A Theory of Economic Disintegration*

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Abstract

We study the impact of unilateral economic disintegration, such as Brexit, on national and international policies. We introduce firm mobility and business-tax policies into a general-equilibrium trade model and analyze the effects of disintegration on tax policies of asymmetric countries. Whereas the disintegrating country taxes less, business taxes converge in the remaining economic area. We highlight important differences with existing two-country models. Moreover, we predict a realignment of trade policies with a deeper integration inside the union and lower tariffs worldwide. The leaving country's endogenous integration response with other countries may fully compensate for the disintegration-induced welfare losses.

Keywords: Trade Policy, Tax Policy, Economic Integration, Firm Delocation

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1 Introduction

After decades of international integration, recent unilateral movements toward economic disintegration have emerged. The United Kingdom's decision to leave the European Union is a prominent example of such protective policy measures.[1] Similarly, in 2018 the United States initiated a trade war with major trade partners.[2] The emergence of protectionism and deglobalization alters nations' economic structure along various dimensions, such as trade costs, production standards, business regulations, and investment opportunities. Thereby, economic disintegration significantly affects consumers' and firms' choices, as well as national tax and international trade policies. In this paper, we investigate the policy implications of deglobalization, particularly the unilateral kind, in which one country disintegrates from a set of other countries, as in the Brexit case. While we frequently refer to disintegration, our model speaks to both unilateral integration and disintegration. We do so in a framework with an arbitrary number of countries, implying that unilateral disintegration affects only a subset of countries directly but induces policy adjustments in all countries. This is a central difference with existing two-country models that abstract from policy responses in third countries.

Tax Policies. We study the impact of unilateral economic disintegration on domestic policies worldwide. We focus on national *tax policies* in the presence of firm relocation, apparently a most relevant margin of adjustment available to governments for responding to economic disintegration.[3] However, our main insights extend to the context of other domestic policy instruments influencing the spatial distribution of economic activity.

[1] See Sampson [2017] for an early overview of the causes and consequences of Brexit.

[2] This recent spread of protectionism has launched a considerable line of structural and empirical research (see, for instance, Amiti, Redding, and Weinstein [2019], Fajgelbaum, Goldberg, Kennedy, and Khandelwal [2020], Barattieri, Cacciatore, and Ghironi [2021], and Li and Whalley [2021]).

[3] A significant body of theoretical and empirical research suggests that countries use their taxes to attract internationally mobile capital, labor, and foreign direct investment. The ongoing globalization of the world economy is known to increase the mobility of production factors and firms across space. As a result, it has led to less progressive income tax schedules (Egger, Nigai, and Strecker [2019]) and lower taxes on corporations (Dyreng, Hanlon, Maydew, and Thornock [2017]), which fuels fears of a "race to the bottom" of taxes. Moreover, there is an ongoing debate about the unilateral introduction of destination-based corporate taxation (Auerbach and Devereux [2018], Becker and Englisch [2020], and Bond and Gresik [2020, 2022]). In this paper, we focus on the level of business taxation, abstracting from the important issue of choosing between different tax instruments.

We introduce international firm relocation into the multi-sector, general-equilibrium trade model of Melitz and Ottaviano [2008] in a highly tractable way. We overcome critical challenges in the economic geography literature by reducing the dimensionality of firm relocation decisions without losing generality at an aggregate level. We allow for firm heterogeneity in relocation costs but assume that industries differ in the subset of countries in which the mobile firms can produce. We demonstrate that each country's Nash equilibrium business-tax policy follows a familiar sufficient statistic—the inverse firm relocation semi-elasticity—which is proportional to the country's equilibrium firm number.[4] Our parsimonious modeling of mobility allows us to derive this sufficient statistic and, hence, Nash equilibrium business-tax policies explicitly in terms of country-pair-specific trade costs, firm-location fixed-cost distributions, country sizes, and consumer preferences. We demonstrate the effects of economic disintegration on domestic tax policies and analyze the underlying economic channels. Moreover, we highlight important differences between unilateral economic disintegration and reverse multilateral integration. Thus, existing models of multilateral (dis)integration lack critical insights when applied to the effects of unilateral economic disintegration on national policies. Our workhorse example for disintegration is a country's departure from an economic union, as in the Brexit case. However, the effects on national policies extend more broadly to any economic disintegration, such as a trade war and the exit from a free-trade area, a trade agreement, or another international treaty.

Specific Results (1). When a country's departure (e.g., from an economic union) raises bilateral trade costs (*trade-cost effect*), the leaving country's tax will decline because higher trade costs reduce the leaving country's number of firms and increase the firm relocation semi-elasticity. The trade-cost effect on the business taxes in the remaining union-member countries depends on market sizes. If the union is small (large) compared to the rest of the world, members' tax-policy responses are, on average, negative (positive). Considerable asymmetries in market sizes cause tax-policy reactions in the union to point in opposite directions and lead to a convergence of taxes there. Since third countries outside the union become more attractive as business locations relative to other countries (higher number of firms), their ability to tax improves (lower relocation semi-elasticity). Underlying these tax adjustments, we identify three channels capturing governments' incentives to attract firms, namely, to i) achieve lower domestic prices (price channel),

[4] E.g., see Feld and Heckemeyer [2011] for a meta-analysis. A similar object—the semi-elasticity of household migration—plays a central role in the optimal taxation of mobile workers (Lehmann, Simula, and Trannoy [2014]).

ii) generate more tax revenues (tax-base channel), and iii) optimally respond to other countries' tax policies (best vs. equilibrium response). We extend our results to various other dimensions of disintegration.

Trade Policies. In addition to studying domestic policies, we employ a first-order approximation approach to deal with the impact of unilateral disintegration on international policies, i.e., the readjustment of cooperative and noncooperative *trade policies* worldwide. Our analysis of trade policies builds on the idea that after the disintegration, the remaining union and the leaving country no longer jointly negotiate their trade policies. We show that the departure of one country from a union has repercussions for that country's and the union's trade policies. While our static model remains ultimately silent about the trigger of economic disintegration, we go beyond the positive question of how disintegration affects trade policies and identify the readjustments of trade policies necessary to ultimately improve the leaving country's welfare, making economic disintegration normatively desirable from the leaving country's perspective.

Specific Results (2). We demonstrate that both the leaving country and the remaining members intensify existing trade agreements with third countries and reduce protectionism, rejecting the hypothesis that a country's disintegration triggers a domino effect of further disintegration. We focus on two important cases: the exit of a country from an integrated area or economic union (case 1), in which countries coordinate their internal non-tariff trade policies, and the exit from a customs union (case 2), where only the external trade policies are jointly set. In the first case, we predict that the countries inside the union further integrate with each other. They lower their internal non-tariff barriers to trade. In the second case, the remaining customs union negotiates lower tariffs with third countries in trade agreements. The leaving country also intensifies trade agreements with third countries. Similarly, noncooperative trade policies of the union members, as well as of the leaving country, become less protective. The welfare implications of disintegration are, therefore, subtle. We show that similar to the rise in trade costs directly associated with the disintegration, the union members' integration steps with each other and third countries generate sizable welfare losses in the leaving country. On the other hand, when exiting a customs union, the realignment of the leaving country's trade policies also has first-order welfare effects. Therefore, while the exit from an economic union is welfare-detrimental, a country that leaves a customs union may fully compensate for the adverse effects if the trade-cost reductions with third countries are substantial.

Brexit. Our model allows us to speak to the likely national and international policy consequences of the UK leaving the EU. Our results suggest that the UK will lower business taxes after Brexit, and business taxes in the remainder of the EU will converge. Third countries, such as the US, can tax more after Brexit. Moreover, we predict that the remaining EU members will further integrate with each other and reconsider protectionist policies toward third countries. The UK compensates for the welfare losses from the rise in trade frictions with the EU by deepening trade relations with third countries.[5]

Related Literature. Our paper relates to two strands of literature. First, we add to the debate on domestic policy in the presence of factor mobility. Usually, this literature addresses locally separated regions whose economic outcomes are linked to each other through the mobility of capital (Zodrow and Mieszkowski [1986] and Wilson [1986]), labor (Lehmann, Simula, and Trannoy [2014]), or foreign direct investment (Haufler and Wooton [1999] and Haufler and Wooton [2006]). Location rents incentivize governments to modify their domestic policy instruments, such as taxes, to attract these factors. As in our model, some authors—for instance, Bucovetsky [1991] and Haufler and Wooton [1999]—consider cross-country asymmetries. We show that, besides the relative size of a given market, as previous work has highlighted, the entire world's economic structure, i.e., trade costs and market sizes worldwide, profoundly affects domestic policy differentials.

We investigate the relationship between regional taxes and trade costs, as Ottaviano and Van Ypersele [2005] and Haufler and Wooton [2010]. In their two-country settings, a decline in trade barriers makes setting up an FDI platform in the larger market less critical to firms. Then, export costs to this market are low, and the firm can easily access both markets irrespective of its location. Conversely, if trade costs are high, firms would like to locate in the large market, regardless of the business-tax differential until the increased degree of regional competition absorbs the location rents in the large market. Although some of the literature has addressed this link, no work endogenizes national and international policies in a model with more than two geographically linked regions.[6] Whereas the two-country and the partial three-country settings

[5] While our predictions are robust to the causes of Brexit, our model is silent about why the UK has decided to exit the EU or join the EU in the first place. We leave such an analysis of these dynamics for future research.

[6] For example, in the three-country models of Raff [2004] and Cook and Wilson [2013], one country's government is presumed to be completely inactive. Darby, Ferrett, and Wooton [2014] consider a three-country model of tax policy and trade, but two of the three markets are connected only through a hub region. Most recently, Fuest and Sultan [2019] assume partial mobility of capital and examine tax policies in a three-country model but ignore trade costs. Complementary to this are more recent papers in which contributors estimate the effects of tax or subsidy competition in quantitative economic geography models, such as Ossa [2015]. So

may conceptually address the impact of an integration that countries accomplish multilaterally, these models cannot examine a country's unilateral decision to integrate or disintegrate from a set of other countries. As we show in our model, reversing the sign of existing conclusions about multilateral economic (dis)integration to speak to the effects of unilateral (dis)integration is misleading.

So far, two key challenges have prevented progress toward more realistic multi-country models. The first is that in a multi-country setting, firm relocation is a multinomial-choice problem. The equilibrium distribution of firms across regions is a function of relative location rents, which, in turn, are endogenous to the distribution of firms. As a result, deriving the objective function of the government in each country is difficult. Second, each country's tax is the best response to all the other countries' taxes. Therefore, the optimal tax in a country is a general-equilibrium object. We overcome both of these issues by reducing the dimensionality of the firm-level relocation problem. Nonetheless, on an aggregate level, the distribution of firms is a high-dimensional object that is still tractable enough to solve for general-equilibrium tax policies. While our setup of firm mobility is in itself theoretically interesting, we expect it to be helpful in quantitative models that otherwise would be computationally too intense—for instance, when they involve many layers of optimization.

The second strand is the literature on trade policy. As in Ossa [2011] and Bagwell and Staiger [2012], we deal with the effects of trade policies in the context of firm relocation. However, these authors do not consider domestic policies, which is a focus of our paper. Furthermore, we augment the classical debate on optimal tariffs, started by Bagwell and Staiger [1999], with two dimensions. First, instead of explicitly deriving globally optimal trade policies, we study the impact of economic disintegration on trade policies worldwide, taking existing imperfections of trade agreements as given. One can apply this approach to other contracting situations beyond trade policies, where agents renegotiate preexisting arrangements after one party leaves an agreement. Second, we examine other components of trade policy, i.e., non-tariff trade barriers. Contrary to tariffs, these non-tariff policy dimensions embrace no government revenue-collection motive while still affecting the terms of trade and the spatial distribution of economic activity. Thus, our paper adds to the growing literature on the economics of deep integration, moving beyond the notion of tariff-oriented trade agreements (see Grossman, McCalman, and Staiger [2021] and Staiger and Sykes [2021]).

Instead of interpreting our results in the context of unilateral economic disintegration, one can also

far, this quantitative literature has not addressed the link to economic integration in further detail.

relate them to the large literature on the gains from trade (see Costinot and Rodríguez-Clare [2014] and Ossa [2016] for two notable reviews). In this literature, contributors quantitatively investigate the effects of trade openness in multi-country, multi-sector, general-equilibrium trade models. A primary focus is on the quantitative effects of trade openness on welfare and optimal tariffs. In this paper, we depart from this focus by highlighting other policy margins—for example, business taxation and non-tariff trade barriers.

Outline of the Paper. The paper is structured as follows. In Section 2, we develop a multi-country, multi-sector, general-equilibrium trade model with firm mobility and noncooperative business taxation. Then, we derive the effects of economic disintegration via changes in trade costs (Section 3) and analyze the central economic channels. In Section 4, we endogenize trade policies to study the readjustment of tariff and non-tariff trade policies worldwide in reaction to economic disintegration. We also analyze when economic disintegration is welfare-improving. In Section 5, we summarize various extensions to our baseline economy. Section 6 concludes with general policy predictions and applies the model to the Brexit case. We relegate all proofs to the Appendix and provide an Online Appendix for model extensions.[7]

2 The Model

2.1 Setup

Timing and Equilibrium Definition. We build a five-stage economy of trade and tax policies, for which we solve by backward induction. In the initial stage (Stage 0), K countries choose their cooperative and noncooperative trade policies. For the moment, if not stated otherwise, we hold all trade policies fixed. Stages 1–4 feature a game of fiscal competition for a given set of trade policies. Let $\mathscr{K}$ denote the nonempty set of countries and $K := |\mathscr{K}| \in \mathbb{Z}^+$ its cardinality. Moreover, we define $\mathscr{K}_U \subseteq \mathscr{K}$ as the nonempty set of countries ("the union" U), from which the leaving country $l \notin \mathscr{K}_U$ disintegrates, and $K_U := |\mathscr{K}_U| \in \mathbb{Z}^+$ as its cardinality. For example, the union can be a customs union, a free-trade area, or a set of countries in a trade agreement. Therefore, in the following, we refer to a country $m \in \mathscr{K}_U$ as a "member country." Note that $1 \leq K_U \leq K$.

In the first stage, each government noncooperatively chooses a business tax, t_i, to maximize national welfare consisting of consumer surplus and tax revenues, taking trade policies as given. For given tax and

[7]The Online Appendix is available here.

trade policies, a continuum of mobile firms selects into countries in the second stage. In the third stage, each mobile firm from the continuum competes in an oligopolistic industry with two other immobile firms in general equilibrium. All firms are single-variety businesses and trade their products worldwide. To achieve tractability in the mobility decisions, we assume that in each industry, firms can produce in only two of several countries. Industries differ in the pair of countries in which firms produce and the country-specific fixed costs of setting up a firm. This describes the key modeling innovation of the paper. In the last stage, households optimally choose their consumption of varieties. To fix ideas, we define the subgame-perfect Nash equilibrium of this game (Stages 1–4).

Definition 1. For given trade policies, the set of tax policies, $\{t_i\}_{i\in\mathscr{K}}$, location, and output choices form a subgame-perfect Nash equilibrium, if

1. consumers choose their consumption bundle to maximize utility, taking prices as given,
2. oligopolistic firms maximize their profits over quantities, taking location decisions of all firms and taxes of all countries as given,
3. mobile firms choose their location optimally, taking taxes as given and anticipating how firms and consumers react optimally in their output and consumption decisions, and
4. governments maximize national welfare over taxes, taking other countries' taxes as given and anticipating the behavior of firms and consumers.

Our model environment shares some similarities and differences with standard international trade models. We consider a multi-sector, general-equilibrium trade model as in Melitz and Ottaviano [2008], but we add firm mobility and business-tax policy. Moreover, firms are oligopolistic and face constant returns to scale instead of producing under monopolistic competition and increasing returns, as in Krugman [1980] and Melitz [2003]. Firm heterogeneity plays a central role in Melitz [2003] and Melitz and Ottaviano [2008], who assume differences in labor requirements across firms, while in our setup, firms differ in relocation fixed costs. Thus, our model implies that firms producing in the same country export the same amount, which is not the case in the other papers.

These differences translate into the effects of trade liberalization via trade-cost changes. Since firms choose their production location according to international after-tax profit differentials, firm mobility amplifies the impact of rising bilateral trade costs. However, the governments may mitigate firm relocation by reducing business taxation. In contrast, in standard trade models, firms' profit levels determine endogenous firm exit and entry. Altogether, in our model, bilateral trade costs determine each country's price level, import volume, and local demand, similar to standard trade models, yielding comparable predictions.

Unilateral Economic Disintegration. We analyze unilateral economic disintegration by carrying out comparative statics of the subgame-perfect Nash equilibrium. Specifically, the trade costs between any pair of countries depend on the level of economic integration between them and may differ across country pairs. We interpret trade costs in a broad sense as the degree of economic integration. Trade costs refer to tariffs and non-tariff trade costs; the latter depend on policies, such as consumer protection, quality requirements, health standards, and environmental protection, and non-policy components, e.g., transport-cost differentials arising from geographical characteristics. An increase in the trade costs of respective country pairs represents one way of capturing economic disintegration. We label the resulting impact on tax policies as a trade-cost effect. Our main result, Proposition 2, speaks to the trade-cost-induced change in business taxes. Later, we will consider alternative dimensions of economic disintegration, such as relocation-cost differentials, that affect equilibrium business taxes. Thus, this section speaks to the positive effects of a country's economic disintegration on countries' business taxes. In Section 4, we study the readjustment in trade policies and turn to the normative question of when it is welfare-improving for a country to disintegrate from a set of other countries.

2.2 Households

Preferences. In each country $i \in \mathscr{K}$, a number n_i of identical households consumes a continuum of differentiated varieties and a numéraire commodity, z_i, produced under perfect competition. Differentiated varieties, $x_i(\mu)$, are indexed by $\mu \in \Omega := [0,1]$. Each variety is produced in an oligopolistic industry with mobile and immobile firms.[8] Households derive the following utility

$$u_i := z_i + \alpha \int_{\mu\in\Omega} x_i(\mu)\, d\mu - \frac{\beta}{2}\int_{\mu\in\Omega} x_i(\mu)^2\, d\mu - \frac{\eta}{2}\left(\int_{\mu\in\Omega} x_i(\mu)\, d\mu\right)^2 \tag{1}$$

[8] All the results carry over when one leaves out the immobile firms and considers only a single mobile firm that produces a given variety, mimicking the firm structure in Melitz and Ottaviano [2008] (but now with firm relocation). To endogenize the degree of local competition to firm relocation, we decided to conduct our baseline analysis under an oligopolistic market structure (see Section 5 for an extension to an arbitrary number of immobile firms).

from the consumption of products manufactured by the numéraire and the oligopolistic industries with $\alpha, \beta > 0$ and, in the base version of our model, $\eta = 0$. These preferences are a particular case of those in Melitz and Ottaviano [2008]. In Section 5, we deal with cross-price effects ($\eta > 0$). Household income comes from the business taxes the government rebates in lump-sum fashion and inelastically supplying labor at a wage rate w.

Utility Maximization (Stage 4). Assuming that all consumers are price takers, the quadratic utility function generates a system of linear aggregate demand functions

$$X_i(\mu) = \frac{n_i(\alpha - p_i(\mu))}{\beta} \tag{2}$$

for each country and industry, where $p_i(\mu)$ denotes the industry-specific local consumer price. Below, we state conditions under which solutions are interior.

2.3 Firms

Production and Trade. Each firm in the oligopolistic industries faces a linear production function with labor as the only input. Exporting one unit of the consumption good from country j to i costs τ_{ij}, where $\tau_{ij} = \tau_{ji} \in \mathbb{R}^{+}$ and $\tau_{ii} = 0$, such that the marginal costs of production read as $w + \tau_{ij}$. For the time being, we assume trade costs to be exogenous, though subject to change with disintegration, and endogenize trade policies in Section 4. Moreover, we abstract from revenue effects of trade taxes/subsidies (in Section 5, we deal with revenue effects).

To avoid corner solutions in the production of differentiated varieties, we assume that $\tau_{ij} \leq (\alpha - w)/3$, for all i, j, so trade flows are weakly positive in equilibrium. Assuming that the production of the numéraire good takes place in every country, the numéraire industry pins down a wage rate w that equalizes across countries. Thereby, an interior solution for trade flows becomes meaningful.[9] Moreover, as Haufler and Wooton [2010], we assume that firm profits do not accrue to residents in $\mathcal{K}$. As we describe in Section 5, our results are robust to the accrual of profits in residents' incomes.

[9]Our assumption on the production structure of the numéraire good appears restrictive, particularly in light of research that has shown the quantitative importance of trade shocks on labor-market outcomes (e.g., Artuç, Chaudhuri, and McLaren [2010] and Dix-Carneiro [2014]). However, assuming instead that trade in the numéraire commodity is not possible, and each country's wage rate forms on the labor market, is not likely to overturn our results. For a more formal exposition, we refer to Section 5.

We assume three firms in each industry.[10] One immobile firm produces in each of the two countries, say countries i and j. A third, mobile firm can decide in which of these two countries it locates. In line with the Ricardian idea of international specialization, the production of that specific good does not take place in other countries, for instance, due to technological, regulatory, or geographical frictions (and consumption takes place through imports). Industries differ in which two countries firms produce and, inspired by Melitz [2003], there are multiple types of industries. For instance, in an ij-industry, firms produce in either country i or j.[11]

Altogether, an industry is a collection of firms producing a specific variety. There are two interpretations of this firm structure. On the one hand, one may think of a set of industries with three firms in each industry (e.g., the clothing sector and the car sector). Each industry differs in the countries that serve as a (potential) production location. On the other hand, the setting could refer to a continuum of varieties (e.g., in the food sector). Three firms produce a specific variety (e.g., apples and bananas). Varieties differ in the countries where firms can produce them.

Profit Maximization (Stage 3). A firm producing in country i and belonging to industry ij maximizes profits by choosing the sales in the home market, x_{ii}, and exports to j and all other countries k, x_{ji} and x_{ki}. Therefore, the maximization problem in the third stage is defined as

$$\pi_i^{ij}(\mu) := \max_{\{x_{ki}(\mu)\}_{k\in\mathscr{K}}} \sum_{k\in\mathscr{K}} \left[p_k(\mu) - w - \tau_{ik}\right] x_{ki}(\mu) \tag{3}$$

subject to the oligopolistic market structure. The solution to this problem translates into market prices that are linear in trade costs (see Appendix A.1). The industry structure implies a home market bias. In general, because trade costs are saved, prices are lower, and demand is higher in a country where a mobile firm locates, compared to the country where the firm could produce (but does not) and third countries. Prices are highest in countries without any production. This price pattern reflects the consequences of competition in markets segregated by trade costs. Pre-tax-variable profits of a firm located in country i read as

$$\pi_i^{ij}(\mu) = \begin{cases} \sum_{k\in\mathscr{K}} \frac{n_k\left(\alpha - w - 2\tau_{ik} + \tau_{jk}\right)^2}{16\beta} & \text{if mobile firm locates in } i \\ \sum_{k\in\mathscr{K}} \frac{n_k\left(\alpha - w - 3\tau_{ik} + 2\tau_{jk}\right)^2}{16\beta} & \text{if mobile firm locates in } j. \end{cases} \tag{4}$$

[10] In Section 5, we relax this assumption.

[11] Throughout the analysis, superscripts will indicate the particular industry type. To rule out asymmetries in initial conditions, we let the mass of potential firms be ex ante equal across countries by partitioning the set of industries Ω into K equal-size intervals.

Thus, mark-ups are endogenous to firms' location decisions. The asymmetry in profits from markets j and any other market $k \neq i, j$ is the consequence of our assumption that in an ij-industry, there is an immobile firm in country j that faces no trade cost in serving its home market, whereas in other countries, there is no domestic firm active by assumption.[12] Note that trade costs are partly but not fully passed on to consumers, thus partially borne by firm owners. Moreover, when the mobile firm locates in i, the impact of a trade-cost change between two countries i and j on the prices in i is half as large as when the firm locates in j. Finally, in each country i, firms pay a fixed location tax t_i.

Firm Heterogeneity and Location (Stage 2). We now turn to the second stage: the location decision of mobile firms. Besides the geographical heterogeneity in industry locations, industries vary in a relative fixed cost F^{ij} of the mobile firms—i.e., a firm pays F^{ij} more in country j than in i.[13] Therefore, one can interpret this fixed cost as the cost of relocating from country i to j, which includes policy and non-policy components. Formally, F^{ij} is uniformly distributed with a cdf $G^{ij}(F^{ij}) = (F^{ij} - \underline{F}^{ij})/(\overline{F}^{ij} - \underline{F}^{ij})$. In this section, for simplicity, we impose symmetry in relocation-cost distributions across country pairs (and relax this assumption in Section 5). That is, we assume $G^{ij}(F^{ij}) = G(F^{ij}) = (F^{ij} - \underline{F})/(\overline{F} - \underline{F})$ and $\overline{F} = -\underline{F}$. Altogether, mobile firms pay different fixed costs of production, giving rise to an extensive margin of firm relocation that affects local prices and production quantities. A mobile firm in industry ij produces in country i as long as after-tax profits[14] are larger in i than in j:

$$\pi_i^{ij}(\mu) - t_i \geq \pi_j^{ij}(\mu) - t_j - F^{ij}. \tag{5}$$

[12] One may easily relax this assumption as long as the additional firms in the other countries are immobile. E.g., when there exists an (immobile) production firm in each country (irrespective of the industry type), profits are

$$\pi_i^{ij}(\mu) = \sum_{k \in \mathcal{K}} (n_k/\beta)(\alpha - w + \sum_{l \in \mathcal{K} \setminus \{i,j\}} \tau_{lk} - (k+1-k_i^{ij})\tau_{ik} + k_j^{ij}\tau_{jk})^2/(k+1)^2,$$

where $k = K+1$ is the total number of firms and $k_i^{ij} = k_j^{ij} + 1 = 2$ ($k_i^{ij} = k_j^{ij} - 1 = 1$) if the mobile firm locates in country i (country j).

[13] This is the main difference from Melitz and Ottaviano [2008]. In their setting, firms vary by their marginal cost draw, giving rise to endogenous firm exit and entry. Here, firm heterogeneity comes from relocation cost draws, which leads to endogenous firm relocation.

[14] While pre-tax variable profits (4) are nonnegative, we cannot guarantee directly that net profits (after tax and fixed cost) are as well. In simulations, we could verify for various parameter-value combinations (including our baseline parametrization) that profits of all firms were nonnegative. The requirement seems to hold more easily when the range of fixed costs is not too broad. In the following, we assume throughout that net profits are nonnegative.

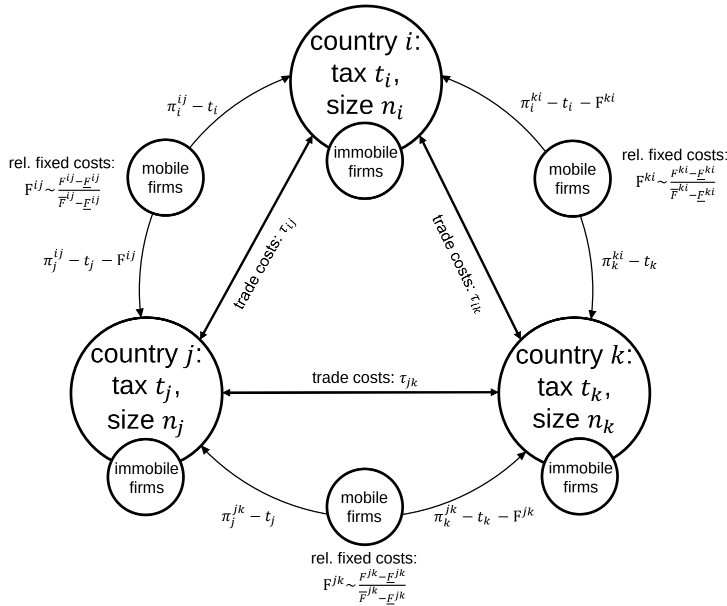

Figure 1: Illustration with $K = 3$

In other words, a firm prefers country i if the advantage in gross profits exceeds the tax differential corrected by the relative fixed cost.

We have introduced the main ingredients of the production and trade structure of our model. Figure 1 illustrates the supply side for the case of three countries. We now turn to solving the locational equilibrium. Since a continuum of industries differs in fixed costs, we can characterize the mass of industries and firms in a country. For this, we define the threshold industry in which the mobile firm is indifferent between the two countries

$$\gamma^{ij} := \pi_j^{ij}(\mu) - t_j - [\pi_i^{ij}(\mu) - t_i]. \tag{6}$$

Substituting from (4), we express the firm's international profit differential (before taxes) in terms of model parameters

$$\pi_j^{ij}(\mu) - \pi_i^{ij}(\mu) = \left(n_j - n_i\right)\tau_{ij}\frac{6(\alpha - w) - 3\tau_{ij}}{16\beta} + \sum_{l \in \mathscr{K}\setminus\{i,j\}} n_l\left(\tau_{il} - \tau_{jl}\right)\frac{6(\alpha - w) - 3\left(\tau_{il} + \tau_{jl}\right)}{16\beta}. \tag{7}$$

Therefore, our concept of mobility allows us to write the threshold industry level in closed form as a function of the model parameters.[15] A convenient property of the fixed location tax and the uniform cost distribution

[15]Mobility between more than two countries would make necessary extensive numerical simulations, as in Ossa [2015]. The advantage of our model is that although the firm-level location decision is binary, the equilibrium firm distribution is a high-

is that the equilibrium firm distribution is linear in the tax differential. Partial-equilibrium comparative statics are given by

$$\frac{\partial \gamma^{ij}}{\partial t_i} = -\frac{\partial \gamma^{ij}}{\partial t_j} = 1, \ \frac{\partial \gamma^{ij}}{\partial \tau_{ij}} = \frac{3\left(n_j - n_i\right)\left(\alpha - w - \tau_{ij}\right)}{8\beta}, \ \frac{\partial \gamma^{ij}}{\partial \tau_{il}} = \frac{3n_l\left(\alpha - w - \tau_{il}\right)}{8\beta}, \text{ and } \frac{\partial \gamma^{ij}}{\partial \tau_{jl}} = \frac{-3n_l\left(\alpha - w - \tau_{jl}\right)}{8\beta}$$

for $j \neq l$. Observing that the sign of $\partial\gamma^{ij}/\partial\tau_{ij}$ depends on the country's relative size, one may recognize a partial-equilibrium feature of economic disintegration, discovered in earlier work: As in Ottaviano and Van Ypersele [2005] and Haufler and Wooton [2010], a rise in trade costs pushes firms to relocate to larger countries. In this case, market-access considerations become more important than business-tax differentials for mobile firms. Moreover, if trade becomes cheaper domestically or more costly for firms located abroad, firms relocate to country i ($\partial\gamma^{ij}/\partial\tau_{il} > 0$ and $\partial\gamma^{ij}/\partial\tau_{jl} < 0$). Since $\gamma^{ij} = -\gamma^{ji}$ and $G()$ is symmetric with $\overline{F} = -\underline{F}$, Lemma 1 directly follows. It will prove convenient when deriving the objective function of the government.

Lemma 1. *Suppose that $\overline{F} = -\underline{F}$. Then, $G(\gamma^{ji}) = 1 - G(\gamma^{ij})$. Moreover, the number of firms in country i is given by $k_i := (K-1) + 1/(2\overline{F})\sum_{j\in\mathscr{K}\setminus\{i\}}(\overline{F} - \gamma^{ij})$.*

Lemma 1 shows that the number of firms in a country is linear in the tax differential of country pairs via the fixed-cost threshold levels shown in (7). This property is also present in Haufler and Wooton [2010], albeit in a model with only two countries. However, a difference is that the tax differential is not weighted by trade costs, as it is in Haufler and Wooton [2010].

2.4 Governments

Here, we describe the first stage of our economy. For a given level of trade costs, we derive Nash equilibrium business taxes set by benevolent social planners in each country, who take account of the effect of taxes on households' consumption choices and location and output decisions of all firms and industries. As mentioned, the trade costs partly result from trade negotiations, whose endogenous formation is studied in detail in Section 4.

The benevolent social planner in country i maximizes the sum of consumer surplus S_i and tax revenues

dimensional object that is tractable enough to study policy implications.

$T_i := t_i k_i$ (recall that profits go to absentee owners) and, therefore, solves the following optimization problem

$$W_i := \max_{t_i} S_i + T_i + n_i w, \tag{8}$$

taking $\{t_j\}_{j \in \mathcal{K} \setminus \{i\}}$ as given. Similarly, welfare is maximized in countries $j \in \mathcal{K} \setminus \{i\}$ over t_j. As usual, the wage income enters welfare linearly due to the quasi-linear utility function. The term is constant, given that wages are pinned down by the numéraire sector. In Appendix A.1, we show that consumer surplus is given by

$$S_i := \sum_{j \in \mathcal{K} \setminus \{i\}} \left[\delta_i^{ij} + \frac{\gamma^{ij} - \underline{F}}{2\overline{F}} \Delta_i^{ij} \right] + \frac{1}{2} \sum_{j \in \mathcal{K} \setminus \{i\}} \sum_{l \in \mathcal{K} \setminus \{i,j\}} \left[\delta_i^{jl} + \frac{\gamma^{jl} - \underline{F}}{2\overline{F}} \Delta_i^{jl} \right], \tag{9}$$

where the consumer-surplus differential and level terms

$$\Delta_i^{jl} := n_i \frac{(3\alpha - 3w - \tau_{ij} - 2\tau_{il})^2 - (3\alpha - 3w - 2\tau_{ij} - \tau_{il})^2}{32\beta} \quad \text{and} \quad \delta_i^{jl} := n_i \frac{(3\alpha - 3w - 2\tau_{ij} - \tau_{il})^2}{32\beta} \tag{10}$$

are defined as functions of the model's primitives $\Theta := (\alpha, \beta, w, (n_i)_{i \in \mathcal{K}}, (\tau_{ij})_{i,j \in \mathcal{K}}, \underline{F}, \overline{F})$.

Country i's consumer surplus is the sum of consumer surplus of all markets relating to the various industry configurations—i.e., i) the industry in which a mobile firm produces, ii) the industry in which a mobile firm could produce but does not, and iii) the industry in which the mobile firm could not produce from the start. The delta parameters capture consumer-surplus differentials that firm relocation induces. They involve quadratic terms of the relevant bilateral trade costs. The quadratic nature comes from the fact that utility is quadratic in the quantity of the differentiated goods. Interestingly, business taxes enter consumer surplus in a linear fashion, as the threshold fixed-cost levels enter linearly in (9) and are themselves simple linear functions of tax differentials (see (6)). We conclude that an increase in country i's business tax reduces consumer surplus only in those industries in which a mobile firm could locate in i. This is intuitive, as a rise in the tax makes production in that country less attractive and, thereby, makes consumers worse off because local prices rise when goods are imported rather than produced at home. Because the number of firms k_i is linear in tax-rate differentials, tax revenues, $t_i k_i$, are quadratic in tax rates. Taken together, social welfare (8) is a relatively simple function of trade costs and business taxes.

Noncooperative Tax Policies (Stage 1). The first-order condition of country i's social planner problem yields a reaction function $t_i(\{t_j\}_{j \in \mathcal{K} \setminus \{i\}}, \Theta)$. As we prove in Appendix A.2, the reaction functions are linear in taxes, and there is a unique intersection of the reaction functions, $t_i(\Theta)$, for $i \in \mathcal{K}$, forming the solution to the tax-competition game. To develop the main intuitions in the following, we draw on a key equilibrium object, the firm relocation semi-elasticity

$$-\frac{\partial \ln(k_i)}{\partial t_i} = -\frac{1}{k_i}\frac{\partial k_i}{\partial t_i},$$

that will be informative about the effects of economic disintegration described in Section 3.

Proposition 1. *Suppose that $\overline{F} = -\underline{F}$. Then, for any $i \in \mathcal{K}$, the subgame-perfect Nash equilibrium of the tax-competition game is given by*

$$t_i = \underbrace{3\overline{F} + \frac{1}{2K-1}\sum_{j\in\mathcal{K}\setminus\{i\}}\left(\pi_i^{ij} - \pi_j^{ij}\right)}_{=-1/\frac{\partial \ln(k_i)}{\partial t_i}} + \frac{1}{2K-1}\sum_{j\in\mathcal{K}\setminus\{i\}}\Delta_i^{ij} + \frac{1}{(K-1)(2K-1)}\sum_{j\in\mathcal{K}}\sum_{l\in\mathcal{K}\setminus\{j\}}\Delta_j^{jl},$$

where the international profit differentials, $\pi_i^{ij} - \pi_j^{ij}$, and consumer-surplus differentials, Δ_i^{ij}, are defined in (7) and (10).

The equilibrium tax depends on international profit differentials and consumer-surplus differentials. The former captures the government's revenue collection motive and directly relates to the inverse firm relocation semi-elasticity, whereas the latter accounts for the government's objective to lower domestic prices.[16] Attracting mobile firms is central for both motives, so the relocation semi-elasticity that measures mobile firms' responsiveness to tax policy becomes the sufficient statistic for business taxation.

Now, we analyze changes in one country pair's trade costs. The left panel of Figure 2 depicts the effect of bilateral trade costs between a smaller and larger country (1 and 2) on Nash equilibrium business taxes. If not stated otherwise, we choose: $\alpha = 7$, $\beta = 1$, $w = 1$, $\overline{F} = -\underline{F} = 0.5$, $K = 5$, $\tau_{ij} = \tau_{ji} = 1$, $\forall i \neq j$, and $\sum_{i\in\mathcal{K}} n_i = 1$. A rise in trade costs τ_{12} and τ_{21} makes the respective countries less attractive to firms and raises the firm relocation semi-elasticity. As a result, countries 1 and 2 compensate by taxing businesses less (black and red lines). Interestingly, the larger country 2 experiences a less-pronounced decline due to its population size (here: $n_2 = (K-1)n_i, \forall i$). This is the described partial-equilibrium effect where a rise in trade costs pushes firms to relocate to larger countries (Ottaviano and Van Ypersele [2005] and Haufler and Wooton [2010]).

[16] If governments were purely revenue-maximizing, leaving aside any consumer-price motive, the equilibrium business tax would be precisely equal to the inverse firm relocation semi-elasticity, $t_i = -1/[\partial \ln(k_i)/\partial t_i]$. Thus, adding the consumer-price motive, the semi-elasticity approximates the level of business taxation, echoing earlier insights in the tax-competition literature about the similarity between revenue and welfare maximization (e.g., Janeba and Smart [2003]).

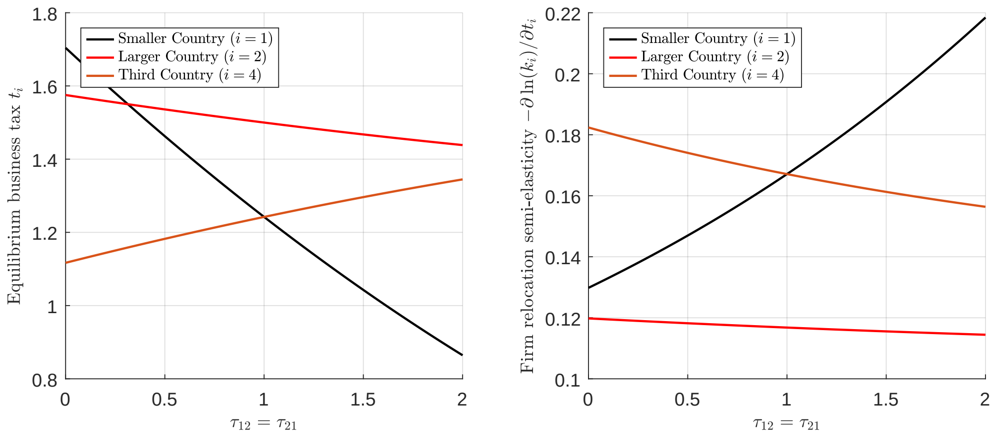

Figure 2: Left Panel: Equilibrium Business Taxes as a Function of Trade Costs; Right Panel: Firm Relocation Semi-Elasticities as a Function of Trade Costs

Third countries become more attractive as a business location, allowing them to tax more (orange line).

The right panel of the figure highlights the close connection to the firm relocation semi-elasticity: Business taxes are inversely related to this sufficient statistic. It determines a government's objective is to attract mobile firms to increase tax revenues (larger tax base) and consumer surplus (lower prices).[17] Observe that the semi-elasticity has a particular transparent form for the given uniform relocation-cost distribution: Its inverse is proportional to the equilibrium number of firms. Thus, the semi-elasticity can be directly estimated from the data, e.g., using each country's firm share.[18]

3 The Impact of Economic Disintegration on Tax Policies

Analyzing the effect of one country pair's bilateral trade costs on domestic policies, while interesting, delivers an incomplete picture of economic disintegration. Now, we study the effects of economic disintegration on

[17] Due to consumer-price motives, business taxes are not exactly equal to the inverse relocation semi-elasticity, but they are very close (see Section 3 for a decomposition of the different channels).

[18] For any alternative specification of the cost distribution, the semi-elasticity would still be proportional to the equilibrium firm number but scaled by its partial-equilibrium response to business taxation. Also, note that the empirical literature usually estimates the semi-elasticity (e.g., of inward FDI) from proportional taxation instead of the fixed location tax considered here. Thus, in a model calibration that targets this semi-elasticity, one would have to premultiply with the average level of domestic profits. In our baseline parametrization, we arrive at a converted semi-elasticity of 0.3, which is at the lower bound of estimated values (see Feld and Heckemeyer [2011]).

tax policy via changes in the costs of bilateral trade between *multiple* countries, giving rise to a trade-cost effect. In Section 5, we augment the debate by other dimensions of disintegration, including a change in the international mobility of firms via location fixed costs (de-harmonization and business-friction effects). In contrast to Melitz [2003] and Melitz and Ottaviano [2008], our focus here is not on intra-industry reallocation effects, as our firms are identical, conditional on location. Rather, it is on the extensive margin of firm location and the effects induced on and by tax policies.

For instance, suppose that countries $\mathcal{K}_U$ are in an economic union and have similar trade costs. What happens to taxes when trade between country l and the economic union becomes more costly? As Proposition 2 shows, the answer depends on the relative sizes of the markets.[19] We relegate the proof and a more technical statement of the proposition to the Appendix B.2.

Proposition 2. *Let trade costs between the leaving and the remaining member countries be initially symmetric.*[20] *Impose cross-country symmetry in population sizes. Country $l \in \mathcal{K} \setminus \mathcal{K}_U$ disintegrates from the member countries $\mathcal{K}_U$ via a rise in trade costs. In the subgame-perfect Nash equilibrium, this*

(a) *decreases the leaving country's business tax,*

(b) *decreases taxes in the remaining member countries if the union is small: $2K_U \leq K$, and*

(c) *raises business taxes in third countries $k \in \mathcal{K} \setminus (\mathcal{K}_U \cup l)$.*

Trade disintegration between l and $\mathcal{K}_U$ makes third countries relatively more attractive and lowers their relocation semi-elasticity, allowing them to tax more (part (c)). The trade-cost effect on the leaving country (part (a)) and the remaining member countries (part (b)) depends on their market sizes. Under symmetric population sizes, the leaving country's business tax declines

$$\sum_{m \in \mathcal{K}_U} \frac{dt_l}{d\tau_{ml}} = \frac{3n(\alpha - w - \tau)}{16\beta} \frac{(5K - 5 - 2K^2)K_U}{(K-1)(2K-1)} < 0. \tag{11}$$

The rising trade costs push firms from the leaving country to either the union or the rest of the world. The relocation semi-elasticity in the leaving country rises, and the business tax goes down. Despite assuming symmetric population sizes, the tax response in member countries still depends on relative market sizes. That is, where the firms from the leaving country relocate to depends on how large the union is relative to the rest

[19] Observe that, for now, we only consider direct effects of economic disintegration, i.e., changes in the trade relations of the leaving country with $\mathcal{K}_U$. In particular, we hold trade relations with third countries fixed.

[20] In Appendix B.2, we deal with initially asymmetric trade costs.

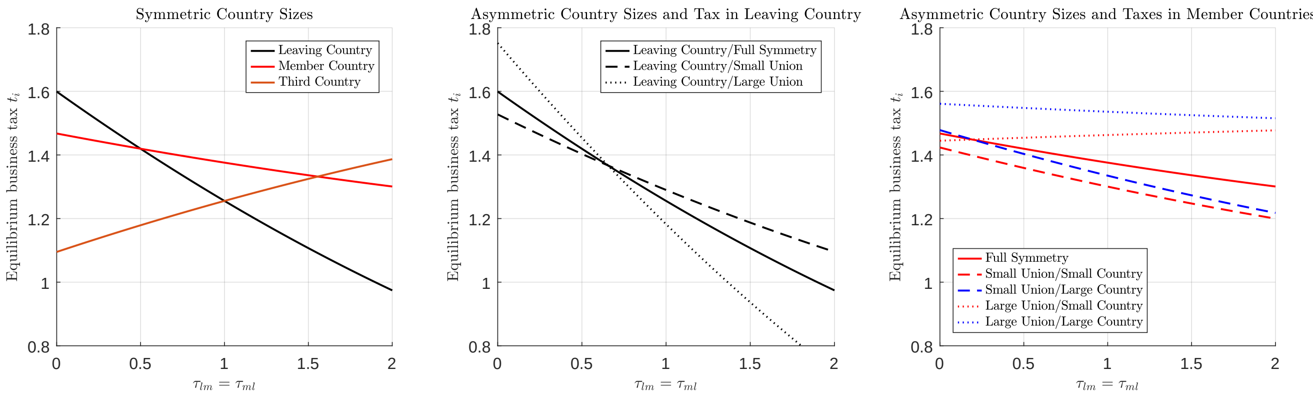

Figure 3: Left Panel: Trade-Cost Effect under Symmetric Country Sizes; Middle Panel: Trade-Cost Effect in the Leaving Country under Asymmetric Country Sizes; Right Panel: Trade-Cost Effect in the Union under Asymmetric Country Sizes

of the world

$$\frac{dt_m}{d\tau_{ml}} + \sum_{j\in\mathscr{K}_U\backslash\{m\}} \frac{dt_m}{d\tau_{jl}} = \frac{3n\,(\alpha - w - \tau)}{16\beta} \frac{(4K_U - 2K - 1)\,(K-1) - 2K_U}{(K-1)\,(2K-1)}. \tag{12}$$

In particular, business taxes in member countries decline if the union is initially small ($2K_U \leq K$). This emerges from the market-access argument (see Section 2.3): In response to higher trade costs, firms relocate to large markets. When trade costs with the leaving country rise, a small union that faces many competing countries experiences a net outflow of firms and a higher firm relocation semi-elasticity. As a result, member countries reduce their business taxes. Vice versa, suppose the union is large and, thus, has a strong internal market that covers most of the demand for tradeable goods and services. Then, rising trade costs lead to more inward FDI and a lower relocation semi-elasticity inside the union. Intuitively, firms relocate to the large union to get low-cost access to this market irrespective of the business tax differential, and member countries' ability to tax improves.

We depict the symmetric case in the first panel of Figure 3, showing the equilibrium taxation as a function of trade costs between the leaving country and (two) union-member countries ($\tau_{lm} = \tau_{lm_1} = \tau_{lm_2}$). If not stated otherwise, in the following simulations, we set: $K_U = 2$ and $\tau_{m_1m_2} = \tau_{m_2m_1} = 0.5$. Therefore, the condition $2K_U \leq K$ is fulfilled. Member countries' business taxes decline (red line), as does the leaving country's tax, and third countries' taxes rise with trade costs (black line and orange line, respectively).

While for transparency, we focus in Proposition 2 on symmetric population sizes, we can also speak to asymmetries. Third countries' tax responses (part (c)) are robust to any asymmetry in population size. The leaving country's tax decline (part (a)) carries over as long as its population is small relative to the members' population: $n_l < 8\bar{n}_U \coloneqq 8\sum_{m\in\mathcal{K}_U} n_m/K_U$. The response of member countries depends on the population sizes of all countries (part (b)). More precisely, the disintegration decreases (increases) a member country's tax if the member is large (small): $n_m \underset{(<)}{>} \phi_1\bar{n}_U - \phi_2 n_l$, where $\phi_1 > 0$ and $\phi_2 > 0$ depend on the number of countries in the union and the world.

The middle panel of Figure 3 illustrates the effect of asymmetric populations, with three different sizes of a member country m_2, whereas the other countries remain symmetric: $n_{m_2} \in \{n_i, n_i/(K-1), n_i(K-1)\}, \forall i \neq m_2$. The larger the member country and, thus, the union size in total, the more the leaving country's tax declines, because with a large union, the leaving country suffers a more severe market-access loss, translating into a more-pronounced rise in the relocation semi-elasticity and a stronger tax-policy response.

Changing the size of the member country m_2 generates asymmetries within the union and affects the union size relative to the rest of the world. Consider a member country that is four times larger than all other countries ($n_{m_2} = n_i(K-1), \forall i \neq m_2$). In such a large union, a convergence of business taxes occurs, which we show in the third panel of Figure 3 (dotted lines). The larger country in the union (m_2) has a lower relocation semi-elasticity and a higher tax initially but experiences a tax reduction as trade costs rise (blue dotted line). Conversely, the smaller union member's (m_1) taxation rises (red dotted line). Holding the relative country sizes inside the union fixed but considering a small union member ($n_{m_2} = n_i/(K-1), \forall i \neq m_2$), business taxes inside the union converge in declining fashion (dashed lines), again reflecting the market-access argument. Altogether, we observe a convergence of union members' taxes, but the direction of convergence depends on the union size relative to the rest of the world.

Two-Country vs. Multi-Country Model. Compared to existing two-country models, our multi-country analysis allows us to identify the policy responses of third countries and asymmetric reactions inside the union. Moreover, a two-country setting may lead to incorrect policy conclusions, even if we impose symmetry in population sizes and abstract from third countries. For example, reconsider the member countries' tax-policy response under symmetry, described by Equation (12), but impose $K_U = K - 1$, so there are no third countries. According to a two-country setting with $K = 2$ and $K_U = 1$, there would be a decline in members' business taxes. However, this policy conclusion is flawed for a large union (here: $K_U \geq 3$), where the multi-country model predicts a rise in members' taxation, as explained above. Therefore, it is essential to consider a setting with multiple member countries whenever the number of member countries is not minor.

Unilateral vs. Multilateral Disintegration. Our model also speaks to the differences between unilateral and multilateral disintegration, which two-country models fail to capture. The main difference is the presence of third countries because otherwise the leaving country would be disintegrating from all other countries. Unilateral disintegration affects the leaving country's trade relations with only a subset of countries (union members), while trade costs with third countries remain stable. To make the consequences transparent, we, again, suppose that population sizes are symmetric and investigate the member countries' tax-policy response. Consider a model without third countries $K_U = K - 1$ and a union with a non-negligible number of members $K_U \geq 3$. As mentioned above, the disintegration raises members' taxes in that case (see (12)). However, a model with third countries ($K_U < K - 1$) predicts a decline in members' taxes whenever $2K_U \leq K$. Thus, the presence of third countries flips the policy predictions if there are enough third countries.

Comparing the models with and without third countries hints at another important dimension: disintegration-induced trade creation and diversion. In the model without third countries, changes in bilateral trade costs affect all countries and firms, since firms do not differ in productivity and there is no comparative advantage within industries. However, in our setup with third countries, a change in trade costs between the leaving country and the union arising from disintegration makes trade with third countries relatively more attractive. More production and exports are created for third countries at the expense of trade between the former union countries. Since we assume that firms face identical marginal costs, the efficiency implications of disintegration differ from those in standard models of trade creation and diversion. Nonetheless, there are efficiency effects because the relocating firms pay the relocation fixed costs and the international tax differential whenever a third country is a high-tax location. Future research may address the role of heterogeneous marginal costs and the implications of disintegration for trade creation and diversion.

Economic Channels. We now turn to the economic forces behind the trade-cost effect. Each country's best-response function (Equation (23)) allows for a decomposition of the equilibrium tax response. First, changing trade costs between the leaving and the member countries alter the government's incentive to attract firms to reduce local consumer prices (consumer-surplus differential measured by Δ_i^{ij}, for $i, j \in \mathscr{K}$). We label this as a "price channel." Moreover, the tax base, determined by the country-specific profit differentials, $\pi_i^{ij} - \pi_j^{ij}$, for $i, j \in \mathscr{K}$, responds to adjustments in trade costs ("tax-base channel"). The sum of price and tax-base channels forms each country's "best response." Finally, in the Nash equilibrium, countries adjust their tax rates in response to each other ("equilibrium response"). Corollary 1 analytically characterizes

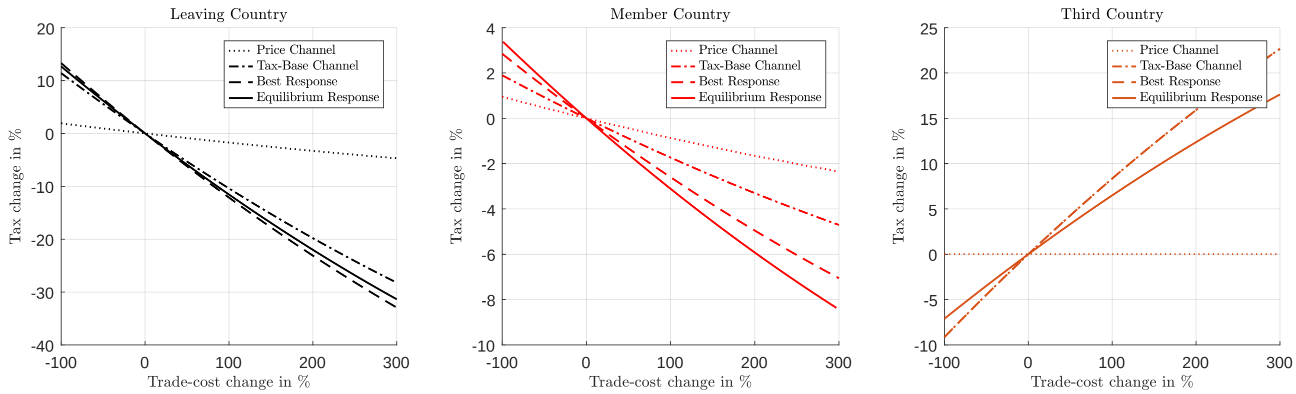

Figure 4: Channel Analysis for Leaving Country (Left Panel), Member Country (Middle Panel), and Third Country (Right Panel)

tax-base and price channels in the symmetric case.

Corollary 1. *Let trade costs between the leaving and remaining member countries be initially symmetric, impose cross-country symmetry in population sizes, and consider the trade-cost effect from Proposition 2. Then, in the leaving country, the tax-base channel is negative and in absolute value stronger than the negative price channel. The price channel in the union is also negative, but the tax-base channel is negative if and only if $2K_U < K$. In third countries, the tax-base channel is positive, and the price channel is zero.*

In Figure 4, we depict the channels in our baseline parametrization ($2K_U < K$) with symmetric country sizes. For the leaving country (left panel), the tax-base channel (dash-dotted black line) primarily drives the best response (dashed black line). This does not mean that consumer surplus is not adversely affected, but consumer-surplus differentials respond (via price changes) in less-pronounced fashion to the disintegration than profit differentials.[21] In the figure, the relative strength of tax-base and price channels is more balanced for a member country (middle panel). Overall, the response is more substantial in the leaving country than in the member country because the leaving country loses firms to the remaining member countries and third countries. Under symmetric population sizes, firms in member countries relocate only to third countries, and an inflow from the leaving country partly offsets this outflow. Also, note that under symmetry, third countries' consumer-surplus differentials are independent of the other countries' bilateral trade costs. Therefore, in the third country, the price channel is zero, and the tax-base channel and best response coincide (right panel).

The adjustment from the best response to the equilibrium seems moderate in both the leaving and member

[21] The reason is that the cost of lost firms enters the consumer surplus linearly and the tax revenues convexly (see Section 2.4).

countries because from each country's perspective, tax cuts and tax hikes abroad balance each other. For example, the leaving country faces a tax hike in third countries and tax cuts in the member countries. In third countries, the equilibrium response in the figure is sizably lower than the best response due to the leaving and member countries' tax cuts.

4 The Impact of Economic Disintegration on Trade Policies

So far, we have studied the effects of a country's disintegration on national business-tax policies, taking international trade policies as given. In this section, we extend our analysis and endogenize trade policies, with the aim of studying the effect of economic disintegration on tax *and* trade policies. While this could be a purely positive analysis, our interest concerns also the welfare effects of economic disintegration.

In Table 1, we illustrate, in our symmetric baseline parametrization with five countries, the effects of a large rise in trade costs between the leaving country and the two union members on the leaving country's aggregate variables, holding all other trade costs fixed. The leaving country reduces its business taxation (e.g., −11.6 percent after a doubling of trade costs) and loses a nonnegligible share of firms (in this case, −6.7 percent). As a result, tax revenues substantially decline (−17.5 percent). The even more pronounced decline in consumer surplus (−22.1 percent) is due to the increasing prices of imports from remaining member countries and the firm losses forcing the leaving country to rely more heavily on costly imports.[22] Altogether, recalling that welfare is the sum of consumer surplus, tax revenues, and wage income, the lower business-tax revenues and higher local consumer prices make the leaving country's disintegration ceteris paribus welfare-detrimental (−19.6 percent).[23]

However, a prominent argument in favor of disintegration, such as Brexit, is that the leaving country may counteract the adverse consequences of disintegration by integrating more with third countries. Therefore, considering the endogenous adjustment of trade policies worldwide in response to economic disintegration is important. Referring to our model in Section 2, cooperative and noncooperative trade policies can be modeled as the initial stage of our economy (Stage 0).

We start our trade-policy analysis with the positive question of how unilateral economic disintegration

[22] This is the gains-from-trade argument, well-documented in the model by Melitz and Ottaviano [2008] and other standard trade models (e.g., Krugman [1980]).

[23] Observe that in our model, welfare declines approximately linearly with trade costs.

	Trade Costs (Baseline)	Trade-Cost Change $\Delta\tau_{ml}$		
	$\tau_{ml} = \tau_{m_1 l} = \tau_{m_2 l} = 0.5$	+50%	+100%	+200%
Equilibrium Business Tax t_l	1.420	−5.9%	−11.6%	−22.0%
Share of Firms $k_l/\sum_{j\in\mathcal{K}} k_j$	0.209	−3.5%	−6.7%	−12.9%
Business-Tax Revenues T_l	9.662	−9.2%	−17.5%	−32.0%
Consumer Surplus S_l	9.201	−11.6%	−22.1%	−40.4%
Welfare $W_l = S_l + T_l + n_l w$	19.062	−10.2%	−19.6%	−35.7%

Table 1: Aggregate Effects on Leaving Country

affects countries' endogenous trade policies (Section 4.1). Then, in Section 4.2, we turn to the question of when a country's disintegration is welfare-improving, taking all tax- and trade-policy responses into account.

4.1 Positive Analysis

In the following, we analyze the effects of disintegration on trade policies around the world: How do (non-tariff) trade policies inside the union change? What are the effects on trade agreements between the leaving country and third countries, as well as between the union and third countries? In the previous section, we characterized unilateral economic disintegration by exogenous changes in trade costs between the respective country pairs. Now, we turn to the endogenous adjustment of trade costs following economic disintegration. The idea is that after the disintegration, the leaving country and the remaining member countries no longer jointly set their trade policies vis-à-vis third countries. The leaving country and the remaining union are free to reoptimize trade policies in their own interest, thus endogenously adjusting the trade costs.

Trade costs between two countries consist of tariffs τ^t_{ij} (trade taxes) and non-tariff trade costs, which, in turn, have a policy component τ^p_{ij} and a non-policy component τ^n_{ij}:[24]

$$\tau_{ij} = \tau^t_{ij} + \tau^p_{ij} + \tau^n_{ij}.$$

Thus, non-tariff trade costs entail local characteristics (such as geographical frictions) and trade policies that, unlike tariffs, do not have government revenue effects (such as environmental protection and product standards). Nevertheless, similar to tariffs, governments may negotiate non-tariff trade policies in an international agreement, which the non-tariff policy component τ^p_{ij} expresses. Altogether, trade policies τ^t_{ij} and τ^p_{ij} form

[24] This definition of trade costs also allows us to incorporate tariffs that affect government revenues into our model of Section 2 (see Section 5).

either cooperatively or noncooperatively. Before presenting our results on trade policies in more detail, we make the following assumption about the effect of trade costs on welfare.

Assumption 1. *Any rise in bilateral trade costs between two countries i and j raises welfare in a third country $k \neq i, j$:*

$$\frac{dW_k}{d\tau_{ij}^p} > 0 \ \ and \ \ \frac{dW_k}{d\tau_{ij}^t} > 0.$$

In Lemma 2, we show conditions under which Assumption 1 holds in our model. The proof (see Appendix C.1) employs the optimality of a country's business taxes and the Nash equilibrium comparative statics, capturing the impact of other countries' tax-policy adjustments on a country's welfare.

Lemma 2. *Let country k's business tax be positive and tariff revenues negligible in the initial subgame-perfect Nash equilibrium. Moreover, suppose that country k's trade costs with other countries are the same $\tau_{ki} = \tau_{kj}$, $\forall i, j$. Then, Assumption 1 holds:*

$$\frac{dW_k}{d\tau_{ij}^p} = \frac{dW_k}{d\tau_{ij}^t} = \frac{dW_k}{d\tau_{ij}} = \frac{\partial W_k}{\partial \tau_{ij}} + \sum_{l \neq k} \frac{\partial W_k}{\partial t_l} \frac{dt_l}{d\tau_{ij}} > 0.$$

Assumption 1 and Lemma 2 have an intuitive appeal. Any protective measure (i.e., tariffs τ_{ij}^t and non-tariff barriers τ_{ij}^p) between two countries proves beneficial to third countries (positive gradient of the welfare function). The reason is that the third country becomes more attractive to businesses as trade costs between the two other countries rise. As a result, firms relocate to the third country and prices decline there, raising tax revenues and consumer surplus. The fact that third countries benefit from a rise in trade costs between two other countries is more general and well-known in the literature on trade policy. Usually, contributors to this literature refer to it as the "terms-of-trade effect of bilateral trade costs" (in particular tariffs) on the world price and, in turn, on third countries' welfare. It may result in bilateral opportunism (as in Bagwell and Staiger [2004]).

Equipped with Lemma 2, we now describe how trade policies form initially and study their readjustment in response to economic disintegration. We draw on the idea that cooperative trade policies result from efficient bargaining (see Grossman and Helpman [1995]). Accordingly, under the transferability of utilities, cooperative trade policies maximize the aggregate welfare of the countries involved. Governments choose the other trade policies noncooperatively to maximize individual welfare. We consider trade policies before the disintegration (labeled "old" equilibrium) and after ("new" equilibrium). Thereby, we take an arbitrary and predetermined set of trade agreements, disregarding the destruction of old and the formation of new trade agreements, and focus on the renegotiation of these existing agreements. Moreover, we assume that trade policies are formed by concave optimization problems leading to interior solutions in the trade-policy space.[25]

Exit from an Economic Union. Denote the vector of non-tariff trade policies between all (remaining) union members as $\boldsymbol{\tau^p_{U,U}}$, and between the leaving country and the (remaining) union as $\boldsymbol{\tau^p_{U,l}}$.[26] In the old equilibrium, these policies maximize the leaving country's and members' joint welfare

$$\left(\boldsymbol{\tau^{p,old}_{U,U}}, \boldsymbol{\tau^{p,old}_{U,l}}\right) := \underset{\left(\boldsymbol{\tau^p_{U,U}}, \boldsymbol{\tau^p_{U,l}}\right)}{\arg\max} \sum_{m \in \mathcal{K}_U \cup \{l\}} W_m(\cdot). \tag{13}$$

In the new equilibrium, the objective function changes because member countries no longer consider the leaving country's welfare in their optimization

$$\left(\boldsymbol{\tau^{p,new}_{U,U}}\right) := \underset{\left(\boldsymbol{\tau^p_{U,U}}\right)}{\arg\max} \sum_{m \in \mathcal{K}_U} W_m(\cdot). \tag{14}$$

While trade costs between the leaving and the member countries rise by the definition of economic disintegration (see previous section), we are now interested in the readjustment of the union's internal trade policies ($\boldsymbol{\tau^{p,old}_{U,U}}$ vs. $\boldsymbol{\tau^{p,new}_{U,U}}$). More explicitly, we compare the union's optimal trade policy vectors satisfying the best-response conditions before and after disintegration

$$\sum_{m \in \mathcal{K}_U \cup \{l\}} \nabla_{\boldsymbol{\tau^p_{U,U}}} W_m\left(\boldsymbol{\tau^{p,old}}, \boldsymbol{\tau^{t,old}}\right) = 0 \text{ and } \sum_{m \in \mathcal{K}_U} \nabla_{\boldsymbol{\tau^p_{U,U}}} W_m\left(\boldsymbol{\tau^{p,new}}, \boldsymbol{\tau^{t,new}}\right) = 0.$$

Exit from a Customs Union. When the leaving country departs from a customs union, one may ask how external trade policies of the union and the leaving country change because they no longer jointly sit at the negotiating table with third countries. Let $\mathcal{K}_{TA}$ be the set of countries that form trade agreements. Accordingly, define $\boldsymbol{\tau^t_{U,TA}}$ ($\boldsymbol{\tau^t_{l,TA}}$) as the vector of cooperative tariffs between the remaining union (leaving

[25]Formally, we suppose that each τ^t_{ij} and τ^p_{ij} can be chosen from a closed interval and, in the following, restrict attention to "interior policy solutions," disregarding trade policies selected from the endpoints of the trade-policy space. To gain an intuition for why solutions to trade policies are interior, consider, for instance, the negotiation of non-tariff trade costs, $\tau_{m_1 m_2}$, inside a union. On the one hand, a rise in $\tau_{m_1 m_2}$ may reduce welfare in countries m_1 and m_2. On the other hand, other member countries, e.g., $m_3, ..., m_{K_U}$, inside the union benefit from a higher $\tau_{m_1 m_2}$ (Lemma 2). As a result, there is a trade-off when choosing $\tau_{m_1 m_2}$ to maximize joint welfare.

[26]As in the previous section, we label the remaining union, from which the leaving country disintegrates, as U, thus, setting apart member countries and and the leaving country $l \notin \mathcal{K}_U$.

country) and any country in $\mathscr{K}_{TA}$. Similarly, denote $\boldsymbol{\tau}^{\boldsymbol{t}}_{\boldsymbol{U},R}$ and $\boldsymbol{\tau}^{\boldsymbol{t}}_{\boldsymbol{l},R}$ as the respective vector of noncooperative trade policies vis-à-vis all other countries $\mathscr{K}_R \coloneqq \mathscr{K} \backslash (\mathscr{K}_{TA} \cup \mathscr{K}_U \cup \{l\})$, where the symbol R stands for rest of the world. In the old equilibrium,

$$\left(\boldsymbol{\tau}^{t,old}_{U,TA}, \boldsymbol{\tau}^{t,old}_{l,TA}\right) \coloneqq \underset{\left(\boldsymbol{\tau}^{t}_{U,TA}, \boldsymbol{\tau}^{t}_{l,TA}\right)}{\arg\max} \sum_{m \in \mathscr{K}_U \cup \{l,TA\}} W_m(\cdot) \tag{15}$$

and

$$\left(\boldsymbol{\tau}^{t,old}_{U,R}, \boldsymbol{\tau}^{t,old}_{l,R}\right) \coloneqq \underset{\left(\boldsymbol{\tau}^{t}_{U,R}, \boldsymbol{\tau}^{t}_{l,R}\right)}{\arg\max} \sum_{m \in \mathscr{K}_U \cup \{l\}} W_m(\cdot), \tag{16}$$

whereas, in the new equilibrium,

$$\left(\boldsymbol{\tau}^{t,new}_{U,TA}\right) \coloneqq \underset{\left(\boldsymbol{\tau}^{t}_{U,TA}\right)}{\arg\max} \sum_{m \in \mathscr{K}_U \cup \{TA\}} W_m(\cdot) \;\text{ and }\; \left(\boldsymbol{\tau}^{t,new}_{l,TA}\right) \coloneqq \underset{\left(\boldsymbol{\tau}^{t}_{l,TA}\right)}{\arg\max}\; W_l(\cdot) + W_{TA}(\cdot) \tag{17}$$

and

$$\left(\boldsymbol{\tau}^{t,new}_{U,R}\right) \coloneqq \underset{\left(\boldsymbol{\tau}^{t}_{U,R}\right)}{\arg\max} \sum_{m \in \mathscr{K}_U} W_m(\cdot) \;\text{ and }\; \left(\boldsymbol{\tau}^{t,new}_{l,R}\right) \coloneqq \underset{\left(\boldsymbol{\tau}^{t}_{l,R}\right)}{\arg\max}\; W_l(\cdot). \tag{18}$$

Accordingly, in the case of an exit from a customs union, we ask how external tariffs of the union and the leaving country change ($\boldsymbol{\tau}^{t,old}_{U,TA}$ vs. $\boldsymbol{\tau}^{t,new}_{U,TA}$, $\boldsymbol{\tau}^{t,old}_{U,R}$ vs. $\boldsymbol{\tau}^{t,new}_{U,R}$ and, respectively, $\boldsymbol{\tau}^{t,old}_{l,TA}$ vs. $\boldsymbol{\tau}^{t,new}_{l,TA}$, $\boldsymbol{\tau}^{t,old}_{l,R}$ vs. $\boldsymbol{\tau}^{t,new}_{l,R}$). The best-response conditions that define optimal trade policies vis-à-vis $TA \in \mathscr{K}_{TA}$ (similarly, vis-à-vis $R \in \mathscr{K}_R$) read as

$$\sum_{m \in \mathscr{K}_U \cup \{l,TA\}} \nabla_{\boldsymbol{\tau}^{t}_{U,TA}} W_m\left(\boldsymbol{\tau}^{p,old}, \boldsymbol{\tau}^{t,old}\right) = 0 \;\text{ and }\; \sum_{m \in \mathscr{K}_U \cup \{TA\}} \nabla_{\boldsymbol{\tau}^{t}_{U,TA}} W_m\left(\boldsymbol{\tau}^{p,new}, \boldsymbol{\tau}^{t,new}\right) = 0.$$

and

$$\sum_{m \in \mathscr{K}_U \cup \{l,TA\}} \nabla_{\boldsymbol{\tau}^{t}_{l,TA}} W_m\left(\boldsymbol{\tau}^{p,old}, \boldsymbol{\tau}^{t,old}\right) = 0 \;\text{ and }\; \nabla_{\boldsymbol{\tau}^{t}_{l,TA}} \left[W_l\left(\boldsymbol{\tau}^{p,new}, \boldsymbol{\tau}^{t,new}\right) + W_{TA}\left(\boldsymbol{\tau}^{p,new}, \boldsymbol{\tau}^{t,new}\right)\right] = 0.$$

First-Order Approximation Approach. Comparing the old and new equilibria is an involved problem because trade policies readjust worldwide and nontrivially affect the best-response conditions of trade policy. We overcome this challenge by employing a first-order approximation approach for studying the readjustment of trade policies worldwide. We suppose that trade-policy adjustments are small, allowing us to evaluate policy changes from first-order approximations of welfare in the new equilibrium after disintegration. Our approach relies on the observation that the objective function of the economic union (the customs union, respectively) changes when one member country leaves, consequently affecting the optimal choices of internal non-tariff and external trade policies, such as tariffs. For a more detailed exposition, we refer to Appendix C.2. In Proposition 3, we show our main result comparing cooperatively- and noncooperatively-chosen trade policies in the old equilibrium (before disintegration) to those in the new equilibrium (after disintegration).

Proposition 3. *Let Assumption 1 hold. Consider a fixed set of trade agreements. Assume that each optimization problem is concave and trade-policy solutions are interior, and let trade-policy changes be small.*

(a) Suppose countries l and $\mathcal{K}_U$ initially form an economic union (old equilibrium), where all member countries jointly bargain over their internal non-tariff trade policies. When country l disintegrates from the economic union (new equilibrium), the remaining member countries integrate more with each other (lower non-tariff trade costs $\tau^{p,new}_{U,U} < \tau^{p,old}_{U,U}$).

(b) Suppose countries l and $\mathcal{K}_U$ initially form a customs union (old equilibrium), jointly setting external tariffs vis-à-vis third countries $\mathcal{K}_{TA}$ and $\mathcal{K}_R$. When country l leaves the customs union (new equilibrium), the leaving country lowers cooperative and noncooperative tariffs toward third countries ($\tau^{t,new}_{l,TA} < \tau^{t,old}_{l,TA}$ and $\tau^{t,new}_{l,R} < \tau^{t,old}_{l,R}$). Likewise, cooperative and noncooperative tariffs by the remaining customs union $\mathcal{K}_U$ decline ($\tau^{t,new}_{U,TA} < \tau^{t,old}_{U,TA}$ and $\tau^{t,new}_{U,R} < \tau^{t,old}_{U,R}$).

To gain an intuition for Proposition 3, observe that after the disintegration, the leaving country l and the remaining member countries do not align their trade policies in each others' interests. Thus, the departure from an economic union means that the member countries no longer coordinate their internal non-tariff trade policies with the leaving country (despite retaining the customs union). As a member of the economic union (old equilibrium), a country l asks the other union countries to raise their non-tariff trade barriers, because this raises l's welfare ($dW_l/d\tau^p_{m,m'} > 0$ by Lemma 2). After the disintegration (new equilibrium), the remaining member countries reoptimize, not considering country l's welfare anymore. As a result, the remaining members undertake efforts to lower their internal non-tariff barriers to trade (part (a)), and the leaving country bears a first-order welfare loss induced by the change in trade costs inside the union.

When the leaving country exits the customs union, the union-member countries lower their cooperatively- and noncooperatively-chosen trade barriers toward third countries (part (b)). Similarly, the leaving country reduces trade barriers vis-à-vis third countries. The intuition for these results is the same as the one for part (a). Before disintegration, the union-member countries and the leaving country jointly negotiate their external trade barriers toward third countries. They set higher tariffs between the remaining member and third countries (between the leaving country and third countries) to improve welfare in the leaving country (member countries). Following disintegration, the leaving country's welfare does not enter the customs union's objective function. Likewise, the leaving country does not consider member countries' welfare in its trade-policy making. Consequently, when disintegrated from each other, the leaving country and the remaining customs union set lower external trade barriers than they would if they were integrated. Altogether, the departure of a country from an economic union leads to a deeper integration inside the union, and exiting a customs union lowers protectionism worldwide. Thus, the initial disintegration triggers a trade-cost reduction process similar to the race-to-the-bottom in the literature on tax competition.

Repercussions on Tax Policies. To determine the full effect of disintegration on tax policies, the trade-cost effect in Proposition 2 must be augmented by the readjustment of trade policies. In the following, we describe the exit from an economic union, where the leaving country remains in the customs union. The impact on the leaving country's business tax remains qualitatively unchanged. By Proposition 2 (a), a rise in trade costs between the leaving country and the remaining union members reduces the leaving country's tax. However, when member countries further integrate in response to the disintegration, the leaving country's tax declines even more, because any bilateral trade-cost reduction lowers other countries' taxes (Proposition 2 (c)). Intuitively, the endogenous reduction in non-tariff trade costs inside the union raises the firm relocation semi-elasticity in the leaving country and, thereby, puts additional downward pressure on its business tax.

As before, the business taxes inside the remaining union may react asymmetrically. Having said this, under symmetric population sizes, the response of taxes inside the union is ultimately positive. The intuition is that despite the leaving country's disintegration, the decline in internal trade costs (between several member countries) makes each union member more attractive as a business location. Third countries may now experience a decline in their business taxes. On the one hand, as trade barriers between the member countries and the leaving countries rise, firms relocate to third countries, increasing taxes there. On the other hand, the decline in the union's internal trade costs pushes firms from third to union-member countries, raising third countries' relocation semi-elasticity. If the economic union is large enough relative to the leaving country, the latter effect dominates the former, leading to lower taxes in third countries.

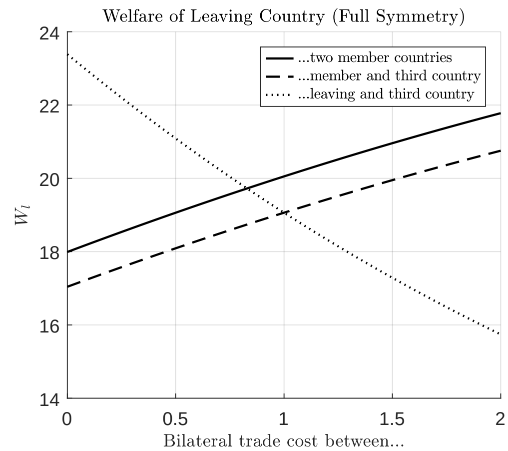

Figure 5: Bilateral Trade Costs and Leaving Country's Welfare

Limitations. While our result is robust to the underlying economic model (as long as Lemma 2 holds), we note several caveats to Proposition 3. First, we only consider changes in existing agreements, disregarding the possibility that economic disintegration may lead to the destruction of other trade agreements or the creation of novel agreements. Moreover, by linearizing welfare functions around an initial equilibrium, we only speak to the direction of small policy changes and disregard larger policy changes and higher-order welfare effects.[27]

In Figure 5, we simulate the leaving country's welfare as a function of trade costs in the symmetric case. The solid (dashed) line shows that, in line with Lemma 2, welfare in the leaving country rises with two member countries' (a member and a third country's) trade costs, while the dotted line indicates that the leaving country's welfare declines when trade with a third country becomes more costly. In our model, welfare appears approximately linear, justifying the linearization method. However, other model parametrizations may give rise to more considerable nonlinearities. Finally, our static model is silent about the question of

[27] This caveat becomes transparent from the best-response conditions. Disintegration directly affects the welfare gradients by changing the objective function. However, welfare gradients also implicitly depend on the trade policies of all other countries, e.g., how third countries adjust their trade policies. While, in our approximation approach, one can ignore this aspect, it becomes important when policy changes and cross-derivatives are large. In this case, our approximation approach is still instructive about how disintegration shifts the best-response conditions of affected countries, revealing the partial-equilibrium trade-policy adjustment (taking the other trade policies as given). Departing from a first-order approximation would make it necessary to impose more structure on the underlying economy to know the sign and the size of all second and higher derivatives of welfare functions with respect to trade policies. In Appendix C.1, we present the second derivatives of the welfare function in our model.

why the leaving country has decided to disintegrate and why it joined the union in the first place. We leave a dynamic analysis of economic disintegration to future research.

4.2 Welfare-Improving Disintegration

The above-described combination of rising trade costs induced by the disintegration and the endogenous trade-cost reductions in its response, raises an important question: When is economic disintegration welfare-improving for the leaving country? Even if global free trade is efficient and countries generally gain from economic integration, leaving a customs union allows a country to readjust trade policies solely in its own interests. Therefore, it is possible that the leaving country can benefit from disintegration. To analyze the overall impact on the leaving country's welfare, we need to add up all effects from endogenous trade-policy adjustments. First, there are adverse welfare effects of disintegrating from the union due to higher consumer prices, lower inward FDI, and a higher relocation semi-elasticity that reduces the business tax (see Table 1). Second, the remaining union members respond by deepening trade relations with each other (exit from an economic union) and third countries (exit from a customs union). These policy responses reduce the leaving country's welfare, according to Lemma 2 (see solid and dashed lines in Figure 5). However, exiting a customs union, the leaving country counteracts the welfare losses from lower consumer surplus and tax revenues by integrating further with other countries.

To formalize this, we reconsider the case with symmetric population sizes and suppose a country leaves both an economic and a customs union (as in the Brexit case). The first-order approximation of that country's welfare in the new equilibrium, $W_l(\boldsymbol{\tau}^{\boldsymbol{p},\boldsymbol{new}}, \boldsymbol{\tau}^{\boldsymbol{t},\boldsymbol{new}}) := W_l^{new}$, around the old one, $W_l(\boldsymbol{\tau}^{\boldsymbol{p},\boldsymbol{old}}, \boldsymbol{\tau}^{\boldsymbol{t},\boldsymbol{old}}) := W_l^{old}$, reads as[28]

$$
\begin{aligned}
W_l^{new} - W_l^{old} \approx\ & \underbrace{\nabla_{\tau^{\boldsymbol{p}}_{\boldsymbol{U},\boldsymbol{l}}} W_l^{old}}_{<0} \underbrace{\left(\tau^{\boldsymbol{p},\boldsymbol{new}}_{\boldsymbol{U},\boldsymbol{l}} - \tau^{\boldsymbol{p},\boldsymbol{old}}_{\boldsymbol{U},\boldsymbol{l}}\right)'}_{\substack{>0 \\ \text{[exit economic union]}}} + \underbrace{\nabla_{\tau^{\boldsymbol{t}}_{\boldsymbol{U},\boldsymbol{l}}} W_l^{old}}_{<0} \underbrace{\left(\tau^{\boldsymbol{t},\boldsymbol{new}}_{\boldsymbol{U},\boldsymbol{l}} - \tau^{\boldsymbol{t},\boldsymbol{old}}_{\boldsymbol{U},\boldsymbol{l}}\right)'}_{\substack{>0 \\ \text{[exit customs union]}}} + \underbrace{\nabla_{\tau^{\boldsymbol{p}}_{\boldsymbol{U},\boldsymbol{U}}} W_l^{old}}_{>0} \underbrace{\left(\tau^{\boldsymbol{p},\boldsymbol{new}}_{\boldsymbol{U},\boldsymbol{U}} - \tau^{\boldsymbol{p},\boldsymbol{old}}_{\boldsymbol{U},\boldsymbol{U}}\right)'}_{\substack{<0 \\ \text{[exit economic union]}}} \\
& + \underbrace{\nabla_{\tau^{\boldsymbol{t}}_{\boldsymbol{U},\boldsymbol{TA}}} W_l^{old}}_{>0} \underbrace{\left(\tau^{\boldsymbol{t},\boldsymbol{new}}_{\boldsymbol{U},\boldsymbol{TA}} - \tau^{\boldsymbol{t},\boldsymbol{old}}_{\boldsymbol{U},\boldsymbol{TA}}\right)'}_{\substack{<0 \\ \text{[exit customs union]}}} + \underbrace{\nabla_{\tau^{\boldsymbol{t}}_{\boldsymbol{l},\boldsymbol{TA}}} W_l^{old}}_{<0} \underbrace{\left(\tau^{\boldsymbol{t},\boldsymbol{new}}_{\boldsymbol{l},\boldsymbol{TA}} - \tau^{\boldsymbol{t},\boldsymbol{old}}_{\boldsymbol{l},\boldsymbol{TA}}\right)'}_{\substack{<0 \\ \text{[exit customs union]}}}.
\end{aligned} \tag{19}
$$

Accordingly, leaving a customs union is welfare-improving ($W_l^{new} > W_l^{old}$) if and only if the leaving country

[28] In line with our baseline parametrization, we here neglect the leaving country's and the union's noncooperative trade-policy adjustments vis-à-vis third countries. Adding these responses would be straightforward. Moreover, one can show that in the symmetric case, a country's welfare declines with its trade costs.

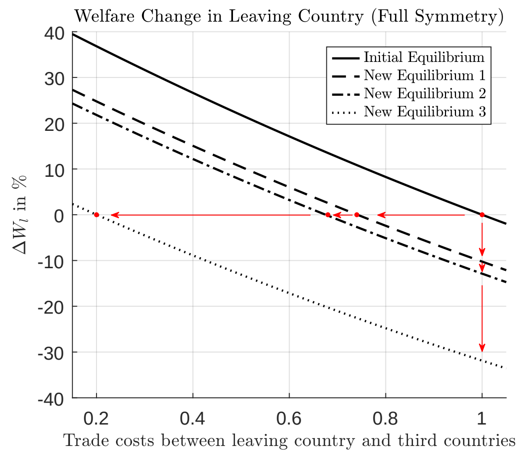

Figure 6: Endogenous Trade Policies and Exit Incentives; New Equilibrium 1: Initial Equilibrium + Disintegration (50%-Rise in Trade Costs); New Equilibrium 2: Equilibrium 1 + Response of Member Countries (50%-Decline in Internal Trade Costs); New Equilibrium 3: Equilibrium 2 + Response of Member Countries (50%-Decline in External Trade Costs)

negotiates substantial trade-cost reductions with third countries $\boldsymbol{\tau_{l,TA}^{t,new}} \ll \boldsymbol{\tau_{l,TA}^{t,old}}$.

If instead the leaving country remained in the customs union and exited only the economic union, the welfare losses would be smaller because tariffs remained zero ($\boldsymbol{\tau_{U,l}^{t,new}} = \boldsymbol{\tau_{U,l}^{t,old}} = \mathbf{0}$) and the union's external trade policies would be unchanged ($\boldsymbol{\tau_{U,TA}^{t,new}} = \boldsymbol{\tau_{U,TA}^{t,old}}$). However, the leaving country could not adjust its trade policies vis-à-vis third countries ($\boldsymbol{\tau_{l,TA}^{t,new}} = \boldsymbol{\tau_{l,TA}^{t,old}}$). Altogether, disintegration from an economic union is unambiguously welfare-detrimental. On the other hand, leaving a customs union may be welfare-improving for the leaving country due to its further integration with third countries.

In Figure 6, we illustrate this finding. We depict the leaving country's welfare as a function of trade costs with third countries. Thus, the x-axis shows the trade-policy domain of a country leaving a customs union. We stick to our previous symmetric parametrization with a total of five countries and one country leaving two union countries (and two third countries $|\mathcal{K}_{TA}| = 2$).[29] We normalize the leaving country's welfare relative to the initial equilibrium ($W_l = 19.062$ with trade costs $\tau_{lk} = 1, \forall k \in \mathcal{K}_{TA}$). The solid line shows how the leaving country's welfare declines with its trade costs with the third countries in the "Initial Equilibrium." This exercise accounts for all changes in domestic consumer surplus and tax revenues induced by price changes, firm mobility, and Nash equilibrium tax-policy responses, while holding trade costs in all other countries constant.

[29] As before, we ignore tariff revenues.

"New Equilibrium 1" incorporates the disintegration-induced rise in trade costs with the union. We consider a rise in trade costs of $\Delta\tau_{ml} = +50\%$. As a result, the leaving country's welfare shifts down (dashed line), illustrating that disintegration per se generates sizable welfare losses of around 10 percent in the leaving country (see Table 1). Compensating for the welfare losses to return to the initial welfare level requires that the leaving country lowers trade costs with third countries by more than 25 percent. "New Equilibrium 2" (dash-dotted line) adds the union's internal trade-policy response to disintegration, as predicted by Proposition 3 (a) (exit from an economic union). Finally, "New Equilibrium 3" (dashed line) adds the union's external trade-policy response vis-à-vis third countries, according to Proposition 3 (b) (exit from a customs union). We assume a 50%-decline in the union's internal and external trade costs $\Delta\tau_{mm'} = -50\%, \forall m, m' \in \mathcal{K}_U$ and $\Delta\tau_{mk} = -50\%, \forall m, \in \mathcal{K}_U, k \in \mathcal{K}_{TA}$, respectively. Whereas there is a moderate adjustment for the union's internal response (moving from New Equilibrium 1 to 2), the union's external trade-policy changes generate substantial welfare losses (moving from New Equilibrium 2 to 3). Absent any trade-policy response by the leaving country, it would suffer total welfare losses of more than 30 percent. Compensating for these losses to return to the initial pre-disintegration welfare level requires a strong trade-policy response by the leaving country. In this simulation, it would need to lower its trade costs with third countries by at least 80 percent.

In the Appendix (Figure 8), we contrast the fully symmetric setting considered here with a situation where the leaving country is twice as large as the other countries, demonstrating the role of relative market sizes. Initially, the leaving country is home to most firms, faces a lower firm relocation semi-elasticity, and taxes more than the other countries. As a result, the policy response necessary to compensate for the direct welfare losses from disintegration is slightly less pronounced than in the symmetric case. However, this market-size advantage becomes a disadvantage when accounting for union members' (internal and external) trade-policy responses. Intuitively, any integration effort by two countries resembles an increase in relative market size (with zero trade costs as an extreme case). Accordingly, member countries' trade-policy responses induce gains in market size there. Most of the initially large share of firms in the leaving country relocates to member countries. Then, the leaving country needs a much more substantial trade-cost reduction with third countries to remain attractive as a business location and compensate for the welfare losses from member countries' trade-policy responses.[30] Altogether, the effects of economic disintegration on the leaving country's welfare are far from obvious, even if one considers only the trade-policy adjustments addressed by our first-order

[30] This result can also be seen from the welfare gradient in Equation (34) (Appendix C.1).

approach.[31]

5 Extensions

We can extend the base model of Section 3 in various directions. We relegate the proofs of additional results to the Online Appendix.[32]

Other Dimensions of Disintegration. In the following, we consider other dimensions of disintegration. A first alternative way to examine the consequences of economic disintegration for tax policy is to directly differentiate taxes with respect to K_U, as if the number of member countries were defined on a continuous domain, while holding trade costs constant. We label this comparative statics as a *union-size effect*. Assuming symmetry in country sizes as well as in internal and external trade costs, we show in the Online Appendix that business taxes inside the union are greater than outside, and disintegration in the form of a decline in K_U decreases (increases) business taxes in member (non-member) countries, which is in line with Proposition 2 (c) and with Proposition 2 (b) (for a small union compared to the rest of the world). Intuitively, being part of the union makes countries more attractive to firms, lowering the degree of tax competition, measured by the firm relocation semi-elasticity. As another dimension, we can address the direct effects of economic disintegration on firm relocation by allowing for a cost distribution that differs between country pairs: Suppose $F^{ij} := \nu^j - \nu^i + \epsilon^{ij} + \epsilon \in [\underline{F}_{ij}, \overline{F}^{ij}]$ is drawn from a uniform distribution with $\underline{F}^{ij} := \nu^j - \nu^i + \underline{\epsilon}_{ij} + \underline{\epsilon}$ and $\overline{F}^{ij} := \nu^j - \nu^i + \overline{\epsilon}^{ij} + \overline{\epsilon}$. The policy components come from i) the country-specific level of frictions when setting up a business, ν^i, determined by factors such as regulatory complexity or infrastructure and ii) the degree of harmonization in production standards and business regulations between two countries, ϵ^{ij}. The former affects the level of relative relocation costs, whereas the latter alters their variance. An idiosyncratic location preference shock, ϵ, pins down the non-policy component. Raising ν^l leads to a *business-friction effect* of economic disintegration, whereas a rise in $\overline{\epsilon}^{lm} = -\underline{\epsilon}_{lm}$ results in a *de-harmonization effect*.

We show in the Online Appendix that a rise in the degree of harmonization between the two countries l and m, $\overline{\epsilon}^{lm} = -\underline{\epsilon}_{lm}$, reduces all countries' business taxes. Hence, the disintegration of country l via a

[31] This finding holds under the economic conditions described in Bagwell and Staiger [1999] and the subsequent literature. In particular, the efficiency of global free trade remains valid in our approach, which takes existing inefficiencies in trade policies as given and then studies the readjustment of trade policies.

[32] The Online Appendix is available here.

de-harmonization between countries raises taxes everywhere. Intuitively, the higher $\overline{\epsilon}^{lm}$ (and, accordingly, $\overline{F}^{lm} = -\underline{F}_{lm}$), the more firms (and also industries) are attached to countries l and m, and the less should business-tax differentials matter for location decisions. Firm mobility, i.e., the relocation semi-elasticity, decreases, and the respective countries tax more. This spills over to third countries due to the strategic complementarity of tax policies. A business-friction effect in the leaving country can be studied through comparative statics of taxes with respect to ν^l, which makes firm relocation from $m \in \mathscr{K}_U$ to l more costly than the reverse. We demonstrate that this induces a lower tax in the leaving country and increases the tax in the member country. The de-harmonization and the business-friction effects make opposing predictions for the business tax in the leaving country. This makes clear that the nature of economic disintegration is an important aspect to consider when assessing its effects.

Policy Instruments. We introduce *import tariffs* into our model, which, like non-tariff trade barriers, affect consumer surplus and business-tax revenues, but, unlike those, generate additional fiscal revenues. We show in the Online Appendix that this new revenue motive tends to push a country's business tax upwards: When business taxes in a country rise, firms relocate away from that country, and the government generates extra tariff revenues from more imports.[33]

We can consider *competition in regulations* by endogenizing each country's level of business frictions/regulations, ν^i, similar to the noncooperative setting of business-tax policies. A rise in regulations is welfare-detrimental as it triggers firm relocation, reducing consumer surplus and tax revenues. To obtain interior solutions, we introduce a country-specific reduced-form regulation surplus function $V_i\left(\nu^i\right)$. For example, in the context of environmental protection, this surplus function could measure the value of clean air. Then, each government chooses the set of domestic policies $\left(t_i, \nu^i\right)$ to maximize aggregate welfare, taking all the other countries' business taxes and regulations as given. Even absent cross-country complementarities in the surplus function ($dV_i/d\nu^j = 0$), each country's optimal level of regulations will be inefficiently low since a country's government does not consider the positive externality of business regulations on other coun-

[33] By contrast, the reaction of Nash equilibrium business taxes to a rise in non-tariff trade costs is downwards adjusted compared to our baseline setup. Higher trade costs reduce trade volumes such that the extra gains in tariffs decline. Nonetheless, the key trade-offs, especially the above-described effects of economic disintegration, carry over. We note that the business tax of country i is U-shaped in foreign trade taxes, which is similar to Proposition 1 in Haufler and Wooton [2010] but, in our extended setup, for trade-policy instruments that have revenue effects.

tries' welfare. We demonstrate that the domestic policies interact. The level of regulations not only affects equilibrium business taxes, as we emphasize in the business-friction effect, but vice versa. Interestingly, a rise in τ_{jk} improves country i's ability to tax, but it reduces the regulation level ν^i, because higher trade costs abroad enlarge the marginal welfare losses from ν^i.

We also study the scenario of *tax harmonization* (e.g., Conconi, Perroni, and Riezman [2008]), where a subset of countries in a harmonized area, $\mathscr{K}_H \subset \mathscr{K}$, coordinates their level of business taxes to maximize their joint welfare. We demonstrate that the best response functions of countries outside the harmonized area are unaltered relative to the case without tax harmonization. The reaction function in the harmonized area, t_H, accounts for the effects on consumer surplus and tax revenues aggregated over member countries in $\mathscr{K}_H$. In line with conventional wisdom, the coordination of business taxes among some countries reduces the degree of tax competition relative to the setting without harmonization. Conceptually, the harmonized area behaves in business taxation like a large country. The business tax inside the area is higher than outside. The trade-cost effect on the coordinated business tax resembles that of a large country. Moreover, we find that business taxes inside and outside the area are positively associated with $K_H := |\mathscr{K}_H|$. Hence, a country's departure from $\mathscr{K}_H$ decreases taxes worldwide. A reduction in K_H is equivalent to creating a new player in the tax-competition game, which amplifies the degree of competition.

Richer Labor Market. The quantitative importance of trade shocks for *labor-market outcomes* is demonstrated by Artuç et al. [2010], Dix-Carneiro [2014], and others. To allow for such a channel we assume that trade in the numéraire commodity is not possible, and labor supply and demand determine a country's wage level on the labor market. Then, a country's wage goes down when trade with other countries becomes more costly because a country's export volume and inward FDI is reduced, which via a decline in aggregate production shifts down the domestic labor demand curve. Conversely, a country's wage level increases with other countries' trade costs because they raise domestic production.

Tax policies have intuitive effects on wage levels. Any decline in a country's business taxation raises wages in that country (and reduces them abroad) because inward FDI expands the country's aggregate production and labor demand. Interestingly, wage responses have opposing effects on domestic welfare: National income rises with a country's wage level, but higher wages also raise firms' unit production costs, leading to higher domestic prices (smaller consumer surplus) and a more narrow tax base due to firm relocation (lower tax revenues). We show in the Online Appendix how these effects add to governments' reaction functions. Overall, endogenous wages intensify governments' incentives to attract businesses when the impact on national income dominates the effects on the tax base and consumer surplus.

Consumers and Firms. We generalize the model by allowing for *cross-price effects* in the demand for differentiated goods, as initially studied in Melitz and Ottaviano [2008]. For $\eta > 0$, the Nash equilibrium business taxes are revised upwards because the substitutability between the differentiated varieties and the numéraire good rises with $\eta > 0$. Put differently, the presence of cross-price effects shifts down the demand for differentiated varieties, thereby lowering the welfare loss from firm relocation in the differentiated industries. Moreover, in the Online Appendix, we show that cross-price effects make firm relocation self-limiting as it leads to higher domestic prices and profit levels, reducing the incentives to relocate. These two adjustments tend to reduce the semi-elasticity of firm relocation and raise each country's business tax.

In footnote 12, we provide an explicit expression for profits when, on the industry level, production takes place worldwide (rather than in only two countries). We also extend our two-country *industry structure* to an arbitrary number of immobile firms per industry. Our results hold as long as the distribution of immobile firms is similar across countries. A rise in the number of immobile firms in one country has opposing effects on the optimal business tax there. On the one hand, more firms in a country mechanically raise the government's ability to tax. On the other hand, a larger number of firms increases the degree of local intra-industry competition, such that the country becomes less attractive as a business location. These two effects point in the same direction for other countries' Nash equilibrium business taxes. Finally, one may relax the assumption of *binary firm-location choices*. If firm location were a multinomial-choice problem, mobile firms would relocate across multiple countries. This additional firm mobility in each industry intensifies tax competition as it scales up each country's semi-elasticity of firm relocation: A rise in a country's trade costs would induce stronger firm-relocation responses. Conversely, a decline in a country's trade costs triggers additional inward FDI because firms from all industries can relocate into the country. Therefore, we expect that firm relocation across multiple countries strengthens our economic channels.

6 Conclusion

In this paper, we study the policy implications of economic disintegration. We set up a highly tractable multi-country, multi-sector, general-equilibrium trade model where internationally mobile firms generate fiscal competition over business taxes. This particular policy represents any domestic policy affecting the location of economic activity. In our model, the firm relocation semi-elasticity is a sufficient statistic for the business taxation in a given country. The elasticity crucially depends not only on the economic conditions in that country but also on those worldwide. This observation even holds when introducing minimal mobility is introduced, modeled as a bilateral location choice by one firm per industry. We highlight that, as a result, two-country models studied by the previous literature may lead to misleading conclusions about the policy implications of unilateral disintegration. In sum, four policy predictions about unilateral economic disintegration emerge from our analysis:

1. The leaving country reduces its business tax.

2. Business taxes in the remaining member countries converge.

3. Third countries' ability to tax improves.

4. Governments worldwide counter the disintegration by deepening their trade relations.

Application to Brexit. Our results predict a reduction in the UK's business taxation after Brexit and a convergence of taxes in the remaining EU. Third countries, such as the US, can tax more, according to our analysis. At an international level, we expect the remaining EU members to integrate more with each other (lower non-tariff trade costs) and reconsider protectionist policies toward third countries (lower external trade costs). The UK is also supposed to deepen trade relations with third countries, (partly) offsetting the welfare losses from the rise in trade frictions vis-à-vis the EU[34] and the endogenous trade-policy adjustments of the EU.

Causally linking trends in business taxes to Brexit is not trivial. UK's formal exit from the EU occurred at the end of January 2020, coinciding with the coronavirus pandemic that led to exceptional economic circumstances and policy interventions. However, one may argue that, in anticipation, tax policy responded well before the formal Brexit date, starting in the summer of 2016 after the Brexit referendum took place. The UK has decreased taxes between 2016 and 2019 more than the average EU country, which slightly increased its implicit tax rate (effective average tax burden).[35] Recall that Nash equilibrium business taxes

[34] Dhingra, Huang, Ottaviano, Paulo Pessoa, Sampson, and Van Reenen [2017] and Portes and Forte [2017], for instance, estimated welfare losses of up to 10 percent of GDP.

[35] For instance, see European Commission [2021], Tables 6–10.

follow the equilibrium firm number (proportional to inverse firm relocation semi-elasticity). Therefore, our model predicts changes in the location of firms: Firms relocate to the larger market (and third countries) when trade costs between two trade partners increase. This prediction is in line with the estimated FDI effects of Brexit in Siedschlag and Tong Koeckling [2019]. Using FDI greenfield investment in the EU between 2003 and 2015, they calculate a reduction in the UK by 1.8 to 3.6 percent. Overall investment declined in the UK following the Brexit vote, according to Bloom, Bunn, Chen, Mizen, Smietanka, and Thwaites [2019]. Brakman, Garretsen, and Kohl [2021] (Figure 1) find that UK trade has suffered more due to Brexit than other countries'. By comparing 2019 and 2020 as well as the UK with non-EU countries, coronavirus effects are plausibly extracted, so that the remaining difference is attributable to Brexit.[36] Regarding international policies, the UK has signed new trade agreements with Australia, New Zealand, and Singapore. Trade negotiations with other WTO members, such as Canada, India, and the US, are still in progress. We leave an empirical investigation of the consequences of Brexit for tax and trade policies to future research.

A Proofs for Section 2

A.1 Government Objective Function

Consider a mobile firm in country i and industry ij. Inserting the first-order condition for optimal quantities into the profit function (3), delivers pre-tax profits (4) as a function of primitives. The mobile firm locates in country i if and only if $F^{ij} \geq \pi_j^{ij}(\mu) - t_j - \left(\pi_i^{ij}(\mu) - t_i\right) := \gamma^{ij}$. Expanding this expression, the industry threshold becomes (7). Taking derivatives, the partial-equilibrium comparative statics directly follow.

Since there are K countries, one has to consider $\begin{pmatrix} K \\ 2 \end{pmatrix} = \frac{K(K-1)}{2}$ continuums of industries yielding $K(K-1)$ different prices. These read as

$$p_i^{jl}(\mu) = \frac{\alpha + 3w + k_j^*(\mu)\tau_{ij} + k_l^*(\mu)\tau_{il}}{4},$$

for $(k_j^*(\mu), k_l^*(\mu)) \in \{(1,2),(2,1)\}$. Plug these into the demand functions $x_i^{jl}(\mu) = (\alpha - p_i^{jl}(\mu))/\beta$ and sum over all households in a country. The aggregate surplus in country i derived from consumption of goods in

[36] Moreover, Gutiérrez Chacón, Lacuesta, and Martín [2021] show that the UK's import and export shares from Spain have decreased since 2016.

jl-industries simplifies to

$$S_i^{jl}(\mu) = n_i\left(\alpha x_i^{jl}(\mu) - \frac{\beta}{2}\left(x_i^{jl}(\mu)\right)^2 - p_i^{jl}(\mu)x_i^{jl}(\mu)\right) = \begin{cases} n_i\frac{\left(3\alpha-3w-2\tau_{ij}-\tau_{il}\right)^2}{32\beta} & \text{w/ prob } \left(1-G\left(\gamma^{jl}\right)\right) \\ n_i\frac{\left(3\alpha-3w-\tau_{ij}-2\tau_{il}\right)^2}{32\beta} & \text{w/ prob } G\left(\gamma^{jl}\right) \end{cases}. \tag{20}$$

Summing over industries gives a country's total consumer surplus

$$S_i = \sum_{j\in\mathscr{K}\setminus\{i\}}\left[\delta_i^{ij} + \frac{\gamma^{ij}-\underline{F}}{2\overline{F}}\Delta_i^{ij}\right] + \frac{1}{2}\sum_{j\in\mathscr{K}\setminus\{i\}}\sum_{l\in\mathscr{K}\setminus\{i,j\}}\left[\delta_i^{jl} + \frac{\gamma^{jl}-\underline{F}}{2\overline{F}}\Delta_i^{jl}\right] \tag{21}$$

where the factor $1/2$ is applied to avoid double count and $\Delta_i^{jl} := n_i[(3\alpha-3w-\tau_{ij}-2\tau_{il})^2-(3\alpha-3w-2\tau_{ij}-\tau_{il})^2]/(32\beta)$ and $\delta_i^{jl} := n_i(3\alpha-3w-2\tau_{ij}-\tau_{il})^2/(32\beta)$ are functions of the model primitives Θ. Accordingly, the social planner in country i faces the following maximization problem

$$\max_{t_i} S_i + T_i + n_i w,$$

where tax revenues $T_i := t_i[(K-1)+1/(2\overline{F})\sum_{j\in\mathscr{K}\setminus\{i\}}(\overline{F}-\gamma^{ij})]$ follow from Lemma 1.

A.2 Proof of Proposition 1

Since the wage sum is exogenous, the first-order condition is given by

$$\frac{d\left(S_i+T_i+n_iw\right)}{dt_i} = \frac{1}{2\overline{F}}\sum_{j\in\mathscr{K}\setminus\{i\}}\frac{d\gamma^{ij}}{dt_i}\Delta_i^{ij} + (K-1) + \frac{1}{2\overline{F}}\sum_{j\in\mathscr{K}\setminus\{i\}}\left(\overline{F}-\gamma^{ij}\right) + t_i\frac{1}{2\overline{F}}\sum_{j\in\mathscr{K}\setminus\{i\}}\left(-\frac{d\gamma^{ij}}{dt_i}\right) = 0 \tag{22}$$

which is sufficient by the second-order condition

$$\frac{d^2\left(S_i+T_i+n_iw\right)}{dt_i^2} = \frac{1}{2\overline{F}}\sum_{j\in\mathscr{K}\setminus\{i\}}\left(-\frac{d\gamma^{ij}}{dt_i}\right) + \frac{1}{2\overline{F}}\sum_{j\in\mathscr{K}\setminus\{i\}}\left(-\frac{d\gamma^{ij}}{dt_i}\right) = -\frac{(K-1)}{\overline{F}} < 0.$$

The reaction function of country i can be simplified to

$$t_i = \frac{1}{2(K-1)}\left(\sum_{j\in\mathscr{K}\setminus\{i\}}\Delta_i^{ij} + 3\overline{F}(K-1) + \sum_{j\in\mathscr{K}\setminus\{i\}}\left(\pi_i^{ij}-\pi_j^{ij}\right) + \sum_{j\in\mathscr{K}\setminus\{i\}}t_j\right). \tag{23}$$

Business taxes are strategic complements, the relation is linear, and the slope is less than 1. Thus, there will be a unique interior intersection of reaction functions in this tax-competition game. In the following, we derive this intersection. First of all, plug

$$t_i - t_l = \frac{1}{2K-1}\left(\sum_{j\in\mathcal{K}\setminus\{i\}}\Delta_i^{ij} - \sum_{j\in\mathcal{K}\setminus\{l\}}\Delta_l^{lj} + \sum_{j\in\mathcal{K}\setminus\{l\}}\left(\pi_j^{lj}-\pi_l^{lj}\right) - \sum_{j\in\mathcal{K}\setminus\{i\}}\left(\pi_j^{ij}-\pi_i^{ij}\right)\right)$$

into

$$\begin{aligned} t_i = \frac{1}{K-1}\left(\sum_{j\in\mathcal{K}\setminus\{i\}}\Delta_i^{ij} + 3\overline{F}(K-1) - \sum_{j\in\mathcal{K}\setminus\{i\}}\left(\pi_j^{ij}-\pi_i^{ij}\right) - \sum_{j\in\mathcal{K}\setminus\{i\}}\left(t_i - t_j\right)\right) = 3\overline{F} + \frac{1}{2K-1}\sum_{j\in\mathcal{K}\setminus\{i\}}\Delta_i^{ij} \\ + \frac{1}{2K-1}\sum_{j\in\mathcal{K}\setminus\{i\}}\left(\pi_i^{ij}-\pi_j^{ij}\right) + \frac{1}{(K-1)(2K-1)}\sum_{j\in\mathcal{K}}\sum_{m\in\mathcal{K}\setminus\{j\}}\Delta_j^{jm} - \frac{1}{(K-1)(2K-1)}\sum_{j\in\mathcal{K}}\sum_{m\in\mathcal{K}\setminus\{j\}}\left(\pi_m^{jm}-\pi_j^{jm}\right). \end{aligned}$$

To obtain Proposition 1, notice that $\sum_{j\in\mathcal{K}}\sum_{m\in\mathcal{K}\setminus\{j\}}(\pi_m^{jm}-\pi_j^{jm}) = 0$.

B Proofs for Section 3

B.1 Comparative Statics

We now derive comparative statics of business taxes with respect to trade costs and country sizes. Since

$$\pi_i^{ij} - \pi_j^{ij} = \left(n_i - n_j\right)\frac{6\tau_{ij}(\alpha - w) - 3\tau_{ij}^2}{16\beta} - \sum_{l\in\mathcal{K}\setminus\{i,j\}} n_l \frac{6(\alpha - w)\left(\tau_{il}-\tau_{jl}\right) - 3\left(\tau_{il}^2 - \tau_{jl}^2\right)}{16\beta}, \tag{24}$$

differentiation with respect to trade costs yields $d(\pi_i^{ij}-\pi_j^{ij})/d\tau_{ij} = 6(n_i-n_j)(\alpha-w-\tau_{ij})/(16\beta)$, $d(\pi_i^{ij}-\pi_j^{ij})/d\tau_{il} = -6n_l(\alpha-w-\tau_{il})/(16\beta)$, $d(\pi_i^{ij}-\pi_j^{ij})/d\tau_{jl} = 6n_l(\alpha-w-\tau_{jl})/(16\beta)$, $d(\pi_i^{il}-\pi_l^{il})/d\tau_{il} = 6(n_i-n_l)(\alpha-w-\tau_{il})/(16\beta)$, $d(\pi_i^{il}-\pi_l^{il})/d\tau_{ij} = -6n_j(\alpha-w-\tau_{ij})/(16\beta)$, and $d(\pi_i^{il}-\pi_l^{il})/d\tau_{lj} = 6n_j(\alpha-w-\tau_{lj})/(16\beta)$. It is more convenient to write t_i as

$$t_i = 3\overline{F} + \frac{K}{(K-1)(2K-1)}\sum_{l\in\mathcal{K}\setminus\{i\}}\Delta_i^{il} + \frac{1}{2K-1}\sum_{l\in\mathcal{K}\setminus\{i\}}\left(\pi_i^{il}-\pi_l^{il}\right) + \frac{1}{(K-1)(2K-1)}\sum_{j\in\mathcal{K}\setminus\{i\}}\sum_{l\in\mathcal{K}\setminus\{j\}}\Delta_j^{jl} \tag{25}$$

such that

$$\begin{aligned} \frac{dt_i}{d\tau_{ij}} = \frac{K}{(K-1)(2K-1)}\left(-3n_i\frac{\alpha-w-\tau_{ij}}{16\beta}\right) + \frac{1}{2K-1}6\left(n_i-n_j\right)\frac{\alpha-w-\tau_{ij}}{16\beta} \\ + \frac{1}{2K-1}\sum_{l\in\mathcal{K}\setminus\{i,j\}}\left(-6n_j\frac{\alpha-w-\tau_{ij}}{16\beta}\right) + \frac{1}{(K-1)(2K-1)}\left(-3n_j\frac{\alpha-w-\tau_{ij}}{16\beta}\right) \end{aligned}$$

and

$$\frac{dt_i}{d\tau_{jk}} = \frac{1}{2K-1}6n_j\frac{\alpha - w - \tau_{jk}}{16\beta} + \frac{1}{2K-1}6n_k\frac{\alpha - w - \tau_{jk}}{16\beta}$$
$$+ \frac{1}{(K-1)(2K-1)}\left(-3n_j\frac{\alpha - w - \tau_{jk}}{16\beta}\right) + \frac{1}{(K-1)(2K-1)}\left(-3n_k\frac{\alpha - w - \tau_{jk}}{16\beta}\right).$$

Furthermore, since

$$t_i = 3\overline{F} + \frac{K}{(K-1)(2K-1)}3n_i\sum_{j\in\mathscr{K}\setminus\{i\}}\frac{\tau_{ij}^2 - 2\tau_{ij}(\alpha - w)}{32\beta} + \frac{1}{2K-1}\sum_{j\in\mathscr{K}\setminus\{i\}}\left((n_i - n_j)\frac{6\tau_{ij}(\alpha - w) - 3\tau_{ij}^2}{16\beta}\right.$$
$$\left. + \sum_{l\in\mathscr{K}\setminus\{i,j\}} n_l \frac{6(\alpha - w)(\tau_{jl} - \tau_{il}) - 3\left(\tau_{jl}^2 - \tau_{il}^2\right)}{16\beta}\right) + \frac{1}{(K-1)(2K-1)}\sum_{j\in\mathscr{K}\setminus\{i\}}\sum_{m\in\mathscr{K}\setminus\{j\}}3n_j\frac{\tau_{jm}^2 - 2\tau_{jm}(\alpha - w)}{32\beta}, \tag{26}$$

the comparative statics with respect to market size are

$$\frac{dt_i}{dn_i} = \frac{K}{(K-1)(2K-1)}3\sum_{j\in\mathscr{K}\setminus\{i\}}\frac{\tau_{ij}^2 - 2\tau_{ij}(\alpha - w)}{32\beta} + \frac{1}{2K-1}\sum_{j\in\mathscr{K}\setminus\{i\}}\frac{6\tau_{ij}(\alpha - w) - 3\tau_{ij}^2}{16\beta}$$
$$= \frac{K-2}{(K-1)(2K-1)}3\sum_{j\in\mathscr{K}\setminus\{i\}}\tau_{ij}\frac{2(\alpha - w) - \tau_{ij}}{32\beta} \tag{27}$$

and

$$\frac{dt_i}{dn_k} = \frac{1}{2K-1}\sum_{j\in\mathscr{K}\setminus\{i\}}\frac{6(\alpha - w)(\tau_{jk} - \tau_{ik}) - 3\left(\tau_{jk}^2 - \tau_{ik}^2\right)}{16\beta} + \frac{1}{(K-1)(2K-1)}\sum_{j\in\mathscr{K}\setminus\{k\}}3\frac{\tau_{kj}^2 - 2\tau_{kj}(\alpha - w)}{32\beta}$$
$$= -\frac{6(K-1)^2 + 3}{(K-1)(2K-1)}\frac{2\tau_{ik}(\alpha - w) - \tau_{ik}^2}{32\beta} + \frac{6(K-1) - 3}{(K-1)(2K-1)}\sum_{j\in\mathscr{K}\setminus\{i,k\}}\frac{2(\alpha - w)\tau_{jk} - \tau_{jk}^2}{32\beta}. \tag{28}$$

Simplify these expressions to obtain the following Nash equilibrium comparative statics of t_i

(a) with respect to population sizes

$$\frac{dt_i}{dn_i} = \frac{3(K-2)}{(K-1)(2K-1)}\sum_{j\in\mathscr{K}\setminus\{i\}}\tau_{ij}\frac{2(\alpha - w) - \tau_{ij}}{32\beta} \quad \text{and}$$
$$\frac{dt_i}{dn_k} = \frac{6(K-1) - 3}{(K-1)(2K-1)}\sum_{j\in\mathscr{K}\setminus\{i,k\}}\tau_{jk}\frac{2(\alpha - w) - \tau_{jk}}{32\beta} - \frac{6(K-1)^2 + 3}{(K-1)(2K-1)}\tau_{ik}\frac{2(\alpha - w) - \tau_{ik}}{32\beta} \tag{29}$$

(b) with respect to trade costs

$$\frac{dt_i}{d\tau_{ij}} = \left(n_i\,(K-2) - n_j\left[2\,(K-1)^2+1\right]\right)\frac{3}{(K-1)\,(2K-1)}\frac{\alpha - w - \tau_{ij}}{16\beta} \quad \text{and}$$
$$\frac{dt_i}{d\tau_{jk}} = \left(n_j + n_k\right)\frac{3\,(2K-3)}{(K-1)\,(2K-1)}\frac{\alpha - w - \tau_{jk}}{16\beta}. \tag{30}$$

A country's size positively affects its ability to tax, whereas it is not clear how t_i reacts to an expansion of market k. The answer to the latter depends on whether trade costs vis-à-vis market k are low (decline in t_i). Furthermore, when trade costs between j and k rise, country i becomes relatively more attractive, which gives the latter country the leverage to tax more. Moreover, $dt_i/d\tau_{ij}$ will be negative if market i is not too large ($n_i < n_j(2(K-1)^2+1)/(K-2)$). Interestingly, the more countries there are, the larger market i has to be relative to j to have $dt_i/d\tau_{ij} > 0$.

We may also consider the effects of a rise in bilateral trade costs on average taxes. For instance, when trade between two member countries becomes more costly, the average member's tax, $\bar{t}_U := \sum_{m\in\mathcal{K}_U} t_m/K_U$, declines, whereas the average tax of non-member countries, $\bar{t}_{nonU} := \sum_{k\in\mathcal{K}\backslash\mathcal{K}_U} t_k/(K-K_U)$, increases. On the contrary, the higher the bilateral trade costs for two non-member countries, the lower (higher) is the average tax of non-member (member) countries $\bar{t}_{nonU}$ ($\bar{t}_U$). The effects of a rise in trade costs between a member and a non-member country on $\bar{t}_U$ and $\bar{t}_{nonU}$ depend on the relative sizes of the union and the rest of the world.

B.2 Proof of Proposition 2

Symmetry in Trade Costs. We now provide the formal expressions for Proposition 2 in the main text. Suppose that trade costs between the leaving country $l \in \mathcal{K}\backslash\mathcal{K}_U$ and countries $m \in \mathcal{K}_U$ are the same, $\tau = \tau_{ml}$, $\forall m \in \mathcal{K}_U$, and let country l disintegrate from the member countries via a rise in trade costs. To show Proposition 2, we use (30).

For part (a), take country l which is supposed to leave, in the sense that all bilateral trade costs between members and country l are going to increase, and sum $dt_l/d\tau_{ml}$ over all relevant country combinations (i.e., over the set $\mathcal{K}_U$)

$$\sum_{m\in\mathcal{K}_U}\frac{dt_l}{d\tau_{ml}} = \sum_{m\in\mathcal{K}_U}\left(n_l\,(K-2) - 2n_m\left[(K-1)^2+0.5\right]\right)\frac{3}{(K-1)\,(2K-1)}\frac{\alpha-w-\tau}{16\beta}$$
$$= \left(n_l K_U\,(K-2) - \sum_{m\in\mathcal{K}_U} n_m\left[2\,(K-1)^2+1\right]\right)\frac{3}{(K-1)\,(2K-1)}\frac{\alpha-w-\tau}{16\beta}. \tag{31}$$

For $n := n_m = n_n$, we obtain a simpler expression

$$\sum_{m\in\mathcal{K}_U}\frac{dt_l}{d\tau_{ml}} = \frac{(5K-5-2K^2)K_U}{(K-1)(2K-1)}\frac{3n(\alpha-w-\tau)}{16\beta} < 0.$$

Proceed similarly to obtain the reaction of a member country $m \in \mathcal{K}_U$ to the disintegration of l. It is important to note that two effects play a role here. First of all, there is a direct effect induced by the increase in bilateral trade costs between the countries m and l. At the same time, trade costs between l and the other member countries rise. Therefore, the overall effect on the business tax in country m reads as

$$\frac{dt_m}{d\tau_{ml}} + \sum_{j\in\mathcal{K}_U\setminus\{m\}}\frac{dt_m}{d\tau_{jl}} = \frac{3\left((K-1)\left[2\sum_{j\in\mathcal{K}_U} n_j - 2n_l\left(K-K_U\right)-n_m\right] - K_U\left[n_l + \frac{1}{K_U}\sum_{j\in\mathcal{K}_U} n_j\right]\right)}{(K-1)\left(2K-1\right)}\frac{\alpha-w-\tau}{16\beta}. \tag{32}$$

Under symmetric population sizes

$$\frac{dt_m}{d\tau_{ml}} + \sum_{j\in\mathcal{K}_U\setminus\{m\}}\frac{dt_m}{d\tau_{jl}} = \frac{(4K_U-2K-1)\left(K-1\right)-2K_U}{(K-1)\left(2K-1\right)}\frac{3n\left(\alpha-w-\tau\right)}{16\beta}.$$

Therefore, the effect on member countries is negative for $2K_U \leq K$.

For the proof of part (c) we only need to consider one set of effects, namely that the rise in trade costs considered here is a third country effect for non-member countries. That is, for any $k \in \mathcal{K}\setminus(\mathcal{K}_U \cup \{l\})$ the effect on business taxation is given by

$$\sum_{j\in\mathcal{K}_U}\frac{dt_k}{d\tau_{jl}} = \sum_{j\in\mathcal{K}_U}\left(n_j+n_l\right)\frac{3\left(2K-3\right)}{(K-1)\left(2K-1\right)}\frac{\alpha-w-\tau}{16\beta} = \frac{3K_U\left(2K-3\right)\left(\frac{1}{K_U}\sum_{j\in\mathcal{K}_U} n_j + n_l\right)}{(K-1)\left(2K-1\right)}\frac{\alpha-w-\tau}{16\beta} > 0. \tag{33}$$

Asymmetries in Trade Costs. The main insights regarding market sizes carry over when dealing with asymmetries in trade costs. By Equation (30), the positive effect on third countries' taxes (part (c)) is fully robust with respect to including initially asymmetric trade costs. The trade-cost effect on the leaving and the member countries' taxes involves a correction term:

$$\sum_{j\in\mathcal{K}_U}\frac{dt_l}{d\tau_{jl}} = \sum_{j\in\mathcal{K}_U}\frac{dt_l}{d\tau_{jl}}\Big|_{\{\tau_{m'l}\}_{m'\in\mathcal{K}_U}=\tau} + \frac{\sum_{m\in\mathcal{K}_U}\left(n_l\left(K-2\right)-n_m\left[2\left(K-1\right)^2+1\right]\right)\frac{\tau-\tau_{ml}}{K_U\left(\alpha-w-\tau\right)}}{(K-1)\left(2K-1\right)}\frac{3\left(\alpha-w-\tau\right)}{16\beta},$$

and

$$\frac{dt_m}{d\tau_{ml}} + \sum_{j\in\mathscr{K}_U\setminus\{m\}} \frac{dt_m}{d\tau_{jl}} = \frac{dt_m}{d\tau_{ml}}|_{\{\tau_{m'l}\}_{m'\in\mathscr{K}_U}=\tau} + \sum_{j\in\mathscr{K}_U\setminus\{m\}} \frac{dt_m}{d\tau_{jl}}|_{\{\tau_{m'l}\}_{m'\in\mathscr{K}_U}=\tau}$$
$$+ \frac{\sum_{j\in\mathscr{K}_U}\left(n_j+n_l\right)(2K-3)\frac{\tau-\tau_{jl}}{\alpha-w-\tau} - (K-1)(2Kn_l+n_m)\frac{\tau-\tau_{ml}}{\alpha-w-\tau}}{(K-1)(2K-1)} \frac{3(\alpha-w-\tau)}{16\beta}$$

where $dt_l/d\tau_{jl}|_{\{\tau_{m'l}\}_{m'\in\mathscr{K}_U}=\tau}$ and $dt_m/d\tau_{jl}|_{\{\tau_{m'l}\}_{m'\in\mathscr{K}_U}=\tau}$ are the respective derivatives in the symmetric case that lead to Proposition 2.

$$\sum_{m\in\mathscr{K}_U} \frac{dt_l}{d\tau_{ml}}|_{\{\tau_{m'l}\}_{m'\in\mathscr{K}_U}=\tau} = \frac{3\left(K_U(K-2)n_l - K_U\left[2(K-1)^2+1\right]\bar{n}_U\right)}{(K-1)(2K-1)} \frac{\alpha-w-\tau}{16\beta}$$

denotes the response around the symmetric case. If trade flows are positive ($0 \le \tau_{ij} \le (\alpha-w)/3$), the adjustment terms are bounded from above and from below $(\tau-\tau_{ml})/(\alpha-w-\tau) \in [-1/3, 1/2]$. Therefore, under symmetric population sizes ($n_m = \bar{n}_U = n_l$), the effect on the leaving country's tax lies between

$$\sum_{m\in\mathscr{K}_U} \frac{dt_l}{d\tau_{ml}} \in \left[\frac{1}{2}\sum_{m\in\mathscr{K}_U} \frac{dt_l}{d\tau_{ml}}|_{\{\tau_{m'l}\}_{m'\in\mathscr{K}_U}=\tau}, \frac{3}{2}\sum_{m\in\mathscr{K}_U} \frac{dt_l}{d\tau_{ml}}|_{\{\tau_{m'l}\}_{m'\in\mathscr{K}_U}=\tau}\right]$$

and initial asymmetries in trade costs do not qualitatively change the trade-cost effect on the leaving country. In Figure 7, we plot equilibrium business taxes (of the leaving, the member, and third country) over the full range of trade costs, illustrating the trade-cost effect for an arbitrary initial set of trade costs and arbitrary changes in trade costs (symmetric baseline parametrization). The solid black, red, and orange lines on the diagonal represent the symmetric case (Proposition 2). Off-diagonal, one may observe the decline (rise) in the leaving (third) country's business tax that we show above. Starting from an off-diagonal point, the effect on a member country is ambiguous.

B.3 Economic Channels

The reaction functions (23) allow for a decomposition of the trade-cost induced change in business taxation

$$\sum_{m'\in\mathscr{K}_U} \frac{dt_i}{d\tau_{lm'}} = \underbrace{\frac{1}{2(K-1)} \sum_{m'\in\mathscr{K}_U} \sum_{j\in\mathscr{K}\setminus\{i\}} \frac{d\Delta_i^{ij}}{d\tau_{lm'}}}_{\text{price channel}} + \underbrace{\frac{1}{2(K-1)} \sum_{m'\in\mathscr{K}_U} \sum_{j\in\mathscr{K}\setminus\{i\}} \frac{d\left(\pi_i^{ij}-\pi_j^{ij}\right)}{d\tau_{lm'}}}_{\text{tax-base channel}} + \underbrace{\frac{1}{2(K-1)} \sum_{m'\in\mathscr{K}_U} \sum_{j\in\mathscr{K}\setminus\{i\}} \frac{dt_j}{d\tau_{lm'}}}_{\text{best vs. equilibrium response}}.$$

In the following, we are interested in the price and tax-base channels. We impose cross-country symmetry in market sizes $n_i = n_j$, $\forall i, j \in \mathscr{K}$ and let trade costs between the leaving country and the union be symmetric, $\tau =$

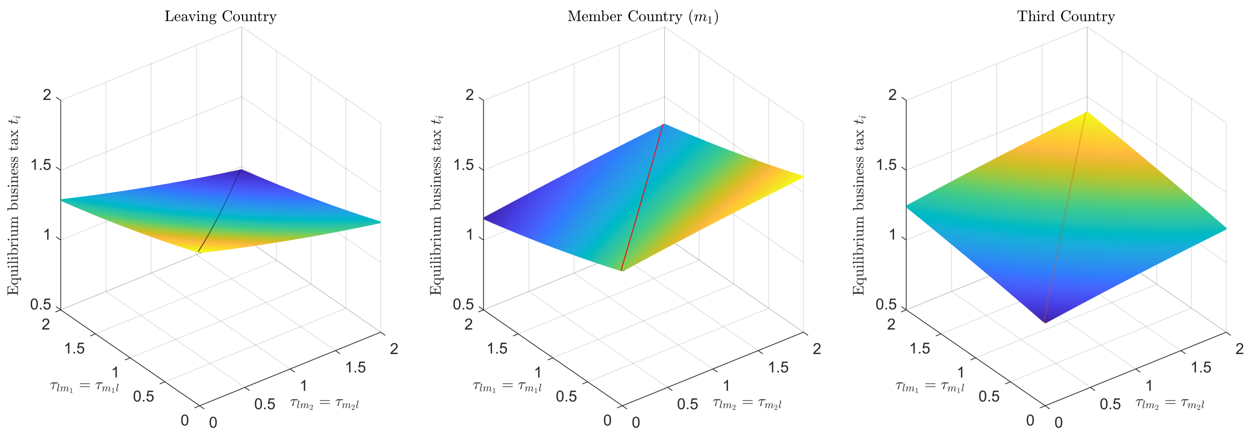

Figure 7: Trade-Cost Effect and Asymmetries in Trade Costs

τ_{ml}, $\forall m \in \mathcal{K}_U$. Then, any member country's price channel reads as

$$-\frac{1}{2(K-1)}\frac{3n(\alpha-w-\tau)}{16\beta}<0$$

and the tax-base channel is given by

$$-\frac{(K-2K_U)}{2(K-1)}\frac{6n(\alpha-w-\tau)}{16\beta}>0 \iff 2K_U>K.$$

The leaving country's tax-base channel

$$-\frac{K_U(K-2)}{2(K-1)}\frac{6n(\alpha-w-\tau)}{16\beta}<0$$

is larger in absolute value than the price channel

$$-\frac{K_U}{2(K-1)}\frac{3n(\alpha-w-\tau)}{16\beta}<0.$$

Finally, third countries' price channel is always zero (irrespective of the symmetry assumptions) and the tax-base channel is positive

$$\frac{K_U}{2(K-1)}\frac{12n(\alpha-w-\tau)}{16\beta}>0.$$

C Proofs for Section 4

C.1 Proof of Lemma 2

First-Order Welfare Effects. To show Lemma 2, first note that welfare of country $k \neq i, j$ depends on t_k only up to second order (envelope theorem). Moreover, observe that trade costs τ_{ij} affect welfare solely through the equilibrium firm distribution. If $\tau_{ik} = \tau_{jk}, \forall i, j$, a trade-cost induced relocation of firms between two countries does not alter a third country's welfare $\Delta_k^{ij} = 0, \forall i, j$.[37] Accordingly, for positive business taxes and negligible tariff revenues,

$$\frac{dW_k}{d\tau_{ij}^p} = \frac{dW_k}{d\tau_{ij}^t} = \frac{dW_k}{d\tau_{ij}} = \frac{1}{2\overline{F}}\left[\left(t_k - \Delta_k^{ki}\right)\frac{d\gamma^{ik}}{d\tau_{ij}}|_{t_k} + \left(t_k - \Delta_k^{kj}\right)\frac{d\gamma^{jk}}{d\tau_{ij}}|_{t_k}\right] > 0 \tag{34}$$

since

$$\frac{d\gamma^{ik}}{d\tau_{ij}}|_{t_k} = \frac{\partial\gamma^{ik}}{\partial\tau_{ij}} + \frac{dt_i}{d\tau_{ij}} = \frac{\left[2(K-1)^2 + 2(K-1) - 1\right]n_j + (K-2)\,n_i}{(K-1)(2K-1)}\frac{3\left(\alpha - w - \tau_{ij}\right)}{16\beta} > 0$$

and

$$\frac{d\gamma^{jk}}{d\tau_{ij}}|_{t_k} = \frac{\partial\gamma^{jk}}{\partial\tau_{ij}} + \frac{dt_j}{d\tau_{ij}} = \frac{\left[2(K-1)^2 + 2(K-1) - 1\right]n_i + (K-2)\,n_j}{(K-1)(2K-1)}\frac{3\left(\alpha - w - \tau_{ij}\right)}{16\beta} > 0.$$

Interestingly, $dW_k/d\tau_{ij}^p$ is ceteris paribus larger, the more sizable country k's market, since t_k, $-\Delta_k^{ki}$, and $-\Delta_k^{kj}$ rise in n_k.

Second-Order Welfare Effects. Figure 5 shows that welfare (here, of the leaving country) is approximately linear in trade costs. However, one may still be interested in the sign and size of second derivatives. Using the previous expression, one may derive higher-order welfare effects. Differentiate (34) with respect to trade

[37] Moreover, we assume that firms are not subsidized. Likewise, we suppose that tariff revenues are negligible. Otherwise, inward FDI could lead to a massive decline tariff revenues, potentially reducing welfare. This is an empirically unrealistic case. Last, imposing similar trade conditions with other countries eliminates another unlikely case: Despite the local price reductions and the revenue gains that inward FDI induces, a third country's welfare still declines because firms abroad relocate in a highly unfavorable fashion, substantially raising import costs in the country.

costs to obtain

$$\frac{d^2W_k}{d\tau_{ij}^s d\tau_{ij}^{s'}} = \frac{1}{2\overline{F}}\left(\frac{d\gamma^{ik}}{d\tau_{ij}}|_{t_k} + \frac{d\gamma^{jk}}{d\tau_{ij}}|_{t_k}\right)\frac{dt_k}{d\tau_{ij}^s} - \frac{1}{2\overline{F}}\frac{\left[2(K-1)^2+3(K-1)-2\right]}{(K-1)(2K-1)}\frac{3(n_i+n_j)}{16\beta}t_k,$$

$$\frac{d^2W_k}{d\tau_{ij}^s d\tau_{ik}^{s'}} = \frac{1}{2\overline{F}}\left(\frac{d\gamma^{ik}}{d\tau_{ij}}|_{t_k} + \frac{d\gamma^{jk}}{d\tau_{ij}}|_{t_k}\right)\frac{dt_k}{d\tau_{ik}^s} - \frac{1}{2\overline{F}}\frac{d\gamma^{ik}}{d\tau_{ij}}|_{t_k}\frac{3n_k(\alpha-w-\tau_{ik})}{16\beta},$$

$$\frac{d^2W_k}{d\tau_{ij}^s d\tau_{jk}^{s'}} = \frac{1}{2\overline{F}}\left(\frac{d\gamma^{ik}}{d\tau_{ij}}|_{t_k} + \frac{d\gamma^{jk}}{d\tau_{ij}}|_{t_k}\right)\frac{dt_k}{d\tau_{jk}^s} - \frac{1}{2\overline{F}}\frac{d\gamma^{ik}}{d\tau_{ij}}|_{t_k}\frac{3n_k(\alpha-w-\tau_{jk})}{16\beta},$$

and

$$\frac{d^2W_k}{d\tau_{ij}^s d\tau_{lm}^{s'}} = \frac{1}{2\overline{F}}\left(\frac{d\gamma^{ik}}{d\tau_{ij}}|_{t_k} + \frac{d\gamma^{jk}}{d\tau_{ij}}|_{t_k}\right)\frac{dt_k}{d\tau_{lm}^{s'}}$$

for $k \neq i, j$, $l, m \neq i, j, k$, and $s, s' \in \{p, t\}$. Observe that $d^2W_k/(d\tau_{ij}^s d\tau_{ij}^{s'}) \lesseqgtr 0$, since $dt_k/d\tau_{ij}^s > 0$. $d^2W_k/(d\tau_{ij}^s d\tau_{ik}^{s'}) < 0$, if $dt_k/d\tau_{ik}^s$, and $d^2W_k/(d\tau_{ij}^s d\tau_{jk}^{s'}) < 0$, if $dt_k/d\tau_{jk}^s < 0$. Finally, $d^2W_k/(d\tau_{ij}^s d\tau_{lm}^{s'}) > 0$ because $dt_k/d\tau_{lm}^{s'} > 0$.

C.2 Proof of Proposition 3

Define $\mathscr{K}_{TA}$ as the set and K_{TA} as the number of countries which participate in trade agreements (e.g., the WTO) but are not part of $\mathscr{K}_U$ or l. Let $\boldsymbol{\tau^{t,old}}$ denote the vector of tariff policies before the disintegration of country l from the union abbreviated U. That is,

$$\boldsymbol{\tau^{t,old}} = \left(\boldsymbol{\tau_{U,U}^{t,old}}, \boldsymbol{\tau_{U,l}^{t,old}}, \boldsymbol{\tau_{U,TA}^{t,old}}, \boldsymbol{\tau_{l,TA}^{t,old}}, \boldsymbol{\tau_{TA,TA}^{t,old}}, \boldsymbol{\tau_{R}^{t,old}}\right) \tag{35}$$

is a vector of trade taxes consisting of (i) the null vector $(\boldsymbol{\tau_{U,U}^{t,old}}, \boldsymbol{\tau_{U,l}^{t,old}})$, which summarizes zero bilateral tariffs in the union, (ii) another vector $(\boldsymbol{\tau_{U,TA}^{t,old}}, \boldsymbol{\tau_{l,TA}^{t,old}}, \boldsymbol{\tau_{TA,TA}^{t,old}})$ which summarizes cooperatively-chosen tariffs within the set of countries $\mathscr{K}_{TA}$, the leaving country, and the union, and (iii) another vector of tariffs which are set noncooperatively

$$\boldsymbol{\tau_{R}^{t,old}} = \left(\boldsymbol{\tau_{U,R}^{t,old}}, \boldsymbol{\tau_{l,R}^{t,old}}, \boldsymbol{\tau_{TA,R}^{t,old}}, \boldsymbol{\tau_{R,R}^{t,old}}\right) \tag{36}$$

vis-à-vis countries from the rest of the world. Moreover, let

$$\boldsymbol{\tau^{p,old}} = \left(\boldsymbol{\tau_{U,U}^{p,old}}, \boldsymbol{\tau_{U,l}^{p,old}}, \boldsymbol{\tau_{U,TA}^{p,old}}, \boldsymbol{\tau_{l,TA}^{p,old}}, \boldsymbol{\tau_{TA,TA}^{p,old}}, \boldsymbol{\tau_{R}^{p,old}}\right) \tag{37}$$

denote the vector of bilateral non-tariff trade costs.

Internal Non-Tariff Trade Policies. A feature of an economic union is that member countries can cooperatively set these non-tariff trade costs. That is, $(\tau_{U,U}^{p,old}, \tau_{U,l}^{p,old})$ is the outcome of efficient Nash bargaining, as described by (13). After the disintegration, the remaining members negotiate their internal trade costs without consideration of country l's welfare, as shown in (14). Consider the first-order Taylor approximation of members' welfare in the new equilibrium

$$\begin{aligned}\sum_{m\in\mathcal{K}_U} W_m\left(\tau_{U,U}^{p,new}, \tau_{U,l}^{p,new}, \cdot\right) &= \sum_{m\in\mathcal{K}_U} W_m\left(\tau_{U,U}^{p,old}, \tau_{U,l}^{p,new}, \cdot\right)\\ &\quad + \sum_{m\in\mathcal{K}_U} \nabla_{\tau_{U,U}^{p}} W_m\left(\tau_{U,U}^{p,old}, \tau_{U,l}^{p,new}, \cdot\right)\left(\tau_{U,U}^{p,new} - \tau_{U,U}^{p,old}\right)' + \text{h.o.t.}\\ &> \sum_{m\in\mathcal{K}_U} W_m\left(\tau_{U,U}^{p,old}, \tau_{U,l}^{p,new}, \cdot\right)\end{aligned} \tag{38}$$

where the inequality holds by the optimality of the new solution ($\tau_{U,U}^{p,new}$ is the only non-tariff trade cost vector that maximizes members' welfare). Rewrite the previous expression to obtain

$$\sum_{m\in\mathcal{K}_U} \nabla_{\tau_{U,U}^{p}} W_m\left(\tau_{U,U}^{p,old}, \tau_{U,l}^{p,new}, \cdot\right)\left(\tau_{U,U}^{p,new} - \tau_{U,U}^{p,old}\right)' > 0. \tag{39}$$

By the old solution's first-order condition $\sum_{m\in\mathcal{K}_U\cup\{l\}} \nabla_{\tau_{U,U}^{p}} W_m(\tau^{p,old}, \tau^{t,old}) = 0$ and, accordingly,

$$\begin{aligned}0 &= \sum_{m\in\mathcal{K}_U\cup\{l\}} \nabla_{\tau_{U,U}^{p}} W_m\left(\tau^{p,old}, \tau^{t,old}\right)\left(\tau_{U,U}^{p,new} - \tau_{U,U}^{p,old}\right)'\\ &= \sum_{m\in\mathcal{K}_U\cup\{l\}} \nabla_{\tau_{U,U}^{p}} W_m\left(\tau_{U,U}^{p,old}, \tau_{U,l}^{p,new}, \cdot\right)\left(\tau_{U,U}^{p,new} - \tau_{U,U}^{p,old}\right)' + \text{h.o.t.}\end{aligned}$$

Therefore,

$$-\nabla_{\tau_{U,U}^{p}} W_l\left(\tau_{U,U}^{p,old}, \tau_{U,l}^{p,new}, \cdot\right)\left(\tau_{U,U}^{p,new} - \tau_{U,U}^{p,old}\right)' > 0$$

and one can conclude that, whenever $\nabla_{\tau_{U,U}^{p}} W_l(\cdot) > 0$ (i.e., the welfare of the leaving country is increasing in two member countries' trade costs as in Assumption 1 and Lemma 2), $\tau_{U,U}^{p,new} < \tau_{U,U}^{p,old}$.

External Tariff Policies. By the construction of an economic union as a customs union trade taxes inside the union remain prohibited $\tau_{U,U}^{t,old} = \tau_{U,U}^{t,new} = 0$, whereas trade taxes between the leaving country and the economic union can be anything after the disintegration. That is, $\tau_{U,l}^{t,old} = 0$ and $\tau_{U,l}^{t,new} \gtreqless 0$. Observe that this includes the case where country l remains in the customs union.

Common external tariffs are an essential feature of the customs union. Therefore, when country l decides to remain a member of the customs union, there will be no first-order change in trade policies vis-à-vis third countries. To put it differently, the countries $\mathscr{K}_U$ and l jointly decide on external trade taxes before and after the disintegration of l. Objective functions and instruments of tariff policies remain the same. Only non-tariff trade barriers inside the customs union change. This change, however, has no first-order effect on the other trade policies. To determine the exact sign of second-order effects, one needs to know about higher derivatives of welfare functions with respect to the respective trade-policy instruments.

Now, suppose that country l departs from the customs union but stays within the set of countries that participate in trade agreements. Fix a country $TA \in \mathscr{K}_{TA}$. Observe that the the Nash bargaining changes from (15) to (17). Again, consider a first-order approximation of welfare in $\mathscr{K}_U$ and TA in the new equilibrium and use the first-order conditions of the respective optimization to show that

$$-\nabla_{\tau^t_{U,TA}} W_l\left(\tau^{p,old}, \tau^{t,old}\right)\left(\boldsymbol{\tau}^{t,new}_{\boldsymbol{U,TA}} - \boldsymbol{\tau}^{t,old}_{\boldsymbol{U,TA}}\right)' > 0,$$

which implies, together with Lemma 2, $\boldsymbol{\tau}^{t,new}_{\boldsymbol{U,TA}} < \boldsymbol{\tau}^{t,old}_{\boldsymbol{U,TA}}$. By a similar reasoning,

$$-\sum_{m\in\mathscr{K}_U} \nabla_{\tau^t_{l,TA}} W_m\left(\tau^{p,old}, \tau^{t,old}\right)\left(\boldsymbol{\tau}^{t,new}_{\boldsymbol{l,TA}} - \boldsymbol{\tau}^{t,old}_{\boldsymbol{l,TA}}\right)' > 0.$$

Therefore, for $\sum_{m\in\mathscr{K}_U} \nabla_{\tau^t_{l,TA}} W_m(\boldsymbol{\tau}^{p,old}, \boldsymbol{\tau}^{t,old}) > 0$ (i.e., members of the union benefit from a trade war between l and TA), $\boldsymbol{\tau}^{t,new}_{\boldsymbol{l,TA}} < \boldsymbol{\tau}^{t,old}_{\boldsymbol{l,TA}}$. Hence, both country l and union-member countries deepen their trade agreement with country TA by lowering trade taxes.

Consider, now, noncooperative trade policies by the economic union vis-à-vis a country in $\mathscr{K}_R$. Use bold letters for trade-policy instruments which are under the control of the respective government. Noncooperative trade policies before and after the disintegration of l are given by (16) and (18), respectively. Again, linearize welfare in the new equilibrium and use the optimality conditions to demonstrate that

$$-\nabla_{\tau^t_{U,R}} W_l\left(\tau^{p,old}, \tau^{t,old}\right)\left(\boldsymbol{\tau}^{t,new}_{\boldsymbol{U},R} - \boldsymbol{\tau}^{t,old}_{\boldsymbol{U},R}\right)' > 0 \text{ and } -\sum_{m\in\mathscr{K}_U} \nabla_{\tau^t_{l,R}} W_m\left(\tau^{p,old}, \tau^{t,old}\right)\left(\boldsymbol{\tau}^{t,new}_{\boldsymbol{l},R} - \boldsymbol{\tau}^{t,old}_{\boldsymbol{l},R}\right)' > 0.$$

One can conclude that $\boldsymbol{\tau}^{t,new}_{\boldsymbol{U},R} < \boldsymbol{\tau}^{t,old}_{\boldsymbol{U},R}$ and $\boldsymbol{\tau}^{t,new}_{\boldsymbol{l},R} < \boldsymbol{\tau}^{t,old}_{\boldsymbol{l},R}$. Therefore, the disintegration of l reduces not only cooperatively-chosen tariffs but also noncooperative tariffs. In Figure 8, we depict the effects of endogenous trade policy adjustments on the welfare of a large leaving country, using the parameter specifications from the main text.

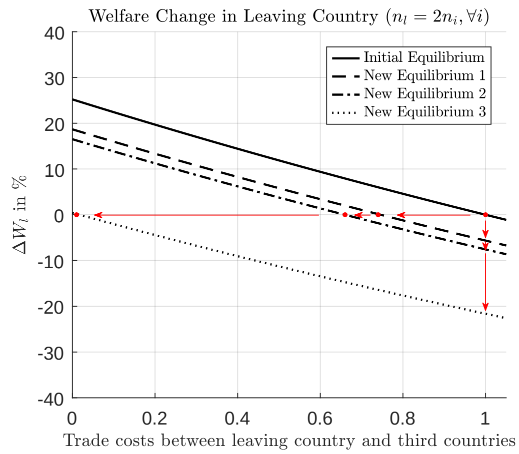

Figure 8: Endogenous Trade Policies and Exit Incentives; New Equilibrium 1: Initial Equilibrium + Disintegration (50%-Rise in Trade Costs); New Equilibrium 2: Equilibrium 1 + Response of Member Countries (50%-Decline in Internal Trade Costs); New Equilibrium 3: Equilibrium 2 + Response of Member Countries (50%-Decline in External Trade Costs)

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