreign households did receive rents from the activities of its firms.

4 Additional Discussion

4.1 Cost Apportionment and Zero Tax Result

This subsection will discuss the relationship between my results and the standard optimal zero tax results in the literature (e.g. Gordon, 1986). In my model, foreign affiliates make taxable profits in a host country despite the fact that there are no aggregate profits. We can obtain zero profits location by location in the current model – as in a setting that directly assumes constant returns to scale production functions – if we assume the presence of a specific type of cost apportionment system. Specifically, we require that initial investment costs are apportioned to each country pro-

portionately to the profits made in that country. Multiplying the free entry condition (3) that holds with equality by the mass of firms that enter in country j, we obtain:

$$\sum_i \int_{\Theta_{ij}} \left(1-\tau_{ij}\right) m_j z_i \pi_{ij}\left(w_i, r\right) g(z) dz = m_j f_j w_j + m_j \phi_j r$$

This condition simply states that the total profits of investors from country j excluding fixed costs are equal to the total fixed costs incurred in entry. If a share s_{ij} of the profits of firms from j were earned from production undertaken in i, the proposed apportionment system would imply that fixed costs equal to $s_{ij}\left(m_j f_j w_j + m_j \phi_j r\right)$ would be apportioned to country i. Consequently, the total profits apportioned to country i net of the fixed costs would be equal to zero:

$$s_{ij} \sum_i \int_{\Omega_{ij}^n} \left(1-\tau_{ij}\right) m_{ij} z_i \pi_{ij}\left(w_i, r\right) g(z) dz - s_{ij}\left(m_j f_j w_j + m_j \phi_j r\right) = 0$$

Thus, with such an apportionment system, there would be no economic profits earned in the host country, and so the basis for the positive optimal tax on foreign investors would no longer be present. A cash flow tax – which is the type of tax considered in the previous sections – would simply generate no revenue. If marginal capital expenses were not fully deductible, then the benchmark optimal zero tax result would hold directly. We can thus interpret the benchmark as implicitly assuming that there is a system which apportions costs so that profits are equal to zero location by location.

A natural example of such an apportionment system would be a specific type of royalty system. If the affiliate is making use of firm-specific assets that are owned by the parent, it should make royalty payments to the parent. It is natural to think of a royalty payment that is based on an arms-length valuation of the implicit firm-specific asset used by the foreign affiliate. If unrelated foreign affiliates could pay for this implicit asset, the equilibrium payment would be equal to the profits that can be made through its use. This is because any payment in excess would cause a loss to the buyer of the asset, while any payment less than profits will give rise to an infinite demand for the asset. If we employ this type of pricing for the asset, the affiliate would pay $\left(1-\tau_i\right) z_i \pi_{ij}\left(w_i, r\right)$ as royalties, and as a result, make no taxable profits.

Note that this type of cost apportionment would not be incentive-compatible. The host country would have an incentive to either tax the royalty payments or limit their deductibility. The royalty payments in this case would in fact be identical to what I have been calling profits so far, and the entire analysis as applied to profits would then apply to royalty payments instead. The model thus also suggests that countries have incentives to tax royalty payments from foreign affiliates to their parents for the same reason they have incentives to tax profits. This is consistent with the fact that

most countries impose taxes on cross-border royalty payments.

A further point to note here is that the royalty system in place in the world does not conform to this theoretically ideal system even aside from taxes and deduction limitations for at least two important reasons. First, only certain specific aspects of a parent's overall contribution to an affiliate's productivity will trigger royalty payments in reality. For example, if an affiliate is productive because of the parent firm's business culture or the quality of its general administration, this may not give rise to corresponding royalty payments. Second, this ideal system would be implausible from an informational standpoint. Standard transfer pricing methods would be unlikely to capture the profitability of an individual technology given that all firms have made the same initial investment.

4.2 Global Distortions

The previous section showed that a small host country that maximizes domestic welfare has an incentive to impose taxes on foreign investors. While optimal from the standpoint of a country that is acting unilaterally, these taxes are distortionary from the point of view of the world as a whole for two reasons. First, the taxes will affect location choice, as is evident from (2). This is because while all explicit costs are deductible, the opportunity costs – the profits that could be earned elsewhere in the world – are not. As a result, taxes will affect the location of production as is standard in models of international taxation.

This first distortion would be absent if the opportunity costs were hypothetically deductible so that the tax would apply only to the inframarginal profits. There is a second distortion that would exist even if opportunity costs were deductible. This second distortion arises because taxes affect the expected profit of an entrant (see (3)). We can imagine an alternative model to the current one where we drop the free entry conditions (3), and the mass of entrants are treated as exogenous. In this alternative model, a hypothetical tax on inframarginal profits would merely be a lump sum transfer from one country to another that has no behavioral effects. Thus, the endogeneity of firm creation – which is governed by the free entry condition – causes an additional global distortion.[9]

Because countries have unilateral incentives to tax foreign investors even when this tax is globally distortionary, the model suggests potential incentives for countries to coordinate to mutually reduce the taxes imposed on foreign investors. This is consistent with the fact that bilateral tax treaties entail reductions in dividend withholding tax rates. The discussion concerning royalties in 4.1 suggests that countries have incentives to tax royalties that are similar to the incentives to tax profits. This model thus also provides a possible explanation for why countries use royalty withholding taxes and why these taxes are reduced by bilateral tax treaties.

[9]Note also that this distortion is distinct from a potential distortion to world savings that would arise if capital supply were not perfectly inelastic.

4.3 Implications for Tax Competition

In this model, there are location rents from the small country's standpoint because of which it will have unilateral incentives to tax foreign investors. These are incentives that would counteract a race to the bottom in an open economy. The incentives to tax foreign investors arise from an externality that the host country imposes on the rest of the world and therefore can only exist in open economies.[10] The model thus identifies a mechanism because of which increased globalization need not be a downward pressure on tax rates.[11]

Given the forces that drive the incentives to tax foreigners, the model suggests two factors that could potentially mitigate the effects of tax competition in reality. First, greater globalization increases the likelihood that investments undertaken in one country contribute to profitability elsewhere in the world. As a result, countries are likely to host firms whose profitability may be connected with investments that were not specifically made with the host country in mind. To the extent that this is the case, host countries would have increased incentives to tax foreign investors.

The second reason is one that has been discussed in the literature before but is present in the current model in a particularly sharp manner. The increasing share of foreign ownership of firms should imply a greater incentive to impose taxes on business income in general (Huizinga and Nielsen, 1997).[12] The existing literature makes this claim in a context where there are rents which give rise to conceptually similar incentives to tax domestic and foreign firms. In the current paper, host-country incentives arise from an externality imposed on the rest of the world and thus these incentives are more directly connected to taxing foreign investors specifically.

[10] In a closed economy, a cash-flow tax would either raise no revenues (if the fixed costs are deductible) or would be sub-optimal because it causes production inefficiency (if the fixed costs are not deductible).

[11] It should be noted that the incentives discussed here apply to taxes on the taxable economic profits of foreign investors. To the extent that variable capital expenses are not deductible, the standard forces leading to downward pressures on tax rates would still be present.

[12] See also Huizinga and Nicodeme (2006), who provide empirical evidence that higher foreign ownership is associated with higher corporate tax rates.

5 Conclusion

This paper shows that small host countries can have incentives to tax inbound FDI even in a competitive setting with free entry. While investors make no aggregate profits worldwide, they make taxable profits in foreign production locations because part of their investment costs are incurred in their home country. Due to firm productivity differences, some firms will be inframarginal in a foreign location. By taxing foreign investors, host countries can partially tax these inframarginal profits. While such taxes discourage investment in the rest of the world, a small country does not internalize this effect and thus has an incentive to tax foreign investors.

A literature based on Diamond and Mirlees (1971) has served as the basis for much of the policy advice in the area of international taxation. The current paper shows that one important piece of advice that is usually taken to be an implication of this framework – that small countries should not impose source-base investment taxes – need not hold even within the framework itself. The reason for this is that location rents that justify taxes on inbound FDI can exist from the standpoint of a host country even in a setting where expected profits are competed away by entry. This analysis thus identifies incentives to tax inbound FDI that are likely to be relevant across a wide range of countries and industries.

Chapter III

Taxing and Subsidizing Foreign Investors

1 Introduction

Most countries impose taxes on foreign investors in the form of corporate and withholding taxes while also having in place various subsidies and tax incentives that are designed to attract them. In this paper, I use a perfectly competitive model with heterogeneous firms to show that a policy of simultaneously imposing taxes and subsidies on foreign firms can be optimal from the point of view of a host country. The government has an incentive to tax inframarginal firms because the burden of this tax will fall on the profits of these firms. It also has an incentive to subsidize foreign firms that are close to the margin in their decision to locate in the host country because the increase in domestic wages generated by such a subsidy can exceed the fiscal cost of the subsidy.

When governments offer subsidies to foreign investors, these policies are often motivated by the notion that the economic activity generated by attracting firms can exceed the fiscal cost to the government. In a closed economy setting, subsidies may be able to encourage certain activities but the fiscal cost of a subsidy will generally exceed the private benefits. This is because the subsidies would be propping up firms that are not efficient enough to operate otherwise. The optimality of the subsidy in the current paper provides a formalization of the idea that in an open economy setting, the economic benefit generated by attracting foreign firms can indeed exceed the fiscal cost. This is possible because the subsidy benefits domestic workers at the expense of foreign workers.

This improvement in domestic welfare from the subsidy is ultimately made possible by an improvement in the host country's terms-of-trade: by attracting foreign firms, the host country is reducing the labor devoted to producing its domestic export good, thereby increasing the relative price of its exports. This improvement in the terms-of-trade is equivalent to an improvement in the relative domestic wage. In this setting, where trade and FDI are substitutes, a subsidy to FDI has a beneficial terms-of-trade effect in much the same was as a tariff usually does. My analysis thus suggests that when policymakers seek to attract foreign firms, this may indirectly be understood in

terms of effects on the terms-of-trade.

A natural question that arises is whether a policy where governments target taxes and subsidies towards specific firms is realistic. Most governments do in practice negotiate with foreign firms and provide subsidies and tax incentives on a case by case basis. Combined with uniform taxes, this means that governments do effectively target their fiscal policies to specific firms. This suggests that they at least believe they can target their policies well enough that it is worthwhile to do so. While I do discuss some ways in which governments may be able to partly target marginal vs. inframarginal firms without requiring information on individual firms, the focus of the current paper is on discussing the incentives to target, taking as given the ability.

While the taxes and subsidies discussed in this paper are optimal for the host country, they introduce inefficiencies from the standpoint of the world as a whole. Consequently, there are potential gains from policy coordination, and this coordination could lead to both lower subsidies and lower taxes. This seems to be consistent with some seemingly contradictory aspects of international tax coordination. For example, while countries and sub-national jurisdictions often discuss potential attempts to reduce harmful tax competition – consistent with a desire to reduce subsidies and tax incentives – bilateral tax agreements routinely involve reductions in withholding taxes imposed on foreign investors. This effort to reduce both taxes and subsidies is particularly notable in the case of the European Union, which has abolished withholding taxes on transfers within the region while at the same time having measures that attempt to curb the use of preferential subsidies.

The existing literature has identified a number of rationales for either taxing or subsidizing inbound FDI. The current paper differs from this literature in two important ways. First, most of this literature highlights either reasons to tax or to subsidize foreign investors but does not explain the simultaneous existence of incentives to impose both taxes and subsidies.[13] Second, the existing work emphasizes how subsidies may be optimal in the presence of market imperfections such as imperfect competition. Particularly relevant to this paper is work that studies investment subsidies in imperfectly competitive models with heterogeneous firms models (Chor, 2009; Bauer et al., 2014; Langenmayr et al., 2015). In these papers, the subsidies indirectly help address the fact that there is inefficiently low production in the imperfectly competitive industry. By contrast, the model in the current paper is perfectly competitive and so the subsidies are not responses to pre-existing market failures.

This paper is also related to a tax competition literature that studies preferential regimes with mobile and immobile tax bases (Janeba and Peters 1999; Keen, 2001; Janeba and Smart, 2003). These papers assume that governments seek to maximize revenue by taxing capital and so do not analyze whether such taxes are optimal from the point of view of domestic welfare. Furthermore,

[13] An exception is Langenmayr et al. (2015), who discuss differential incentives to tax or subsidize high- and low-profitability firms.

while governments have incentives to impose differential tax rates on different bases in these analyses, they have no incentives to impose actual subsidies.

In addition to the existing literature on government policies towards mobile investment, the current paper is also connected to existing work on export subsidies. This literature emphasizes the fact that when there are more than two sectors, export subsidies can be optimal due to terms-of-trade effects. Particularly connected to the current paper, Itoh and Kiyono (1987) use a Ricardian model with a continuum of goods to show that export subsidies imposed on marginal sectors can improve domestic welfare.[14] My paper shows that a similar logic applies in the case of governments seeking to attract FDI. Unlike in the export subsidies literature, however, what matters in the current setting is attracting new firms rather than new export sectors.[15]

The rest of the paper is ordered as follows. Section 2 presents the model. Section 3 shows that a tax on inframarginal firms and a subsidy on marginal firms both improve domestic welfare. Section 4 discusses further some aspects of the analysis. The final section concludes.

2 Model

2.1 Households

There are two countries: the host and foreign country, and these will be denoted country 1 and country 2, respectively. Utility in country i given by:

$$U\left(x_{i1}, x_{i2}\right)$$

x_{ij} denotes the consumption in country i of the country j good. This is similar to an Armington assumption except that goods are differentiated by the ownership country of the firm producing it and not necessarily the location of production. Goods are assumed to be freely traded and the foreign good will be the numeraire; the price of the domestic good will be denoted p_1.

Labor is the only factor of production and is supplied inelastically. As in much of the recent trade literature, FDI is modeled in this paper in terms of firms choosing their location of production rather than as a transfer of a factor of production.[16] Government revenue T_i is rebated lump-sum to the household so that the household's income is: $w_i L_i + T_i$. Owing to free entry, no pure profits will enter the household's budget.

[14] See also related work by Costinot et al. (2015), who show the optimality of using export taxes or subsidies that vary by sector.

[15] This also implies that it is not essential for there to be more than two goods here.

[16] Having mobile capital in addition to labor would not alter the basic point that is made in this paper.

I assume that preferences are identical and homothetic, and that the two goods are net substitutes. The assumption of identical and homothetic preferences is made primarily for the purpose of providing a clearer analysis. The assumption that the goods are substitutes will be a sufficient condition for a key result. Given these assumptions, the demand function can be written as:

$$x_{ij}(p_1, w_i L_i + T_i) = \theta_j(p_1)(w_i L_i + T_i),$$

with $\theta_j'(p_1) < 0$.

2.2 Production

Each country has a mass of firms M_i that will be determined endogenously by free entry. Firms produce their home country good under perfect competition. Throughout, I will use the term "home country" to refer to the ownership country of the firm and not necessarily to where it chooses to engage in production. Firms are assumed to produce under decreasing returns to scale, reflecting the presence of an implicit firm-specific factor. The decreasing returns to scale allows us to incorporate fixed costs and firm-level heterogeneity without introducing imperfect competition.

In order to focus sharply on the main point of the paper, I will assume that only firms from the foreign country engage in FDI. To do so, they must pay a fixed cost that will permit them to produce in the host country instead of producing in their home country. This fixed cost varies at the firm-level and is drawn upon domestic entry from a probability distribution $G(f)$ with density $g(f)$. I also assume that the support of this distribution is unbounded above. Since the fixed cost is the sole dimension of heterogeneity between firms, it will be convenient to index firms by their fixed cost f.[17]

A firm producing in country i that is from j solves the following problem:

$$\max_{l} \quad \left[1 - \tau_{ij}(f)\right]\left(p_j F_{ij}(l) - w_i l\right) - s_{ij}(f),$$

where $F_{ij}(l)$ is the production function; w_i is the wage in country i ; and$\tau_{ij}(f)$ and $s_{ij}(f)$ are the tax and the subsidy schedules faced by a firm with fixed cost f. The results in this paper will focus on showing that certain types of policies improve domestic welfare and I will discuss these specific policy instruments in Section 3. To avoid the presence of fiscal externalities that could complicate the interpretation of my results, I assume throughout that domestic firms receive no taxes or subsidy: $\tau_{ii} = 0$ and $s_{ii}(f) = 0$. The firm solves this problem by setting the marginal product of labor equal to the wage:

[17]Unlike in much of the work in the international trade literature following Melitz (2003), I assume that the heterogeneity is in the fixed costs rather than in marginal costs. This is not essential for the main point in the current paper.

$$p_j F'_{ij}(l) = w_i$$

Notice that the way the policies are specified, they do not distort a firm's problem conditional on location choice. The presence of additional margins of distortion would not, however, alter the main point of this paper. The firm's problem gives rise to a pre-tax variable profit function, a supply function and a labor demand function: $\pi_{ij}\left(p_j, w_i\right)$, $q_{ij}\left(p_j, w_i\right)$ and $l_{ij}\left(p_j, w_i\right)$.

A firm from the foreign country with FDI cost f has the option to produce in either country. The marginal firm that is indifferent about where to produce is defined by:

$$\left[1 - \tau_{12}\left(f\right)\right]\pi_{12}(w_1) + s_{12}(f^*) - f^* w_2 = \pi_{22}(w_2) \tag{8}$$

A firm with a lower cost of FDI than the cutoff (i.e. with $f < f^*$) will produce in the host country while firms with higher costs (i.e. $f > f^*$), will produce in the foreign country. I will throughout assume an interior solution where at least some firms engage in FDI.

2.3 Equilibrium

The mass of firms from each country M_i will be endogenously determined by a free-entry condition which states that a potential entrant makes zero expected profits net of a fixed cost of entryϕ_i. Note that this fixed cost is distinct from the fixed cost of FDI and does not vary across firms. Since I have assumed that host country firms do not engage in FDI, potential domestic entrants are essentially identical and so their free entry condition simply states that profits are deterministically equal to the fixed cost:

$$\pi_{11}(p_1, w_1) = \phi_1 w_1 \tag{9}$$

The equivalent condition for entrants in the foreign country is given by:

$$\int_{f^*}^{\infty} \left[\pi_{22}(w_2)\right] g(f) df + \int_{0}^{f^*} \left[\left(1 - \tau_{12}\right)\pi_{12}(w_1) - f w_2 + s_{12}\left(f\right)\right] g(f) df = \phi_2 w_2$$

To close the model, we need market clearing conditions for goods and factors. The market clearing condition for good 1 is:

$$\theta_1\left(p_1\right) W = M_1 q_{11}\left(p_1, w_1\right), \tag{10}$$

where W is world aggregate income. The left-hand side above captures the world demand for the

good and the right-hand side the world supply. Note that since host country firms do not engage in FDI by assumption, the world supply is entirely provided by production taking place in the host country. The labor market clearing condition in country 1 is:

$$L_1 = M_1 l_{11}(p_1, w_1) + G(f^*) M_2 l_{12}(w_2) \tag{11}$$

The goods and labor market clearing conditions for country 2 are similar.

2.4 Small Country

In order to illustrate the central point of the paper as clearly as possible, it will be convenient to work under the assumption that the host country is small. The small country assumption is not conceptually important here but it will allow us to focus sharply on the mechanisms driving the results. Given the Armington-like assumption (i.e. the host and foreign country goods are exogenously differentiated), this is in any case not a classical small country setting because the small country will still have world market power in its own good. I discuss the differences in large country case further in Section 4.2.

The small country assumption means that from the standpoint of the host country's policies, we can take the foreign wage, w_2, the mass of firms in the rest of the world, M_2, and world aggregate income W as given. The endogenous variables are then: w_1, p_1, M_1 and f^*. These are determined by (8), (9), (10), and (11). Note that the small country ignores the foreign free-entry condition as well as the foreign market clearing conditions.

We can further simplify this setup into a system of two equations and two variables. From the free-entry condition (9), we can write $p_1 = p_1(w_1)$, where $p_1'(w_1) > 0$. Next, we can combine the goods market clearing condition and the labor market clearing condition to eliminate M_1 and obtain a single augmented labor market clearing condition:

$$L_1 = \frac{\theta_1 [p_1(w_1)] W}{q_{11}[p_1(w_1), w_1]} l_{11}[p_1(w_1), w_1] + G(f^*) l_{12}(w_1) \tag{12}$$

The other remaining condition is the condition defining the marginal foreign investors, (8). Together, these two conditions will determine w_1 and f^*.

The marginal foreign investor condition implies a relationship between $f^*$and w_1 that we can write as $f^* = \Phi(w_1, s)$. Appendix B.2 shows that $\partial\Phi/\partial w_1 < 0$ and $\partial\Phi/\partial s > 0$. The intuition for $\partial\Phi/\partial w_1 < 0$ is that at a higher wage, firms would be less willing to locate in the host country and so the marginal firm has to be one with a lower cost of FDI. $\partial\Phi/\partial s > 0$ because a higher subsidy will encourage more firms to enter at any wage.

The augmented labor market clearing condition also implies a relationship between $f^*$and w_1 that we can write as $f^* = \Gamma(w_1)$. Since the small country's share of global income is negligible, we

can ignore the effect of T_1 on global demand. In this case, $\partial\Gamma/\partial w_1 > 0$ (see Appendix B.3). The intuition for this is that if there are more foreign firms (higher f^*), wages have to rise to reduce the quantity of labor demanded and restore equilibrium. The preference restrictions ensure that increased labor demand will indeed lead to a higher wage. Since the wage is connected to the price of the domestic good through free-entry, this would not necessarily be the case if the host and foreign country goods were complements. Note also that this substitutability assumption is sufficient but not necessary.

3 Inframarginal Taxes and Marginal Subsidies

In this section, I will first show that a tax on inframarginal firms and a subsidy for marginal firms both improve domestic welfare. To make it clear that these results do not derive from the interaction of the tax and the subsidy or from potential fiscal externalities, I will initially analyze each policy separately. Thereafter, I will show that it is optimal to simultaneously employ taxes and subsidies.

3.1 Inframarginal Tax

Consider an equilibrium without taxes or subsidies. Now consider introducing what I will call an inframarginal tax. An inframarginal tax is a tax on foreign firms with sufficiently low f that leaves the marginal investor untaxed. A tax will be inframarginal in this sense as long as the taxed firms have low enough f and the tax rate is not too high. Of the two conditions that determine the equilibrium in the host country, tax and subsidy policies only affect the marginal foreign investor condition, (8). Even here, it is only policies that affect the marginal firm that matter. Thus, taxes on inframarginal firms have no effect on the equilibrium w or f^*. Thus, an inframarginal tax will necessarily improve welfare.

A couple of points should be noted regarding this result. First, the profits of inframarginal firms are rents from the standpoint of the host country. As discussed in greater detail in Chapter II, they are not true rents because from a global standpoint, they affect entry incentives in the foreign country through free-entry. However, the small country ignores this effect because the ex-ante probability of a potential foreign entrant locating in the host country is negligible. Second, given the current setup, taxes can affect a firm's location choice but do not distort a firm's problem conditional on location. If there were an additional margin of distortion – perhaps arising from imperfect deductibility of variable expenses – this proof would be more complex. Nevertheless, the key point that gives rise to an incentive to tax inframarginal firms is the fact that part of the burden falls on the profits of the foreign investors, and this would be true even with intensive margin distortions.

3.2 Marginal Subsidies[18]

We will now consider a policy whereby the government offers a subsidy to firms that are close to the margin. Each subsidized firm will receive a fixed subsidy s. Under this assumption, the marginal foreign investor condition becomes:

$$\pi_{12}(w_1) + s - f^* w_2 = \pi_{22}(w_2)$$

We can now define $\underline{f}$, which will be a firm that is indifferent about locating in the country without a subsidy in the equilibrium where the subsidy is employed, by the following condition:

$$\pi_{12}(w_1) - \underline{f} w_2 = \pi_{22}(w_2)$$

The type of policy I consider is one where the subsidy s is offered to firms between f^* and $\underline{f}$. Importantly, this means that the rate of the subsidy is connected to the set of firms subsidized. As the subsidy rate goes to zero, the set of firms that can be attracted vanishes and so f^* approaches $\underline{f}$. As the subsidy gets larger, f^* and $\underline{f}$ diverge from each other.

With the subsidy described in this manner, we can first look at the effect of a small increase in the subsidy around $s = 0$ on the total subsidy bill. The subsidy bill is given by:

$$-T_1 = M_2 s \left[G(f^*) - G(\underline{f}) \right]$$

Differentiating with respect to s and evaluating at $s = 0$, we obtain:

$$-\frac{dT_1}{ds}\bigg|_{s=0} = M_2 \left\{ s \frac{d}{ds} \left[G(f^*) - G(\underline{f}) \right] + \left[G(f^*) - G(\underline{f}) \right] \right\}_{s=0} = 0$$

The derivative above has two terms. The second term captures the mechanical increase in the subsidy bill when the rate is increased, while the first term captures the behavioral response. The fact that the effect of the behavioral response is equal to zero when $s = 0$ is standard. What is special here is that even the mechanical increase in the subsidy bill is of second-order. This is the case because by construction, as the subsidy rate approaches zero, the subsidy base also vanishes. Intuitively, the closer to the margin one decides to target, the smaller the subsidy one needs.

The above analysis shows that the fiscal cost of a small subsidy increase around $s = 0$ is insignificant. This implies that as long as the subsidy increases utility from private consumption, it will be optimal to impose a sufficiently small subsidy. Household welfare is given by the indirect utility function: $V_1(p_1, w_1 L_1 + T_i)$. The effect of the subsidy on welfare is:

[18] The analysis in this section parallels Itoh and Kiyono's (1987) study of export subsidies.

$$\begin{aligned}
\left.\frac{dV_1}{ds}\right|_{s=0} &= \frac{\partial V_1}{\partial p} p_1'(w_1)\frac{dw_1}{ds} + \frac{\partial V_1}{\partial w}\left(L_1\frac{dw_1}{ds} + \left.\frac{dT_1}{ds}\right|_{s=0}\right) \\
&= \frac{dw_1}{ds}\frac{\partial V_1}{\partial w}\left[-x_{11}p_1'(w_1) + L_1\right] \\
&= \frac{dw_1}{ds}\frac{\partial V_1}{\partial w}\frac{1}{w_1}\left[-x_{11}p_1'(w_1)w_1 + w_1L_1\right] \\
&= \frac{dw_1}{ds}\frac{\partial V_1}{\partial w}\frac{1}{w_1}\left[w_1L_1 - p_1x_{11}\right]
\end{aligned}$$

The third equality above uses Roy's identity and the fourth uses the fact that $p_1'(w_1)w_1 = p_1$ (see Appendix B.1. for a proof of this fact). Since the household spends some income on the foreign good, household income is greater than its expenditure on the domestic good: $w_1L_1 - p_1x_1 > 0$. Thus, the sign of the effect of the subsidy on private welfare is given by the sign of dw_1/ds. The intuition for this is that a simultaneous increase in the wage and the price of the domestic good still implies greater purchasing power with respect to the foreign good.

Given that the subsidy bill is of second-order in the subsidy rate, to show that a small subsidy is optimal, it now suffices to show that $dw_1/ds > 0$. With the functions defined earlier, the equilibrium w_1 is determined by:

$$\Phi(w_1, s) = \Gamma(w_1) \tag{13}$$

Using the implicit function theorem:

$$\frac{dw_1}{ds} = -\frac{\partial\Phi/\partial s}{\partial\Phi/\partial w_1 - \partial\Gamma/\partial w_1} > 0$$

The intuition here is straightforward. An increase in the subsidy attracts more firms, causing an increase in labor demand; in order to maintain equilibrium, the wage must rise.

3.3 Simultaneous Taxes and Subsidies

The results so far have shown that a tax on inframarginal firms and a subsidy to marginal firms each improves welfare separately. The fact that it is optimal for the host country to simultaneously impose taxes and subsidies follows easily from the foregoing analysis. The earlier argument that inframarginal taxes improve welfare applies without modification even in the presence of a subsidy to marginal firms. In the case of the subsidy, the analysis needs to take into account how the subsidy will affect tax revenue. In particular, by increasing wages, the subsidy will reduce the profits of foreign firms and thereby reduce tax revenues. In Appendix B.4, I show that a sufficiently small

subsidy will improve welfare in the presence of inframarginal taxes despite this fiscal externality. It is thus optimal for the host country to simultaneously tax inframarginal firms and subsidize marginal ones.

4 Further Discussion

4.1 Terms of Trade

The fact that $dw_1/ds > 0$ also implies that $dp_1/ds > 0$ since free-entry has allowed us to write p_1 as an increasing function of w_1. Since the price of the foreign good is the numeraire, p_1 is simply the conventional terms-of-trade and so $dp_1/ds > 0$ captures an improvement in the terms of trade. Given the numeraire choice, w_1 is the single factoral terms-of-trade (Viner, 1937) and so the increase in the wage as defined here is itself a different type of terms-of-trade appreciation.

Note also that if p_1 were fixed by the world market – so that there are no terms of trade effects possible – $w_1$would also be fixed by free entry and so dw_1/ds would be equal to zero. Without terms-of-trade effects, the increased entry by foreign firms would not actually lead to an increase in labor demand because it would perfectly crowd out the labor demand of domestic firms. This illustrates how the presence of terms-of-trade effects here is essential to ensure the intuitive property that a subsidy that attracts foreign firms will increase wages.

4.2 Large Country

The variables that the small country takes as fixed owing to its size are the foreign wage, w_2, and the foreign mass of firms, M_2. Given the numeraire choice (i.e. $p_2 = 1$), the foreign wage would in fact be fixed by the foreign free-entry condition even in the absence of a small host country assumption. Thus, the only additional margin in case of a large country are changes in M_2. The difference between a small country and a large one is that the latter internalizes to some extent how its tax and subsidy policies will affect business creation in the rest of the world.

Taxes in the large host country would reduce the profits of potential entrants in the foreign country, and so lead to a lower M_2. This would thus reduce the country's incentives to tax foreign firms. Nevertheless, the optimality of the tax arises from the fact that part of the incidence falls on foreigners, so this would not qualitatively affect the results here. In the case of a subsidy, the expected profit of a foreign entrant would increase and thus, so would M_2. A large country would internalize this benefit and so would have an even stronger incentive to impose a subsidy.

4.3 Implementability and Targeting

Throughout this analysis, I have assumed that the government is able to distinguish marginal firms from inframarginal ones. A policy of this type could be constructed using a uniform tax in conjunction with targeted subsidies. This is close to the actual practice in many countries, since governments do negotiate with firms and provide subsidies and tax incentives on an individual basis. This suggests that governments believe they have enough information to carry out such a policy well enough to make it worthwhile. My analysis shows that if the government is able to target firms in this manner, then imposing taxes and subsidies simultaneously can make sense. While not the focus of the current paper, it is still natural to ask whether my analysis can be informative about potential targeting methods.

First, note that any firm that is attracted to the country by a subsidy is necessarily a marginal firm. This means that if we start in equilibrium and then offer a subsidy to new firms, the new entrants will be marginal firms. Thus, a policy of offering incentives to new firms that enter a country – a common practice throughout the world – could be self-targeting. Of course, such a policy will be effective only if the new entrants are in fact ones that are attracted to the country by the policy. To the extent that there are changes in economic conditions that make the country more attractive to certain foreign investors, new entrants will not necessarily be marginal. While a more thorough analysis of the desirability of these types of policies would require a dynamic model of entry and exit that is beyond the scope of the present paper, these considerations are suggestive of a role for such policy instruments.

There is also a second method of targeting that is particularly stark in in this setting. A policy of offering every foreign firm a fixed subsidy and a uniform tax rate would guarantee in this model that inframarginal firms are taxed at a higher rate than marginal ones. With an appropriate subsidy and tax rate, it would be possible for the government to subsidize marginal firms while taxing inframarginal ones. In addition to the current model, this type of policy would also effectively distinguish between marginal and inframarginal firms in models such as Helpman et al. (2004), where only the largest and most productive firms engage in FDI.

Note, however, that this type of policy is unlikely to be a perfect targeting mechanism in reality. In particular, fixed costs are not the only relevant margin for FDI: it is possible that a highly profitable firm is marginal because it would almost as profitable elsewhere in the world. This could be the case, for example, in models such as Burbidge et al. (2006) and the one in Chapter II where firm productivity varies across locations. Nevertheless, to the extent that fixed costs are important in determining the extensive margin of FDI, fixed subsidies could potentially be a useful component of an overall tax-subsidy policy or as part of negotiations with foreign firms.

4.4 Global Distortions and Coordination

The results in the current paper explain why countries have incentives to tax inframarginal firms and subsidize marginal ones. Given the nature of these policies, they improve domestic welfare at the cost of foreigners. By reducing investment and labor demand in the rest of the world, subsidies hurt foreign workers. As discussed above, this is equivalent to an improvement in the host country's terms-of-trade. As with the subsidy, the burden of the tax is also partly borne by foreign agents.

Given that these are distortionary policies that improve domestic welfare at the cost of foreigners, the global first-best optimum would entail no such taxes or subsidies. The model thus suggests why tax coordination efforts could lead to reductions in both taxes and subsidies. This seems consistent with the fact that countries often discuss coordination efforts to fight tax competition but are also engaged in tax arrangements that mutually reduce the tax burden faced by foreign investors. Particularly relevant here, the European Union has abolished withholding taxes on transactions within the region and it has also issued directives curbing preferential regimes sustained by what it deems to be discriminating subsidies. My analysis provides an explanation that rationalizes this simultaneous concern with both the imposition of taxes and subsidies on foreign investors in the context of policy coordination efforts.

5 Conclusion

This paper shows that a policy of simultaneously taxing and subsidizing foreign investors can be optimal for a host country. A tax on inframarginal firms raises revenue at the cost of the profits of these relatively immobile firms, while a subsidy on marginal firms can increase domestic wages by attracting economic activity at a low fiscal cost. The optimality of the subsidy here provides a formalization of the common notion that the economic activity generated in a jurisdiction by attracting mobile firms can be worth the fiscal cost. This effect is ultimately made possible by an improvement in the country's terms-of-trade.

These policies improve domestic welfare by hurting foreigners and are thus not optimal from the standpoint of the world as a whole. Consequently, the model is able to explain why bilateral treaties entail reductions on taxes on foreign investors while at the same time, policymakers are concerned about the harmful competitive effects of subsidies and tax incentives. The European Union in particular has abolished withholding taxes within the region but has also issued directives against preferential regimes, consistent with these considerations.

Chapter IV

Optimal Tariffs with Inframarginal Exporters

1 Introduction

The study of trade policy has been a central concern in economics since the inception of the field. Much of this analysis has centered around understanding the incentives that countries may have to impose tariffs. While there is a vast literature on this topic, the basic rationales identified in the literature generally fall into one of two basic categories. The first – dating to Torrens (1884) – is that it may be optimal for countries to impose tariffs when they have some power to affect world market prices. The second is that tariffs can be beneficial when there are pre-existing distortions, as in Mills' (1848) infant industry argument.

The current paper identifies a reason why the optimal tariff can be positive for a small country with no world market power in a setting without pre-existing distortions. When there are inframarginal exporters, a small country has an incentive to impose tariffs to tax some of the rents that these firms earn from exporting. To show that this is truly an independent reason to impose tariffs, I develop a heterogeneous firms model with fixed costs of exporting in a setting that preserves perfect competition. Fixed costs are possible despite perfect competition because each firm produces under decreasing returns to scale. If there were no fixed costs of exporting, the optimal tariff in this setting would be equal to zero just as in the standard small open economy analysis.

The extensive margin of trade is the key theme in the international trade literature that deals with heterogeneous firms following Melitz (2003). Demidova and Rodriguez-Clare (2010), Felbermeyer et al. (2013), Haaland and Vanables (2014) and Costinot et al. (2016) study optimal trade policy in the context of this type of model with monopolistic competition and firm heterogeneity. As Helpman and Krugman (1989) point out, monopolistically competitive models have two characteristics that can give rise to a positive optimal tariff: the presence of a distortion due to

imperfect competition, and the fact that due to firm-level product differentiation, even small countries will have some world market power. Thus, both of the traditional reasons for an optimal tax are present in such settings even apart from any extensive-margin considerations. Consequently, it is difficult to specifically interpret the normative implications of the extensive margin of trade and the presence of inframarginal exporters using this type of model. Indeed, this existing literature has not identified the key point of the current paper: that the extensive margin of trade can itself give rise to a positive optimal tariff. This paper is able to overcome this difficulty by developing a model with an extensive margin but without imperfect competition.

The current paper is also connected to a broader literature studying trade policy under imperfect competition, which often highlights the importance of exporter rents. In particular, Katrak (1977) and Svedberg (1979) explain how tariffs can be optimal when the importing country is supplied by a foreign monopolist. The literature has interpreted this argument as a second-best case for tariffs that rests on the pre-existing distortion created by imperfect competition. My analysis too highlights the role of tariffs in taxing exporter rents, but it shows that such a motive is not merely a byproduct of imperfect competition. This point is substantively important because the most common objection to the tariff argument in imperfectly competitive settings is that tariffs are dominated by policies that directly address the distortion. The tariff motive in this paper is not subject to this objection since there are no pre-existing distortions in my setting.

While the incentive to impose tariffs identified here does not rely on the importing country having monopoly power in the world market for any good, it is still a type of terms-of-trade argument. Owing to the fixed costs of exporting, the price in the importing country is higher than in the exporting country. The importing country is able to improve domestic welfare by reducing the pre-tariff price in its domestic market. A common skepticism about the importance of terms-of-trade motives for tariffs arises from the fact that price manipulation does not seem to be a compelling account of policymaker intent. By providing a version of the terms-of-trade argument that can be understood in terms of a policymaker's desire to tax away exporting rents, the current paper strengthens the case for the relevance of terms-of-trade analysis. It thereby also strengthens the case for a version of the terms-of-trade theory of multilateral trade agreements (Bagwell and Staiger, 1999), which views such agreements as being a response to a terms-of-trade induced prisoner's dilemma.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 studies the optimal tariff problem. Section 4 discusses some additional considerations and the final section concludes.

2 Model

2.1 Setup

I study a partial equilibrium setting with a small home country and a large foreign country. Households consume a numeraire good m and the good of interest x, with utility in the home country given by:

$$U = m + V(x)$$

I assume that $\lim_{x->0} V'(x) = \infty$ to ensure that there will always be some consumption of x in the home country in equilibrium regardless of the price. In order to highlight the main contribution of the paper, I assume that x is produced only in the foreign country.[19]

There is a mass $\hat{n}$ of firms that produce x in the foreign country. It will not matter for this analysis whether $\hat{n}$ is determined endogenously by free entry or is exogenous because either way, it would be exogenous from the standpoint of the small country. Firms produce under decreasing returns to scale with labor as the only factor of production. Each firm can choose to pay a firm-specific fixed cost f in terms of labor in order to be able to export. The fixed costs will be drawn from a distribution $G(f)$ with density $g(f)$, with $f \in [\underline{f}, \infty]$. I assume for clarity of exposition that the fixed costs are the only dimension of heterogeneity in the model.

Given the model setting, an individual firm will either export or produce for the domestic market in the foreign country but will not do both. A potential concern with this is that in reality, firms that export do also produce for their domestic market. There are two responses to this concern. First, the main purpose of this paper is not to provide an alternative to the standard heterogeneous trade model but to show that the presence of inframarginal firms can itself motivate a positive optimal tariff. This setup allows us to have inframarginal producers without introducing any other factor that would make tariffs optimal, and so is well-suited for the purpose of this analysis. Second, we could interpret the unit of analysis here as "production lines" rather than necessarily as separate firms. With such an interpretation, the same firm could for produce for the domestic market and for export through different production lines.[20]

[19] Allowing for the presence of domestic import-competing firms would not alter the main point of this paper.

[20] If the model were to be modified to have firms with multiple production lines and productivity heterogeneity at the firm-level, it would be able to generate the empirical pattern that larger and more productive firms are more likely to be exporters.

2.2 Firm's Problem

We can now turn to the analytics of the firm's problem. If a firm in the foreign country produces for its domestic market, it maximizes:

$$\max_{l} \quad \hat{p}F(l) - \hat{w}l,$$

where $\hat{p}$ is the price of x in the foreign country and $\hat{w}$ is the wage in the foreign country. The production function is assumed to satisfy $F'(.) > 0$ and $F''(.) < 0$. This optimization problem yields a profit function $\pi(\hat{p})$ (suppressing $\hat{w}$) and a supply function $q(\hat{p})$. If a firm with fixed cost f chooses to produce for export, it maximizes:

$$\max_{l} \quad pF(l) - \hat{w}l - f\hat{w},$$

where p is the tariff-exclusive price in the home country. Solving this problem yields a variable profit function $\pi(p)$ and supply function $q(p)$. Note that the variable profit function and the supply function are the same for domestic production and for export; only the price received by the firm is different.

A firm will choose to either produce for the domestic market or export depending on which choice will allow it to make more profits. Note that since there are fixed costs associated with exporting but not with domestic production, this must mean that the producer price in the home country is greater than that in the foreign country, i.e. $p > \hat{p}$, if there are positive supplies in both.

We can define a marginal firm f^* that is indifferent between producing domestically and exporting as follows:

$$\pi(\hat{p}) = \pi(p) - f^*\hat{w} \tag{14}$$

Firms with $f < f^*$ will export and firms with $f > f^*$ will produce for the domestic market. Since the distribution of fixed costs is unbounded above, and the assumption on preferences guarantees that there will be some export of x in equilibrium, an interior solution for f^* is guaranteed.

We can close the model with the market clearing conditions for the foreign and home country markets, respectively:

$$\hat{D}(\hat{p}, \hat{\Pi}) = \hat{n}q(\hat{p})\left[1 - G(f^*)\right]$$

$$D\left[p + \tau\right] = \hat{n}q(p)G(f^*), \tag{15}$$

where $\hat{\Pi}$ are the profits that accrue to foreign households from the activities of its firms; these would be zero if $\hat{n}$ were determined by free entry. Note that the law of one price does not hold because the fixed costs of exporting need to be factored into the price in the home country, and so we have a separate market clearing condition for each country.

Since the home country is assumed to be small, it takes the price in the foreign country $\hat{p}$ as exogenous and ignores the foreign market clearing condition when formulating its policies. There are then two variables that are endogenous for the small country – f^* and p – and these are pinned down by two conditions, (14) and (15).

A few points of comparison with models such as Melitz (2003) should be noted here. In the Melitz model, the fixed costs are factored into the price of individual varieties because the prices of varieties that are not exported are effectively equal to infinity. As a result of this, the price index faced by foreign importers reflects the presence of these fixed costs even though the price of an individual variety that is exported does not. In the current model, there is a single variety and the fixed costs directly affect the price through the market clearing condition. In this sense, the price of the good here is comparable to the price index in the monopolistically competitive model.[21]

3 Tariff Analysis

3.1 Tariff Incidence

The definition of the marginal exporter (14) and the market clearing condition (15) both imply relationships between p and f^*. We can define a function $f^* = \Phi(p)$ to capture the relationship implied by the marginal exporter condition. Using the implicit function theorem:

$$\frac{\partial \Phi(.)}{\partial p} = -\frac{-q(p)}{\hat{w}} > 0$$

The intuition is as follows. At a constant f^*, an increase in the price in the home market would cause the profits from exporting to exceed the profits from producing for the foreign hone market. In order to restore equilibrium, the marginal firm needs to be one with a higher fixed cost.

We can similarly define a relationship implied by the market clearing condition: $f^* = \Gamma(p, \tau)$. As before, we can sign this relationship:

$$\frac{\partial \Gamma(.)}{\partial p^*} = -\frac{D'(.) - \hat{n}q'(p)G(f^*)}{-\hat{n}q(p)g(f^*)} < 0$$

[21] Note also that both Melitz (2003) and the current model implicitly require limits to cross-border shopping or intermediation; otherwise, the fixed costs would simply become irrelevant.

The signing follows from the fact that demand is downward sloping, $D'(.) < 0$, and firm supply is upward sloping, $q'(p) > 0$. Intuitively, an increase in the price would decrease quantity demanded and increase quantity supplied at a constant f^*. To clear the market, we need fewer exporters and so a lower f^*. The relationship between $\Gamma(.)$ and τ is given by:

$$\frac{\partial \Gamma(.)}{\partial \tau} = -\frac{D'(.)}{-\hat{n}q(p)g(f^*)} < 0$$

Thus, at a constant p, an increase in τ would decrease f^*. This is because the increase in τ would reduce quantity demanded to below quantity supplied, and so the number of exporting firms must fall (i.e. f^* must fall) in order to restore equilibrium.

With these functions defined, the equilibrium p is given by the following equality:

$$\Phi(p) = \Gamma(p, \tau)$$

Using the implicit function theorem again, we can obtain the total effect of τ on p:

$$\frac{dp}{d\tau} = -\frac{-\partial \Gamma(.)/\partial \tau}{\partial \Phi(.)/\partial p - \partial \Gamma(.)/\partial p} < 0$$

This result puts together the intuition for the pieces discussed above. An increase in the tariff causes a reduction in demand, and since the market has to clear, this is a downward pressure on the number of firms. In order to induce fewer firms to export to the market, the price in the market must be lower. From this result (i.e. that the tariff reduces the producer price), it should already be clear that the optimal tariff for the importing country will be positive since foreigners bear part of the tariff incidence.

To see this formally, note the indirect utility function: $V[p + \tau, \tau D(.)]$. Differentiating with respect to τ and evaluating at $\tau = 0$, we obtain:

$$\begin{aligned} \left.\frac{dV}{d\tau}\right|_{\tau=0} &= -D(.)\left[\frac{dp}{d\tau} + 1\right] + D(.) + \tau \left.\frac{dD(.)}{d\tau}\right|_{\tau=0} \\ &= -D(.)\frac{dp}{d\tau} > 0 \end{aligned}$$

Ordinarily, for a small country, $dp/d\tau = 0$ because the tariff-exclusive price p is pinned down by the world market price. In the current setting, p is not pinned down by the world market price and so it will no longer be the case that $dp/d\tau = 0$. Indeed, we just saw that $dp/d\tau < 0$, and so the optimal tariff is positive.

3.2 Optimal Tariff Formula

Using the fact that $f^* = \Phi(p)$, we can define the foreign export supply function as:

$$M(p) = \hat{n} q(p) G[\Phi(p)]$$

The standard formula for the partial equilibrium optimal tariff as the inverse of the foreign export supply elasticity holds in this setting (see Appendix C.1 for the derivation):

$$\frac{\tau^*}{p} = \left[\frac{\partial M(p)}{\partial p} \frac{p}{M(p)} \right]^{-1}$$

In the standard framework, the export supply elasticity faced by the small country is infinite. In the current model, we can derive a formula for the export supply condition by using the marginal firm condition (14) (see Appendix C.2):

$$\begin{aligned} \frac{dM}{dp}\frac{p}{M} &= q'(p)\frac{p}{q(p)} + \left\{ g(f^*) \frac{f^*}{G(f^*)} \right\} \times \left\{ \frac{\partial [\pi(p) - \pi(\hat{p})]}{\partial p} \frac{p}{\pi(p) - \pi(\hat{p})} \right\} \\ &= \varepsilon_{q,p} + \varepsilon_{G,f} \times \varepsilon_{\pi - \hat{\pi}, p} \end{aligned}$$

The first term $\varepsilon_{q,p}$ is the supply elasticity of a firm and it captures an individual firm's supply response to a change in the price. The second term $\varepsilon_{G,f} \times \varepsilon_{\pi-\hat{\pi},p}$ measures the extent of the extensive margin response. The magnitude of the extensive margin response depends on $\varepsilon_{G,f}$, which is the elasticity of the probability distribution $G(f)$ at f^*. It also depends on $\varepsilon_{\pi-\hat{\pi},p}$, which captures the extent to which the gap between profits made by exporting vs. producing for the domestic market – $\pi(p) - \pi(\hat{p})$ – is sensitive to the price in the importing country.

This formula provides several pieces of intuition regarding the optimal tariff in this model. First, note that if the extent of firm heterogeneity vanished, such that $G(f)$ were to approach a degenerate distribution, then the density $g(f)$ would approach a Dirac delta function with an effectively infinite slope at the mass point. Consequently, $\varepsilon_{G,f}$ would become infinite and the optimal tariff would go to zero. Second, as the overall magnitude of the fixed costs becomes small, p approaches $\hat{p}$, and so $\pi(p) - \pi(\hat{p})$ approaches zero. In this case, $\varepsilon_{\pi-\hat{\pi},p}$ would become infinite, leading again to a zero optimal tariff. These two points together illustrate clearly how both firm heterogeneity and fixed exporting costs are essential to this positive optimal tariff result. This is because it is the combination of firm heterogeneity and fixed costs that creates the presence of inframarginal exporters.

The exact role of $\varepsilon_{q,p}$ in this formula is somewhat difficult to interpret because a finite supply elasticity is a consequence of decreasing returns to scale, and decreasing returns are essential to every piece of this model. Specifically, without decreasing returns, we cannot have fixed costs or

firm heterogeneity in this setting. Despite this difficulty, it is not surprising that a higher supply elasticity at the firm-level would contribute to a higher overall export supply elasticity.

4 Additional Considerations

4.1 Tariffs as an Indirect Rent Tax

The tariffs imposed by the small country do not affect the price in the foreign market and the effect of the tariff on foreigners must be on the profits of foreign firms. The effect of tariffs on the profits of foreign firms is given by:

$$\begin{aligned}\frac{d\hat{\Pi}}{d\tau} &= \frac{d}{d\tau}\left\{\int_{\underline{f}}^{f^*}\hat{n}\left[\pi(p)-fw\right]g(f)df+\int_{f^*}^{\infty}\hat{n}\pi\left(\hat{p}\right)g\left(f\right)df\right\}\\ &= \int_{\underline{f}}^{f^*}\hat{n}\frac{d\pi(p)}{d\tau}g(f)df+\hat{n}\left[\pi(p)-f^*\hat{w}-\pi\left(\hat{p}\right)\right]g\left(f^*\right)\end{aligned}$$

Since the marginal firm is indifferent between exporting and producing for the domestic market, the second term above is zero. Thus:

$$\frac{d\hat{\Pi}}{d\tau}=\int_{\underline{f}}^{f^*}\hat{n}\frac{d\pi(p)}{d\tau}g\left(f\right)df$$

Now, let us define the rents earned by foreign exporters:

$$R_X=\int_{\underline{f}}^{f^*}\hat{n}\left[\pi(p)-f\hat{w}-\pi\left(\hat{p}\right)\right]g(f)df$$

These rents are the difference between the profits made by exporting and the profits that the firm would make if it did not export. Note that in this setting with decreasing returns to scale, the opportunity cost to the firm of not exporting is given by the profits it would earn if it used its production function to produce for the domestic market instead. Differentiating this expression with respect to the tariff, we obtain:

$$\begin{aligned}
\frac{dR_X}{d\tau} &= \int_{\underline{f}}^{f^*} \hat{n}\frac{d\left[\pi(p)\right]}{d\tau}g(f)df + \hat{n}\left[\pi(p) - f^*\hat{w} - \pi\left(\hat{p}\right)\right]g(f^*) \\
&= \int_{\underline{f}}^{f^*} \hat{n}\frac{d\left[\pi(p)\right]}{d\tau}g(f)df \\
&= \frac{d\hat{\Pi}}{d\tau}
\end{aligned}$$

Thus, the effect of a tariff on overall profits of foreign firms is equal to the effect of the tariff on the rents earned by inframarginal exporters. This clearly highlights the fact that the tariff affects foreigners precisely because they are a tax on exporter rents.

One point to note here is that the type of rents defined here will exist even if the total mass of foreign firms $\hat{n}$ were determined by free-entry rather than being exogenous. With free-entry, firms would break even in expectation and so they would earn no true rents. Nevertheless, they could still earn more by exporting than they would if they were to produce in their domestic market. While not true rents because of free entry, these exporting rents would still be rents from the standpoint of a small importing country that would treat $\hat{n}$ as exogenous in any case.[22]

4.2 Terms-of-Trade

The small country in the preceding analysis does not have any world market power. Nevertheless, the argument presented in this paper is still a terms-of-trade argument. The fixed costs of exporting create a barrier between the prices in the importing and exporting countries. Thus, even though the small country cannot affect the price of any good in the rest of the world, it can affect the pre-tariff price in its domestic market and so can reduce the relative price of its import good.

The version of the terms-of-trade argument in this paper helps address some of the common objections to the real-world relevance of terms-of-trade considerations.[23] One common reason for skepticism about the terms-of-trade argument is that price manipulation is not a plausible account of policymaker intent. In the current paper, the tariff motive can alternatively be understood as an indirect tax on the profits of foreign firms. This is arguably a realistic account of what might motivate governments to impose tariffs. A second potential difficulty with the usual terms-of-trade argument is that we see small countries also impose substantial tariffs, whereas the the standard

[22] See Chapter II for more on this distinction between true rents and rents from the standpoint of a country in the context of taxes on FDI.

[23] See Bagwell and Staiger (2002) for more discussion of these objections.

terms-of-trade argument assumes large countries. The version of the terms-of-trade argument here applies directly to small countries and so is not subject to this difficulty.

This rent tax interpretation of the role of tariffs provides an alternative way to think of the role of trade agreements within the terms-of-trade framework of Bagwell and Staiger (1999). Importers have incentives to impose tariffs as a way of taxing the profits earned by foreign exporters. Trade agreements allow countries to reduce the profit taxes faced by their own exporters in return for giving up some power to tax the profits of foreign exporters.

5 Conclusion

This paper shows that the presence of inframarginal exporters gives rise to an independent incentive to impose tariffs. Inframarginal exporters earn rents through their exporting activities and tariffs allow the importing country to tax a portion of these rents. By developing a perfectly competitive model with an extensive margin of trade, I am able to show that this rent motive for imposing tariffs holds even though the importing country has no world market power and there are no pre-existing distortions. In particular, my analysis does not rely on imperfect competition, and so unlike most of the arguments in favor of tariffs found in the imperfect competition literature, it is not subject to the objection that countries would be better off directly dealing with the market imperfection rather than using trade policy.

While the analysis in this paper does not rely on the importing country having any world market power, the optimal tariff is still based on a terms-of-trade effect. This is because owing to fixed costs of exporting, the price in the domestic market will be different from the world market price, and a small country does have power in its domestic market. An attractive feature of the type of terms-of-trade motive presented in this paper is that it can alternatively be understood as a tax on the exporting profits earned by foreign firms – an arguably a more plausible account of policymaker intent than a desire to manipulate world prices. This analysis thus strengthens the case for the real-world relevance of terms-of-trade considerations in trade policy.

A Appendix to Chapter II

A.1 Profit Function Property

In this appendix, I show that we can write the variable pre-tax profits in the following separable form: $\pi_{ij}(w_i, r, \tilde{z}_i) = \tilde{z}_i^{1/(1-\lambda)} \pi_{ij}(w_i, r)$. First, note that from the homogeneity of the production function, we can use Euler's rule to obtain:

$$(F_l(.)l + F_k(.)k) = \lambda F(.),$$

where$\lambda < 1$ is the returns to scale parameter. The first-order conditions are: $\tilde{z}_i F_l(.) = w_i$ and $\tilde{z}_i F_k(.) = r$. Using the first-order condition, the firm's variable profits before taxes are:

$$\begin{aligned} \pi_{ij}(w_i, r, \tilde{z}_i) &= \tilde{z}_i F(.) - \tilde{z}_i F_l(.)l - \tilde{z}_i F_k(.)k \\ &= \tilde{z}_i F(.) - \lambda \tilde{z}_i F(.) \\ &= (1-\lambda)\tilde{z}_i F(.) \end{aligned}$$

Thus, the firm's variable profits are proportional to firm sales.

Next, we can differentiate maximized profits, $\tilde{z}_i F(.) - wl - rk$, with respect to $\tilde{z}_i$ using the envelope theorem to get:

$$\begin{aligned} \frac{d\pi_{ij}(.)}{d\tilde{z}_i}\frac{\tilde{z}_i}{\pi_{ij}(.)} &= F(.)\frac{\tilde{z}_i}{\pi_{ij}(.)} \\ \frac{d\pi_{ij}(.)}{d\tilde{z}_i}\frac{\tilde{z}_i}{\pi_{ij}(.)} &= F(.)\frac{\tilde{z}_i}{(1-\lambda)\tilde{z}_i F(.)} \\ \frac{d\pi_{ij}(.)}{d\tilde{z}_i}\frac{\tilde{z}_i}{\pi_{ij}(.)} &= \frac{1}{1-\lambda} \end{aligned}$$

The above expression is a separable first-order differential equation and can be solved as follows:

$$
\begin{aligned}
\frac{1}{\pi_{ij}(.)} d\pi_{ij}(.) &= \frac{1}{1-\lambda}\frac{1}{\tilde{z}_i} d\tilde{z}_i \\
\int \frac{1}{\pi_{ij}(.)} d\pi_{ij}(.) &= \frac{1}{1-\lambda}\int \frac{1}{\tilde{z}_i} d\tilde{z}_i + c \\
\log \pi_{ij}(.) &= \frac{1}{1-\lambda}\log \tilde{z}_i + c \\
\log \pi_{ij}(.) &= \log \tilde{z}_i^{1/(1-\lambda)} e^c \\
\pi_{ij}(w_i, r, \tilde{z}_i) &= \tilde{z}_i^{1/(1-\lambda)} e^c
\end{aligned}
$$

In order to solve for the constant of integration e^c, we can set $\tilde{z}_i$ to some arbitrary value - say one - to obtain:

$$\pi_{ij}(w_i, r, 1) = e^c$$

If we define $\pi_{ij}(w_i, r) \equiv \pi_{ij}(w_i, r, 1)$, then the profits of an individual firm can be expressed as being proportional to a general term that is common to all firms: $\pi_{ij}(w_i, r, \tilde{z}_i) = \tilde{z}_i^{1/(1-\lambda)} \pi_{ij}(w_i, r)$.

A.2 Expressions for $d\Pi_{12}/d\tau_1$ and $dR_{12}/d\tau_1$

This Appendix derives expressions for $d\Pi_{12}/d\tau_1$ and $dR_{12}/d\tau_1$.

$$
\begin{aligned}
\frac{d\Pi_{12}}{d\tau_1} &= -m_2 \int_{\Theta_{12}} z_1 l(.) \frac{dw_1}{d\tau_1} g(z) dz \\
&+ m_2 \int_{\partial\Theta_{12}} (v \cdot u) z_1 \pi_{12}(.) g(z) dz \\
&= -L_{12}\frac{dw_i}{d\tau_i} + m_2 \int_{\partial\Theta_{12}} (v \cdot u) z_1 \pi_{12}(.) g(z) ds, \qquad (16)
\end{aligned}
$$

where L_{12} is the total labor used by foreign firms in country i. In taking the derivative (first equality above), I use a generalization of Leibniz's rule for differentiating an integral. The first term captures the change in profits that arises from changes in the profits of inframarginal firms, using Hotelling's Lemma to differentiate the profit function. The second term captures the change in profits due to a change in the set of firms that locate in the country. The term v is a two-dimensional vector that captures how the boundary set changes with the tax rate (i.e. the "velocity" of the boundary set), u is the unit normal vector and ds is the surface differential.

The derivative of R_{12} can be derived in a similar manner:

$$\begin{aligned}
\frac{dR_{12}}{d\tau_1} &= -\Pi_{12} - m_2 \int_{\Theta_{12}} (1-\tau_1) z_1 l(.) \frac{dw_1}{d\tau_1} g(z) dz \\
&+ m_2 \int_{\partial\Theta_{12}} (v \cdot u) \left[(1-\tau_1) z_1 \pi_{12}(.) - z_2 \pi_{22}(w_2, r) \right] ds \\
&= -\Pi_{12} + -m_2 \int_{\Theta_{12}} (1-\tau_1) z_1 l(.) \frac{dw_1}{d\tau_1} g(z) dz \\
&= -\Pi_{12} + -(1-\tau_1) L_{12} \frac{dw_1}{d\tau_1} \qquad (17)
\end{aligned}$$

The third after the first equality captures the change in the set of firms locating in the country as a result of the tax rate change. It is equal to zero because firms on the boundary set $\partial\Theta_{12}$ make no inframarginal profits by definition.

A.3 Positive Optimal Tax Rate

This appendix proves that the optimal tax rate is positive. I first deal with the case without domestic firms, which is also the case discussed in the main text. The main text shows that the optimal tax rate will be positive if $dR_{12}/d\tau_1 < 0$.

$$R_{12} = m_2 \int_{\Theta_{12}} \left[(1-\tau_1) z_1 \pi_{12}(w_1, r) - z_2 \pi_{22}(w_2, r) \right] g(z) dz$$

$$\frac{dR_{12}}{d\tau_1} = m_2 \int_{\Theta_{12}} \left\{ z_1 \frac{\left[d(1-\tau_1) \pi_{12}(w_1, r) \right]}{d\tau_1} \right\} g(z) dz$$

Note now that a firm that is on the boundary set, i.e. $z \in \partial\Theta_{12}$, will be indifferent between locating in country 1 and country 2:

$$\begin{aligned}
(1-\tau_1) z_1 \pi_{12}(w_1, r) &= z_2 \pi_{22}(w_2, r) \\
(1-\tau_1) \pi_{12}(w_1, r) &= a_{12} \pi_{22}(w_2, r), \qquad (18)
\end{aligned}$$

where a_{12} is the cutoff value of z_2/z_1 that defines the indifferent firm. For later use, note that (18)

implies a function $a_{12} = \gamma(w_1, \tau_1)$, with $\partial\gamma/\partial w_1 < 0$ and $\partial\gamma/\partial\tau_1 < 0$.

Differentiating (18), we obtain:

$$\frac{d}{d\tau_1}\left[(1-\tau_1)\,\pi_{12}\,(w_1,r)\right] = \frac{da_{12}}{d\tau_1}\pi_{22}\,(w_2,r)$$

Thus:

$$\begin{aligned}\frac{dR_{12}}{d\tau_1} &= m_2 \int\limits_{\Theta_{12}} \left[z_1 \frac{da_{12}}{d\tau_1}\pi_{22}\,(w_2,r)\right] g(z)dz \\ &= \frac{da_{12}}{d\tau_1} \times m_2 \int\limits_{\Theta_{12}} \left[z_1\pi_{22}\,(w_2,r)\right] g(z)dz\end{aligned}$$

Thus, the sign of $dR_{12}/d\tau_1$ will be the same as the sign of $da_{12}/d\tau_1$. Since higher taxes will cause firms to leave country 1, it follows that the new marginal firm will be one that is relatively more productive in country 1, i.e. $da_{12}/d\tau_1 < 0$. To show this formally, we need to use the labor market clearing condition.

With no domestic firms, the labor market clearing condition is:

$$\begin{aligned}L_1 &= m_2 \int\limits_{\Theta_{12}} l_{ij}\,(w_1,r,z_1)\,g(z)dz \\ &= m_2 \int\limits_{0}^{z_1^{max}} \int\limits_{0}^{a_{12}z_1} l_{12}\,(w_1,r,z_1)\,g(z)dz,\end{aligned}$$

where z_1^{max} is the upper-bound on productivity for z_1. The right-hand side above is decreasing in w_1 and increasing in a_{12}. Thus, this expression defines a positive relationship between w_1 and a_{12}. This is intuitive: at a fixed wage, more firms would mean that labor supply exceeds labor demand, necessitating an increase in the wage to restore equilibrium. We can express this relationship as a function: $a_{12} = \delta(w_1)$ with $\partial\delta/\partial w_1 > 0$. This function, together with $\gamma(w_1,\tau_1)$ defined earlier implies that an increase in τ_1 will shift down $\gamma(.)$ and cause a movement along $\delta(.)$ corresponding to a lower wage. Consequently, $dw_1/d\tau_1 < 0$ and $da_{12}/d\tau_1 < 0$. This should be unsurprising: higher taxes on FDI reduce the number of firms that site in the host country and reduce domestic wages.

The case with domestic firms operating in equilibrium is simpler from the point of view of optimal taxation. In this case, the domestic free-entry condition holds with equality:

$$\int_{\Theta_{11}} z_1 \pi_{11}(w_1, r)\, g(z) dz + \int_{\Theta_{21}} (1-\tau_2)\, z_2 \pi_{21}(w_2, r)\, g(z) dz = f_1 w_1 + \phi_1 r$$

Differentiating this expression, we obtain:

$$\begin{aligned} -\frac{dw_1}{d\tau_1} \int_{\Theta_{11}} l_{11}(w_1, r, z_1)\, g(z) dz + \int_{\partial\Theta_{11}} (v \cdot u)\, z_1 \pi_{11}(w_1, r)\, g(z) ds & \\ + \int_{\partial\Theta_{21}} (v \cdot u)(1-\tau_2)\, z_1 \pi_{21}(w_2, r)\, g(z) ds &= f_1 \frac{dw_1}{d\tau_1} \end{aligned}$$

Note that: $\int_{\partial\Theta_{11}} (v \cdot u)\, z_1 \pi_{11}(w_1, r)\, g(z) ds = \int_{\partial\Theta_{21}} (v \cdot u)(1-\tau_2)\, z_1 \pi_{21}(w_2, r)\, g(z) ds$ because a marginal firm by definition would make the same profit if it located in the foreign country. Thus, the total profit loss for a marginal firm as a result of higher host-country taxation is equal to zero. Consequently:

$$-\frac{dw_1}{d\tau_1} \left(\int_{\Theta_{11}} l_{11}(w_1, r, z_1)\, g(z) dz + f_1 \right) = 0$$

$$\frac{dw_1}{d\tau_1} = 0$$

Since $dw_1/d\tau_1 = 0$, it follows immediately that the optimal tax rate will be positive in this case.

A.4 Optimal Tax Formula

This appendix will derive a formula for the optimal tax rate. As shown in the main text, the first-order condition for the optimal tax formula is:

$$L_{12} \frac{dw_1}{d\tau_1} + \Pi_{12} + \tau_1 \frac{d\Pi_{12}}{d\tau_1} = 0$$

Using (16) and (17), we can obtain the following:

$$-(1-\tau_1) \left(-\frac{dw_1}{d\tau_1} L_{12} \right) + \Pi_{12}$$

$$
\begin{aligned}
+\tau\left[m_2 \int_{\partial\Theta_{12}} (v\cdot u)\, z_1 \pi_{12}(.)\, g(z) ds\right] &= 0 \\
-\frac{dR_{12}}{d\tau_1} + \frac{\tau_1}{1-\tau_1}\left[-\frac{dR_{12}}{d\tau_1} + \frac{d}{d\tau_1}(1-\tau_1)\Pi_{12}\right] &= 0
\end{aligned}
$$

Thus, the optimal tax rate is:

$$
\tau_1 * = \frac{dR_{12}/d\tau_1}{\frac{d}{d\tau_1}(1-\tau_1)\Pi_{12}}
$$

B Appendix to Chapter III

B.1 An Implication of Free Entry

Differentiating the domestic free entry condition with respect to s, we obtain:

$$\begin{aligned}
\pi_{11}\left[p_1\left(w_1\right), w_1\right] &= \phi_1 w_1 \\
x_{11} p_1'(w_1)\frac{dw_1}{ds} - l_{11}\left(.\right)\frac{dw_1}{ds} &= \phi_1 \frac{dw_1}{ds} \\
w_1 p_1'(w_1) &= \frac{w_1\phi_1 + w_1 l_{11}\left(.\right)}{x_{11}} \\
w_1 p_1'(w_1) &= \frac{\pi_{11}\left(.\right) + w_1 l_{11}\left(.\right)}{x_{11}} \\
w_1 p_1'(w_1) &= \frac{p_1 x_{11}}{x_{11}} = p_1
\end{aligned}$$

B.2 Function Implied by Marginal Foreign Investor Condition

The marginal foreign investor condition is:

$$\pi_{12}(w_1) + s - f^* w_2 = \pi_{22}(w_2)$$

We can write this relationship as a function $f^* = \Phi(w_1, s)$, and use the implicit function theorem together with Hotelling's Lemma to obtain:

$$\frac{\partial \Phi\left(,\right)^*}{\partial w_1} = -\frac{-l(.)}{-w_2} < 0$$

$$\frac{\partial \Phi\left(,\right)^*}{\partial s} = -\frac{1}{-w_2} > 0$$

Thus, $\Phi_1\left(,\right) < 0$ and $\Phi_2\left(,\right) > 0$. The intuition is discussed in the main text.

B.3 Function Implied by the Augmented Labor Market Clearing Condition

The augmented labor market clearing condition is:

$$L_1 = \frac{\theta_1 [p_1(w_1)] W}{q_{11}[p_1(w_1), w_1]} l_{11}[p_1(w_1), w_1] + G(f^*) l_{12}(w_1)$$

This relationship implies a function $f^* = \Gamma(w_1)$. To sign $\partial\Gamma(.)/\partial w_1$, we can use the implicit function theorem again. For clarity, it is useful to consider each relevant term separately:

1. $\partial\theta_1[p_1(w_1)]/\partial w_1 = \frac{\partial\theta_1}{\partial p_1} p_1'(w_1) < 0$
2. $\{\partial q_{11}[p_1(w_1), w_1]/\partial w_1\}\{w_1/q_{11}\} = \frac{\partial q_{11}}{\partial p}\frac{w_1 p_1'(w_1)}{q_{11}} + \frac{\partial q_{11}}{\partial w}\frac{q}{q_{11}} = \frac{\partial q_{11}}{\partial p}\frac{p_1}{q_{11}} + \frac{\partial q_{11}}{\partial w_1}\frac{w_1}{q_{11}} = 0$
3. $\{\partial l_{11}[p_1(w_1), w_1]/\partial w_1\}\{w_1/l_{11}\} = \frac{\partial l_{11}}{\partial p_1}\frac{w_1 p_1'(w_1)}{l_{11}} + \frac{\partial l_{11}}{\partial w}\frac{w_1}{l_{11}} = 0$
4. $\partial G(f^*) l_{12}(w_1)/\partial w_1 = G(f^*)\frac{\partial l_{12}}{\partial w_1} < 0$
5. $\partial G(f^*) l_{12}(w_1)/\partial f^* = g(f^*) l_{12}(w_1) > 0$

The derivations above repeatedly use the fact from Appendix B.1 that $w_1 p_1'(w_1) = p_1$. Point 1 uses the fact that the host country good and the foreign good are substitutes. Points 3 and 4 above use the homogeneity of the supply and factor demand function, respectively. These expressions imply that $\partial\Gamma(.)/\partial w_1 > 0$. The intuition as well as the role of the preference assumptions are discussed in the main text.

B.4 Optimality of the Subsidy in the Presence of Taxes

As mentioned in the text, the argument from Section 3.1 that inframarginal taxes improve welfare is true regardless of the presence of a subsidy. This appendix shows the optimality of imposing a subsidy in the presence of a taxes. First, note that since the equilibrium is still determined by (13) without modification, the earlier argument that $dw_1/ds > 0$ still holds.

Overall government revenue is now given by:

$$T_1 = -M_2 s[G(f^*) - G(\underline{f})] + M_2 \int_0^{f^*} \tau_{12}(f)\,\pi_{12}(w_1)\, g(f) df$$

The effect of the subsidy on revenue at $s = 0$ is:

$$\begin{aligned}
\left.\frac{dT_1}{ds}\right|_{s=0} &= M_2\left\{s\frac{d}{ds}\left[G(f^*)-G(\underline{f})\right]+\left[G(f^*)-G(\underline{f})\right]\right\}_{s=0}-\frac{dw_1}{ds}M_2\int_0^{f^*}\tau_{12}(f)\,l_{12}(w_1)\,g(f)df \\
&= -\frac{dw_1}{ds}M_2\int_0^{f^*}\tau_{12}(f)\,l_{12}(w_1)\,g(f)df \\
&= -\frac{dw_1}{ds}\tau_{12}L_{12},
\end{aligned}$$

where $L_{12}\equiv M_2 l_{12}(w_1)$ is the total labor used by foreign firms and $\tau_{12}\equiv\int_0^{f^*}\tau_{12}(f)\,g(f)df$ is the average tax rate. We see from the above derivative that unlike in the case without taxes, the fiscal cost of the subsidy is no longer equal to zero. This is because the subsidy reduces tax revenue by reducing the profits of foreign firms. We now need to take this fiscal externality into account.

The effect of the subsidy on welfare is:

$$\begin{aligned}
\left.\frac{dV_1}{ds}\right|_{s=0} &= \frac{\partial V_1}{\partial p}p_1'(w_1)\frac{dw_1}{ds}+\frac{\partial V_1}{\partial w}\left(L_1\frac{dw_1}{ds}+\left.\frac{dT_1}{ds}\right|_{s=0}\right) \\
&\quad \frac{\partial V_1}{\partial p}p_1'(w_1)\frac{dw_1}{ds}+\frac{\partial V_1}{\partial w}\left[L_1\frac{dw_1}{ds}-\frac{dw_1}{ds}\tau_{12}L_{12}\right] \\
&= \frac{dw_1}{ds}\frac{\partial V_1}{\partial w}\frac{1}{w_1}\left[-x_{11}w_1p_1'(w_1)+w_1L_1-w_1\tau_{12}L_{12}\right] \\
&> \frac{dw_1}{ds}\frac{\partial V_1}{\partial w}\frac{1}{w_1}\left[-p_1x_{11}+w_1(L_1-L_{12})\right] \\
&= \frac{dw_1}{ds}\frac{\partial V_1}{\partial w}\frac{1}{w_1}\left[-p_1x_{11}+w_1(L_{11}+M_1\phi_1)\right] \\
&= \frac{dw_1}{ds}\frac{\partial V_1}{\partial w}\frac{1}{w_1}\left[-p_1x_{11}+p_1M_1q_{11}\right]>0,
\end{aligned}$$

where L_{11} is defined as the total labor used in production by domestic firms. Since labor is used either by foreign firms, or by domestic firms, or in order to pay fixed costs, $L_1=L_{11}+L_{12}+M_1\phi_1$. Furthermore, $w_1M_1\phi_1$ is equal to the variable profits of domestic firms because of free entry. Thus, $w_1M_1\phi_1+w_1L_{11}$ is the sum of profits and wages and so is equal to firm sales: p_1q_{11}. The term $-p_1x_{11}+p_1M_1q_{11}$ gives the exports (i.e. production minus consumption) of the domestic good in value terms and so is positive.

C Appendix to Chapter IV

C.1 Optimal Tariff Formula

The government solves:

$$\max_{\tau} \; V\left[p+\tau, \tau D(.)\right]$$

Taking the first-order condition and using Roy's identity, we obtain:

$$-D(.)\left[\frac{dp}{d\tau}+1\right]+D(.)+\tau\frac{dD(.)}{d\tau}=0$$

$$-D(.)\left[\frac{dp}{d\tau}+1\right]+D(.)+\tau\frac{dD(.)}{d\tau}=0$$

$$-D(.)\frac{dp}{d\tau}+\tau\frac{dD(.)}{d\tau}=0$$

Since there are no domestic firms, $D(.)=M(.)$. Thus:

$$\begin{aligned}\frac{\tau^*}{p} &= \frac{dp}{d\tau}\frac{1}{p}\left(\frac{dM(.)}{d\tau}\frac{1}{M(.)}\right)^{-1} \\ &= \left[\frac{dM(p)}{dp}\frac{p}{M(p)}\right]^{-1}\end{aligned}$$

C.2 Formula for the Foreign Export Supply Elasticity

$$\frac{dM}{dp}=\frac{d}{dp}\left\{\hat{n}q(p)G\left[\Phi(p)\right]\right\}$$

$$\frac{dM}{dp} = \hat{n}q'(p)G[f^*] + \hat{n}q'(p)g[f^*]\frac{\partial\Phi(p)}{\partial p}$$

$$\frac{dM}{dp}\frac{p}{M} = q'(p)\frac{p}{q(p)} + \frac{g(f^*)}{G(f^*)}\frac{\partial\Phi(p)}{\partial p}p$$

$$\frac{dM}{dp}\frac{p}{M} = q'(p)\frac{p}{q(p)} + g(f^*)\frac{f^*}{G(f^*)}\frac{\partial\Phi(p)}{\partial p}\frac{p}{f^*}$$

$$\frac{dM}{dp}\frac{p}{M} = q'(p)\frac{p}{q(p)} + g(f^*)\frac{f^*}{G(f^*)}\frac{\partial[\pi(p)-\pi(\hat{p})]}{\partial p}\frac{p}{\pi(p)-\pi(\hat{p})}$$

References

Bagwell, K. and R. W. Staiger (1999, March). An economic theory of GATT. *American Economic Review 89*(1), 215–248.

Bagwell, K. and R. W. Staiger (2004). *The economics of the world trading system*. MIT Press.

Bauer, C., R. B. Davies, and A. Haufler (2014). Economic integration and the optimal corporate tax structure with heterogeneous firms. *Journal of Public Economics 110*, 42–56.

Burbidge, J., K. Cuff, and J. Leach (2006). Tax competition with heterogeneous firms. *Journal of Public Economics 90*(3), 533–549.

Chor, D. (2009). Subsidies for FDI: Implications from a model with heterogeneous firms. *Journal of International Economics 78*(1), 113–125.

Costinot, A., D. Donaldson, J. Vogel, and I. Werning (2013). Comparative advantage and optimal trade policy. Technical report, National Bureau of Economic Research.

Costinot, A., A. Rodríguez-Clare, and I. Werning (2016). Micro to macro: Optimal trade policy with firm heterogeneity. Technical report, National Bureau of Economic Research.

Davies, R. B. and C. Eckel (2010). Tax competition for heterogeneous firms with endogenous entry. *American Economic Journal: Economic Policy 2*(1), 77–102.

Demidova, S. and A. Rodriguez-Clare (2009). Trade policy under firm-level heterogeneity in a small economy. *Journal of International Economics 78*(1), 100–112.

Demidova, S. and A. Rodriguez-Clare (2013). The simple analytics of the melitz model in a small economy. *Journal of International Economics 90*(2), 266–272.

Devereux, M. P. and R. G. Hubbard (2003). Taxing multinationals. *International Tax and Public Finance 10*(4), 469–487.

Dharmapala, D., J. Slemrod, and J. D. Wilson (2011). Tax policy and the missing middle: Optimal tax remittance with firm-level administrative costs. *Journal of Public Economics 95*(9), 1036–1047.

Diamond, P. A. and J. A. Mirrlees (1971). Optimal taxation and public production I: Production efficiency. *American Economic Review*, 8–27.

Dixit, A. (1985). Tax policy in open economies. *Handbook of Public Economics 1*, 313–374.

Felbermayr, G., B. Jung, and M. Larch (2013). Optimal tariffs, retaliation, and the welfare loss from tariff wars in the melitz model. *Journal of International Economics 89*(1), 13–25.

Gordon, R. H. (1986). Taxation of investment and savings in a world economy. *American Economic Review*, 1086–1102.

Gordon, R. H. and A. L. Bovenberg (1996). Why is capital so immobile internationally? possible explanations and implications for capital income taxation. *The American Economic Review*, 1057–1075.

Gordon, R. H. and J. R. Hines (2002). International taxation. *Handbook of public economics 4*, 1935–1995.

Haaland, J. I. and A. J. Venables (2014). Optimal trade policy with monopolistic competition and heterogeneous firms. *NHH Dept. of Economics Discussion Paper* (33).

Helpman, E. and P. R. Krugman (1989). *Trade policy and market structure*. MIT press.

Helpman E., Melitz, M. and S. Yeaple (2004, March). Export versus FDI with heterogeneous firms. *American Economic Review 94*(1), 300–316.

Hopenhayn, H. A. (1992). Entry, exit, and firm dynamics in long run equilibrium. *Econometrica: Journal of the Econometric Society*, 1127–1150.

Huizinga, H. (1992). The tax treatment of R&D expenditures of multinational enterprises. *Journal of Public Economics 47*(3), 343–359.

Huizinga, H. and S. B. Nielsen (1997). Capital income and profit taxation with foreign ownership of firms. *Journal of International Economics 42*(1), 149–165.

Itoh, M. and K. Kiyono (1987). Welfare-enhancing export subsidies. *The Journal of Political Economy*, 115–137.

Janeba, E. and W. Peters (1999). Tax evasion, tax competition and the gains from nondiscrimination: The case of interest taxation in europe. *The Economic Journal 109*(452), 93–101.

Janeba, E. and M. Smart (2003). Is targeted tax competition less harmful than its remedies? *International Tax and Public Finance 10*(3), 259–280.

Katrak, H. (1977). Multinational monopolies and commercial policy. *Oxford Economic Papers 29*(2), 283–291.

Keen, M. (2001). Preferential regimes can make tax competition less harmful. *National Tax Journal*, 757–762.

Keen, M. and K. Konrad (2013). The theory of international tax competition and coordination. In C. R. F. M. Auerbach, A. and E. Saez (Eds.), *Handbook of Public Economics*, Volume 5, Chapter 5, pp. 257–328. Elsevier.

Langenmayr, D., A. Haufler, and C. J. Bauer (2015). Should tax policy favor high-or low-productivity firms? *European Economic Review 73*, 18–34.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica 71*(6), 1695–1725.

Mills, J. (1848). On colonies and colonization. *Principles of political economy*, 540–560.

Mintz, J. and H. Tulkens (1996). Optimality properties of alternative systems of taxation of foreign capital income. *Journal of Public 60*(3), 373–399.

Pflüger, M. and J. Südekum (2013). Subsidizing firm entry in open economies. *Journal of Public Economics 97*, 258–271.

Razin, A. and E. Sadka (1991). Efficient investment incentives in the presence of capital flight. *Journal of International Economics 31*(1), 171–181.

Suarez-Serrato, J. C. and O. Zidar (2014). Who benefits from state corporate tax cuts? A local labor markets approach with heterogeneous firms. Technical report, National Bureau of Economic Research.

Svedberg, P. (1979). Optimal tariff policy on imports from multinationals. *Economic Record 55*(1), 64–67.

Torrens, R. (1844). The budget: On commercial policy and colonial policy. *London: Smith, Elder*.

Wilson, J. D. (1986). A theory of interregional tax competition. *Journal of urban Economics 19*(3), 296–315.

Zodrow, G. R. and P. Mieszkowski (1986). Pigou, tiebout, property taxation, and the underprovision of local public goods. *Journal of urban Economics 19*(3), 356–370.