An Economic Analysis of Extraterritorial Taxation*

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Abstract

This paper proposes an economic analysis of extraterritorial tax policy. We consider a country imposing a top-up profit tax to foreign firms accessing its market. We analyze the effects of this tax on firm behavior and welfare and derive conditions for optimal policy in a flexible monopolistic competition model. Extraterritorial taxation generates additional tax revenues but leads to domestic price increases. In the most stripped-down analysis, extraterritorial taxation follows a simple $s > t$ logic. For a country accounting for a fraction s of a firm's sales, it is welfare-increasing to introduce an extraterritorial tax as long as s is greater than the foreign tax rate t. When foreign firms are not taxed abroad, tax revenue gains dominate consumer surplus losses even for small countries. The larger the consumption market the higher the ability to tax, with gains that are convex in market size. These intuitions generalize in more sophisticated settings, where the minimum sales share needed to implement an extraterritorial tax depends on a terms-of-trade externality and a profit-displacement effect. A top-up profit tax on foreign firms has better welfare effects than a tariff, both unilaterally and in the Nash equilibrium. Extraterritorial tax collection turns the logic of tax competition on its head: large consumer market countries (for which revenue gains swamp price increases) have incentives to tax the undertaxed profits of foreign firms, encouraging foreign countries to increase their own tax rates, leading to a race to the top.

Keywords: tax competition, multinational firms, monopolistic competition
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1 Introduction

A key issue in the regulation of globalization is how to achieve effective minimum standards. International competition can lead to a race to the bottom, where producers relocate to the territories offering the most favorable norms. This is a salient concern in tax policy, where it has long been understood that international tax competition can lead to suboptimally low equilibrium tax rates (see, e.g., Keen and Konrad, 2013). But the issue extends beyond taxation and also applies to environmental standards, carbon pricing, and the regulation of artificial intelligence.

To address this challenge, an increasingly used policy involves conditioning market access on compliance with basic norms. Examples of this approach include the use of mirror clauses in trade agreements (conditioning market access on pesticide usage limits, for instance) and the European Union corporate sustainability due diligence directive (instructing corporations to address adverse human rights and environmental impacts of their action outside of Europe). In all these cases, governments attempt to impose minium standards on foreign producers.

Our paper asks a simple question: can this logic be applied to tax policy too? That is, to what extent can countries require foreign economic actors accessing their market to be subject to minimum tax rates?

To address this question, we propose an economic analysis of extraterritorial tax policy. We consider a country (or coalition of countries) A imposing a top-up tax to non-resident actors. Our analysis can be applied to the taxation of corporations, individuals, or carbon; in our main analysis we focus on corporations. Country A sets a minimum corporate income tax rate t_A^{min} which it views as the standard to be met by domestic and foreign firms alike. We consider a move by A to overtax foreign firms if they are taxed below t_A^{min} abroad, and ask: How would firms respond to this tax? What would be its effect on welfare? And what is the minimal coalition size needed to successfully implement such a tax?

At the outset it is worth mentioning that there is a precedent for this type of exterritorial taxation: the international agreement creating a 15% minimum tax on large multinational firms, known as Pillar Two of the OECD two pillar solution. This agreement, which started to be implemented in 2024, contains a clause allowing participating countries to collect the minimum taxes that non-participating countries forego. The goal of this provision it to incentivize all countries to join the agreement and to ensure that, even if some abstain, all large multinationals are nonetheless subject to a 15% minimum tax rate.[1] Praised by some (e.g., Clausing, 2024;

[1] About 140 jurisdictions have committed to implementing the minimum tax agreement. As of March 2025,

Kysar, 2024), this provision has been castigated by others; in January 2025 President Trump threatened to sanction countries that would implement it.[2] Despite these debates, there is to date no formal analysis of this type of mechanism. Our paper aims to fill this gap by providing a general theory of extraterritorial taxation that includes the Pillar Two mechanism as a special case.

To do so, we develop a flexible model of international taxation in which firms produce in multiple countries and sell in multiple destination market countries, one of which, country A, imposes an extraterritorial top up tax. The top up tax is higher for firms that make a larger fraction of their sales in A—in effect, tying market access to compliance with A's taxation standard. We begin in Section 2 by considering a simple benchmark case of monopolistic competition by foreign multinationals with iso-elastic demand in the consumption market. This simple case allows us to transparently capture the key trade-off involved with extraterritorial taxation. On the one hand this policy generates additional tax revenues for the country implementing it, but on the other firms respond by increasing their price, hurting consumers. At worst, foreign firms may leave the market completely. Section 3 considers a number of generalizations: variables elasticities of demand, different market structures, and endogenous foreign tax rates. We study the Nash equilibrium in Section 4 and provide numerical calibrations in 5. The conclusion discusses how the results can be applied to carbon and individual taxation.

Our main findings can be summarized as follows. In the most stripped-down analysis, extraterritorial taxation follows a simple $s > t$ logic. For a country accounting for a fraction s of a firm's sales, it is welfare-increasing to introduce an extraterritorial top up tax as long as s is greater than the foreign tax rate t. In particular, if the foreign tax rate is zero (i.e., for a firm operating in a tax haven), extraterritorial taxation is always welfare-increasing, no matter the size of the country implementing it. Contrary to a widely-held view, even a small country alone has the power to partially curb the use of tax havens by foreign multinational companies. The larger the consumption market, the higher the ability to tax, with gains that are convex in market size. A large enough coalition of countries can top-up high foreign taxes, but a small country alone cannot overtax firms that are already heavily taxed abroad.

These results generalize to more sophisticated settings, where the minimum sales share

50 territories had started to do so, according to a tracker maintained by PwC (2025). Notably, however, the United States had not passed legislation to implement it. The application of the rules allowing participating countries to tax undertaxed foreign firms—known as the undertaxed profit rules (UTPR)—started in 2025 and was scheduled to begin in 2026 in the case of the domestic profits of US multinationals.

[2]See "The Organization for Economic Co-operation and Development Global Tax Deal," memorandum for the Secretary of the Treasury, `https://www.whitehouse.gov/presidential-actions/2025/01/the-organization-for-economic-co-operation-and-development-oecd-global-tax-deal-global-tax-deal/`.

needed to implement an extraterritorial top up tax turns out to be smaller than t. This minimum sales share depends on externalities that are central to the analysis of trade policy with imperfectly competitive markets: a terms-of-trade effect (the ability of the destination market country to exert monopsony power on foreign firms' pricing decisions) and a profit-displacement effect (the extent to which domestic firms gain profits at the expense of foreign firms).[3] The larger the terms-of-trade and the profit-displacement effects, the smaller the sales share needed to top up foreign taxes.

We also show that extraterritorial top up taxes, although they share some of the characteristics of tariffs, have more desirable features than tariffs, both unilaterally and in the Nash equilibrium. Unilaterally, the pass-through of an extraterritorial top up tax into prices is lower than the pass-through of a tariff. When factoring in the best response of other countries, extraterritorial top up taxes create different incentives and equilibrium. In a tariff war, countries retaliate by imposing tariffs of their own, leading to outcomes that are typically Pareto-dominated (see Ossa, 2014, for a quantitative analysis). With extraterritorial top up taxes, countries are incentivized to collect taxes themselves rather than letting other countries do it on their behalf. This leads to an equilibrium that, under certain conditions, Pareto-dominates the uncooperative Nash equilibrium of the international tax competition game.

In effect, extraterritorial taxation turns the logic of tax competition on its head. In the standard world of tax competition, small countries have incentives to offer low tax rates—the revenues gained by attracting activity or profits from abroad swamp the loss due to a lower tax collection on the domestic tax base. As small countries cut their tax rates, other countries are forced to follow through, leading to a race to the bottom. With extraterritorial taxation, by contrast, large countries have incentives to top up foreign taxes—the tax revenue gains, for them, swamp price increases. As large countries collect the taxes that other countries forego, foreign countries are incentivized to increase their own tax rates, leading to a race to the top. This makes extraterritorial top up taxes a potentially powerful tool to endogenously achieve effective minimum global standards. The key question is what is the minimum country or coaliton size needed to unleash this race to the top, which is the core issue we investigate in this paper.

An extraterritorial top up tax requires relatively detailed firm-level data to be implemented:

[3]The profit displacement effect corresponds to what is known as the "profit shifting effect" in the trade policy literature (Brander and Spencer, 1985). To avoid confusion, we keep the term "profit shifting" to refer to the shifting of profit within subsidiaries of a given multinational group in response to tax differentials (as in the literature on the taxation of multinational firms) and use "profit displacement" to refer to the gain in profit by domestic firms that strategic trade policies (including those we study in this paper) can generate.

information on the country-by-country profits and tax payments of foreign companies. This is more demanding than a tariff, which only requires information on the value of goods crossing borders. Since 2016, however, countries have automatically shared data on the country-by-country accounts of large multinational firms. The information needed to implement an extraterritorial top up tax has thus largely become available.[4]

Our paper relates to the large literature analyzing policies to foster coordination on common standards and avoid international leakages. A body of work studies these questions in the context of environmental issues; see Markusen (1975) for a classic analysis and Fontagné and Schubert (2023) for a recent review. Within that literature our paper is most closely related to Nordhaus (2015) who analyzes how countries can use the threat of tariffs to ensure the stability of "climate clubs"; Farrokhi and Lashkaripour (2025) provide a comprehensive quantitative investigation. Our main contribution is to analyze a new mechanism, extraterritorial top up taxes.[5] Our quantitative analysis highlights that unlike contingent tariffs, extraterritorial top up taxes do not require major economic powers like the United States, the European Union, and China to form an initial alliance. Instead, much smaller initial coalitions of countries can successfully top up foreign taxes and endogenously start a race to the top.

We also add to the large body of work on tariffs, historically the main form of extraterritorial taxation (in the sense of trying to make non-residents pay). The classical reference on optimal tariffs is Johnson (1951); recent empirical investigations include the influential work of Fajgelbaum et al. (2020). Methodologically, our work is close to Fajgelbaum and Khandelwal (2024), who study the effects of tariffs and tariffs exemptions on firm behavior in a monopolistic competition setting.

We also contribute to the literature on the theory of international tax competition and coordination. The seminal contribution of Kanbur and Keen (1993) studies tax competition when countries differ in size. A large body of work studies the properties of different instruments to mitigate tax competition, including the use of apportionment formula (Gordon and Wilson, 1986) and border adjustment, as in the destination-based corporate cash flow tax of Auerbach and Devereux (2018). As in Gordon and Wilson (1986) we use a partial equilibrium set up; general equilibrium effects are the subject of much previous work on corporate taxation. As in

[4]The compilation and exchange of country-by-country reports is currently limited to multinational companies with more than 750 million euros in sales (which are also those in scope of the Pillar Two minimum tax); a more systematic implementation of extraterritorial profit taxation would require extending these reporting requirements to smaller firms.

[5]Saez and Zucman (2019, chapter 6) sketched the extraterritorial top up tax tax analyzed here (to our knowledge the first expression of this idea) but did not provide a formal analysis. This mechanism was incorporated in the Pillar Two agreement announced in 2021.

Auerbach and Devereux (2018), we focus on the taxation of economic rents. It is well known that even a tax based on economic rents distorts behavior in an international setting; our analysis is focused on these distortions.

Last, we add to the burgeoning literature studying the global minimum tax announced in 2021 (Johannesen, 2022; Janeba and Schjelderup, 2023). Our contribution here is to study the effects of its extraterritorial provision. In addition to Pillar Two, there has also been a growing use of tariff-equivalent measures like Digital Service Taxes since the late 2010s. A common concern with these policies is their adverse effects on domestic prices, as evidence by Langenmayr and Muddasani (2025). Our framework focused on price effects of extraterritorial taxes lends itself well to the analysis of such policies.

2 Extraterritorial Taxation in a Simple Monopolistic Competition Model

2.1 Definitions

Consider a multinational firm producing in countries $i \in \mathcal{I}$ with customers in countries $j \in \mathcal{J}$. The worldwide sales of the firm are:

$$S(\mathbf{p}) = \sum_{j \in \mathcal{J}} p_j q_j(p_j)$$

where $\mathbf{p} = (p_j)_{j \in \mathcal{J}}$ is the price vector across countries. Corporate taxes t_i are levied in production countries and the tax base consists of pure profit. Post-tax profits are

$$\Pi(\mathbf{p}) = \sum_{i \in \mathcal{I}} (1 - t_i) \sum_{j \in \mathcal{J}} (p_j - c_{ij})\, q_j(p_j)$$

where c_{ij} is the marginal cost of production in country i for sales in country j. It can be thought of as $c_i \times \tau_{ij}$ where τ_{ij} are trade costs.

Undertaxed profits and extraterritorial tax. Country $j = 0$ considers introducing an extraterritorial top-up profits tax. To characterize this tax, we first define a firm's *undertaxed profits* $\Pi^u(\mathbf{p})$ as the total amount of pre-tax profits taxed below a certain rate t_0^{min}:

$$\Pi^u(\mathbf{p}) = \sum_{i \in \mathcal{I}} \mathbb{1}_{t_i < t_0^{min}} \sum_{j \in \mathcal{J}} (p_j - c_{ij})\, q_j(p_j)$$

Undertaxed profits $\Pi^u(\mathbf{p})$ are closely linked to the base of the extraterritorial top up tax we study in this paper. Specifically, in our baseline mechanism, the base of the top up tax is $\Pi^u(\mathbf{p}) \cdot s_0(\mathbf{p})$, where

$$s_0(\mathbf{p}) = \frac{p_0 q_0(p_0)}{S(\mathbf{p})}$$

is the fraction of the firm's sales made in 0. This base is then subject to a top up rate $t_0^{min} - t^u$, where t^u is the tax rate on undertaxed profit (by definition smaller than t_0^{min}). We call this baseline mechanism *tax deficit collection* (TDC).

In words, with a TDC, country 0 subjects a fraction s_0 of a firms's foreign undertaxed profit to its own taxation standard t_0^{min}. The larger the share of the firm's sales made in 0, the closer the firm must get to country's 0 standard. In the extreme case where $s_0 = 1$ (the firm makes all its sales in country 0), then all undertaxed profit are subject to the top up rate $t_0^{min} - t^u$, i.e., the tax rate on undertaxed foreign profits becomes t_0^{min}. If $s_0 = 0$ (the firm does not sell in 0), the extraterritorial tax is zero.

We also analyze the case where the base of the extraterritorial is simply $\Pi^u(\mathbf{p})$ instead of $\Pi^u(\mathbf{p}) \cdot s_0(\mathbf{p})$, i.e., the base does not depend on s_0. The top-up rate remains $t_0^{min} - t^u$. This case corresponds to the extraterritorial mechanism, known as the undertaxed profit rules (UTPR), included in the Pillar Two minimum tax. The coalition of countries 0 implementing this agreement can top up foreign taxes to ensure that the multinationals of non-participating countries are subject to t_0^{min}, irrespective of what fraction of their sales they make in 0.[6] This amounts to fully imposing the minimum taxation standard of 0 to foreign producers. Intuitively, and as our analysis will clarify, this approach requires a larger coalition size than our baseline instrument.

Tax deficit. It is also useful to define the *tax deficit (TD)* of a firm. The tax deficit is the difference between what the firm pays in tax globally and what it would pay, everything else equal, if its profits were taxed at least at t_0^{min} in each production country:

$$TD(\mathbf{p}) = \sum_{i \in \mathcal{I}} \max\left\{t_0^{min} - t_i, 0\right\} \sum_{j \in \mathcal{J}} \left(p_j - c_{ij}\right) q_j(p_j)$$

The tax deficit is closely linked to the revenue of the extraterritorial top up tax. Specifically, in our baseline mechanism (TDC), the mechanical revenue of the top up tax is $TD(\mathbf{p}) \cdot s_0(\mathbf{p})$. Of

[6] In the current Pillar-Two rules, this top-up tax is then shared among participating countries as follows: 50% of the tax revenues are allocated proportionally to the capital stock owned by the affected multinationals in each participating country and 50% proportionally to the number of employees.

course, because the tax will distort behavior, actual revenue collected will not equal mechanical revenue. The firm will change its prices $\mathbf{p}$, reducing both $s_0(\mathbf{p})$ and $TD(\mathbf{p})$, so that actual revenue will be lower than $TD(\mathbf{p}) \cdot s_0(\mathbf{p})$.

In the special case of the UTPR, the mechanical revenue of the top up tax is simply TD. Country 0 aims to collect all the tax deficit of foreign firms, irrespective of what fraction of their sales they make in 0. In that case, as we shall see, behavioral responses will be along the extensive margin (stopping to serve customers in 0), so that actual revenue will be either TD or nil.

Effective tax rates. Even though only country 0 collects the top up tax revenue, from a firm's perspective a top up tax applied by country 0 increases the effective tax rate t_i in all countries where $t_i < t_0^{min}$. With a TDC, the effective tax rate in each country i becomes

$$\tilde{t}_i := t_i + s_0(\mathbf{p}) \max\left\{t_0^{min} - t_i, 0\right\}$$

while in the case of the UTPR it becomes

$$\tilde{t}_i := t_i + \max\left\{t_0^{min} - t_i, 0\right\}$$

In both cases, denoting $\pi_i(\mathbf{p}_i) = \sum_{j \in \mathcal{J}} (p_j - c_{ij})\, q_j(p_j)$ the pre-tax profits in country i, we can write global post-tax profits as:

$$\Pi(\mathbf{p}) = \sum_{i \in \mathcal{I}} \left(1 - \tilde{t}_i\right) \pi_i(\mathbf{p}_i)$$

Example 1 (Tax deficit collection, 2 countries). Consider a world with two economies, country 0 (say, Continental Europe) and country H (say, Ireland).

A firm produces in H, makes $s_0 = 60\%$ of its sales in 0 and $1 - s_0 = 40\%$ in H. The firm makes €100 in profit, all of which is taxed in H. The tax rate in country H is $t_H = 5\%$ hence the firm pays €5 in taxes globally.

Country 0 now considers an extraterritorial tax deficit collection with a top up rate $t_0^{min} - t_H$ equal to 15% (i.e., $t_0^{min} = 20\%$). The base of the top up tax is the undertaxed profit of the firm ($\Pi^u =$ €100) times the share of the firm's sales made in 0. Before behavioral responses, this share is $s_0 = 60\%$, hence the base of the top up tax is $\Pi^u \cdot s_0 =$ €60. The mechanical top-up tax revenue for country 0 is $(t_0^{min} - t_H) \cdot \Pi^u \cdot s_0 = 15\% \times$ €60 = €9. Equivalently, one could say that the tax deficit TD of the firm is €15 and country 0 aims to collect a fraction $s_0 = 60\%$

of this tax deficit. This top up tax results in a (mechanical) increase in the global effective tax rate of the firm from 5% to 14%.

Naturally, the top up tax is going to generate behavioral responses. As shown in Section 2.3, the firm will change its prices $\mathbf{p}$. Undertaxed profit $\Pi^u(\mathbf{p})$ and the sales share $s_0(\mathbf{p})$—hence the base of the tax—will fall. Revenue actually collected will be lower than the mechanical revenue of €9.

Example 2 (tax deficit collection, N countries). Consider the country-by-country report published by the oil and gas company Shell (Appendix Table A1). The report shows a country breakdown of the sales, profit, and tax payments (among other indicators) of this company in 2023.

Assume the United States (country 0) sets a $t_0^{min} = 21\%$ minimum tax rate standard. For each country where Shell books any profit, we can compute the mechanical increase in tax liability if $t_0^{min} = 21\%$ applied in that country; summing across countries we obtain the global tax deficit TD. Because the tax deficit is computed country by country, there is a positive global tax deficit as soon as the firm has an effective tax rate lower than 21% in at least one country, even if, as is the case for Shell, the company's global effective tax rate is larger than $t_0^{min} = 21\%$.

In 2023, out of $24.9 billion in total pretax profit, Shell had undertaxed profits Π^u of $5.7 billion, mainly in the Bahamas, Kazakhstan, and Switzerland. These profits were taxed at $t^u = 6.1\%$, hence the firm's total tax deficit TD equaled $(t_0^{min} - t^u) \cdot \Pi^u = \$847$ million. Shell made $s_0 = 22.6\%$ of its sales in the United States.[7] The base of a tax deficit collection by the United States would have been $\Pi^u \cdot s_0 = \$1.3$ billion and the mechanical revenue gain for the United States $(t_0^{min} - t^u) \cdot \Pi^u \cdot s_0 = \$191$ million.

Example 3 (UTPR). Consider a world with two coalitions of countries. One, coalition 0, applies a common minimum standard $t_0^{min} = 15\%$, the other, coalition H, does not and has a corporate tax rate of $t_H < t_0^{min}$. One can think of 0 as the coalition of countries implementing the Pillar Two global minimum tax agreement, and coalition H as non-Pillar-Two countries. Coalition 0 collects a top up tax on all the firms of H to ensure their tax rate reaches 15%,

[7] We compute the distribution of sales using the third-party revenues variable published in the country-by-country report. Using total revenue would lead to allocating a higher fraction of sales to offshore centers, which have disproportionate amounts of related-party revenue. Note, however, that even third-party revenues are an imperfect proxy for sales to final customers, as firms can book sales to third-parties in tax havens (Laffitte and Toubal, 2022) or more broadly due to the use of export platforms. Addressing this issue would require restating third-party revenues on an ultimate destination basis; see Chouc (2022) for an attempt.

irrespective of their s_0. The base of this top up tax is undertaxed profit Π^u and the rate is $(t_0^{min} - t_H)$. The mechanical revenue is $\Pi^u \cdot (t_0^{min} - t_H) = TD$, not $TD \cdot s_0$ as in example 1.

Applying the UTPR to the case of Shell, the base is $\Pi^u = \$4.2$ billion. The base is lower than in Example 2, because t_0^{min} is lower (15% as opposed to 21%); for instance profits booked in Kazakhstan, where $t_i = 17\%$, are no longer included in Π^u. The effective tax rate on undertaxed profit is $t^u = 2.4\%$ and the mechanical tax revenue gain for coalition 0 is $TD = (t_0^{min} - t_H) \cdot \Pi^u = \$528$ million. If TD does not change in response to the tax, then actual revenues correspond to the mechanical revenues, making the UTPR a simple knife-edge case to analyze.

2.2 Consumers

Having defined and illustrated our key concepts, we now turn to the economic model. We consider an open economy j populated by a L_j identical consumers endowed with income Y_j/L_j. Consumers have preferences over an outside homogenous good z_j and a bundle of differentiated goods $\mathcal{X}_j$ produced by domestic firms ($\mathcal{X}_{jj}$) and foreign firms ($\mathcal{X}_{ij}$ for origin countries $i \neq j$). Each firm f from $i \in \mathcal{I}$ produces a variety for this market in quantity $q_{fij} = L_j x_{fij}$. Utility of a consumer is:

$$U_j = z_j + \frac{\eta}{\eta - 1}\left[\mathcal{X}_j^{\frac{\eta-1}{\eta}} - 1\right] \quad \text{with} \quad \mathcal{X}_j = \left(\sum_{i\in\mathcal{I}} \mathcal{X}_{ij}^{\frac{\nu-1}{\nu}}\right)^{\frac{\nu}{\nu-1}} \quad \text{and} \quad \mathcal{X}_{ij} = \left(\sum_{f=1}^{N_i} x_{fij}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

The upper-nest price index P_j for the differentiated good is given by

$$P_j = \left(\sum_{i\in\mathcal{I}} P_{ij}^{1-\nu}\right)^{\frac{1}{1-\nu}} \text{ where } P_{ij} = \left(\sum_{f=1}^{N_{ij}} p_{fij}^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$$

is the price index for the CES-bundle originating from i and N_{ij} is the number of firms from i selling to j.

Three parameters characterize this nested CES framework: the elasticity of substitution between the homogenous good and the differentiated good (η); the elasticity of substitution, within the differentiated good, between what originates from different countries (ν); and the elasticity of substitution between imported varieties from a given origin (σ). The elasticities are strictly larger than one. Under this nesting, we typically expect $\eta > \nu > \sigma$ even though our derivations hold more generally.

2.3 Firms and Pricing Strategies

Consumers expenditure on the differentiated goods is given by $P_j^{1-\eta}$. The market share in j of goods produced in i is $\lambda_{ij} = P_{ij}^{1-\nu}/P_j^{1-\nu}$. Within the set of varieties originating from i,

consumers allocate their expenditure according to $\lambda_{fij} = p_{fij}^{1-\sigma}/P_{ij}^{1-\sigma}$.
The market structure in each nest is characterized by monopolistic competition: firms are "price-index-takers" and maximize their profits.
We assume throughout that firms are symmetric in each nest, we have. Dropping the subscript f, we conveniently write the demand in j for the variety produced by a firm from i as

$$q_{ij}(p_{ij}) = A_{ij}p_{ij}^{-\sigma}$$

where A_{ij} is an endogenous demand shifter that depends on prices and the number of varieties in other nests, i.e., $A_{ij} = L_j P_j^{\nu-\eta} N_{ij}^{\frac{\sigma-\nu}{1-\sigma}} p_{ij}^{\sigma-\nu}$. When the foreign destination j is not served by firms from i, i.e., $N_{ij} = 0$, then $A_{ij} = 0$. We will also refer the knife-edge case where there is only 1 foreign firm - a monopoly - selling to country 0, which is obtained for $\eta = \nu = \sigma$.
Since firms take A_j as given, the parameter σ also characterizes the elasticity of demand for their variety. We relax the constant-elasticity assumption in Section 3.1 where we explore the implications of variable elasticities.

Country 0 introduces an extraterritorial Tax Deficit Collection. We assume country 0 is a pure destination market for foreign firms, which do not produce there. This implies that, conditional on import prices, the market power of foreign firms is irrelevant to the importing country. This guarantees that country 0's extraterritorial policy instruments remain extraterritorial in that they do not aim at correcting a domestic monopoly distortion. However, when foreign firms compete with domestically-owned firms, we will see that TDC might leads to profit displacement.

We assume that each destination country j is served through only one i. The profit-maximization problem of the firm becomes:

$$\max_{p_j} \sum_i (1-t_i) \sum_j (p_j - c_{ij})\, q_j(p_j) - s_0(\mathbf{p}) TD(\mathbf{p})$$

The allocation of sales to market 0 (originating from a country i) with prices $\mathbf{p}$ is given by

$$s_{i0}(\mathbf{p}) = \frac{A_{i0}p_{i0}^{1-\sigma}}{S(\mathbf{p})}$$

where $S(\mathbf{p}) = \sum_{i,j\in\mathcal{I}\times\mathcal{J}} A_{ij}p_{ij}^{1-\sigma}$ denotes a firm's global sales. Maximizing profits with respect to p_0 leads to the first-order condition

$$\left((1-t_i) - \left(s_0(\mathbf{p}) \sum_i \max\left\{t_0^{min} - t_i, 0\right\}\right)\right) \pi_i'(p_0) - \frac{\partial s_0}{\partial p_0} \sum_{ij;j\neq 0} \max\left\{t_0^{min} - t_i, 0\right\} \pi_i(p_0) = 0$$

where $\pi_i(\mathbf{p}_i) = \sum_j \pi_{ij}(p_j)$.

Proposition 1: Firms' prices under extraterritorial taxation. *When country 0 introduces its extraterritorial tax, foreign firms increase their price in country 0 and decrease their price in other countries relative to their standard monopoly pricing:*

$$\begin{aligned} \text{In country 0:} \quad & \frac{p_0 - c_{i0}}{p_0} = \frac{1}{\sigma} + \frac{\sigma - 1}{\sigma}\left(\frac{1 - s_0}{1 - \tilde{t}_0}\frac{TD}{S}\right) \geqslant \frac{1}{\sigma} \\ \text{In countries } j \neq 0: \quad & \frac{p_j - c_{ij}}{p_j} = \frac{1}{\sigma} - \frac{\sigma - 1}{\sigma}\left(\frac{s_0}{1 - \tilde{t}_0}\frac{TD}{S}\right) \leqslant \frac{1}{\sigma} \end{aligned} \tag{1}$$

Proof. See Appendix A.2. □

This proposition provides a simple expression for the effect of country 0's extraterritorial taxes on the firm's pricing strategies. The key insight is the following. To avoid the tax, the firm wants to re-shuffle its sales out of country 0. Re-shuffling sales can be done by increasing prices in 0 and by cutting prices in the rest of the world. Changing prices, however, has a cost: it reduces the firm's monopoly profit. There is thus a trade-off between tax minimization (which pushes the firm to reshuffle a lot) and monopoly pricing maximization (which pushes it to reshuffle little). The optimal pricing strategy strikes a balance between these two forces. In general there is an interior solution and the optimal strategy is not to leave country 0. Moreover, even though there is no policy change in $j \neq 0$, the tax introduced by country 0 affects prices in j. A number of additional points are worth noting.

First, if all sales are made in country 0 (i.e., $s_0 = 1$), then the tax does not distort prices in 0 relative to standard monopoly pricing:

$$\frac{p_0 - c_{i0}}{p_0} = \frac{1}{\sigma} \quad \text{i.e.,} \quad p_0 = \frac{\sigma}{\sigma - 1} c_{i0}$$

In that case profits in all countries i are taxed at the minimum rate $\tilde{t}_i = t_0^{min}$ (or at t_i if $t_i > t_0^{min}$) and the incidence of the collection of the tax deficit is on firm owners only, not on consumers. More generally, a firm with a large market share in 0 will not increase its price in 0 much—but rather cut its price in the rest of the world. Conversely, a firm with a small market share in 0 will not cut its prices in the rest of the world much—but rather increase its price in 0. The price distortion is borne by consumers in small markets.

Second, the price distorsion (always relative to monopoly pricing) increases with a firm's initial global effective tax rate t. When country 0 introduces its extraterritorial tax, the global average effective tax rate of the firm rises from t to $\tilde{t}_0$. For instance if all countries j have the same

tax rate $t < t_0^{min}$, then the new global effective tax rate of the firm becomes $\tilde{t}_0 = t + s_0(t_0^{min} - t)$. When the initial tax rate t is high, post-tax profits are low and the gains from maximizing monopoly profits are small. However, the gains from minimizing the extraterritorial tax by reshuffling sales do not depend on t (but only on the top-up rate $t_0^{min} - t$). Hence with a high initial tax rate t, the firm prioritizes sales reshuffling over monopoly profits, leading to a high price distortion. In sum, firms that are already highly taxed will be more responsive to the additional tax introduced by country 0.

Third, the price distortion increases the ratio of the global tax deficit w.r.t. global sales TD/S i.e. tax-avoidance intensitiy. If there is no tax deficit, then the extraterritorial tax is zero and we are back to standard monopoly pricing. The price distortion also rises with the top-up rate $t_0^{min} - t$ and with the elasticity of demand σ.

Last, the extraterritorial tax affects its base (the apportioned undertaxed profit $s_0(\mathbf{p}) \cdot \Pi^u(\mathbf{p})$) in multiple ways. As the firms changes its pricing strategy, s_0 falls. Undertaxed profits also fall, because pre-tax profits fall. Since profits are maximized with respect to $\mathbf{p}$ before the introduction of the TDC, the change in $\mathbf{p}$ leads to lower pre-tax profits. Because profits are maximized country-by-country pre-TDC, pre-tax profits are lower in each country post-TDC, including in those countries where profits are undertaxed.[8]

2.4 Equilibrium

In what follows we consider that undertaxed firms produce in a country $i \neq 0$ where profits are taxed at an effective rate t. We also assume without loss of generality that consumption in country 0 is split between production originating from country i and domestic production. We start our analysis with a lemma that characterizes the impact of an extra-territorial tax on firm profitability. Global profits are obtained from the addition of sales weighted by firms' post-tax profit margin, i.e., post-tax profits divided by sales, across destinations.

In our baseline set-up with monopolistic competition and iso-elastic demand, firms will charge the same markup irrespectively of the goods destination. The profit margin is then given by the inverse of the demand-elasticity σ for any destination. Now in response to an extra-territorial tax we have seen that firms adjust their prices and thereby their markup. Doing so, they reshuffle their sales away from country 0 and dampen their tax burden. Nevertheless,

[8] One could also imagine that in response to country 0's policy, other countries will increase their own corporate tax rate, which would further reduce the tax deficit. These policy changes are exogenous to firms so we can simply report t instead of $t(t^{min})$ when describing their optimal pricing strategy. However, the assumptions on $t(t^{min})$ will matter to determine the optimal minimum tax and the best-responses of other countries.

we can show the following:

Lemma 1: *After the introduction of the top-up tax, post-tax profits in each destination remain proportional to sales weighted by firms' (effective) keep rate. In particular, the profits of a firm producing in a single jurisdiction i can be expressed as:*

$$\Pi = (1 - \tilde{t}_i)\frac{S}{\sigma}$$

.

Proof. See Appendix A.3. □

Consequently, for $t < t^{min}$, the tax deficit and undertaxed profits are given respectively by $TD = (t^{min} - t)\Pi^u$ and $\Pi^u = \frac{S}{\sigma}$.

All variables are easily expressed as a function of firms' prices and thereby s_0.To solve for the equilibrium s_0^*, note first that absent distortions, global sales allocation is proportional to demand shifters $s_0 = \frac{A_{i0}}{\sum_{j\in\mathcal{J}} A_j}$. After the introduction of the extraterritorial tax by country 0, p_0 increases, sales in 0 fall while sales in other countries increase, hence the global sales share s_0 falls. We denote δ the normalized top-up tax rate introduced by country 0:

$$\delta = \frac{t_0^{\min} - t}{1 - t}$$

In words, δ is the top-up rate normalized by the keep rate. After the introduction of the top up tax, prices become

$$p_{i0} = \frac{\sigma}{\sigma - 1}\frac{c}{1 - \frac{1}{\sigma}\frac{(1-s_0)\delta}{1-s_0\delta}} \quad p_{ij} = \frac{\sigma}{\sigma - 1}\frac{c}{1 + \frac{1}{\sigma}\frac{s_0\delta}{1-s_0\delta}} \text{ with } j \neq 0$$

We can show (see Appendix A.4) that the equilibrium sales share $s_0^*(\delta)$ is implicitly solved by

$$\frac{1 - s_0^*}{s_0^*} = \underbrace{\frac{\sum_{j\neq 0} A_{ij}}{A_{i0}}}_{\text{Undistorted global sales allocation}} \left(\frac{1 - \frac{\delta}{\sigma} - \rho s_0^*\delta}{1 - \rho s_0^*\delta}\right)^{1-\sigma} \tag{2}$$

where $\rho = \frac{\sigma-1}{\sigma}$.

The intensity of competition among firms embedded in the endogenous demand shifter A_{ij} will generally respond to a top-up tax in each destination. In the knife-edge case of a single monopolist, $A_{ij} = L_j$ is constant and proportional to population size. Overall, the impact of δ on s_0 depends on the details of the market structure.

Note that given $A_{ij}, j \in \mathcal{J}$, the LHS (resp. RHS) of (2) is increasing (decreasing) in s_0. Thus, abstracting from competition effects, the direct effect of the extraterritorial tax $\delta > 0$ is to reshuffle firms' sales away from country 0 towards other destination markets.

When firms are competing monopolistically in each nest, the demand shifters A_j are endogenous. The global sales share of any firm from country i in 0 becomes:
where $\lambda_{j,-k}$ represents the expenditure share in market j on varieties from all origins except k.

$$s_{i0}(\delta) = \frac{1}{1 + \sum_{j \in \mathcal{J}} \frac{L_j}{L_0} \left(\frac{1-\lambda_{0,-i}(\delta)}{1-\lambda_{j,-i}(\delta)} \right)^{\frac{\nu-\eta}{1-\nu}} \left(\frac{1-\frac{\delta}{\sigma}-\frac{\sigma-1}{\sigma}s_{i0}(\delta)\delta}{1-\frac{\sigma-1}{\sigma}s_{i0}(\delta)\delta} \right)^{1-\nu}}$$

Plugging the definition of the expenditure shares $\lambda_{j,-k}$ as a function of prices which depend, in turn, on s_0 pins down the equilibrium. We now turn to the impact of TDC on equilibrium prices in destination markets.

Proposition 2: Price incidence of a marginal extraterritorial tax. *For a small (normalized) top-up tax δ, the incidence of a marginal increase in the extraterritorial tax is given by:*

$$\begin{aligned} \text{In country 0:} \quad & \frac{1}{p_{i0}} \frac{\partial p_{i0}}{\partial \delta} \approx \frac{1 - s_0}{\sigma} \\ \text{In countries } j \neq 0\text{:} \quad & \frac{1}{p_{ij}} \frac{\partial p_{ij}}{\partial \delta} \approx -\frac{s_0}{\sigma} \end{aligned} \tag{3}$$

Proof. See Appendix A.5. □

Two remarks are in order. Consider first the case of untaxed firms, i.e., $t = 0$, so that $\delta = t^{min} - t$ boils down to the top-up rate. Proposition 2 shows that the price increase in country 0 is proportional to the share of foreign sales $(1 - s_0)$ and inversely proportional to the elasticity of substitution σ. Conversely, the price decrease in other countries is proportional to country 0's market share s_0 (and also inversely proportional to σ). Countries with smaller market shares will see larger price increases relative to their pre-tax price level. This result indicates that countries accounting for a larger share of global sales can experience proportionally smaller domestic price increases when implementing a TDC, enabling them to sustain higher extraterritorial tax rates with less distortion to consumer welfare.

Second, when $t > 0$, Proposition 2 implies that the incidence of the top-up tax $t^{min} - t$ will be magnified by $1/(1 - t)$. In line with the intuition behind the role of t already discussed in Proposition 1, firms will reshuffle their sales across destinations more strongly when their foreign tax rate is higher.

2.5 Welfare Analysis and Minimum Coalition Size

2.5.1 Welfare Components

Welfare in country 0 is equal to an endowment term Y, consumer surplus from both domestically and foreign-produced varieties, tax revenue from the extraterritorial policy that is rebated lump-sum, and a fraction of profits from domestic production:

$$W_0 = Y + CS_0 + TR_0 + \alpha PS_{00} \tag{4}$$

where α represents the fraction of domestic profits that country 0 takes into account in its welfare calculation. For instance α could be lower than 1 if the firm is partly owned by non-residents.

Tax revenue from the extraterritorial policy can be expressed as a function of the normalized top-up rate and global undertaxed profits:

$$TR_0 = \delta(1-t)s_0\Pi^u \tag{5}$$

We assume that firms that produce domestically are already subject to territorial taxation and thus have no tax deficit in the eyes of country 0. Consequently, the prices of domestically produced varieties are not affected by the top up tax.

If there is an interior maximum for welfare as a function of δ, then the first-order condition must be satisfied, i.e., $\frac{\partial W_0}{\partial \delta} = 0$.

Since the prices of only foreign firms are impacted by the top-up tax, only consumer surplus from imported varieties is impacted. By the envelope theorem, the marginal variation in consumer surplus with respect to δ is given by:

$$\frac{\partial CS_0}{\partial \delta} = -S_0 \frac{1}{p_0} \frac{\partial p_{i0}}{\partial \delta}$$

The change in tax revenue from the extraterritorial policy takes into account both the direct effect of changing the rate δ and the tax base effects through changes in s_0 and Π^u:

$$\frac{\partial TR_0}{\partial \delta} = (1-t)s_0\Pi^u + \delta(1-t)\left(\frac{\partial s_0}{\partial \delta}\Pi^u + s_0\frac{\partial \Pi^u}{\partial \delta}\right) \tag{6}$$

Last, the change in domestic profits taken into account in welfare is:

$$\alpha(1-t^0)\frac{\partial PS_{00}}{\partial \delta}$$

After some derivations (see Appendix A.7), we obtain:

$$\frac{\partial PS_{00}}{\partial \delta} = L_0 \left(\frac{\nu - \eta}{\sigma} \right) \lambda_{00} N_{i0}^{\frac{1-\nu}{1-\sigma}} P_0^{\nu-\eta} p_{i0}^{-\nu} \frac{\partial p_i 0}{\partial \delta}$$

Combining these components gives us the first-order condition for the optimal top-up tax rate. Under certain conditions, which we will specify in the next sections, this yields a simple rule relating the optimal tax rate to country 0's market share and the existing foreign tax rate.

2.5.2 Minimum Coalition Size

We think of the coalition as a group of countries that would act as a single jurisdiction 0 of size s_0. The minimum size required for a top-up to be welfare increasing can be found of by computing the global sales share at which a jurisdiction 0 is indifferent. To do so, we solve for $\frac{dW_0}{d\delta} = 0$ at $\delta = 0$:

$$0 = \frac{\partial CS_0}{\partial p_{i0}} \frac{\partial p_{i0}}{\partial \delta}\bigg|_{\delta=0} + (1-t) s_0 \Pi^u|_{\delta=0} + \alpha L_0 \left(\frac{\nu - \eta}{\sigma} \right) \lambda_{00} N_{i0}^{\frac{1-\nu}{1-\sigma}} P_0^{\nu-\eta} p_{i0}^{-\nu} \frac{\partial p_{i0}}{\partial \delta}\bigg|_{\delta=0}$$

Dividing by the number of imported varieties and rearranging, we obtain:

$$\frac{1}{p_{i0}} \frac{\partial p_{i0}}{\partial \delta} (1 - \alpha \left(\frac{\nu - \eta}{\sigma} \right) \lambda_{00}) \Big)_{\delta=0} = \frac{1-t}{\sigma}$$

Using that the pass-through relationship from Proposition 2, $\frac{p_\delta}{p} = \frac{1-s_0}{\sigma}$ depends directly on the size s_0 of the country raising the TDC , we can solve for the minimum coalition size. We summarize this result in the following proposition:

Proposition 3: Minimum coalition size. *Any coalition of size $s > \bar{s}$ will find it welfare-increasing to introduce an extraterritorial Tax Deficit Collection, where*

$$\bar{s} = \frac{t - \alpha \left(\frac{\nu-\eta}{\sigma} \right) \lambda_{00}}{1 - \alpha \left(\frac{\nu-\eta}{\sigma} \right) \lambda_{00}} \tag{7}$$

This expression represents the minimum global sales share needed for a country to benefit from implementing an extraterritorial tax. Several results are worth noting.

First, when there is no profit-displacement effect (i.e., $\nu = \eta$ or $\lambda_{00} = 0$), then the minimum coalition size takes a very simple formulation:

$$\bar{s} = t$$

That is, for a country accounting for a fraction s of a firm's sales, it is welfare-increasing to introduce an extraterritorial top up tax as long as s is greater than the foreign tax rate t.

Second, the profit-displacement effect $\alpha\left(\frac{\nu-\eta}{\sigma}\right)\lambda_{00}$ reduces this threshold, making it easier for smaller countries to benefit from extraterritorial taxation. Third, when there is a lot of competition between domestic firms (high σ), the profit-displacement effect is reduced. In the extreme case where there is a infinite substitutability among domestic firms' varieties ($\sigma = \infty$), the profit-displacement effect vanishes and we are back to $\bar{s} = t$.

Last, if $\lambda_{00} = 0$ and $t = 0$ (i.e., there are only foreign firms and these foreign firms pay zero tax), then $\bar{s} = 0$: the optimal top up rate is positive, which we summarize in the following Corollary:

Corollary 1: *A unilateral collection of untaxed profits by destination markets is always welfare increasing.*

This shows that whatever the size of the country, it is always welfare-increasing to impose a positive extraterritorial tax to untaxed foreign firms. The drop in consumer surplus caused by the rise in prices is offset by the gains in tax revenues. This is illustrated by Figure 1, in the special case where $\lambda_{00} = 0$, meaning country 0 only consumes the imported good.

When t is high, we know from Proposition 1 that firms will prioritize sales reshuffling over monopoly profits. This translates into a higher incidence on prices (Proposition 2) and weakens the ability of a given coalition to collect its share of the tax-deficit.

Special case: UTPR. When country 0 collects the full tax deficit of a foreign firm, the base of the extraterritorial tax does not depend anymore on s_0. Firms do not have incentives to re-shuffle sales out of 0 and no incentives to change $\mathbf{p}$.

This does not mean that there is no behavioral response to the tax. Behavioral responses are on the extensive margin: keeping serving customers in 0 (if after-tax profits made by selling to 0, $(1-t)\pi_0$, are larger than the top-up tax $(t_0^{min} - t)\cdot\Pi$) or leaving the market. Since $\pi_0 = s_0 \cdot \Pi$, the cutoff sales share $\bar{s_0}$ above which a firm keeps selling in 0 is:

$$\bar{s}_0 = \frac{t^{min} - t}{1 - t}$$

Conversely, the maximum extraterritorial tax rate that 0 can choose is:

$$\bar{t}^{min} = t + s_0(1 - t)$$

Overall it must be that

$$s_0 > \delta$$

2.6 Optimal Policy

2.6.1 Key Trade-Offs

When choosing t_0^{min} the trade-off is the following: a higher rate increases tax revenues but reduces the base; moreover, consumer surplus falls due to the rise in prices. The optimal policy is given by $\frac{\partial W_0}{\partial \delta} = 0$ which, using the computations in Appendix A.6, boils down to:

$$\left[\underbrace{1}_{\text{CS loss}} + \underbrace{\delta \frac{(1-t)}{\sigma}((\eta-1)+\lambda_{00}(\nu-\eta))}_{\text{Tax base erosion}} - \underbrace{\alpha\left(\frac{\nu-\eta}{\sigma}\right)\lambda_{00}}_{\text{Profit displacement}}\right]\frac{1}{p_{i0}}\frac{\partial p_{i0}}{\partial \delta} = \underbrace{\frac{(1-t)}{\sigma}}_{\text{Tax revenue gain}} \tag{8}$$

The optimal top-up rate balances consumer surplus loss and tax-base erosion against a higher tax rate and a profit-displacement effects. The size of the consumer surplus, tax-base erosion and profit-displacement effects depends on the effect of the TDC on prices. A higher rate of pass-through into prices and thereby a higher tax-base elasticity reduce the optimal top-up rate.

2.6.2 First-Order Approximations

Starting from our minimum coalition size, we can define the maximal foreign tax rate $\bar{t}$ above which a coalition of size s_0 would find it welfare increasing to collect its share of the tax deficit. From Proposition 3, we obtain that $\bar{t} = 1 - (1-s_0)\left(1-\alpha\left(\frac{\nu-\eta}{\sigma}\right)\right)$

Starting from our welfare function above, we look for an approximation of δ given by

$$\delta \approx \frac{W_{\delta t}(0,\bar{t})}{W_{\delta\delta}(0,\bar{t})}(\bar{t}-t)$$

Proposition 4: Optimal rate for small market shares s_0 ***and small*** t***.*** *For small top-up, meaning when* s_0*,* λ_{00} *and* t *are small, the optimal unilateral top-up rate is*

$$\delta \approx \frac{\sigma}{\eta}\left(s_0 + \alpha\lambda_{00}\left(\frac{\nu-\eta}{\sigma}\right) - t\right) \tag{9}$$

where λ_{00} *is the share of expenditures on the differentiated good* $\mathcal{X}$ *that goes to the domestic firm and* t^0 *is the tax rate at which the domestic firm is taxed in country 0.*

Proof. See Appendix A.8. □

Several results are worth noting.

First, optimal wedge increases with ability to tax / contain the distortion which comes with sales reshuffling.

Second, optimal wedge decreases with the rate at which profits are already taxed.

Third, if there is no local firm, then $\lambda_{00} = 0$ and thus

$$\delta \approx \frac{\sigma}{\eta}(s_0 - t)$$

In the simplest case where there is just a foreign monopolist, facing a demand curve with elasticity $\sigma = \eta$ then the optimal top-up boils down to $\delta^* = s_0 - t$. With a range of monopolistically competitive firms the optimal top-up is higher (as $\sigma > \eta$).

Last, when the share of domestic firms is no-longer negligible, the optimal top-up rate formula for a small s_0 and α generalizes to

$$\delta \approx \frac{\sigma}{\eta + \lambda_{00}(\nu - \eta)}\left(s_0 + t^0\lambda_{00}(\nu - \eta) - t\right) \tag{10}$$

2.6.3 Welfare Gains from TDC and Coalition Size

We next examine the potential gains from coordinated tax policy. While each country can implement extraterritorial taxation unilaterally, coordination may enhance welfare outcomes. A country's ability to collect tax deficits depends crucially on its market size, which determines its monopsony power over foreign firms. Our analysis reveals that the welfare gains from coordination are not merely proportional to coalition size but exhibit increasing returns. To demonstrate this formally, we analyze per-capita welfare in country 0 as a function of coalition size. Let L_i represent the population (market size) of the rest of the world. Using the envelope theorem and differentiating per-capita welfare with respect to L_i, we obtain $\frac{\partial W_0}{\partial L_i} < 0$, indicating that welfare in country 0 declines as the relative size of foreign markets increases. Moreover, foreign country size shifts upwards the marginal social welfare impact of extraterritorial taxation, i.e., $\frac{\partial^2 W_0}{\partial \delta \partial L_i}$ is negative, implying that optimal tax rates are higher for larger coalitions.

This leads to our next key result:

Proposition 5: Effects of coalition size. *Assuming no domestic production ($\lambda_{00} = 0$), a larger coalition of countries will (i) implement a higher optimal extraterritorial tax rate and (ii) realize greater per-capita welfare gains from such taxation. In other words, the welfare gains increase more than proportionally with coalition size.*

This is illustrated in Figure 3.

3 Generalization

In this Section we consider a number of extensions of our baseline monopolistic competition benchmark with CES preferences. For most of these extensions, we focus on the $\lambda_{00} = 0$ case, e.g., when there is no clear "protectionist" motive for resorting to extraterritorial taxation. This allows us to isolate new channels at play when we depart from our benchmark. We reintroduce the profit-displacement externality at the end of this Section.

3.1 Variable Elasticity of Demand

Our baseline model relied on several simplifying assumptions, including constant elasticity of substitution (CES) preferences and constant marginal costs. We now consider a single foreign firm but extend our analysis to more general demand and cost structures to investigate the robustness of our results and gain additional insights about the welfare implications of extraterritorial taxation.

3.1.1 General Setup with Variable Elasticity

A monopolist faces a general demand function in country j:

$$q_j(p_j) = A_j h(p_j)$$

where the elasticity of demand $\sigma(p_j) := -\frac{p_j h'(p_j)}{h(p_j)}$ can vary with price, rather than being constant as in the CES case. We also allow for variable marginal costs by assuming a separable cost function $\sum_j C_j(h(p_j))$.

Under these more general conditions, and using the results in Appendix A.1, the pricing strategies of the multinational firm are adjusted as follows. When country 0 introduces an extraterritorial tax, prices become:

In country 0:

$$p_0 = \frac{\sigma(p_0)C_0'}{\sigma(p_0) - 1} \frac{1}{1 - \frac{(1-s_0)\delta}{1-s_0\delta}\mathcal{M}}$$

In countries $j \neq 0$:

$$p_j = \frac{\sigma(p_j)C_j'}{\sigma(p_j) - 1} \frac{1}{1 + \frac{s_0\delta}{1-s_0\delta}\mathcal{M}}$$

where $\mathcal{M} = \frac{\Pi^u}{S}$ denotes the global profit margin. These expressions generalize our baseline results and highlight how price distortions do not depend directly on the variable elasticity of demand and the shape of the cost function.

3.1.2 Optimal Top-up with Variable Elasticity

For small market shares, the optimal extraterritorial tax rate becomes:

$$\delta \approx \frac{1}{\sigma(p_0)\mathcal{M}} \left(\varepsilon_{\sigma,p} + \varepsilon_{C',q}\sigma(p_0) + s_0 - t\right)$$

This formula introduces two key parameters that were not present in our baseline model: $\varepsilon_{\sigma,p} = -\frac{p_j \sigma'_m}{\sigma_m}$: the elasticity of the monopolistic markup with respect to price, which captures the pass-through rate; $\varepsilon_{C',q} = \frac{C''_j}{C'_j}$: the elasticity of marginal cost concerning quantity, which captures cost convexity.

Country 0's ability to collect the tax deficit is enhanced under two conditions: a lower firm pass-through rate, i.e., when firms absorb more of the tax in their margins rather than passing it to consumers, the price increase in country 0 is smaller for a given tax rate; a downward move of the monopolist on its marginal cost curve in the presence of decreasing returns to scale, i.e., the contraction of production due to the tax leads to lower marginal costs, which can partially offset the price increase.

Both elements represent additional sources of monopsony power for country 0 beyond market size s_0 and can be understood as analogous to the terms-of-trade motive for tariff setting in international trade theory.

3.1.3 Complete Pass-Through Case

To assess how conservative our baseline CES model is, we can consider the case of complete and constant *absolute* pass-through. In this scenario, the optimal tax rate becomes:

$$\delta \approx \frac{1}{\mathcal{M}\sigma(p)} \left(s_0 - t + \frac{1}{\sigma(p) - 1}\right)$$

This shows that even with complete pass-through, a positive extraterritorial tax rate can be optimal for a small market s_0 relative to the foreign tax rate t. The term $\frac{1}{\sigma-1}$ represents an additional motive for taxation arising from the destination country's ability to exercise monopsony power.

3.1.4 Comparison with Baseline Results

Our analysis with variable elasticity generalizes the key insights from the baseline model while revealing new mechanisms through which countries can benefit from extraterritorial taxation. The baseline CES model with constant marginal costs represents a conservative case for the

welfare effects of extraterritorial taxation, as additional sources of monopsony power can make taxation more attractive.

This generalization confirms that our key result—that large enough countries can benefit from unilaterally collecting their share of multinational firms' tax deficits—holds under more realistic demand and cost assumptions. Moreover, it suggests that the welfare gains may be larger than those estimated in the baseline model when firms face variable elasticity of demand or increasing marginal costs. These additional channels are well-documented in the trade policy where tariffs can be used to manipulate the terms of trade when the foreign export supply curve is strictly increasing (e.g. $C' \neq 0$) and as a 2nd-best policy instrument to extract rents (Brander and Spencer, 1985)

3.2 Oligopoly

We now extend our analysis to oligopolistic market structures where multinational firms compete "head-to-head" with domestic producers. Under Cournot competition with iso-elastic inverse demand in destination market 0, given by $p(q_0 + Q_{-0}) = A^{1/\sigma}Q^{-1/\sigma}$, the multinational's local market share $s_0^{dom} = q_0/Q$ affects the elasticity of its residual demand.

The pricing strategy of a multinational firm under extraterritorial taxation becomes:

$$\frac{p_0 - c_0}{p_0} = \frac{s_0^{dom}}{\sigma} + \left(1 - \frac{s_0^{dom}}{\sigma}\right)\left(\frac{1 - s_0}{1 - \tilde{t}_0}\right)\frac{TD}{S} \tag{11}$$

This result generalizes our baseline model, which is obtained when $s_0^{dom} = 1$ (no competitor on each producer variety). The incidence of the tax on prices depends on the intensity of competition, independently of the elasticity parameter σ. As the firm's domestic market share s_0^{dom} declines, the distortionary effect of the tax diminishes because consumers can substitute toward competitors' products.

3.3 Profit Shifting to Tax Havens

When multinational firms engage in profit shifting, our extraterritorial taxation framework requires adjustment. Assume a fraction γ_H of global profits is shifted to tax havens where they face a tax rate t_H, resulting in an observed global effective tax rate t. Our previous results continue to hold after redefining the normalized top-up rate:

$$\delta = \gamma_H \frac{t^{min} - t_H}{1 - t} \tag{12}$$

This formulation has important implications. First, extraterritorial taxation remains welfare-enhancing when the effective tax rate t is sufficiently low and the market share s_0 is not too small. Second, the optimal top-up rate now depends on the distribution of profits across jurisdictions.

For example, consider a multinational with an EU market share of 20% and global profits facing an effective tax rate of 15%, arising from 20% taxation in the US and zero taxation in tax havens. The optimal normalized wedge $\delta \approx 5\%$ implies a top-up rate of 17%.

3.4 Price-Taking Firms

We now consider an important special case where firms are price-takers in each destination market. This analysis demonstrates that our baseline monopolistic competition model provides conservative estimates of the effectiveness of extraterritorial taxation. By examining the opposite end of the market power spectrum, we establish the robustness of our main results while highlighting that the welfare benefits of tax deficit collection are amplified in the absence of market power, suggesting our primary framework understates the potential welfare gains.

3.4.1 Model Setup with Variable Costs

In contrast to our baseline model, we now assume firms take prices as given in each destination market. Production costs are separable across countries with a potentially variable cost function $C(q_j)$ for sales in market j. The global sales share in country j is still defined as $s_j = \frac{p_j q_j}{\sum_j p_j q_j}$ where prices p_j are now exogenous from the firm's perspective. Under the tax deficit collection (TDC) policy, total profits are:

$$\sum_i (1 - t_i) \sum_j (p_j q_j - C(q_j)) - s_0 TD$$

Using that $\frac{\partial s_0}{\partial q_0} = \frac{s_0(1-s_0)}{q_0}$, and after some manipulations, we obtain the counterpart of Proposition 1 when the foreign monopolist is price-taker:

$$\frac{p_0 - C'(q_0)}{p_0} = \frac{1 - s_0}{1 - \tilde{t}_i} \frac{TD}{S}$$

Similarly, for other destination markets $j \neq 0$:

$$\frac{p_j - C'(q_j)}{p_j} = -\frac{s_0}{1 - \tilde{t}_i} \frac{TD}{S}$$

This leads to the same qualitative pattern as in our baseline model: firms adjust quantities such that their markups increase in country 0 and decrease elsewhere. However, since firms

are price-takers, these adjustments occur through quantity changes rather than direct price manipulation. In contrast to Proposition 2, the incidence of TDC falls on quantities.

3.4.2 Iso-Elastic Cost Function and Relationship to Baseline Model

To establish a direct parallel with our baseline model, consider an iso-elastic cost function $C(q) = q^{\frac{\gamma}{\gamma-1}}$ where $\gamma > 1$ represents the elasticity of the marginal cost curve. With this specification: $S = \left(\frac{\gamma}{\gamma-1}\right)\Gamma$ and $\Pi = \frac{\Gamma}{\gamma-1} = \frac{S}{\gamma}$ where Γ represents the total cost. The tax deficit becomes $TD = (t^{min} - t)\frac{S}{\gamma}$ and the markup equations can be rewritten as:

$$\frac{p_0 - C'(q_0)}{p_0} = \frac{(1 - s_0)}{1 - \delta s_0}\frac{\delta}{\gamma}$$

$$\frac{p_j - C'(q_j)}{p_j} = -\frac{s_0}{1 - \delta s_0}\frac{\delta}{\gamma}$$

where $\delta = \frac{t^{min}-t}{1-t}$ is the normalized top-up rate as before.

Interestingly, by setting $\gamma = \sigma$, we recover exactly the same market share equations as in our baseline monopolistic competition model. This isomorphism highlights that the price elasticity parameter σ in our baseline model plays two roles: it determines both the demand elasticity and the rate of profitability. In the price-taking case, γ only captures the rate of profitability.

A first key insight is that when firms are price-takers, the extraterritorial tax has significantly less impact on the tax base through the price channel. While firms can still reshuffle their sales across destination markets by adjusting quantities, the erosion of the tax base is more limited compared to the monopolistic competition case. Second, the welfare implications of TDC under price-taking differ importantly from our baseline model. Since there is no direct price incidence on consumers (at least for a small market share of targeted firms), consumer surplus is not impacted by TDC. This means the welfare calculation simplifies to:

$$W_0 = Y + \delta(1 - t)s_0\frac{S}{\gamma}$$

The optimal tax policy boils down to maximizing tax revenue, as there is no offsetting loss in consumer surplus. This implies that countries have even stronger incentives to implement TDC when facing price-taking firms compared to firms with market power.

The welfare-maximizing top-up rate under price-taking is higher than in the monopolistic competition case, equal to the revenue-maximizing rate. This reinforces the general pattern

established in our baseline analysis: the ability of destination countries to implement extraterritorial taxation increases when firms have less market power or face more elastic demand conditions.

3.5 Top Up Taxes with Terms-of-Trade and Profit-Displacement Effects: A Synthesis

In an environment where the foreign monopolist's profits are initially evenly distributed across jurisdictions, we can derive a general expression for the minimum coalition size required for welfare-enhancing extraterritorial taxation:

$$\bar{s} = 1 - (1 - t)\frac{1 + TOT}{1 - PSX} \tag{13}$$

where $TOT = \varepsilon^0_{\sigma,p} + \varepsilon^0_{C',q}$ captures the country's ability to exert monopsony power on firms' pricing decisions. This effect leads to lower marginal production costs or reduced markups—an effect we term the terms-of-trade externality. Meanwhile, PSX represents the profit-displacement externality, measuring the extent to which profits are shifted from foreign to domestic firms. Under our nested CES preferences, this externality was expressed as $PSX = \alpha\left(\frac{\nu-\eta}{\sigma}\right)\lambda_{00}$.

The minimum coalition size $\bar{s}$ decreases as either the terms-of-trade effect or the profit-displacement externality strengthens. This relationship implies that smaller coalitions can successfully implement extraterritorial taxation when these effects are more pronounced. Our analysis thus provides a nuanced characterization of when extraterritorial taxation enhances welfare, even for relatively small countries or coalitions.

Crucially, we find that even when both externalities are absent ($TOT = 0$ and $PSX = 0$)—conditions under which traditional trade policy instruments would unambiguously reduce welfare—the extraterritorial tax collection (TDC) remains welfare-enhancing for any coalition whose size exceeds the foreign effective tax rate t. This underscores the fundamental difference between TDC and conventional trade policies: while the latter primarily operate through terms-of-trade and profit-displacement channels, TDC directly addresses under-taxation through a mechanism that can benefit even small jurisdictions. We illustrate this case below.

3.6 Comparison with Tariff-Equivalent Measures

A natural question is how tax deficit collection (TDC) compares to more traditional instruments of extraterritorial taxation, particularly tariffs. This comparison is especially relevant given the recent proliferation of tariff-equivalent measures such as Digital Service Taxes (DSTs). We

consider a foreign monopolist that faces an iso-elastic demand and produces under constant marginal costs. Muting both TOT and PSX channels, the optimal tariff is null.

In our baseline model with monopolistic competition and CES preferences, a tariff unambiguously decreases welfare. Under iso-elastic demand and constant marginal cost assumptions, the importing country has no monopsony power, and the terms-of-trade channel is muted. In contrast, tax deficit collection can increase welfare under certain conditions. The welfare function under TDC is:

$$W_0 = Y + \left[\frac{1}{\sigma - 1} + \left(t_0^{min} - t\right)\right] \frac{S_0}{\sigma}$$

while the welfare function under a tariff (where S_0 represents tariff-inclusive sales) is:

$$W_0 = Y + \left[\frac{1}{\sigma - 1} + \left(\frac{\tau}{1+\tau}\right)\right] S_0$$

The key differences between these two instruments lie in their incidence on prices and sales. Here tariffs have full pass-through onto consumer prices, while the pass-through of TDC is moderated by the firm's ability to reshuffle sales across markets. Figure 3 summarizes the impact of TDC and tariffs on consumer surplus, tax revenue and welfare.

In contrast to standard tariffs, countries are incentivized to collect taxes themselves rather than allowing other countries to do so on their behalf. This creates incentives for low-tax jurisdictions to increase their own tax rates, potentially leading to a "race to the top" rather than a "race to the bottom."

In summary, our analysis suggests that TDC is welfare-superior to tariffs, particularly for larger economies. The incidence of TDC on consumer prices is lower than that of tariffs, and the dynamic incentives created by TDC are more conducive to global welfare improvement than those created by traditional tariff policies.

4 Conclusion and Extensions

This paper provides a theory of extraterritorial taxation. We consider a country unilaterally topping up the taxes paid by foreign firms accessing its market. We examine the consequences of such a tax for firms' pricing decisions, government revenue, domestic welfare, and study the minimum coalition size needed to successfully implement such top up taxes.

Our analysis focused on corporate taxes but our framework could be extended to study individual and carbon taxes. Just like a coalition of country may wish to ensure its minimum corporate tax rate applies abroad, so too could it want to ensure its carbon tax rate applies

abroad.[9] Different instruments have been proposed in the literature and some are beginning to be implemented. Starting in 2026 the European Union will apply a carbon border adjustment mechanism (CBAM), a carbon tariff on products products such as steel, cement and some electricity, imported to the European Union and under-taxed abroad. In effect CBAM aims to ensure that EU imports are subject to the same carbon standard as the one prevailing for goods produced in the European Union, incentivizing foreign producers to abate carbon emissions themselves. Campolmi et al. (2024) study a simpler mechanism, a leakage border adjustment mechansm (LBAM), that does not require measuring embedded emssions. Nordhaus (2015) famously proposed contingent tariffs to encourage all countries to implement the carbon price set by members of a climate club.

The mechanism we propose differs from these earlier approaches. With an extraterritorial carbon tax, a country or coalition A would first compute the "carbon tax deficit" of foreign firms, i.e., the difference between what a firm pays in carbon tax globally, and what it would pay if its carbon emissions were subject to A's reference carbon tax rate *in each country where the firm operates*. Country A would then collect a share of this carbon tax deficit, for instance a fraction s_A equal to the fraction of the firm's sales made in A. In contrast to CBAM, it is not only imports made by A that would be taxed, but all the production of foreign firms to the extent that is taxed below A's reference carbon tax rate. This would remove incentives for firms to export relatively clean goods to A while keeping relatively dirty goods for domestic consumption (or exports to countries other than A), addressing a key limitation of border-adjustment mechanisms (Böhring et al., 2022). In contrast to LBAM, which penalizes all imports irrespective of their carbon content, our mechanism incentivizes foreign countries to upgrade their carbon standards. In contrast to climate clubs, the mechanism we propose does not assume that a large alliance of countries has alredy been formed but studies what a single country can do on its own (of course, as we have seen, larger coalitions can do more). The main drawback of our approach is that it requires more information: countries would need to be able to observe the carbon emitted by foreign firms (and any carbon taxes paid) on a country-by-country basis. One possibility would be to add such reporting requirements to the existing country-by-country reports of large multinational firms.

[9]The underlying rationales are not exactly the same: in the case of carbon taxation, this approach could be justified by the global externality of carbon emissions, while in the case of a minimum corporate tax, the traditional justification (as in the Pillar Two agreement) involves the risk of a race to the bottom leading to an equilibrium with too low (e.g., Pareto-dominated) corporate tax rates. Our theory takes the motives for having an extraterritorial tax as given. In that sense it is not a theory of optimal taxation from a global perspective, but an analysis of the optimality of extraterritorial top up taxes from a single-country, unilateral perspective.

Our analysis could also be applied to extraterritorial individual income and wealth taxation. As a simple extension, one could analyze a tax on the shareholders of large multinational companies to the extent that the net worth of these shareholders exceeds a certain level (say, $1 billion). A country A would consider that these wealthy individuals have a "tax deficit" if their effective tax rate falls below a certain standard (e.g., the ratio of individual income taxes paid to wealth is below 2%) and collect a portion of that deficit—e.g., proportionally to the fraction s_A of the multinational's sales made in A, or proportionally to the fraction of the time spent by that person in A throughout her life. Zucman (2024) describes options along these lines in the context of a coordinated minimum tax on ultra-high-net-worth individuals. An analysis of the legal evolutions that such proposals would call for is a fruitful avenue for future research.

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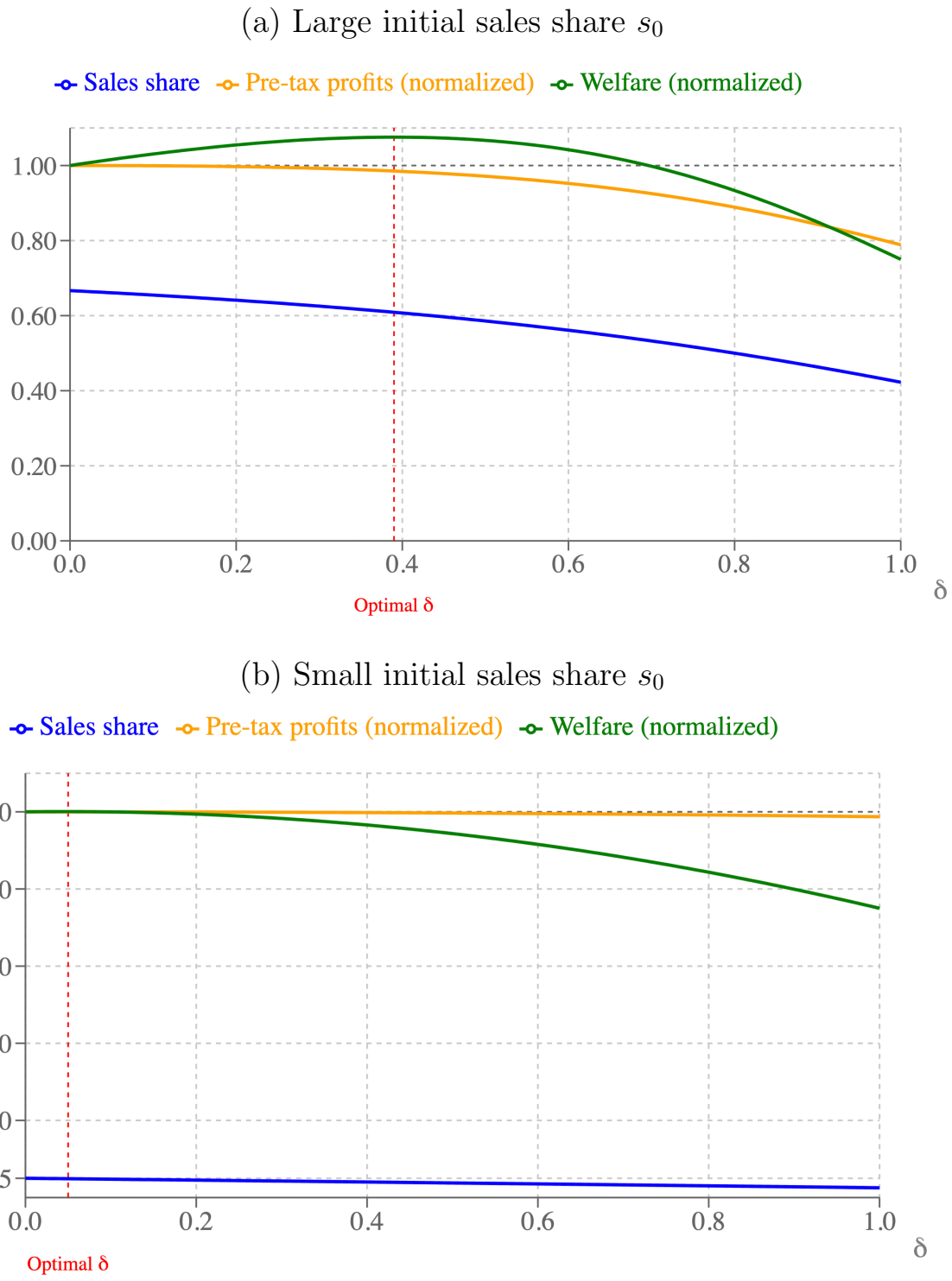
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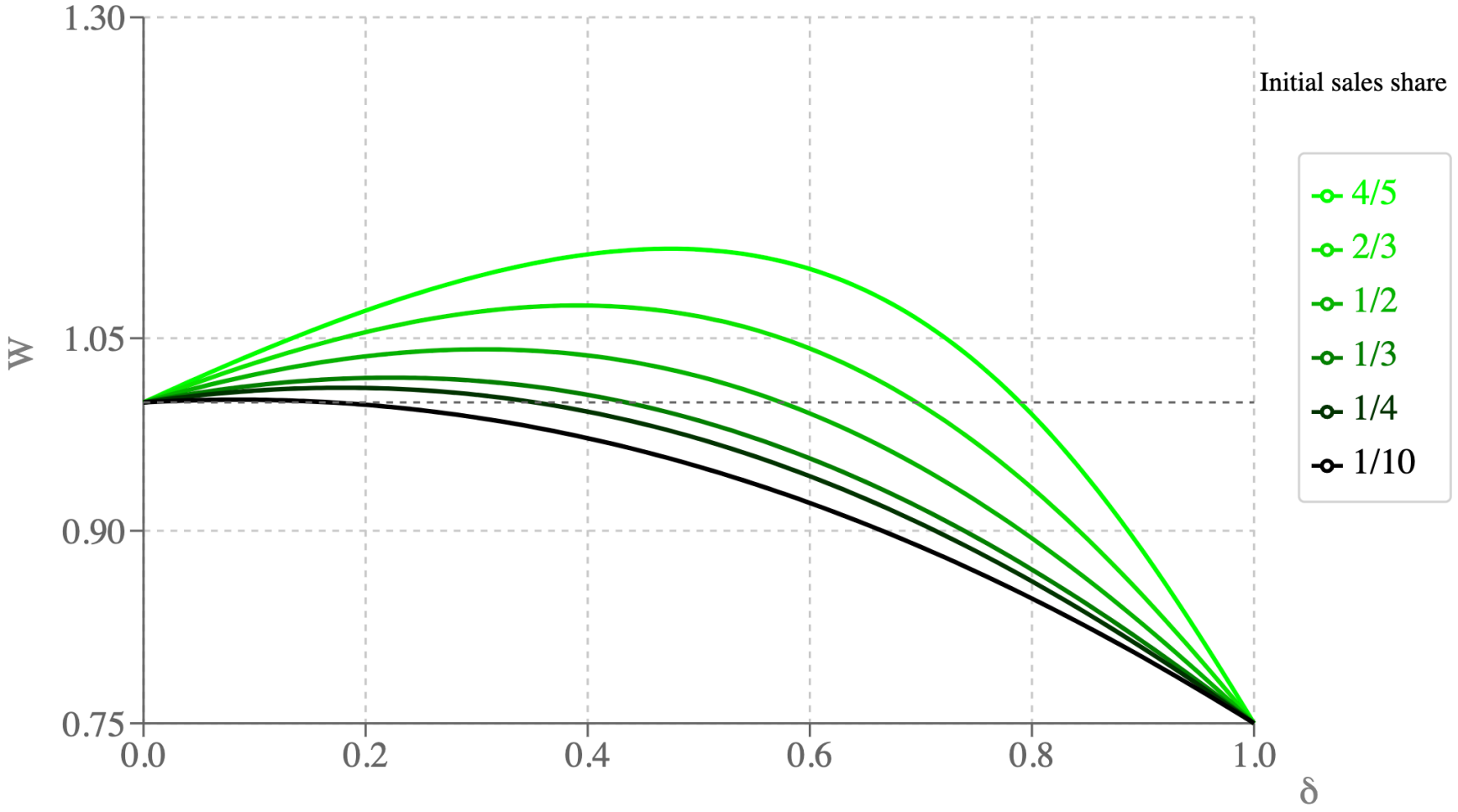
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Figure 1: Profits, Sales Share, and Welfare as a Function of Normalized Top-Up Rate



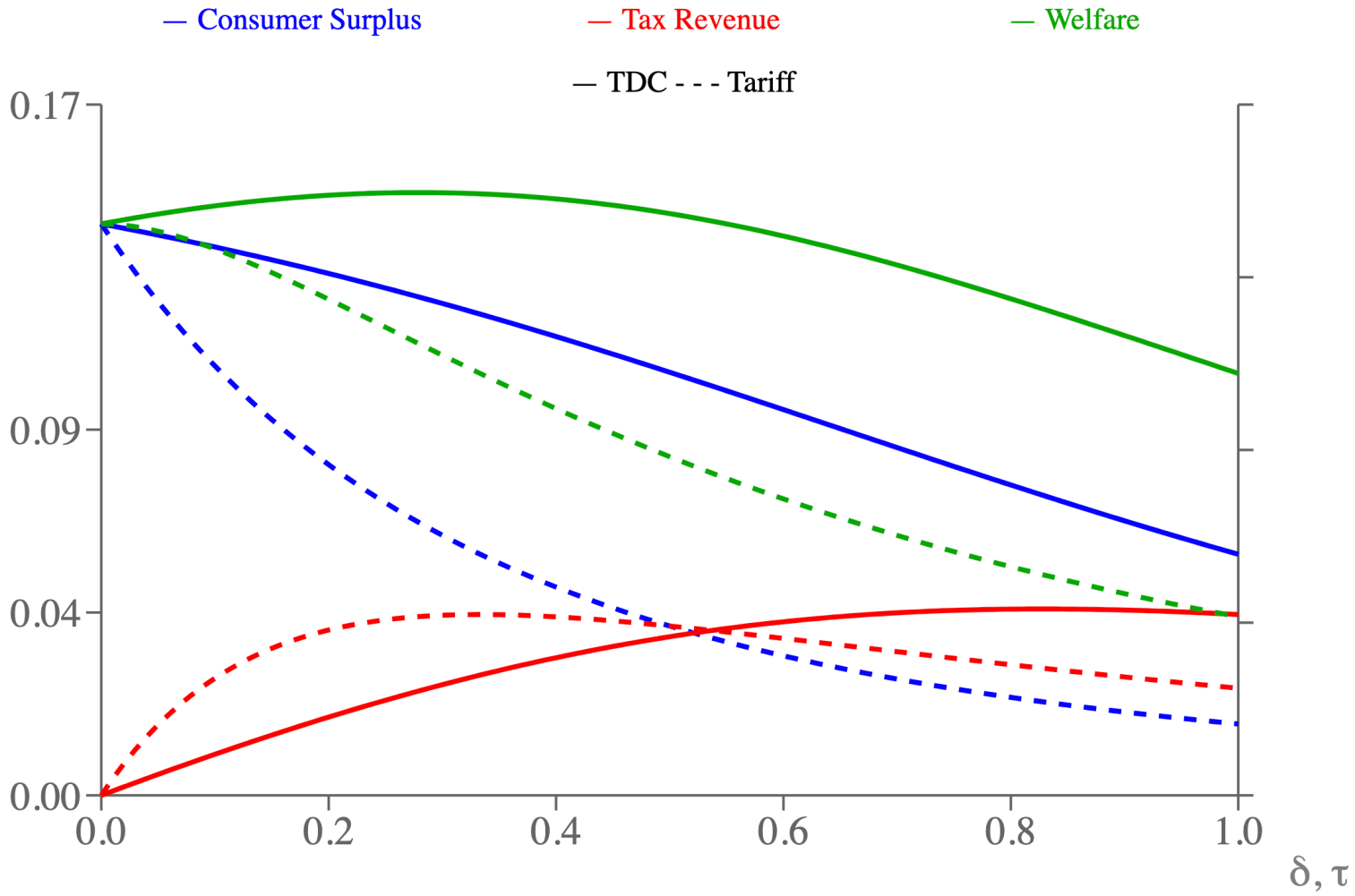
Notes: This figure considers an extraterritorial normalized top up profit tax at rate δ introduced by a country 0 and shows how the sales share s_0, pre-tax profits, and normalized welfare of country 0 vary with δ. Panel (a) considers a country 0 with a large initial sales share of 2/3, while Panel (b) considers a country with a small initial sales share of 5%. In both cases $\eta = \nu = \sigma = 2$, and the foreign tax rate $t = 0$. The red dashed line indicates the optimal top-up rate that maximizes welfare. Pre-tax profits and welfare are normalized to 1 at $\delta = 0$, while the blue lines show the actual values of the sales share s_0 (which falls with δ).

Figure 2: Optimal Tax Rate and Welfare Increase With Country Size



Notes: This figure shows how normalized welfare of country 0 varies with the top up rate δ of country 0's extraterritorial tax, for different country sizes. The curves correspond to different initial sales shares: 4/5, 2/3, 1/2, 1/3, 1/4, and 1/10. All welfare values are normalized to 1 at $\delta = 0$. In all cases, $\eta = \nu = \sigma = 2$.

Figure 3: Extraterritorial Top-Up Tax vs. Tariff



Notes: This figures compares the effects of a tax deficit collection (TDC) vs. tariffs on consumer surplus, tax revenue, and welfare as a function of the normalized top up rate δ and the tariff rate τ. Solid lines represent TDC while dashed lines represent Tariff. In all cases, $\sigma = \eta = \nu = 4$ and the foreign profit tax rate $t = 0$.

Appendix

A Proofs

A.1 Changes in sales allocation share w.r.t. price changes

The global sales share of a firm in destination market $j \in \mathcal{J}$ is given by

$$s_j = \frac{p_j h_j(p_j)}{\sum_{k \in \mathcal{J}} p_k h_k(p_k)} \tag{14}$$

where $h_j(p_j)$ is a general demand function. The derivative of the market share with respect to price p_j is:

$$\frac{\partial s_j}{\partial p_j} = s_j(1 - s_j)\frac{1 + p_j h_j'(p_j)/h_j(p_j)}{p_j} \tag{15}$$

Denoting the price elasticity of demand as $\sigma_j(p_j) := -\frac{p_j h_j'(p_j)}{h_j(p_j)}$, we have:

$$\frac{\partial s_j}{\partial p_j} = (1 - \sigma_j(p_j))\frac{s_j(1 - s_j)}{p_j} \tag{16}$$

For the special case in our baseline model where $h_j(p_j) = A_j p_j^{-\sigma}$ with constant elasticity $\sigma > 1$, we have $\sigma_j(p_j) = \sigma$

Hence the response of the global sales share in j to a price change in j is given by

$$\frac{\partial s_j}{\partial p_j} = (1 - \sigma)\frac{s_j(1 - s_j)}{p_j} \tag{17}$$

The response of the global sales share in destination $k \in \mathcal{J}$ to a price change in another destination market $j \in \mathcal{J}$ is given by:

$$\frac{\partial s_k}{\partial p_j} = s_k s_j \frac{\sigma_j(p_j) - 1}{p_j} \tag{18}$$

Under a CES demand function where $\sigma_j(p_j) = \sigma$, this simplifies to:

$$\frac{\partial s_k}{\partial p_j} = s_k s_j \frac{\sigma - 1}{p_j} \tag{19}$$

A.2 Proof of Proposition 1

Starting from the first-order condition

$$\left((1 - t_i) - \left(s_0(\mathbf{p}) \sum_i \max\left\{t_0^{min} - t_i, 0\right\}\right)\right)\pi_i'(p_0) - \frac{\partial s_0}{\partial p_0} \sum_{ij; j \neq 0} \max\left\{t_0^{min} - t_i, 0\right\}\pi_i(p_0) = 0,$$

which can be expressed more compactly as

$$(1-\tilde{t}_i(s_0))\pi_i'(p_0) - \frac{\partial s_0}{\partial p_0} TD = 0$$

Using the definition of $\pi_i'(p_0)$, and denoting $\mu_j = \frac{p_j - c_{ij}}{p_j}$ the relative markup in j , the above-expression leads to

$$(1-\tilde{t}_i(s_0))(A_0 p_0^{1-\sigma}(1-\sigma\mu_0)) - \frac{\partial s_0}{\partial p_0} TD = 0$$

Dividing by global sales S we obtain

$$(1-\tilde{t}_i(s_0))s_0(1-\sigma\mu_0) - \frac{\partial s_0}{\partial p_0}\frac{TD}{S} = 0$$

And so

$$\frac{p_0 - c_{i0}}{p_0} = \frac{1}{\sigma} - \frac{1-\tilde{t}_i(s_0)}{s_0\sigma}\frac{\partial s_0}{\partial p_0}\frac{TD}{S}$$

Turning to the price set in other countries, i.e., p_j with $j \neq 0$, the first-order condition is distorted by the tax in 0 in the following way:

$$(1-\tilde{t}_{i(j)})\pi_j'(p_j) - \frac{\partial s_0}{\partial p_j} TD = 0$$

Using Appendix A.1, we can conclude that when 0 introduces the top-up tax (unilateral tax), the multinational distorts its prices as follows

$$p_0 = \frac{\sigma}{\sigma-1}\frac{c_0}{1-\frac{1-s_0}{1-\tilde{t}_{i(0)}}\frac{TD}{S}} > \frac{\sigma}{\sigma-1}c_0; \quad p_j = \frac{\sigma}{\sigma-1}\frac{c_j}{1+\frac{s_0}{1-\tilde{t}_{i(j)}}\frac{TD}{S}} < \frac{\sigma}{\sigma-1}c_j.$$

A.3 Proof of Lemma

Let's consider a simplified setting where the firm produces only in country i and sells to destination markets $j \in \mathcal{J}$. The firm's global post-tax profits after the introduction of the extraterritorial tax are:

$$\Pi(p) = (1-t_i)\sum_{j\in\mathcal{J}}(p_{ij} - c_{ij})q_j(p_{ij}) - s_{i0}(p)TD(p)$$

where p_{ij} is the price charged in destination j for goods produced in country i, and c_{ij} is the marginal cost of production in country i for sales in country j.

The tax deficit is defined as:

$$TD(p) = \max\{t_0^{\min} - t_i, 0\}\sum_{j\in\mathcal{J}}(p_{ij} - c_{ij})q_j(p_{ij})$$

The first-order condition with respect to price p_{i0} in country 0 gives:

$$(1 - t_i - s_{i0}\max\{t_0^{\min} - t_i, 0\})\pi_{i0}'(p_{i0}) - \frac{\partial s_0}{\partial p_{i0}}TD(p) = 0$$

This can be rewritten more compactly as:

$$(1-\tilde{t}_i)\pi'_{i0}(p_{i0}) - \frac{\partial s_0}{\partial p_{i0}} TD = 0 \quad \text{(FOC/0)}$$

where $\tilde{t}_i = t_i + s_0(p)\max\{t_0^{\min} - t_i, 0\}$ is the effective tax rate.
Similarly, for any other destination market $j \neq 0$, the FOC with respect to p_{ij} gives:

$$(1-\tilde{t}_i)\pi'_{ij}(p_{ij}) - \frac{\partial s_0}{\partial p_{ij}} TD = 0 \quad \text{(FOC/j)}$$

The global sales share of the firm in destination market j is:

$$s_{ij} = \frac{p_{ij} q_{ij}(p_{ij})}{\sum_{k\in\mathcal{J}} p_{ik} q_k(p_{ik})}$$

Using the formula for the derivatives under CES demand:

$$\frac{\partial s_{i0}}{\partial p_{i0}} = (1-\sigma)\frac{s_0(1-s_{i0})}{p_{i0}} \quad \text{and} \quad \frac{\partial s_{i0}}{\partial p_{ij}} = \frac{s_{ij} s_{i0}(\sigma-1)}{p_{ij}}$$

Substituting into the FOCs:

$$(1-\tilde{t}_i)\pi'_{i0}(p_{i0}) + (1-\sigma)\frac{s_0(1-s_0)}{p_{i0}} TD = 0 \quad \text{(FOC/0)}$$

$$(1-\tilde{t}_i)\pi'_{ij}(p_{ij}) - \frac{s_j s_0(\sigma-1)}{p_{ij}} TD = 0 \quad \text{(FOC/j)}$$

Summing the FOCs over all markets, weighted by the respective prices p_{ij}:

$$\sum_{j\in\mathcal{J}} (1-\tilde{t}_i) p_{ij}\pi'_{ij}(p_{ij}) = 0 \tag{20}$$

For the CES demand function $q_j(p_{ij}) = A_j p_{ij}^{-\sigma}$, we have:

$$\begin{aligned} p_{ij}\pi'_{ij}(p_{ij}) &= A_j p_{ij}^{1-\sigma} - \sigma(p_{ij} - c_{ij}) A_j p_{ij}^{-\sigma} \\ &= S_{ij} - \sigma \Pi_{ij}/(1-\tilde{t}_i) \end{aligned}$$

where $S_{ij} = p_{ij} q_j(p_{ij})$ represents sales in market j from production in country i, and $\Pi_{ij} = (1-\tilde{t}_i)(p_{ij} - c_{ij}) q_j(p_{ij})$ represents post-tax profits from sales in market j produced in country i.
Thus, equation (20) becomes:

$$\sum_{j\in\mathcal{J}} (1-\tilde{t}_i) S_{ij} - \sigma \sum_{j\in\mathcal{J}} \Pi_{ij} = 0$$

This simplifies to:

$$(1-\tilde{t}_i) S_i = \sigma \Pi_i$$

where $S_i = \sum_{j\in\mathcal{J}} S_{ij}$ represents total sales and $\Pi = \sum_{j\in\mathcal{J}} \Pi_{ij}$ represents total post-tax profits.

Therefore, after the introduction of the top-up tax, post-tax profits remain proportional to sales weighted by the firm's effective keep rate $(1-\tilde{t}_i)$, with the proportionality constant being $\frac{1}{\sigma}$.

A.4 Distorted Market Shares

Assume single-sourcing and single tax-residence so that undertaxed profits Π^u. In this case, the definition of undertaxed profits does not depend on t as long as $t < t_0^{min}$. Production takes place in a single country with tax rate t which is not the country that collects the deficit. Now by definition $TD = (t^{min} - t)\Pi^u$ and $\Pi^u = \frac{S}{\sigma}$ where S are total sales.

Prices become

$$p_0 = \frac{\sigma}{\sigma - 1} \frac{c}{1 - \frac{1}{\sigma}\frac{(1-s_0)\delta}{1-s_0\delta}} \quad p_{-0} = \frac{\sigma}{\sigma - 1} \frac{c}{1 + \frac{1}{\sigma}\frac{s_0\delta}{1-s_0\delta}}$$

where $\delta = \frac{t^{min}-t}{1-t}$ is the top-up rate normalized by the keep rate.

For $s_0 = 1$ or $\delta = 0$ we're back to the undistorted price. For $s_0 \approx 0$ we have $p_0 = \frac{\sigma}{\sigma-1}\frac{c}{1-\frac{\delta}{\sigma}}$, i.e.

$$p_0 = \frac{\sigma}{\sigma - 1} \frac{\sigma}{\sigma - \delta} c$$

To solve for the equilibrium global sales share in 0 start with

$$s_0 = \frac{A_0 p_0^{1-\sigma}}{\sum_i A_i p_i^{1-\sigma}} = \frac{1}{1 + \frac{A_i}{A_0}\frac{p_i^{1-\sigma}}{p_0^{1-\sigma}}}$$

And

$$\frac{p_i}{p_0} = \frac{1 - s_0\delta - \frac{\delta}{\sigma}(1 - s_0)}{1 - s_0\delta + \frac{\delta}{\sigma}s_0}$$

Rearrange as

$$\frac{p_i}{p_0} = \frac{1 - \frac{\delta}{\sigma} - s_0\delta + \frac{s_0\delta}{\sigma}}{1 - s_0\delta + \frac{1}{\sigma}s_0\delta} \equiv \frac{1 - \frac{\delta}{\sigma} - \rho s_0\delta}{1 - \rho s_0\delta}$$

so, given A_i, s_0 is solved implicitly through

$$s_0 = \frac{A_0 p_0^{1-\sigma}}{\sum_i A_i p_i^{1-\sigma}} = \frac{1}{1 + \frac{\sum_{i\neq 0} A_i}{A_0}\left(\frac{1-\frac{\delta}{\sigma}-\rho s_0\delta}{1-\rho s_0\delta}\right)^{1-\sigma}}$$

A.5 Proof of Proposition 2

Starting from the expression of the optimal price, we obtain that

$$\frac{1}{p_0}\frac{\partial p_0}{\partial \delta} = \frac{1 - s_0(\delta) + (-1 + \delta)\delta s_0'(\delta)}{(-1 + \delta s_0(\delta))(\delta - \sigma + \delta(-1 + \sigma)s_0(\delta))}$$

Using that $s_0'(\delta)$ for small δ is finite and evaluating the expression in $\delta = 0$ leads back to

$$\frac{1}{p_0}\frac{\partial p_0}{\partial \delta} \approx \frac{1 - s_0(0)}{\sigma}.$$

For a small s_0 and keeping the first-order terms, we obtain instead

$$\frac{1}{p_0}\frac{\partial p_0}{\partial \delta} \approx \frac{1 - s_0 + \frac{\delta}{\sigma}}{\sigma}$$

A.6 Expenditure variations on the foreign good and social welfare maximization

Total sales are given by:

$$S_0 = N_{i0} p_{i0} x_{i0} \equiv \left(1 + \left(\frac{N_{00}}{N_{i0}}\right)^{\frac{1-\nu}{1-\sigma}} \left(\frac{p_{00}}{p_{i0}}\right)^{1-\nu}\right)^{\frac{\nu-\eta}{1-\nu}} N_{i0}^{\frac{1-\eta}{1-\sigma}} p_{i0}^{1-\eta} \tag{21}$$

And the inverse of the expenditure share in 0 on goods that are taxed is given by:

$$\frac{1}{1-\lambda_0(\delta)} = 1 + \left(\frac{N_{00}}{N_{i0}}\right)^{\frac{1-\nu}{1-\sigma}} \left(\frac{p_0}{p_{i0}(\delta)}\right)^{1-\nu} \tag{22}$$

Now, log-differentiating

$$\frac{S_0'}{S_0} \equiv -\left(\frac{\nu-\eta}{\nu-1}\right)\left(-\frac{\partial\lambda_0(\delta)}{\partial\delta}\frac{1}{1-\lambda_0(\delta)}\right) - (\eta-1)\frac{p_{i0}'}{p_{i0}}$$

which can be simplified further using that

$$\lambda_0'(\delta)(1-\lambda_0(\delta)^0) = (\nu-1)\lambda_0(\delta)\frac{p_{i0}'(\delta)}{p_{i0}(\delta)}$$

$$\frac{S_0'}{S_0} \equiv -(\nu-\eta)\left(\lambda_{00}(\delta)\frac{p_{i0}'(\delta)}{p_{i0}(\delta)}\right) - (\eta-1)\frac{p_{i0}'}{p_{i0}}$$

$$\frac{S_0'}{S_0} \equiv -\left((\eta-1) + \lambda_{00}(\delta)(\nu-\eta)\right)\frac{p_{i0}'}{p_{i0}}$$

This last expression is the tax base reduction induced by the TDC.
The first-order condition associated with welfare maximization can be written as:

$$0 = -S_0\frac{1}{p_{i0}}\frac{\partial p_{i0}}{\partial\delta} + (1-t)s_0\Pi^u + \delta(1-t)\left(\frac{\partial s_0}{\partial\delta}\Pi^u + s_0\frac{\partial\Pi^u}{\partial\delta}\right) + \alpha\left(\frac{\nu-\eta}{\sigma}\right)\lambda_{0,0}q_{i0}\frac{\partial p_{i0}}{\partial\delta}$$

which further simplifies as:

$$0 = -S_0\frac{1}{p_{i0}}\frac{\partial p_{i0}}{\partial\delta} + (1-t)\frac{S_0}{\sigma} + \delta\frac{(1-t)}{\sigma}\frac{\partial S_0}{\partial\delta} + \alpha\left(\frac{\nu-\eta}{\sigma}\right)\lambda_{0,0}q_{i0}\frac{\partial p_{i0}}{\partial\delta}.$$

Dividing by firm output we obtain:

$$0 = -\frac{1}{p_{i0}}\frac{\partial p_{i0}}{\partial\delta} + \frac{(1-t)}{\sigma} + \delta\frac{(1-t)}{\sigma}\frac{1}{S_0}\frac{\partial S_0}{\partial\delta} + \alpha\left(\frac{\nu-\eta}{\sigma}\right)\lambda_{0,0}\frac{1}{p_{i0}}\frac{\partial p_{i0}}{\partial\delta}$$

Last, using the tax base erosion formula derived at the beginning of this section, we obtain

$$0 = \left[-1 - \delta\frac{(1-t)}{\sigma}\left((\eta-1) + \lambda_i^0(\delta)(\nu-\eta)\right) + \alpha\left(\frac{\nu-\eta}{\sigma}\right)\lambda_{0,0}\right]\frac{1}{p_{i0}}\frac{\partial p_{i0}}{\partial\delta} + \frac{(1-t)}{\sigma}.$$

A.7 Changes in Producer Surplus

Total profits from domestic firms can be expressed as $PS_{00} = N_{0,0}L_0P_0^{\nu-\eta}P_{00}^{\sigma-\nu}p_{00}^{1-\sigma}$ where $P_0^{\nu-\eta} = \left(P_{00}^{1-\nu} + N_{i0}^{\frac{1-\nu}{1-\sigma}}p_{i0}^{1-\nu}\right)^{\frac{\nu-\eta}{1-\nu}}$.

Differentiating with respect to p_{i0} leads to

$$\frac{\partial PS_{00}}{\partial p_{i0}} = N_{0,0}L_0\frac{\partial P_0^{\nu-\eta}}{\partial p_{i0}}P_{00}^{\sigma-\nu}p_{00}^{1-\sigma}$$

Plugging the definition of P_{00}, this leads to:

$$\frac{\partial PS_{00}}{\partial p_{i0}} = N_{0,0}L_0\frac{\partial P_0^{\nu-\eta}}{\partial p_{i0}}\left(N_{0,0}^{\frac{1-\nu}{1-\sigma}}p_{00}^{1-\nu}\right)^{\frac{\sigma-\nu}{1-\nu}}p_{00}^{1-\sigma}$$

Simplifying, we obtain:

$$\frac{\partial PS_{00}}{\partial p_{i0}} = L_0\frac{\partial P_0^{\nu-\eta}}{\partial p_{i0}}\left(N_{0,0}^{\frac{1-\nu}{1-\sigma}}\right)p_{00}^{1-\nu\cdot\frac{\sigma-\nu}{1-\nu}+1-\sigma}$$

Regrouping terms we obtain:

$$\frac{\partial PS_{00}}{\partial p_{i0}} = L_0\left[\frac{(\nu-\eta)N_{i0}^{\frac{1-\nu}{1-\sigma}}P_0^{(\nu-\eta)-1}p_{i0}^{-\nu}}{}\right]N_{0,0}^{\frac{1-\nu}{1-\sigma}}p_{00}^{1-\nu\cdot\frac{\sigma-\nu}{1-\nu}+1-\sigma}$$

Hence the final expression:

$$\frac{\partial PS_{00}}{\partial p_{i0}} = L_0\left(\frac{\nu-\eta}{\sigma}\right)\lambda_{0,0}N_{i0}^{\frac{1-\nu}{1-\sigma}}P_0^{\nu-\eta}p_{i0}^{-\nu}$$

Figure A1: Example of Extraterritorial Top-Up Tax: Shell

	Published by Shell				Notions used in this paper, computed for t_{min} = 21%				Memo	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
	Third-party revenues ($ million)	Profit before tax ($ million)	Tax accrued ($ million)	Number of employees	Undertaxed profit ($ million) Π^u	Tax rate on undertaxed profit t^u	Top-up tax rate $t^{min} - t^u$	Tax deficit ($ million) TD = $\Pi^u.(t^{min} - t^u)$	Share of sales s_i	Effective tax rate t_i
Albania	0	(32)	0	74	0				0.0%	
Algeria	0	(0)	0	0	0				0.0%	
Argentina	843	47	0	214	47	0%	21%	10	0.3%	0%
Australia	4,093	2,571	1,031	3,541	0				1.3%	40%
Austria	1,290	9	0	91	9	1%	20%	2	0.4%	1%
Bahamas	9,452	1,595	0	44	1,595	0%	21%	335	2.9%	0%
Barbados	0	(7)	0	0	0				0.0%	
Belgium	1,263	(4)	15	355	0				0.4%	
Bermuda	0	37	0	3	37	0%	21%	8	0.0%	0%
Bolivia	101	(94)	0	20	0				0.0%	
Brazil	254	619	742	878	0				0.1%	120%
Brunei	250	68	38	5	0				0.1%	55%
Bulgaria	274	9	1	68	9	10%	11%	1	0.1%	10%
Cambodia	2	2	0	0	2	0%	21%	0	0.0%	0%
Canada	15,533	(738)	185	3,601	0				4.8%	
Cayman Islands	0	(0)	0	0	0				0.0%	
Chile	22	5	0	0	5	0%	21%	1	0.0%	0%
China	3,790	129	45	4,788	0				1.2%	35%
Colombia	15	(42)	0	5	0				0.0%	
Cyprus	11	(0)	2	0	0				0.0%	
Czech Republic	666	(2)	(0)	85	0				0.2%	
Denmark	247	(95)	0	529	0				0.1%	
Dominican Republic	0	0	0	0	0	0%	21%	0	0.0%	0%
Egypt	407	172	72	270	0				0.1%	42%
El Salvador	0	0	0	0	0				0.0%	
Finland	241	(0)	(0)	3	0				0.1%	
France	2,764	(19)	4	557	0				0.9%	
Germany	27,012	566	192	6,096	0				8.4%	34%

Ghana	8	1	0	20	1	0%	21%	0	0.0%	0%
Gibraltar	3	0	0	0	0	13%	8%	0	0.0%	13%
Guam	0	1	0	0	1	0%	21%	0	0.0%	0%
Hong Kong	1,465	61	10	151	61	17%	4%	3	0.5%	17%
Hungary	780	8	1	94	8	8%	13%	1	0.2%	8%
India	1,606	310	82	12,790	0				0.5%	26%
Indonesia	1,239	348	11	525	348	3%	18%	62	0.4%	3%
Iraq	0	17	0	165	17	0%	21%	3	0.0%	0%
Ireland	1	0	0	0	0	0%	21%	0	0.0%	0%
Isle of Man	0	0	0	0	0	0%	21%	0	0.0%	0%
Italy	3,143	223	65	334	0				1.0%	29%
Japan	751	18	7	206	0				0.2%	38%
Jordan	0	(2)	0	2	0				0.0%	
Kazakhstan	82	1,429	236	243	1,429	17%	4%	64	0.0%	17%
Kuwait	303	200	24	145	200	12%	9%	18	0.1%	12%
Libya	0	(0)	0	1	0				0.0%	
Luxembourg	264	(10)	0	12	0				0.1%	
Macau	61	14	2	1	14	12%	9%	1	0.0%	12%
Malaysia	8,770	1,055	310	4,971	0				2.7%	29%
Mauritania	0	(118)	0	1	0				0.0%	
Mauritius	0	(53)	2	6	0				0.0%	
Mexico	1,275	(484)	1	454	0				0.4%	
Morocco	0	(0)	0	0	0				0.0%	
Mozambique	0	(0)	0	0	0				0.0%	
Myanmar	0	(0)	0	0	0				0.0%	
Namibia	1	(92)	(0)	6	0				0.0%	
Netherlands	33,315	(17)	352	8,980	0				10.3%	
New Zealand	0	3	0	0	3	0%	21%	1	0.0%	0%
Nigeria	1,396	952	755	2,569	0				0.4%	79%
Norway	334	2,167	1,486	435	0				0.1%	69%
Oman	1,457	4,507	3,423	482	0				0.5%	76%
Pakistan	1,279	(75)	8	378	0				0.4%	
Palau	0	1	0	0	1	0%	21%	0	0.0%	0%
Panama	0	0	0	0	0				0.0%	
Peru	32	2	0	10	2	0%	21%	0	0.0%	0%
Philippines	3,333	10	7	5,071	0				1.0%	66%
Poland	1,796	(33)	(5)	5,608	0				0.6%	

Puerto Rico	0	0	0	0	0	0%	21%	0	0.0%	0%
Romania	0	(0)	0	73	0				0.0%	
Russia	0	(30)	0	18	0				0.0%	
Saint Lucia	0	(1)	0	0	0				0.0%	
Sao Tome and	0	(49)	0	0	0				0.0%	
Saudi Arabia	0	0	0	9	0				0.0%	
Senegal	0	(0)	0	5	0				0.0%	
Singapore	46,224	(31)	54	3,568	0				14.3%	
Slovakia	449	11	2	41	11	21%	0%	0	0.1%	21%
Slovenia	123	2	1	25	0				0.0%	31%
South Africa	4,157	(73)	0	546	0				1.3%	
South Korea	249	(11)	10	144	0				0.1%	
Spain	692	4	2	261	0				0.2%	47%
Suriname	1	(27)	0	1	0				0.0%	
Sweden	226	4	1	5	0				0.1%	26%
Switzerland	1,531	1,896	62	127	1,896	3%	18%	336	0.5%	3%
Syria	0	(0)	0	0	0				0.0%	
Taiwan	0	0	0	6	0	14%	7%	0	0.0%	14%
Tanzania	0	(6)	0	14	0				0.0%	
Thailand	2,854	90	20	453	0				0.9%	22%
Togo	0	(0)	0	0	0				0.0%	
Trinidad and	1,161	364	294	408	0				0.4%	81%
Tunisia	50	18	11	21	0				0.0%	62%
Turkey	6,679	73	30	584	0				2.1%	41%
Ukraine	0	0	0	0	0				0.0%	48%
United Arab	8,002	1,173	251	374	0				2.5%	21%
United Kingdom	46,553	6,469	1,406	7,094	0				14.4%	22%
United States of	72,919	(198)	100	20,049	0				22.6%	
Uruguay	1	(11)	0	1	0				0.0%	
Venezuela	1	(5)	3	5	0				0.0%	
Vietnam	68	4	1	82	0				0.0%	26%
Total	**323,166**	**24,899**	**11,351**	**98,801**	**5,694**	**6.1%**	**14.9%**	**847**	**100%**	45.6%

Notes: this table re-produces four columns of the public country-by-country report of Shell for the year 2023 (cols. 1 to 4). It then uses this information to compute undertaxed profit and tax deficits relative to a reference tax rate of 21% (cols. 5 to 8). In 2023, Shell made $24.9 billion in profit, of which $5.7 billion was taxed at less than 21%. A full collection of this tax deficit would generate a $847 million mechanical increase in tax revenue globally. If the United States implemented a "Tax Deficit Collection" mechanism, it would collect s_0 = 22.6% of this sum, leading to a mechanical increase in tax revenue of $191 million for the United States.