A Theory of Economic Disintegration*

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Abstract

We study the impact of unilateral economic disintegration, such as Brexit, on the design of national and international policies. We develop a highly tractable multi-country, multi-sector general equilibrium trade model with firm mobility and business tax policies representative of any national policy that alters the spatial distribution of economic activity. We identify the model's dimensions of economic disintegration, such as tariffs, non-tariff barriers, the de-harmonization of production standards and regulations, business frictions, and household migration, and analyze their differential effects on the domestic policies of asymmetric countries. Whereas the disintegrating country is likely to reduce its tax, business taxes tend to converge in the remaining economic area. Third countries' ability to tax improves. At an international level, we predict a counterforce to deglobalization. A country's disintegration from an integrated area leads to a deeper integration inside the area. The departure of a country from a customs union lowers tariffs worldwide.

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

JEL Classification: D78, D86, F13, F15, H25, R13

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1 Introduction

After decades of international integration, recent unilateral movements towards economic disintegration have emerged. The United Kingdom's decision to leave the European Union is a prominent example of such protective policy measures. Similarly, this is the case for the renegotiation of NAFTA and the failure to finalize trade agreements like TPP and TTIP.[1]

The emergence of protectionism and deglobalization alters nations' economic structure along various dimensions, such as trade costs, production standards, business regulations, and migration opportunities. Thereby, economic disintegration affects consumers' and firms' choices, as well as national tax and international trade policies non-trivially. In this paper, we investigate the policy implications of deglobalization, particularly of the unilateral kind, in which one country disintegrates from a set of other countries, as in the Brexit case. While we frequently speak about disintegration, our model speaks both to unilateral integration and disintegration.

National 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, which appear to be the most relevant margin of adjustment available to governments to respond to economic disintegration.[2] However, one can broadly understand our economic insights in the context of other domestic policy instruments influencing the spatial distribution of economic activity.

We introduce international firm relocation into the classical multi-country, 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 (see below) by reducing the dimensionality of the individual relocation decisions without losing generality at an aggregate level. We allow for firm heterogeneity in relocation costs, but assume that industries differ in which subset of countries the mobile firms are able to produce. The parsimony in the modeling of mobility allows us to derive each country's Nash equilibrium business tax policy in closed form as a function of country-pair specific trade costs, firm-location fixed cost distributions, country sizes, and consumers' preferences. We characterize economic disintegration along several model

[1]This recent spread of protectionism has launched a considerable line of structural and empirical research (see, for instance, Barattieri, Cacciatore, and Ghironi (2018), Amiti, Redding, and Weinstein (2019), Fajgelbaum, Goldberg, Kennedy, and Khandelwal (2020), and Li and Whalley (2020)).

[2]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.

dimensions: The level of tariffs, non-tariff trade costs, business frictions, the de-harmonization of production standards and business regulations, and changes in market sizes induced by household mobility.

Moreover, we highlight significant differences between unilateral economic disintegration and reverse multilateral integration. Thus, existing models of multilateral (dis-)integration lack critical insights when applying them 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 we derive extend, similar to those on international policies, more broadly to any economic disintegration, such as the exit from a free-trade area, a trade agreement, or another international treaty like the Paris Agreement by the United Nations.

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. The trade-cost effect on the business taxes set by the remaining union member countries depends on the union size. Under considerable asymmetries in member countries' size, tax policy reactions within the union point in opposite directions and lead to a convergence of taxes inside the union. Since third countries outside the economic union become more attractive as a business location relative to the other countries, their ability to tax improves. These insights hold for both tariffs and non-tariff barriers to trade.

Furthermore, relocating firms face higher mobility costs (captured by a mean-preserving spread in the cost relocation distributions) when production standards and business regulations diverge across nations after a country's disintegration (*de-harmonization effect*). Thus, in the short run, when firms do not anticipate this cost change, they may become less mobile across countries, which tends to raise taxes in our model. In the long run, economic disintegration discourages investment in the leaving country because it raises setup costs in that country (*business-friction effect*). We capture this effect, in our static model, as a shift in the relocation cost function. Hence, we highlight substantial differences in the domestic policy responses depending on whether or not firms anticipate the economic disintegration. Although the de-harmonization and the business-friction effect are at first glance tailor-made to the case of a country's exit from an integrated area (e.g., Brexit), they may also occur in other situations of economic disintegration (e.g., the departure of the US from a multilateral institution). We also document a *migration effect* that accounts for disintegration-induced household emigration from the leaving country and resembles in its consequences the business-friction effect. Finally, we identify a *union-size effect* that is similar to the trade-cost effect.

International Policies. In addition to studying domestic policies, we develop a novel approach to deal with the impact of unilateral disintegration on international policies, i.e., the readjustment of cooperative and non-cooperative *trade policies* worldwide. We show that the disintegration of one country from an agreement has global repercussions for existing international agreements. Consequently, the welfare implications of unilateral economic disintegration become less straightforward compared to those of a reverse multilateral integration.[3]

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. We focus on two important cases: the departure from an integrated area or economic union (case 1), where 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 integrate more with each other. They lower their internal non-tariff barriers to trade. In the second case, the remaining customs union member countries negotiate lower tariffs with third countries in regional trade agreements. The leaving country also intensifies trade agreements with third countries. Similarly, non-cooperative trade policies by the union members, as well as by the leaving country, become less protective. Overall, our results suggest a counterforce to deglobalization.

The intuition behind the further integration efforts, for instance, among the remaining union members is that, before the departure, the existing policies were optimal given trade costs between all countries. However, upon the departure of a country, the old trade policies are no longer optimal for the reduced set of remaining countries. We show that the adjustment of the policies goes in the direction of further integration if this change makes third countries, including the leaving country, worse off. This holds in our model when trade costs between countries are not too different and initial taxes are positive.

Policy Implications. Our model allows us to speak to the likely *domestic policy* consequences

[3]Contributors to the modern trade policy literature, initiated by Bagwell and Staiger (1999), highlight the advantages of forming international trade agreements to overcome the Prisoner's Dilemma of terms-of-trade manipulation. Ceteris paribus, in a state of multilateral economic disintegration, countries are worse off than under free trade.

of the UK leaving the EU. The results suggest that the UK lowers taxes after Brexit. We predict business taxes in the remainder of the EU to converge. Third countries, e.g., the US, can tax more after Brexit. At the same time, our model applies beyond the case of Brexit. A similar argument applies to countries that engage in a trade war or consider leaving the WTO. When the US pursues a trade war with China, our model predicts that the US would need to lower business taxes to compensate for the loss in attractiveness as a business location.

Naturally, these predictions are somewhat speculative, as Brexit happened only recently and overlapped with the Corona pandemic, making it difficult to separate the different motivations behind policy changes. In retrospect, we consider the 2004 and 2007 Eastern enlargement of the European Union as an example of unilateral economic integration (in the sense of a subset of countries joining an economic union, while other countries remained outsiders to the union). Overall, corporate tax rates have been on a declining trend in most countries long before and after enlargement, reflecting a general race-to-the-bottom situation. Our model can explain this globalization-induced trend by countries' intensified exposure to an increased number of competing markets.[4] Beyond this overall trend, there are differences in the extent of downward adjustment that can be related to our model predictions.

For example, while only a few of the ten countries that joined the EU in 2004 lowered corporate tax rates (Czech Republic, Estonia, Slovenia), most new member countries kept their business taxes roughly constant in the following years, reflecting a relative increase.[5] Our model predicts this relative rise in business taxes of the new members. Inside the European Union, a diversion of tax rates should be expected, according to our model, with smaller countries lowering their rates and large countries raising theirs. Interestingly, Austria and other smaller countries, such as the Netherlands, Finland, Denmark, and Greece, decreased their corporate tax rates, while France kept them roughly constant. Germany reduced its business tax substantially from high levels, contrary to our described trade-cost effect following the 2004 enlargement of the EU. However, within our framework, the decline is consistent with Germany's increased integration with large Asian markets, for instance, China.

Besides domestic tax policies, our model also speaks to the policy implications regarding *international trade policies*. In the context of Brexit, the remaining EU members integrate more

[4] However, our model does not capture various other motives for this trend, e.g., profit shifting by multinational corporations and distributional objectives.

[5] The statements in this paragraph about business taxes draw on the statutory corporate tax data from the OECD tax database.

with each other and reconsider protectionist policies toward third countries. The UK compensates for the rise in trade frictions vis-à-vis the EU by deepening trade relations with third countries. Consequently, the welfare implications from Brexit become ambiguous. It may well be the case that the UK and the remaining European Union are adversely affected, as the conditions under which these countries trade with each other worsen due to Brexit. At the same time, both the UK and the EU can now renegotiate trade agreements with other countries (e.g., the US, India, and China) without the need to consider each other. Thus, when reevaluating trade policies towards these countries, the EU's objective function changes as the UK no longer sits at the negotiating table. Similarly, the UK now sets its policies towards China, India, and the US solely in its own interest. In turn, cooperative and non-cooperative trade policies towards these countries readjust, making the welfare implications of disintegration non-trivial.

Related Literature. Our paper relates to two strands of literature. Firstly, we add to the debate on domestic policy in the presence of economic mobility. Usually, in this literature, there are 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 of the authors, for instance, Bucovetsky (1991) and Haufler and Wooton (1999), address cross-country asymmetries. We show that, besides the relative size of a given market, as highlighted in previous work, the world economy's institutional structure 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 reduction in trade barriers makes it less critical for a firm to set up an FDI platform in the larger market. Export costs to this market are then low, and the firm can easily access both markets irrespective of its location. Vice versa, if trade costs are high, firms would like to locate in the large market regardless of the business tax differential until the location rents in the large market are absorbed by an increased degree of regional competition. 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

[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

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, it is misleading to reverse the sign of existing conclusions about multilateral economic (dis-)integration to speak to the effects of unilateral (dis-)integration. Similarly, as we show, it is misleading to consider only a subset of disintegration dimensions.

Two key challenges have, so far, prevented progress to more realistic multi-country models. The first one 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 are, in turn, endogenous to the distribution of firms. As a result, it is hard to derive the objective function of the government in each country. Secondly, 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. Simultaneously, on an aggregate level, the firm distribution 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 of theoretical interest, we expect it to be helpful in quantitative models that would be otherwise 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 under 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), by two dimensions. Firstly, instead of explicitly deriving globally optimal trade policies, we study the incidence of economic disintegration on trade policies worldwide, taking existing imperfections of trade agreements as given. One can apply this approach to various other contracting situations, beyond trade policies, where agents renegotiate preexisting arrangements after one party leaves an agreement. Secondly, 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

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

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 (for example, Grossman, McCalman, and Staiger (2019) and Staiger and Sykes (2021)).

Instead of interpreting our results in the context of unilateral economic disintegration, one can also 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 by highlighting other policy margins, for example business taxation and non-tariff trade barriers.

Outline of the paper. This paper is structured as follows. In Section 2.1, we first develop a multi-country, multi-sector general equilibrium trade model with firm mobility and non-cooperative business taxation. Then, we derive the effects of economic disintegration along several dimensions in a three-country (Section 2.2) and a K-country setup (Section 2.3), and consider various model extensions (Section 2.4). In Section 2.5, we endogenize trade policies to study the readjustment of tariff and non-tariff trade policies worldwide in reaction to economic disintegration. Section 3 concludes. We relegate all relevant proofs to the Online Appendix.

2 The Impact of Unilateral Economic Disintegration on National and International Policies

We start with an analysis of the impact of economic disintegration on tax policies. We refer to economic disintegration as the departure of one country from a trade agreement formed by a set of countries (in the following, called an "economic union"). We introduce firm mobility and tax policy into a three-country version of the Melitz and Ottaviano (2008) multi-sector general equilibrium trade model. Our approach allows us to derive each country's optimal Nash equilibrium tax policies. We then identify several model dimensions of economic disintegration and analyze their effects on tax and trade policies.

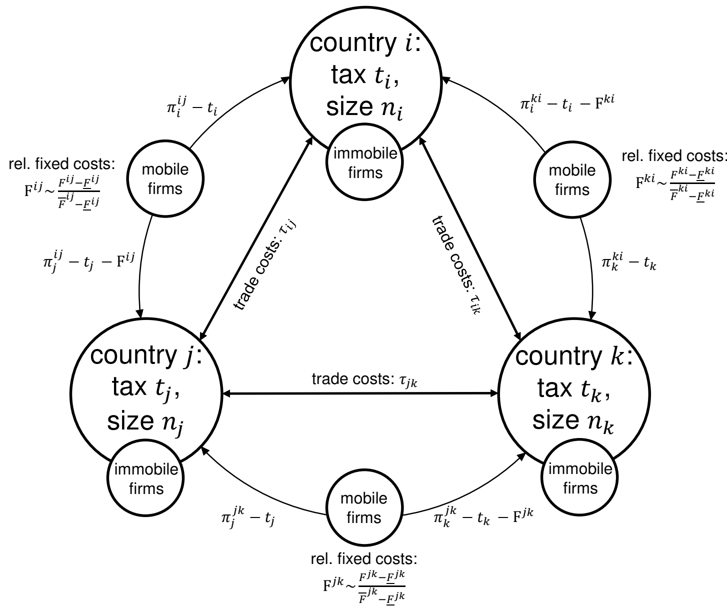

Figure 1: The Three-Country Model

2.1 The Three-Country Model

Timing. We build a five-stage economy, $\mathscr{E}$, of trade and tax policies which we solve by backward induction. In the initial stage (Stage 0), countries choose their cooperative and non-cooperative trade policies (Section 2.5). For the moment, if not stated otherwise, we hold all trade policies fixed. Stages 1-4 feature, for a given set of trade policies, a game of fiscal competition with initially three countries. Let $\mathscr{K}$ denote the non-empty set of countries and $K := |\mathscr{K}| \in \mathbb{Z}^+$ its cardinality. Accordingly, in this section, we consider $K = 3$, but in Section 2.3, we extend the model and the main economic insights to $K > 3$. Figure 1 illustrates the three-country economy.

In the first stage, taking trade policies as given, each government non-cooperatively chooses a business tax, t_i, to maximize national welfare consisting of consumer surplus and tax revenues. For given tax and trade policies, a continuum of mobile firms selects into countries in the second stage. In the third stage, each mobile firm competes in an oligopolistic industry with two other immobile firms in general equilibrium. All firms are single-product businesses and trade their products worldwide. To achieve tractability, we assume that, in each industry, firms can produce in only two out of multiple countries. Industries differ in the pair of countries in which firms produce and the country-specific fixed costs of setting up a firm. In the fourth 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. Consider economy $\mathscr{E}$. 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 the other countries' taxes as given and anticipating the behavior of firms and consumers as described in Stages 1-3.

Unilateral Economic Disintegration. We analyze unilateral economic disintegration by carrying out comparative statics of this subgame-perfect Nash equilibrium. Specifically, the trade costs between any pair of countries depend on the level of economic integration between these two countries and may differ across country pairs. An increase in the trade costs of respective country pairs captures economic disintegration. We label the resulting impact on tax policies as a trade-cost effect. Moreover, we consider country-pair-specific distributions of the fixed cost to set up a firm that will allow us to derive a de-harmonization effect and a business-friction effect. Finally, we deal with household migration between countries as a simultaneous offsetting change in the population between country pairs (migration effect). There are two main advantages of our approach. Firstly, we impose no a priori assumption on the specific type of economic disintegration. Secondly, all the effects are equally applicable to small and large policy changes.

2.1.1 Households

Preferences. In each country $i \in \mathscr{K}$, a number n_i of identical households consumes a continuum of differentiated varieties, which oligopolistic firms produce, 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, which consists of three firms.[7]

[7]All the results carry over when one leaves out the immobile firms and considers only a single mobile firm that produces a given variety, which mimics the firm structure in Melitz and Ottaviano (2008) (but now with endogenous location choice). To endogenize the degree of local competition to firm relocation, we decide to conduct our baseline analysis under an oligopolistic market structure.

Households derive the following utility

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

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 2.4, we deal with cross-price effects ($\eta > 0$). Household income comes from the business taxes the government rebates in lump-sum fashion and from inelastically supplying labor. Under the assumption that the production of the numéraire good takes place in every country, the numéraire industry pins down a wage rate w which equalizes across countries.

Utility Maximization (Stage 4). 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.

2.1.2 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 $w + \tau_{ij}$.[8] We interpret trade costs in a broader sense as the degree of economic integration. These refer to all non-tariff barriers to trade of goods and services such as consumer protection, quality requirements, health standards, and environmental protection. Moreover, our definition of trade costs includes transport cost differentials arising from geographical characteristics and tariffs. Altogether, trade costs raise the unit costs of producing for a foreign market. When introducing firm heterogeneity, we also address non-tariff barriers that affect firms' setup costs. For the time being, we assume trade costs to be exogenous, although subject to change with disintegration, and we abstract from revenue effects of trade taxes/subsidies. In Section 2.4, we deal with revenue

[8] In Section (1.7) of the Supplementary Online Appendix, we relax the assumption that trade costs are symmetric across firms and industries (see https://www.vwl.uni-mannheim.de/(...)/Janeba/Supplementary_Online_Appendix_for_A_Theory_of_Economic_Disintegration_22102021.pdf).

effects and show that our results carry over. Moreover, we endogenize tariff and non-tariff trade policies (Section 2.5).

In order to avoid corner solutions, assume that $\tau_{ij} \leq \frac{\alpha - w}{3}$, for all i, j, so that trade flows are weakly positive in equilibrium. As Haufler and Wooton (2010), we assume that firm profits do not accrue to residents in $\mathscr{K}$. As we describe in Section 2.4, our results are robust to the accrual of profits in residents' incomes.

Firm Heterogeneity. Inspired by Melitz (2003), we introduce firm heterogeneity as follows. In each industry, there are three firms.[9] 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 the third country, say country k, the production of that specific good is not possible, perhaps due to technological, regulatory, or geographical frictions (and consumption takes place through imports). This location structure is in line with the Ricardian idea of international specialization. However, industries differ in which two of the three countries they can produce. Specifically, there are three types of industries. In an ij-industry, firms are active either in country i or j. jk- and ki-industries are defined accordingly. Throughout the analysis, superscripts will indicate the particular industry type. To rule out asymmetries in initial conditions, let the mass of potential firms be ex ante equal across countries. That is, we partition the set of industries Ω into K equally sized intervals.

Our use of the term "industry" should be explained. An industry is a collection of firms producing a specific variety. For $\eta = 0$, there are two interpretations of this firm structure. On the one hand, there may be 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.

Industries differ in a relative fixed cost F^{ij} that the mobile firm pays when comparing the two possible locations – i.e., a firm pays F^{ij} more in country j than in i. One can, therefore, interpret this fixed cost as the cost of relocating from country i to j.[10] We assume that F^{ij} has policy and non-policy components. The policy components are given by the country-specific

[9] In Section 2.4, we relax this assumption.

[10] This is the main difference to 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 emigration and immigration.

level of frictions when setting up a business, ν^i and ν^j, which are determined by factors such as bureaucracy, regulatory complexity, access to infrastructure, and the availability of land. Another policy component is 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.

Formally, let $F^{ij} := \nu^j - \nu^i + \epsilon^{ij} + \epsilon$ where $\epsilon^{ij} + \epsilon \in \left[\underline{\epsilon}_{ij} + \underline{\epsilon}, \overline{\epsilon}^{ij} + \overline{\epsilon}\right]$ is drawn from a uniform cumulative distribution function with zero mean. Therefore, F^{ij} is also uniformly distributed with a CDF $G^{ij}\left(F^{ij}\right) = \frac{F^{ij} - \underline{F}^{ij}}{\overline{F}^{ij} - \underline{F}^{ij}}$, where $\underline{F}^{ij} := \nu^j - \nu^i + \underline{\epsilon}_{ij} + \underline{\epsilon}$ and $\overline{F}^{ij} := \nu^j - \nu^i + \overline{\epsilon}^{ij} + \overline{\epsilon}$. In this section, we impose, for simplicity, symmetry in relocation cost distributions across country pairs. That is, we assume $G^{ij}\left(F^{ij}\right) = G\left(F^{ij}\right) = \frac{F^{ij} - \underline{F}}{\overline{F} - \underline{F}}$. In Section 2.2.2, we explicitly deal with the effects of the country- and country-pair-specific policy components that alter the mean and the variance of relocation costs ($\nu^j - \nu^i$ and $\overline{\epsilon}^{ij}$, respectively). Altogether, each mobile firm pays different fixed costs of production, giving rise to an extensive margin of firm relocation, which affects local prices and production quantities.

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 k, x_{ji} and x_{ki}. The maximization problem in the third stage is, therefore, defined as

$$\pi_i^{ij}(\mu) := \max_{x_{ii}(\mu), x_{ji}(\mu), x_{ki}(\mu)} \left[p_i(\mu) - w\right] x_{ii}(\mu) + \left[p_j(\mu) - w - \tau_{ij}\right] x_{ji}(\mu) + \left[p_k(\mu) - w - \tau_{ik}\right] x_{ki}(\mu) \tag{3}$$

subject to the oligopolistic market structure. Then, pre-tax variable profits of a firm located in country i read as

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

Thus, prices and mark-ups are endogenous to the location decisions of firms. The asymmetry in profits from markets j and k is the consequence of our assumption that in an ij-industry there is an immobile firm present in country j that faces no trade cost in serving its home market, whereas in country k there is no domestic firm active by assumption.[11] In each country i, firms

[11] One may easily relax this assumption, as long as this additional firm in country k is immobile.

are taxed lump-sum with t_i.

Firm Relocation (Stage 2). We now turn to the second stage: the location decision of mobile firms. The mobile firm in industry ij produces in country i as long as after-tax profits[12] are larger in i than in j:

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

In other words, a firm prefers country i if the advantage in gross profits exceeds the tax differential corrected by the relative fixed cost. Since we have a continuum of industries that differ in fixed costs, we can now characterize the mass of industries and firms in a country. For this, we define the following threshold industries in which the mobile firm is indifferent between the two countries

$$\gamma^{ij} := \pi_j^{ij}(\mu) - t_j - \left[\pi_i^{ij}(\mu) - t_i\right], \quad \gamma^{ki} := \pi_i^{ki}(\mu) - t_i - \left[\pi_k^{ki}(\mu) - t_k\right]. \tag{6}$$

In country i, the mass of industries with one regional firm (i.e., one immobile firm) is given by

$$G\left(\gamma^{ij}\right) + \left[1 - G\left(\gamma^{ki}\right)\right], \tag{7}$$

where the first term refers to the industries with low fixed costs in country j relative to i, and similar for the second term, where fixed costs measure the set-up cost in country i relative to k. The mass of industries with two regional firms (i.e., one mobile and one immobile firm) in i reads as

$$\left[1 - G\left(\gamma^{ij}\right)\right] + G\left(\gamma^{ki}\right). \tag{8}$$

Notice that households in country i consume goods produced by jk-industries, but there is no production in or relocation towards i, which significantly simplifies the analysis. 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-dimensional object that is tractable enough to study policy implications. Our concept of mobility allows us to write the threshold industry level in closed form as a function of the model parameters. In particular, it is linear in the tax

[12] While pre-tax variable profits (4) are non-negative, we cannot guarantee directly that net profits (after tax and fixed cost) are as well. In simulations, we were able to verify for various parameter value combinations that there exist subgame-perfect equilibria in which the profits of all firms were non-negative. 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 non-negative.

differential

$$\gamma^{ij} = \tau_{ij}\left(n_j - n_i\right)\frac{6(\alpha - w) - 3\tau_{ij}}{16\beta} + n_k\left(\tau_{ik} - \tau_{jk}\right)\frac{6(\alpha - w) - 3\left(\tau_{ik} + \tau_{jk}\right)}{16\beta} + t_i - t_j. \tag{9}$$

Comparative Statics. The partial equilibrium comparative statics are intuitive. The higher the tax in country i relative to j and k, the more firms move out of that country (γ^{ij} increases and γ^{ki} decreases, respectively). Observing that the sign of $\frac{\partial \gamma^{ij}}{\partial \tau_{ij}}$ 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 move to larger countries. In this case, market access considerations become more important compared to business tax differentials for mobile firms. Moreover, if trade becomes more costly for firms located abroad, firms move to country i ($\frac{\partial \gamma^{ij}}{\partial \tau_{ik}} > 0$ and $\frac{\partial \gamma^{ij}}{\partial \tau_{jk}} < 0$).

2.1.3 Governments

Non-Cooperative Tax Policies (Stage 1). In this section, we consider the first stage of our economy. That is, for a given level of trade costs, we derive Nash equilibrium taxes set by benevolent social planners in each country, who take the effect of taxes on households' consumption choices and location and output decisions of all firms and industries into account.

Consider country i. We compute the total number of firms (as opposed to the mass of industries) by adding Equation (7) and two times Equation (8). Hence, tax revenues read as $T_i := t_i\left[3 - G\left(\gamma^{ij}\right) + G\left(\gamma^{ki}\right)\right]$. Moreover, the Online Appendix shows that consumer surplus is given by

$$S_i := G\left(\gamma^{ij}\right)\Delta_i^{ij} + G\left(\gamma^{jk}\right)\Delta_i^{jk} + G\left(\gamma^{ki}\right)\Delta_i^{ki} + \delta_i^{ij} + \delta_i^{jk} + \delta_i^{ki}, \tag{10}$$

where Δ_i^{ij}, Δ_i^{jk},Δ_i^{ki}, δ_i^{ij}, δ_i^{jk}, and δ_i^{ki} are defined as functions of the model's primitives

$$\Theta := \left(\alpha, \beta, w, (n_i)_{i\in\mathscr{K}}, (\tau_{ij})_{i,j\in\mathscr{K}}, \underline{F}, \overline{F}\right).$$

The benevolent social planner in country i maximizes the sum of consumer surplus and tax revenues (recall that profits go to absentee owners) and, therefore, solves the following optimization problem

$$W_i := \max_{t_i} S_i + T_i + n_i w, \tag{11}$$

taking t_j and t_k as given. Similarly, welfare is maximized in countries j and k over t_j and t_k, respectively.

The first-order condition of the social planner problem yields a reaction function $t_i\left(t_j, t_k, \Theta\right)$ for each country i. As we show in the Online Appendix, the reaction functions are linear in taxes and there is a unique intersection of the reaction functions, $t_i\left(\Theta\right)$ for $i \in \mathscr{K}$, forming the solution to the tax competition game. In the following, we consider the equilibrium of this game with three countries.

Nash Equilibrium Comparative Statics. Lemma 1 verbally summarizes comparative statics of Nash equilibrium taxes with respect to trade costs and country population sizes (without offsetting population changes elsewhere). For a more technical statement, we refer to the Online Appendix.

Lemma 1 (trade cost and population changes)**.** *In the subgame-perfect Nash equilibrium of economy $\mathscr{E}$,*

(a) *a rise in country i's population size, n_i, increases that country's business tax, whereas an increase in another country's population, n_j, reduces country i's tax, as long as trade between these countries is not too cheap relative to the one between other countries ($\tau_{ij} \not\ll \tau_{jk}$), and*

(b) *a rise in country i's trade costs vis-à-vis another country j, τ_{ij}, decreases country i's business tax, as long as it is not too large relative to the other country ($n_i \not\gg n_j$). An increase in the trade costs of other countries, τ_{jk}, raises country i's business tax.*

Lemma 1 (a) shows that an increase in absolute market size, for instance, induced by population growth in a country, improves that country's ability to tax. Therefore, larger countries tend to tax more. The effect of a growing population in another country is less clear. The relationship between t_i and n_j is positive if the trade of country j with k is very costly compared to the one with country i. On the other hand, $\frac{dt_i}{dn_j} < 0$ if τ_{ij} and τ_{jk} are sufficiently similar. The same arguments apply to the effects of n_k on t_i. When i and j form an economic union (i.e., $\tau_{ik} = \tau_{jk} > \tau_{ij}$), an enlargement of market k reduces taxes inside the union.

Moreover, higher trade costs between countries j and k unambiguously lead to an increase in the tax in country i. Intuitively, countries j and k lose attractiveness when their trade costs rise, which puts country i in the position to tax more. Moreover, provided that country i is not too large, higher trade costs for firms in i put pressure on i's government to lower the tax to attract firms. If country i is very large relative to j, $\frac{dt_i}{d\tau_{ij}}$ can be positive. Then, an increase in τ_{ij} makes tax savings motives less relevant for the location choice of firms because these just want to have low-cost access to the huge market. In other words, the tax base of country i becomes less elastic in response to a rise in τ_{ij}. However, one should note that the taxes in i and j cannot increase simultaneously. That is, there will always be a country that has to lower its tax.

Having dealt with these comparative statics, in Corollary 1 in the Online Appendix, we consider comparative statics of the (unweighted) average taxes with respect to trade costs. When bilateral trade costs between i and j increase, the average tax in these countries falls. The same holds for the average tax worldwide. A rise in τ_{ij} reduces economic activity worldwide, and attracting firms to improve domestic prices becomes more important.

2.2 The Impact of Economic Disintegration on Tax Policies

In the following, we consider several channels through which economic disintegration affects tax policy. First, the costs of bilateral trade between countries change (trade-cost effect). Moreover, economic disintegration alters the international mobility of firms via location fixed costs (de-harmonization effect and business-friction effect). Finally, we deal with the possible migration of households (migration effect). As already mentioned, we do not impose any assumption on the underlying institutional structure. Our leading example is the exit from an economic union, as in the Brexit case. However, the main insights carry over to other forms of disintegration.

2.2.1 Trade-Cost Effect

Suppose, for instance, that countries i and j are in an economic union (e.g., the EU) and have similar trade costs. What happens to taxes when trade between country k (e.g., the UK) and the economic union becomes more (or less) costly? As Proposition 1 shows, the answer depends on the relative sizes of the three markets. The proposition follows from Lemma 1. Again, we relegate a more technical formulation of Proposition 1 to the Online Appendix.

Proposition 1 (trade-cost effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$. Let trade costs between the leaving and the remaining countries be sufficiently similar initially. Then, the disintegration of country k via a rise in bilateral trade costs with countries i and j*

(*a*) *reduces the leaving country's business tax, as long as its population is not too large relative to the other countries, and*

(*b*) *reduces taxes in the other countries, as long as these are not too large in terms of* *population relative to the leaving country. Under considerable asymmetries in population sizes, business taxes in countries i and j converge.*

(c) *Under symmetric population sizes of all three countries, the disintegration reduces taxes in all countries.*

When countries have the same population size ($n_i = n_j = n_k$), the tax in the leaving country always declines. The same holds if it is not too large relative to the other countries (the economic union). The market access argument described above drives this result.

If market sizes are equal, taxes in the remaining economic union decrease. If the leaving country is huge (small) relative to the economic union, taxes in the union will decline (rise). Notice that the reaction of taxes inside the economic union can be asymmetric depending on the relative size of the two markets. Let j be the largest of the three markets. Observe that the increase in trade costs with country k may help the smaller country i to tax more, whereas the larger country j needs to lower its tax. Country j still taxes more than i, but taxes converge as a reaction to the disintegration of k.

By comparing Proposition 1 to Lemma 1, one can easily see how a two-country setting, as studied in the previous literature, fails to capture the effects of a country's economic disintegration. In Lemma 1, we show that firms move to the larger market in response to a rise in trade costs (e.g., the economic union). This reaction would lower business taxes in the smaller leaving country but increases taxes in the larger market (the economic union). According to Proposition 1, however, business taxes may decline everywhere. Moreover, a two-country setting cannot address the potentially asymmetric reactions among the remaining member countries.

As we show in the Online Appendix, the assumption that trade costs are initially similar can easily be relaxed. We demonstrate how to adjust the proposition when trade costs differ. The size of the additional term is relatively small and does not alter the main insights concerning relative market sizes. Moreover, the magnitude of the adjustment is decreasing in the number of competing countries K (see Section 2.3).

Proposition 1 is our first main result. It speaks to the hypothesis that, after Brexit, the UK lowers its tax, and this, in turn, puts pressure on the tax policies of countries inside the union. Taking the populations of the UK and France (which is very similar at 66 and 67 million) and Germany at 83 million, a UK departure from a union among these three countries would lead to lower taxes in all countries according to this simple three-country setup. The hypothetical exit of a somewhat smaller country like Spain (47 million) from a joint union with France and Germany, however, would lead to an increase in the business tax in France (whereas still lowering taxes in the other two countries).

2.2.2 De-Harmonization Effect and Business-Friction Effect

De-Harmonization Effect. So far, we have considered asymmetries which directly affect production choices by firms, that is, the intensive margin of firm decisions. Through pre-tax profit differentials, these asymmetries also change cutoff industries, which determine the relative number of firms. By contrast, we now consider the direct effects of economic disintegration on firm relocation. Recall from Equation (5) that a firm in industry ij locates in country i only if $\pi_i^{ij}(\mu) - t_i \geq \pi_j^{ij}(\mu) - t_j - F^{ij}$. That is, the firm has to cover a location cost drawn from a cost distribution. This cost distribution may differ between country pairs. Note that these cost distributions influence relocation elasticities, which vary origin-destination-wise. Relocation within the union is typically cheaper than from the inside of the union to the outside. Thus, the relocation-cost differential is another dimension of economic integration. It describes the degree of harmonization or mutual acceptance of production standards and other business regulations a country pair has reached. One should note that, through this channel, economic integration tends to intensify tax competition, as it simplifies firm relocation and, hence, makes tax bases more elastic. Contributors to the tax competition literature have extensively studied this mechanism. However, the literature is silent about what happens to taxes when one country disintegrates from a set of other countries by de-harmonizing and, as a result, faces a less elastic tax base. This de-harmonization effect is intuitive in the case of an exit from an economic union. However, it applies more broadly to disintegration whenever governments reduce their efforts to reach similar standards and regulations by multilateral agreements, such as in health and environmental protection.

We operationalize this channel as follows. Recall that $F^{ij} \in \left[\underline{F}_{ij}, \overline{F}^{ij}\right]$ is drawn from a uniform distribution $G^{ij}\left(F^{ij}\right) = \frac{F^{ij} - \underline{F}^{ij}}{\overline{F}^{ij} - \underline{F}^{ij}}$. Suppose for now that both countries have the same level of business frictions ($\nu^i = \nu^j$) such that $-\underline{F}_{ij} = \overline{F}^{ij}$. Now we can directly interpret $\overline{\epsilon}^{ij}$ and, hence, $\overline{F}^{ij} = \overline{\epsilon}^{ij} + \overline{\epsilon}$ as the degree of harmonization between i and j. Therefore, economic disintegration induces a mean-preserving spread in the distribution of relative fixed costs. The higher $\overline{\epsilon}^{ij}$ (and, accordingly, $\overline{F}^{ij} = -\underline{F}_{ij}$), the more firms, and in this setting also industries, are attached to a particular country, and the less should business tax differentials matter for location decisions. When country k disintegrates from i and j, $\overline{\epsilon}^{jk}$ and $\overline{\epsilon}^{ki}$ rise in our model.

To dissect this effect, let us for now assume full country symmetry in all primitives of the model other than the distribution of fixed costs between any two countries. Then, we can derive each country's equilibrium tax as a function of $\left(\overline{\epsilon}^{ij}\right)_{i,j\in\mathscr{K}}$. For a detailed exposition, we refer to the Online Appendix. We can now state Proposition 2.

Proposition 2 (de-harmonization effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ and suppose that trade costs and country sizes are identical. Let the degree of harmonization in business regulations across countries be sufficiently similar initially. Then, a rise in the degree of harmonization between two countries reduces all country's business taxes. Hence, the disintegration of country k via a de-harmonization between countries raises taxes everywhere.*

The mechanism behind this finding is known from the literature. By construction of our model, a rise in $\overline{\epsilon}^{jk}$ makes tax bases in the countries j and k less elastic, which tends to increase taxes in these countries. In the Nash equilibrium, this spills over to the tax of country i. Due to the strategic complementarity of tax policies, t_i increases.

In most cases and in particular for similar initial conditions, the tax of a country goes up when the fixed cost distribution widens between that country and another one, that is, t_i increases in $\overline{\epsilon}^{ij}$. As we show in the Online Appendix, however, there may be cases in which the tax falls ($\frac{dt_i}{d\overline{\epsilon}^{ij}} < 0$).

With regard to economic disintegration, the proposition describes another potential effect of the disintegration of country k from i and j, which we label as a de-harmonization effect. When $\overline{\epsilon}^{jk}$ and $\overline{\epsilon}^{ki}$ increase simultaneously, tax bases become less elastic between the economic union and the exiting country k. The lower mobility of firms causes taxes to rise everywhere. Note that the response in tax rates from the de-harmonization effect is the opposite of the one from the trade-cost effect (in the case of symmetric countries). So far, we have described origin-destination-specific asymmetries in the firm relocation costs and analyzed the impact of a drop in the mobility of firms between countries. Our second main result suggests that business taxes will increase everywhere if economic disintegration occurs only in the form of more firm attachment to their countries. When interpreting the reduction in firm mobility as a feature of economic disintegration, two notes of caution are indicated, however.

First, the rise in $\overline{\epsilon}^{jk}$ and $\overline{\epsilon}^{ki}$ characterizes the economic disintegration of country k only in the short run, as it regards those firms which already exist and decide to relocate after the disintegration of k. For example, when firms anticipate the exit of country k from the economic union, the country's disintegration may discourage prospective entrepreneurs from investing in a firm located in k initially. To summarize, in the long run, the mass of potential firms is endogenous to the degree of economic integration. Accordingly, one of our extensions in Section 2.4 regards the effects of changing the ex-ante distribution of firms.

Business-Friction Effect. Second, we have assumed that economic disintegration triggers a mean-preserving spread in the relocation cost distribution. Therefore, a rise in $\overline{\epsilon}^{jk}$ affects countries j and k in the same way, which seems reasonable in the context of production standards and harmonization of regulations. However, regarding the effects of the disintegration of country k from j, it might be that production frictions in country k increase such that firm relocation from j to k becomes more costly than vice versa.

Therefore, we now consider the case where the disintegration causes firm relocation cost distributions to shift. As before, $F^{ij} \in \left[\underline{F}_{ij}, \overline{F}^{ij}\right]$ is drawn from a uniform distribution $G^{ij}\left(F^{ij}\right) = \frac{F^{ij} - \underline{F}^{ij}}{\overline{F}^{ij} - \underline{F}^{ij}}$ where $\overline{F}^{ij} - \underline{F}^{ij} = \overline{F}^{jk} - \underline{F}^{jk} = \overline{F}^{ki} - \underline{F}^{ki}$. However, now the relocation cost distributions are allowed to have a different mean: $\nu^{ij} := \nu^{j} - \nu^{i} \gtreqless \nu^{jk} := \nu^{k} - \nu^{j} \gtreqless \nu^{ki} := \nu^{i} - \nu^{k}$.

By considering comparative statics of taxes with respect to these means, we can study the effects of a shift in the relocation cost distributions. In particular, we are interested in the case where locating in the leaving country becomes more costly relative to setting up a business in the other countries (e.g, the economic union). In Proposition 3, we show that the effects point in intuitive directions. We prove the statement in the Online Appendix.

Proposition 3 (business-friction effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$. An increase in the average cost of setting up a business in a country relative to another country induces a lower tax in the former country and increases the tax in the latter one. Hence, the disintegration of country k via a rise in business frictions lowers the business tax in the leaving country and increases taxes elsewhere.*

When ν^{ij} increases, the cost of locating in country j relative to country i goes up on average. As a consequence, country i gains market shares. Vice versa, country i loses industries after a rise in ν^{ki}. In the former case, country i's ability to tax improves. In the latter case, country i has to lower its business tax. A change in ν^{jk} does not affect t_i because the reduction in t_k just offsets the rise in t_j.

Consider again the situation in which country k disintegrates from an economic union formed by i and j. When this disintegration makes it relatively more costly to set up a business in country k than inside the economic union, ν^{ki} decreases and ν^{jk} rises. By Proposition 3, country k has to lower its business tax. Members of the economic union tax more.

2.2.3 Migration Effect

So far, we have dealt with changes in parameters that directly affect the production side. Now, we deal with economic disintegration as a trigger of household migration.[13] Migration flows are particularly relevant if a country leaves an economic union that guarantees the free movement of labor. To provide an example, after Brexit, some EU citizens in the UK may return to their home countries or other countries in the union. However, also other forms of economic disintegration induce household migration. The reason is that economic disintegration affects local prices and, therefore, utility levels of households in a given country. When households are internationally mobile just like firms, they will migrate from one jurisdiction to another as long as the difference in utilities exceeds the migration cost.

In the following, we deal with the effects of exogenously driven migration on taxes. Unlike Lemma 1, we now assume that the world population stays constant and consider only population shifts between countries. Moreover, we return to the case where fixed cost distributions are symmetric, $\overline{F}^{ij} = \overline{F}$ for any i, j. Proposition 4 follows from the comparative statics of Lemma 1. For a more detailed statement, we refer to the Online Appendix.

Proposition 4 (migration effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ and suppose that trade costs are sufficiently similar initially. Then, household migration from country i to j decreases country i's tax and increases the tax in j. The reaction in country k's tax is positive if and only if trade with country j is cheaper than with i ($\tau_{jk} < \tau_{ik}$). Hence, the migration into an integrated area triggered by the disintegration of country k lowers the leaving country's business tax and increases taxes inside the integrated area.*

The effects of migration (i.e., a change in the size of countries while holding $\sum_{i \in \mathscr{K}} n_i$ fixed) on taxes depend on the origin and the destination of migration flows. Migration from the leaving country into another country reduces the leaving country's tax and allows the destination country

[13] See, for example, Caliendo, Opromolla, Parro, and Sforza (2017) who document the migration flows caused by the EU enlargement and quantitatively assess the resulting welfare effects.

to tax more. The tax in the third country, which is not directly affected by migration, rises as well if trade with the destination country is cheap. Hence, migration into an integrated area, such as an economic union, a customs union, or a free-trade area, in which trade is cheaper than outside, increases taxes in the integrated area. The intuition is that the integrated area grows as a whole such that member countries become more attractive to mobile firms irrespective of whereto migrants precisely move.

What is the average effect of a population shift from the leaving country towards a member country? One can see from Corollary (3) in the Online Appendix that the average tax of these two countries declines. In other words, the leaving country reduces its tax by more than the member country can raise its tax. The average tax of the world increases. As described above, the population shift improves the other member country's ability to tax. In sum, taxes in the integrated area increase. This rise outweighs the reduction in the tax of the leaving country, such that the effect on the average tax of the world is positive.

Altogether, referring to our leading example of an economic union, migration from outside to inside the union increases taxes inside the union and reduces the leaving country's tax. This migration effect is the third central insight from our model.

2.3 The K-Country Model

Having described the three-country model, extending our economy $\mathscr{E}$ to an arbitrary number of K countries is straightforward and, at the same time worthwhile, because it allows us to analyze the effects of disintegration on third countries that are not directly affected. Let $\mathscr{K}_{EU} \subseteq \mathscr{K}$ denote the non-empty set of countries from which the leaving country disintegrates and $K_{EU} := |\mathscr{K}_{EU}| \in \mathbb{Z}^+$ its cardinality. For example, this 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 $m \in \mathscr{K}_{EU}$ to as a "member country." Note that $1 \leq K_{EU} \leq K$. For simplicity, let us consider the case where $\overline{F} = -\underline{F} > 0$. As we have seen, we can readily relax this assumption. However, in this section, we want to focus on two additional dimensions of economic disintegration, which the three-country model is unable to address. First, we show the effect of a rise in trade costs between a country leaving the economic union and the remaining member countries on third countries' tax policy. In the Brexit case, these are countries that were already outside the union before the exit (like the US, India, or China), which occurs when $K_{EU} < K$. Secondly, we impose some symmetry assumptions and derive the tax policy of each country as a function of K_{EU}. These assumptions allow us to model economic disintegration purely as a change in K_{EU}. For a detailed derivation of the K-country model, we refer to the Online Appendix.

2.3.1 Trade-Cost Effect

We now state Proposition 5, which is the K-country counterpart to Proposition 1.[14] It is useful to define the average population of the member countries as $\bar{n}_{EU} = \frac{1}{K_{EU}} \sum_{m \in \mathcal{K}_{EU}} n_m$. We relegate the proof and a more technical statement of the proposition to the Online Appendix.

Proposition 5 (trade-cost effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathcal{E}$. Let trade costs between the leaving and the remaining countries be sufficiently similar initially. Suppose that country $l \in \mathcal{K} \backslash \mathcal{K}_{EU}$ disintegrates from the member countries $m \in \mathcal{K}_{EU}$. Then, the disintegration of country l via a rise in trade costs*

(a) *decreases the leaving country's business tax unless its population is very large relative to $\bar{n}_{EU}$,*

(b) *decreases taxes in the remaining member countries under symmetric population sizes, if the union faces many competing markets, and can have asymmetric effects under considerable asymmetries in market sizes, and*

(c) *raises taxes in third countries $\mathcal{K} \backslash (\mathcal{K}_{EU} \cup l)$.*

Trade disintegration between l and $\mathcal{K}_{EU}$ makes third countries relatively more attractive, which allows them to tax more (part (c)). As for the three-country case already described, the tax of country l will decrease in the aftermath of its disintegration (e.g., from the economic union) provided that it is not too large relative to the average member country.

The reaction of taxes in member countries is case-specific. It depends on the size of the leaving country, the respective member country, as well as the average member country. In general, the effect in a member country is positive if the average market size is large enough relative to the respective member country's market and the one of the leaving country, revealing a similar convergence result as in Proposition 1.

[14]Observe that we only consider direct effects of economic disintegration, i.e. changes in the trade relations of the leaving country with $\mathcal{K}_{EU}$. In particular, we hold trade relations with third countries fixed which is plausible in the Brexit case since the UK remains part of the WTO. Moreover, it ignores the possibility that the UK might form new trade agreements, e.g. with the US. In Section 2.5, we study, however, the readjustment of trade policies for a given set of trade agreements.

After imposing cross-country symmetry in market size ($n := n_m = n_l$), the derivative in (b) reduces to

$$\frac{dt_m}{d\tau_{ml}} + \sum_{j \in \mathcal{K}_{EU} \setminus \{m\}} \frac{dt_m}{d\tau_{jl}} = \frac{4K_{EU} - 2K - 1}{2K - 1} \frac{3n(\alpha - w - \tau)}{16\beta} \begin{cases} > 0 & for\ 4K_{EU} > 2K + 1 \\ < 0 & for\ 4K_{EU} < 2K + 1 \end{cases}. \tag{12}$$

Referring to the departure from an economic union, taxes inside the union rise when it has many member countries. In our setting, this corresponds to a particularly strong internal market, which covers most of the demand for tradeable goods and services. Furthermore, one can observe the effects of globalization, here interpreted as the number of countries in the world that are related through trade and firm investment. The more competing countries the economic union faces (K), the more sensitive react members' tax bases and, hence, taxes to a member country's disintegration. Put differently, in a globalized world, the union is vulnerable to the fiscal consequences of economic disintegration. In the context of Brexit, the condition for members' taxes to rise, according to Equation (12), is clearly not given. The number of countries in the world is larger than twice the EU's 27 member states.

Equation (12) transparently reveals two respects in which reverse unilateral integration may differ from unilateral disintegration: Both the sign and the size of the effects depend on the initial level of economic integration. As described, whether the response of business taxes is positive in the union depends on the number of competing markets. Moreover, for initially high trade costs, the effect size is small. Thus, one should be careful when inferring the effects of disintegration (e.g., Brexit) from the years of partial integration (e.g., in the 1970s when the UK joined the union and the integration was at an early stage).

Similar to Proposition 1, there is no need to consider symmetric trade costs between the leaving and the member countries, as we show in the Online Appendix. Moreover, the statement regards any type of economic disintegration that leads to a rise in trade costs between the leaving country and the remaining members.

In Corollary 5 in the Online Appendix, we consider the impact on world, EU, and non-EU average taxes. The disintegration of country l increases on average taxes of third countries, but reduces the average tax worldwide. This result is robust and does not depend on country sizes or the number of countries in the union. The effect on the average tax in the remaining economic union is case-specific, as Equation (12) suggests. That is, the average tax inside the union rises in reaction to the disintegration when the remaining economic union size is considerable. Vice versa, at a late stage of globalization, the number of rival markets (i.e., K) is significant, and member countries need to lower their taxes to stay competitive on the world market after the exit of a union member.

2.3.2 Union-Size Effect

Another way to examine the consequences of economic disintegration for tax policy is to impose some symmetry assumptions across countries and to directly differentiate taxes with respect to K_{EU}, as if the number of member countries was defined on a continuous domain.[15] In particular, assume symmetry in country sizes as well as in internal and external trade costs as in a customs or an economic union.

Assumption 1. *Let $n := n_i = n_j$ for all $i, j \in \mathscr{K}$. Moreover, let internal and external trade costs be symmetric, $\tau^* := \tau_{ij} = \tau_{ik}$ for all $i, j, k \in \mathscr{K}_{EU}$ and $\tau := \tau_{lm} = \tau_{ln} > \tau^*$ for all $l \in \mathscr{K}$ and $m, n \in \mathscr{K} \setminus \mathscr{K}_{EU}$. Let $K_{EU} > 1$.*

In the Online Appendix, we show that under Assumption 1 the tax of member countries, t_m, and the one of non-member countries, t_n, are functions of a reduced set of model primitives $\widetilde{\Theta} := \left(\alpha, \beta, w, n, \tau^*, \tau, \overline{F}, K, K_{EU}\right)$. In Proposition 6, we summarize our main findings.

Proposition 6 (union-size effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K > 2$ countries. Let Assumption 1 hold and suppose that $K, K_{EU} \in \mathbb{R}^+$. Then,*

(a) business taxes inside the union are larger than outside,

(b) a rise in the number of member countries increases business taxes in member countries, and

(c) a rise in the number of member countries decreases business taxes in non-member countries.

As implied by (a), being part of the economic or a customs union makes countries more attractive to firms, which lowers tax competition for these countries. Thus, ceteris paribus the tax of the country that leaves the economic or the customs union declines.

[15]This procedure is in its flavor similar to the literature on the effects of federalism and government decentralization on private investment (e.g., Kessing, Konrad, and Kotsogiannis (2006)).

Moreover, when the union loses member countries, the taxes inside the union will fall, and those outside the union will rise. The latter mirrors Proposition 5 (c). The former, however, will only be in line with Proposition 5 (b) if the union is small compared to the rest of the world. This conflicting finding is not surprising since the analysis conducted in this section is, due to Assumption 1, much more gritty than the one in Section 2.3.1.

Regarding the effects of globalization on taxes, one may differentiate the average worldwide business tax with respect to K. In the Online Appendix, we show that the derivative is positive. That is, overall taxes decline as globalization increases the number of competing markets.

In this section, we have extended our model to any number of countries (K) with an arbitrary institutional structure (K_{EU}). As we have seen, the results and intuitions formed in the three-country world remain valid.

2.4 Extensions

In this section, we consider various extensions of the base model and summarize the main findings. In a Supplementary Online Appendix, we provide detailed derivations.[16]

Tariff Revenues and Subsidy Expenditures. Firstly, we explicitly incorporate revenue effects from tariffs into our model. That is, aside from non-tariff trade barriers, we allow for the presence of import and export tariffs. Just as non-tariff trade barriers, trade taxes affect consumer surplus and revenues from taxing corporations. Besides, tariffs generate additional fiscal revenues. For non-negative import tariffs and export subsidies, the optimal business tax of a country is revised upwards. The intuition is as follows: when business taxes in a country rise, firms move away from that country. As a result, the government generates extra tariff revenues and saves expenditures on export subsidies.

Accordingly, the reaction of Nash equilibrium business taxes to a rise in non-tariff trade costs is downwards adjusted. The reason is that higher trade costs reduce trade volumes such that the extra gains in tariffs (expenditure savings) decline. Nonetheless, the key trade-offs, in particular concerning the above-described effects of economic disintegration, carry over.

Another remarkable feature is that the business tax of country i is U-shaped in foreign trade taxes. This pattern is similar to Proposition 1 in Haufler and Wooton (2010) but in our setting for

[16] The Supplementary Online Appendix is available at https://www.vwl.uni-mannheim.de/(...)/Janeba/Supplementary_Online_Appendix_for_A_Theory_of_Economic_Disintegration_22102021.pdf.

trade policy instruments that have revenue effects.

Accrual of Profits. Secondly, recall that, in our baseline economy, firm profits accrue to citizens in third countries or, at least, do not enter social welfare. This assumption is only reasonable for very wealthy investors and a government with a pronounced redistributive goal but not for smaller entrepreneurs or investors. Therefore, we now deal with the domestic accrual of profits.

We distinguish two polar cases of firm ownership. The first one considers internationally mobile entrepreneurs who only enter the social welfare of a country when they decide to locate their business there. Usually, this is the case for smaller businesses. In the second case, citizens directly hold a diversified portfolio of enterprises worldwide. This assumption is realistic for mid- and big-cap companies with shares traded on international financial markets. In both cases, the social marginal welfare weight of firm ownership slightly modifies the optimal business tax. Moreover, in the former case, taxes are revised downwards by the accrual of domestic profits and, in the Nash equilibrium, of foreign profits. In the latter case, taxes account for the accrual of international profit differentials. This distinction is intuitive, as, in the first case, social welfare is a function of national income. However, when citizens are shareholders of firms worldwide, they only care about the size but not about the location of accrued profits. For both cases, our main insights carry over, as shown in the Supplementary Online Appendix.

Industry Size. We generalize our economy to an arbitrary number of immobile firms in each 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 the country mechanically raise the government's ability to tax. On the other hand, more firms increase the degree of local competition such that the country becomes less attractive as a business location to mobile firms. In the Nash equilibrium, these two effects point in the same direction for the taxes of the other countries. Using this model specification, we can shed light on the anticipatory effects of economic disintegration. Suppose that some previously immobile firms anticipate a country's disintegration and decide to initially locate in the economic union instead of the leaving country. This reallocation of firms mechanically lowers (improves) the disintegrating country's (member countries') ability to tax. At the same time, firms face more competition in the member countries, which lowers mark-ups there. Vice versa, in the leaving country, firms generate higher profits.

Cross-Price Effects. We generalize the model by allowing for cross-price effects in the demand for differentiated goods. For $\eta > 0$, the Nash equilibrium business taxes are revised upwards. The substitutability between the differentiated varieties and the numéraire rises with η. Put differently, the presence of cross-price effects shifts down the demand for differentiated varieties, thereby reducing the welfare loss from firm emigration in the differentiated industries.

Relative to Lemma 1, there are two adjustments. The first one regards the marginal effect on the aforementioned reduction in welfare losses. The second adjustment captures that the consumer surplus loss from taxing businesses is endogenous to the average price level. For similar trade costs and market sizes, which rule out the Metzler paradox, the effects point in opposite directions. However, the central intuitions regarding the impact of disintegration (e.g., via a rise in trade costs) carry over.

Competition in Regulations. We introduce competition in regulations into the first stage of our economy, in addition to the business tax as a policy instrument. That is, we endogenize each country's level of business frictions/regulations, ν^i, similar to the non-cooperative setting of business tax policies. Then, each government chooses the set of domestic policies $\left(t_i, \nu^i\right)$, taking all the other countries' business taxes and regulations as given. A rise in the level of regulations is welfare-detrimental as it triggers firm emigration, which reduces consumer surplus and tax revenues. Therefore, to obtain interior solutions, we introduce a country-specific reduced form regulation surplus $V_i\left(\nu^i\right)$ that is assumed to be increasing, concave, and, for simplicity, independent from taxes. In the context of environmental protection, this surplus could measure the value of clean air. Even without cross-country complementarities in this surplus function ($\frac{dV_i}{d\nu^j} = 0$), the optimal level of regulations is inefficiently low since a country's government does not consider the positive externality of business regulations on other countries' welfare. Thus, just as in the tax competition game, countries would gain from the international coordination of business regulations.

We demonstrate that the domestic policies interact: The optimal business tax is not only affected by the level of regulations, as in Proposition 3, but also vice versa. Interestingly, their (partial equilibrium) comparative statics may point in opposite directions. For example, whereas a rise in τ_{jk} improves country i's ability to tax, it amplifies the size of lost tax revenues and, hence, the welfare costs of ν^i. Accordingly, country i's optimal level of business regulations declines. Altogether, the impact of economic disintegration on the other domestic policies may significantly differ from those on business taxes, even if the domestic policy closely resembles a business tax from mobile firms' perspective as it is the case for business regulations.

Harmonization of Business Taxes. We also consider the scenario of partial 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. Again, there exists a unique Nash equilibrium in taxes set by the subset of countries and all other countries, which can be derived from the government's (modified) reaction functions. The formulas for the non-cooperative tax policies 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 average effects on consumer surplus and tax revenues.

The coordination of business taxes among some countries reduces ceteris paribus the degree of tax competition relative to the setting without harmonization. Conceptually, the harmonized area behaves in its setting of business taxes similar to a large country. Therefore, the impact of economic disintegration on the coordinated business tax resembles the one on a large country's tax policy.

To further shed light on the economic disintegration, we impose cross-country symmetry in market sizes and trade costs. This assumption yields a symmetric tax outside of $\mathscr{K}_H$ in addition to the one inside. In line with the intuition that the harmonized area acts as a large market and is more attractive as a business location than the other isolated markets, the business tax inside the area is higher than outside. Similar to Proposition 6, we differentiate business taxes with respect to the number of members in the harmonized area, K_H, as if it was defined on a continuous domain. Both inside and outside the area, business taxes are positively associated with K_H. Hence, a country's departure from the set of countries that coordinates their business tax policy decreases taxes worldwide. The reason is that the according reduction in K_H is equivalent to creating a new player in the tax competition game and, as a result, amplifies the degree of competition.

Richer Labor Market. In the following, we shortly describe how the presence of a richer (more carefully modeled) labor market affects our insights.[17] In our economy, free trade in the numéraire commodity equalizes the wage rate across countries and labor supply is inelastic. Suppose that trade in the numéraire commodity is not possible, and elastic labor supply (via an additively separable disutility from labor) and labor demand determine a country's wage rate on the labor

[17] The quantitative importance of trade shocks on labor market outcomes is demonstrated by Artuç, Chaudhuri, and McLaren (2010), Dix-Carneiro (2014), and others.

market. As households' utility is linear in the consumption of the numéraire, a change in tax revenues that the government rebates to households in lump-sum fashion has no income effects on labor supply. However, due to endogenous firm migration, a change in business taxes affects labor demand. The lower a country's business tax, the more mobile firms move into that country, increasing labor demand. The equilibrium wage rate and, thus, welfare in the country rises. Therefore, a richer labor market gives a country's government an additional incentive (aside from lower consumer prices and higher tax revenues) to reduce business taxes to attract mobile firms (more tax competition). Altogether, this extra wage channel strengthens our main results.

Proportional Tax on Profits. Furthermore, one may replace the lump-sum tax with a proportional tax on profits $\tilde{t}_i(\mu)$. Observe that the latter tax is equivalent to the former one for $\tilde{t}_i(\mu) = t_i/\pi_i^{ij}(\mu)$ in a given industry $\mu \in [0, 1]$. A rise in the lump-sum tax is associated with a higher proportional tax. Accordingly, our analysis above addresses the level of proportional taxes. The proportional tax affects firm relocation (threshold industries γ^{ij}) in the same way as the lump-sum tax. Country i's tax rate $\tilde{t}_i(\mu)$ is the same for all industries with the same firm mobility outcomes and, thus, with the same profit level $\pi_i^{ij}(\mu)$ (e.g., for all $F^{ij} < \gamma^{ij}$). However, it declines in the industry's profit level $\pi_i^{ij}(\mu)$. Domestic firms in sectors with less competing firms in their home market (e.g., $F^{ij} < \gamma^{ij}$ in country i) realize high profits, whereas firms with more local competition (e.g., $F^{ij} \geq \gamma^{ij}$ in country i) have low profits. Thus, a country i's government gives a tax discount on high-profit industries. These are sectors in which the government tries to attract firms that choose the other country. The government levies a higher tax on more competitive/low-profit industries where the government can attract firms in any case.

Firm Relocation across Multiple Countries. Finally, one may relax the assumption of binary firm relocation choices. To achieve the degree of tractability necessary to solve explicitly for the Nash equilibrium business tax policies, we have restricted the analysis to a firm's location choice between two countries in a given industry. If, by contrast, firm location were a multinomial choice problem, mobile firms would relocate across multiple countries. This additional firm mobility would intensify tax competition as it scales up each country's elasticity of relocation: Since each mobile firm can relocate to any other country instead of one specific country that may be relatively unattractive as a business location, a rise in a country's trade costs would induce stronger firm emigration responses. Vice versa, a decline in a country's trade costs triggers additional firm immigration because firms from all industries (also those where the country is not part of the relocation choice set in our model) can move into the country. Therefore, we expect that firm relocation across multiple countries strengthens our findings.

2.5 The Impact of Economic Disintegration on Trade Policies

In this section, we consider another dimension of economic disintegration: Trade policies around the world endogenously react to economic disintegration. Referring to our model described in Section 2.1, the setting of cooperative and non-cooperative trade policies can be modeled as the initial stage of our economy (Stage 0).[18] Taking an arbitrary, previously determined set of trade agreements as given, we develop a novel approach for studying the readjustment of trade policies worldwide triggered by economic disintegration.

We consider unilateral economic disintegration as the departure of one country from an economic union (e.g., "soft Brexit") or a customs union (e.g., "hard Brexit"). We refer to an economic union as a set of countries that form a customs union and cooperatively set their internal non-tariff trade policies. A customs union is defined, as usual, by a set of countries that jointly negotiate their common external tariffs.

We analyze the effects on trade policies around the world in response to disintegration: How do (non-tariff) trade policies inside the union change, and how do these affect endogenous tax policies in turn? How are regional trade agreements between the economic union and third countries affected? What are the effects on trade agreements between the leaving country and third countries?

Readjustment of Trade Policies (Stage 0). To answer these questions, we develop a novel approach for the study of trade policies. Trade costs between two countries $\tilde{\tau}_{ij} = t_{ij} + \tau_{ij}$ include tariffs t_{ij} (trade taxes) and non-tariff trade costs τ_{ij}.[19] Note the difference in notation between tariffs (trade taxes) t_{ij} and business taxes t_i. As in the previous section, non-tariff trade costs τ_{ij}

[18]At first glance, studying cooperative trade policies seems contradictory to the non-cooperative approach we have adopted in the context of tax policies. However, it fits well the situation of the EU, in which member countries have jointly introduced projects like the Single European Act (SEA) of 1987 to facilitate trade and commerce in the union, whereas the setting of business tax policies has so far been independent (due to unanimity requirements in tax matters at the EU level). The SEA and the free flow of goods, factors, and services in the EU have taken precedence over tax policies and, therefore, justify our timing assumptions: Countries choose trade policies simultaneously before tax policies.

[19]This definition of trade costs also allows us to incorporate tariffs (that affect government revenues) into our model of Section 2 (see Section (1.1) in the Supplementary Online Appendix available at https://www.vwl.uni-mannheim.de/(...)/Janeba/Supplementary_Online_Appendix_for_A_Theory_of_Economic_Disintegration_22102021.pdf).

entail local characteristics (such as geographical frictions) and non-tariff trade policies (such as environmental protection and product standards) that do not have government revenue effects, unlike tariffs t_{ij}. Nevertheless, similar to tariffs, governments in an economic union can negotiate non-tariff trade policies to a certain extent. We draw on the idea that cooperative trade policies result from efficient bargaining (see Grossman and Helpman (1995) and subsequent literature). Then, under the transferability of utilities, efficient cooperative trade policies maximize the respective sum of welfare, as described below. Our approach considers trade policies before (labeled as "old" optimum) and after the disintegration ("new" optimum). However, before presenting our approach in more detail, we state the following result.

Lemma 2. *Consider the subgame-perfect Nash equilibrium of economy $\mathcal{E}$ with $\overline{F}^{ij} = -\underline{F}_{ij}$ for all i, j. For positive business taxes, similar trade costs, and small tariffs, a rise in bilateral trade costs between two countries raises welfare in third countries: $\frac{dW_k}{d\tau_{ij}} > 0$ and $\frac{dW_k}{dt_{ij}} > 0$.*

In the Supplementary Online Appendix (Section (2.1)), we prove Lemma 2 in our model. The proof employs the optimality of a country's business taxes and the Nash equilibrium comparative statics to capture the impact of other countries' adjustment in tax policies on a country's welfare.

Lemma 2 has an intuitive appeal. It means that any protective measure (i.e., tariffs t_{ij} as well as non-tariff barriers summarized in τ_{ij}) 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. Not even the reduction in the latter countries' business taxes resulting from the rise in trade costs can compensate for this: Firms move to the third country, and prices decline there. This price effect raises welfare.

The assertion 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 a third countries' welfare. It may result in bilateral opportunism (as in Bagwell and Staiger (2004)). We now present our approach.

The Approach. Assume that each government optimization problem is concave and solutions are interior.[20] Moreover, suppose that trade policy changes are small. Then, we can describe our

[20]To gain an intuition for why solutions are interior, consider, for instance, the multilateral negotiation of bilateral non-tariff trade costs, τ_{mn}, inside a union. On the one hand, a rise in τ_{mn} may reduce welfare in countries m and n. On the other hand, other member countries inside the union benefit from a higher τ_{mn} (Lemma 2). As a result, there is a trade-off when choosing τ_{mn} to maximize joint welfare.

approach as a four-step procedure:

1. Approximate the respective objective function (e.g., countries' joint welfare in a trade agreement) in the new optimum around the old optimum.

2. Use the optimality of the old and new trade policy choices.

3. Impose the first-order conditions of the old optimum.

4. Relate the sign of the gradient of welfare to the change in trade policies.

Our main observation is that the objective function of the economic union (the customs union, respectively) changes when one member country leaves. As a consequence, the optimal choice of the internal non-tariff, as well as external trade policies, is affected. External trade policies include, in particular, tariffs. These form within the framework of regional trade agreements with other markets as customary in the WTO or countries set them non-cooperatively. Moreover, one should note that the described economic disintegration means effectively, although not legally, the creation of a new trading partner for all countries worldwide, with whom they can form new trade agreements.

Using the described four-step procedure, we compare cooperative and non-cooperatively chosen trade policies in the old optimum to those in the new optimum. We summarize the insights from our approach in Proposition 7. For a more detailed exposition, we refer to the Online Appendix.

Proposition 7 (endogenous trade policy responses to disintegration)**.** *Let the assumptions of Lemma 2 hold. Assume that each optimization problem is concave and solutions are interior and let trade policy changes be small.*

(*a*) *Suppose countries l and $\mathcal{K}_{EU}$ initially form an economic union (old optimum), where member countries bargain their internal non-tariff trade policies. When country l disintegrates from the economic union (new optimum), the remaining member countries integrate more with each other (lower non-tariff trade costs).*

(*b*) *Suppose countries l and $\mathcal{K}_{EU}$ initially form a customs union (old optimum). When country l leaves the customs union (new optimum), the leaving country lowers cooperative and non-cooperative tariffs toward third countries. Likewise, cooperative and non-cooperative tariffs by the customs union vis-à-vis third countries decline.*

In summary, the remaining member countries take efforts to lower their internal non-tariff barriers to trade (part (a)). Intuitively, changes in non-tariff trade barriers do not induce a first-order gain or loss on total welfare inside the economic union. However, for the old bargaining solution to be optimal, in the new optimum, the leaving country has to bear a welfare loss induced by the change in trade costs inside the union. Given Lemma 2, this can only be achieved by a reduction in trade costs. Hence, member countries integrate more with each other by reducing their internal non-tariff trade costs.

When the leaving country also exits the customs union, the union member countries lower cooperatively and non-cooperatively set trade barriers toward third countries (part (b)). For instance, the EU member countries and the US that are part of the WTO decrease their bilateral tariffs after Brexit. Moreover, the EU members implement lower tariffs toward non-WTO member countries. Similarly, trade barriers between the UK and the US decline after Brexit. The UK also lowers tariffs toward non-WTO members. The intuition for these results is the same as the one for part (a). Therefore, the departure of a country from an economic union leads ceteris paribus to a deeper integration of multilaterally formed institutions around the world and less protectionism. This suggests a counterforce to deglobalization.

Repercussions on Tax Policies. Disintegration affects the formation of trade policies in the initial stage of our economy $\mathscr{E}$ (Stage 0). For instance, when a country leaves an economic union and stays in the customs union ("soft Brexit"), the trade-cost effect in Proposition 5 needs to be augmented by the readjustment of non-tariff trade costs as follows.[21]

The statement about the impact on the leaving country's (e.g., UK's) business tax remains qualitatively unchanged. However, the endogenous reduction in non-tariff trade costs inside the economic union puts additional downward pressure on the leaving country's business tax.

As before, the business taxes inside the remaining economic union (e.g., Germany, France,...) may react asymmetrically. Having said this, under symmetric population sizes, the response of taxes inside the union will be positive. The reason is that the endogenous decline in internal trade costs makes the economic union more attractive as a business location raising member countries' ability to tax.

Third countries (e.g., the US, China,...) may now experience a decline in their business taxes. On the one hand, trade barriers between the member countries and the leaving countries rise,

[21] For mathematical details, see Supplementary Online Appendix (Section (2.2)).

which increases third countries' taxes (Proposition 5). On the other hand, the adjustment in member countries' trade policies lowers third countries' attractiveness as a business location. 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.

Normative Implications. As a byproduct of our above analysis, one can note that the normative implications of economic disintegration are generally ambiguous. The main reason for this insight is the fact that trade policies around the world change with the degree of economic integration between a subset of countries.

To give an example, consider the welfare in the country leaving an economic union. Several effects of trade policy changes add up. There are adverse effects since the remaining member countries in the economic union do not regard the leaving country's welfare when adjusting their cooperative and non-cooperative trade policies towards third countries as well as their internal degree of economic integration. Having said that, after the disintegration, the leaving country is free to set its non-cooperative external tariffs solely to its advantage. The renegotiation of existing trade agreements may be beneficial or detrimental to the leaving country. One can show that the leaving country and the respective contractual partner improve their joint surplus after the disintegration. However, this does not mean that the leaving country is better off. It may well be the case that the presence of other countries in the trade agreement, here the member countries of the economic union, proves beneficial to the leaving country. As a consequence, the economic disintegration and the resulting absence of the member countries in the trade agreement are welfare-detrimental to the leaving country. By similar arguments, the normative effects on countries in the economic union and third countries are ambiguous.[22]

To summarize, in this section, we have endogenized different dimensions of trade policy, namely tariffs and non-tariff trade costs. Altogether, along these different dimensions of trade policy, the remaining countries of an economic union take further steps towards the economic integration of their internal market when being confronted with the disintegration of a former member. After the disintegration from a customs union, the leaving country, as well as the remaining economic union, intensify their trade relations with other countries.

[22]These findings hold 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. Our central insight is to take existing inefficiencies in trade policies as given. Based on this, trade policies react worldwide to economic disintegration. Therefore, its normative implications may be far from obvious, even if one considers only first-order effects, which we address in our approach.

These further steps of economic integration do, of course, not necessarily mean that economic disintegration stabilizes multilateral institutions. It is possible that leaving a union is beneficial from a unilateral perspective, although it is multilaterally detrimental. Moreover, each loss of a member country jeopardizes the credibility of these institutions and increases the uncertainty of economic policy (see Davis (2016), Steinberg (2019), and Caldara, Iacoviello, Molligo, Prestipino, and Raffo (2020)). Also, note that these considerations assume a fixed set of trade agreements. It could be that, after disintegrating, the leaving country negotiates trade agreements with countries that do not form an agreement with member countries, and vice versa. Without imposing more structure on the underlying economy, it is a priori unclear whether countries breach existing or form new trade agreements.

3 Conclusion and Discussion

In this paper, we study the policy implications of economic disintegration. We identify several empirically testable dimensions along which disintegration affects nations' economic environment and, in turn, national policies. We set up an analytically highly tractable multi-sector, multi-country general equilibrium trade model where a set of internationally mobile firms generates fiscal competition over business taxes. This particular policy is representative of any domestic policy affecting the location of economic activity. Thereby, the firm relocation elasticity is a sufficient statistic for the optimal tax in a given country. This elasticity crucially depends not only on the economic conditions in that country but also on those worldwide. This observation even holds when a minimum of mobility is introduced, modeled as a bilateral location choice by one firm per industry. As a result, the whole economic structure influences domestic policies in each country. An important lesson from our approach is that a two-country analysis is potentially misleading when studying the effects of disintegration on national policies. By considering an arbitrary number of countries, our model takes such a broader perspective.

Economic disintegration may affect the underlying economic structure along very distinct dimensions. For example, it is not only associated with a change of the bilateral costs of trade (trade-cost effect). But disintegration also alters other economic parameters that affect nations' economic geography (de-harmonization effect and business-friction effect). As we show, these can have different policy implications. In sum, we make four policy predictions about uniltateral economic disintegration:

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 a country's economic disintegration by deepening their existing trade relations – a counterforce to deglobalization.

We recognize several limitations to our economic geography model. Firstly, we note the simplicity of the supply side in our model, such as the two-country industry structure that allowed us to obtain clear-cut policy predictions. For example, Caliendo and Parro (2015) demonstrate the quantitative importance of incorporating input-output linkages. However, putting an even more complex economic structure might cloud the relevant policy implications. Moreover, labor is an internationally mobile factor, as in Caliendo, Dvorkin, and Parro (2019). This feature holds especially true in the long run. Our comparative statics show that, even in the absence of wage effects, the number of residents strongly affects national policies and its connection to economic integration merely through market size (migration effect). Studying the interplay of national and international policies under the full mobility of firms, labor, and capital, we consider a promising area of future research.

Besides studying domestic policies, we show the impact of unilateral disintegration on trade policies. As we have argued, the counterforce-to-deglobalization result is robust to the underlying economic model. Moreover, beyond trade policies, it applies more broadly to any type of disintegration from a jointly formed agreement by economic agents. This readjustment of multilateral policies makes the welfare effects of economic disintegration very subtle. A limitation of our approach is that it can only address small policy changes. To consider large changes, one needs to know the sign and the size of the cross derivatives of welfare functions with respect to international policies. This requirement would make it necessary to impose more structure on the underlying economy.

Finally, in our analysis, we remain agnostic about the driving forces of economic disintegration. For instance, economic disintegration could reflect changes in a society's policy preferences. Thus, making these drivers of disintegration more explicit, e.g., by modeling political economy forces, is another interesting direction.

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Online Appendix for “A Theory of Economic Disintegration”

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Abstract

This is the Online Appendix for “A Theory of Economic Disintegration” by Janeba and Schulz (2021). In Section 1, we formalize the three-country model and derive the trade-cost effect. In Section 2, we characterize the de-harmonization effect, the business-friction, and the migration effect. Section 3 extends our analysis to K countries and proves the trade-cost effect and the union-size effect. In Section 4, we endogenize trade policies in the degree of economic integration.

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Contents

1 Proofs for Section 2.1

1.1 Derivation of Optimal Taxes

In order to derive consumer surplus, note that there are three continuums of industries. Depending on whether F^{ij} is less or greater than the threshold of an indifferent industry γ^{ij}, there are two distinct location outcomes per industry type such that we need to consider six different price levels. In the following, take country i's perspective. Use firms' optimal production quantities to show that the prices read as

$$p_i^{ij}(\mu) = \begin{cases} \frac{\alpha+3w+\tau_{ij}}{4} & if\, F^{ij} \geq \gamma^{ij} \\ \frac{\alpha+3w+2\tau_{ij}}{4} & if\, F^{ij} < \gamma^{ij} \end{cases}, \quad p_i^{jk}(\mu) = \begin{cases} \frac{\alpha+3w+2\tau_{ij}+\tau_{ik}}{4} & if\, F^{jk} \geq \gamma^{jk} \\ \frac{\alpha+3w+\tau_{ij}+2\tau_{ik}}{4} & if\, F^{jk} < \gamma^{jk} \end{cases},$$

and

$$p_i^{ki}(\mu) = \begin{cases} \frac{\alpha+3w+2\tau_{ik}}{4} & if\, F^{ki} \geq \gamma^{ki} \\ \frac{\alpha+3w+\tau_{ik}}{4} & if\, F^{ki} < \gamma^{ki} \end{cases}, \tag{1}$$

for any $j,k \in \mathscr{K} \backslash \{i\}$. In general, prices are lower in a country if a mobile firm locates there because trade costs are saved. Plug these prices into the demand functions $x_i^{ij}(\mu) = \frac{\alpha - p_i^{ij}(\mu)}{\beta}$, $x_i^{jk} = \frac{\alpha - p_i^{jk}(\mu)}{\beta}$, and $x_i^{ki}(\mu) = \frac{\alpha - p_i^{ki}(\mu)}{\beta}$ to obtain household consumer surplus. Multiply with the size of the market to obtain aggregate consumer surplus in country i

$$\begin{aligned} S_i = {} & n_i\left(1 - G\left(\gamma^{ij}\right)\right)\left(\alpha x_i^{ij}(\mu) - \frac{\beta}{2}\left(x_i^{ij}(\mu)\right)^2 - p_i^{ij}(\mu) x_i^{ij}(\mu)\right)|_{F^{ij} \geq \gamma^{ij}} \\ & + n_i G\left(\gamma^{ij}\right)\left(\alpha x_i^{ij}(\mu) - \frac{\beta}{2}\left(x_i^{ij}(\mu)\right)^2 - p_i^{ij}(\mu) x_i^{ij}(\mu)\right)|_{F^{ij} < \gamma^{ij}} \\ & + n_i\left(1 - G\left(\gamma^{jk}\right)\right)\left(\alpha x_i^{jk}(\mu) - \frac{\beta}{2}\left(x_i^{jk}(\mu)\right)^2 - p_i^{jk}(\mu) x_i^{jk}(\mu)\right)|_{F^{jk} \geq \gamma^{jk}} \\ & + n_i G\left(\gamma^{jk}\right)\left(\alpha x_i^{jk}(\mu) - \frac{\beta}{2}\left(x_i^{jk}(\mu)\right)^2 - p_i^{jk}(\mu) x_i^{jk}(\mu)\right)|_{F^{jk} < \gamma^{jk}} \\ & + n_i\left(1 - G\left(\gamma^{ki}\right)\right)\left(\alpha x_i^{ki}(\mu) - \frac{\beta}{2}\left(x_i^{ki}(\mu)\right)^2 - p_i^{ki}(\mu) x_i^{ki}(\mu)\right)|_{F^{ki} \geq \gamma^{ki}} \\ & + n_i G\left(\gamma^{ki}\right)\left(\alpha x_i^{ki}(\mu) - \frac{\beta}{2}\left(x_i^{ki}(\mu)\right)^2 - p_i^{ki}(\mu) x_i^{ki}(\mu)\right)|_{F^{ki} < \gamma^{ki}} \end{aligned}$$

which simplifies to $S_i = \delta_i^{ij} + G\left(\gamma^{ij}\right)\Delta_i^{ij} + \delta_i^{jk} + G\left(\gamma^{jk}\right)\Delta_i^{jk} + \delta_i^{ki} G\left(\gamma^{ki}\right)\Delta_i^{ki}$, where $\delta_i^{ij} := n_i\left(\frac{\left(3\alpha - 3w - \tau_{ij}\right)^2}{32\beta}\right)$, $\delta_i^{jk} := n_i\left(\frac{\left(3\alpha - 3w - 2\tau_{ij} - \tau_{ik}\right)^2}{32\beta}\right)$, $\delta_i^{ki} := n_i\left(\frac{\left(3\alpha - 3w - 2\tau_{ik}\right)^2}{32\beta}\right)$, $\Delta_i^{ij} := n_i\left[\left(\frac{\left(3\alpha - 3w - 2\tau_{ij}\right)^2}{32\beta}\right) - \left(\frac{\left(3\alpha - 3w - \tau_{ij}\right)^2}{32\beta}\right)\right]$, $\Delta_i^{jk} := n_i\left[\left(\frac{\left(3\alpha - 3w - \tau_{ij} - 2\tau_{ik}\right)^2}{32\beta}\right) - \left(\frac{\left(3\alpha - 3w - 2\tau_{ij} - \tau_{ik}\right)^2}{32\beta}\right)\right]$, and $\Delta_i^{ki} := n_i\left[\left(\frac{\left(3\alpha - 3w - \tau_{ik}\right)^2}{32\beta}\right) - \left(\frac{\left(3\alpha - 3w - 2\tau_{ik}\right)^2}{32\beta}\right)\right]$.

The first-order condition with respect to the business tax (wage income is constant)

$$\frac{d\left(S_i + T_i\right)}{dt_i} = \frac{1}{\overline{F} - \underline{F}}\left(\Delta_i^{ij}\frac{d\gamma^{ij}}{dt_i} + \Delta_i^{ki}\frac{d\gamma^{ki}}{dt_i}\right) + 3 - G\left(\gamma^{ij}\right) + G\left(\gamma^{ki}\right) + t_i\frac{1}{\overline{F} - \underline{F}}\left(-\frac{d\gamma^{ij}}{dt_i} + \frac{d\gamma^{ki}}{dt_i}\right) = 0 \tag{2}$$

is a sufficient condition for a maximum by the concavity of welfare because

$$\frac{d^2\left(S_i + T_i\right)}{dt_i^2} = \frac{1}{\overline{F} - \underline{F}}\left(-\frac{d\gamma^{ij}}{dt_i} + \frac{d\gamma^{ki}}{dt_i}\right) + \frac{1}{\overline{F} - \underline{F}}\left(-\frac{d\gamma^{ij}}{dt_i} + \frac{d\gamma^{ki}}{dt_i}\right) = -\frac{4}{\overline{F} - \underline{F}} < 0.$$

Country i's reaction function is therefore given by

$$t_i = \frac{1}{4}\left(\Delta_i^{ij} - \Delta_i^{ki} + 3\overline{F} - 3\underline{F} + \pi_i^{ij} + \pi_i^{ki} - \pi_j^{ij} - \pi_k^{ki} + t_j + t_k\right). \tag{3}$$

Notice that t_i is linear in t_j and t_k. As standard in most of the tax competition literature, business taxes are strategic complements. Moreover, the slope of the reaction functions is less than 1. Hence, this system of equations exhibits a unique solution

$$t_i = \frac{3}{2}\left(\overline{F} - \underline{F}\right) + \frac{3}{10}\left(\Delta_i^{ij} - \Delta_i^{ki}\right) + \frac{1}{10}\left(\Delta_j^{jk} - \Delta_j^{ij}\right) + \frac{1}{10}\left(\Delta_k^{ki} - \Delta_k^{jk}\right) + \frac{1}{5}\left(\pi_i^{ij} + \pi_i^{ki} - \pi_j^{ij} - \pi_k^{ki}\right). \quad (4)$$

1.2 Proof of Proposition 1

By differentiating Equation 4[1], and using our assumption of non-negative trade flows, $\tau_{ij} \leq \frac{\alpha-w}{3}$ for all i, j, Lemma 1 follows.

Lemma 1. *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K = 3$ countries. For any $i, j, k \in \mathscr{K}$ the following Nash equilibrium comparative statics hold for t_i*

(a) *with respect to country sizes:* $\frac{dt_i}{dn_i} = 3\tau_{ij}\frac{2(\alpha-w)-\tau_{ij}}{320\beta} + 3\tau_{ik}\frac{2(\alpha-w)-\tau_{ik}}{320\beta}$ *and* $\frac{dt_i}{dn_j} = 9\tau_{jk}\frac{2(\alpha-w)-\tau_{jk}}{320\beta} - 27\tau_{ij}\frac{2(\alpha-w)-\tau_{ij}}{320\beta}$

(b) *with respect to trade costs:* $\frac{dt_i}{d\tau_{jk}} = 9\left(n_j + n_k\right)\frac{\alpha-w-\tau_{jk}}{160\beta} > 0$ *and* $\frac{dt_i}{d\tau_{ij}} = \left(3n_i - 27n_j\right)\frac{\alpha-w-\tau_{ij}}{160\beta}$.

By summing up the expressions in part (b) of Lemma 1, we obtain Corollary 1.

Corollary 1. *For any $i, j, k \in \mathscr{K}$,* $\frac{d\frac{1}{2}(t_i+t_j)}{d\tau_{ij}} = -12\left(n_i + n_j\right)\frac{\alpha-w-\tau_{ij}}{160\beta}$, $\frac{d\frac{1}{2}(t_i+t_k)}{d\tau_{ij}} = \left(6n_i - 9n_j\right)\frac{\alpha-w-\tau_{ij}}{160\beta}$, *and* $\frac{d\frac{1}{3}\sum_{k\in\mathscr{K}} t_k}{d\tau_{ij}} = -5\left(n_i + n_j\right)\frac{\alpha-w-\tau_{ij}}{160\beta}$.

Proposition 1 also trivially follows from Lemma 1.

Proposition 1 (trade-cost effect)**.** *Consider the subgame-perfect equilibrium of economy $\mathscr{E}$ with $K = 3$. Let $\tau_{ik} = \tau_{jk}$. Then, the disintegration of country k via a rise in bilateral trade costs with countries i and j has the following tax effects*

(a) $\frac{dt_i}{d\tau_{ik}} + \frac{dt_i}{d\tau_{jk}} = \left(3n_i + 9n_j - 18n_k\right)\frac{\alpha-w-\tau}{160\beta}$ *and*

(b) $\frac{dt_k}{d\tau_{ik}} + \frac{dt_k}{d\tau_{jk}} = \left(6n_k - 27n_i - 27n_j\right)\frac{\alpha-w-\tau}{160\beta}$.

Under symmetric population sizes of all three countries, the disintegration reduces taxes in all countries.

Observe that the assumption of identical trade costs, $\tau_{ik} = \tau_{jk}$, is not very restrictive. In particular, the insights about the role of market sizes remain unchanged. For $\tau_{ik} \neq \tau_{jk}$, the signs

[1] If not stated otherwise, the equation numbering relates to the equations in this Online Appendix and not to those in the paper.

of the comparative statics are as follows $sign\left(\frac{dt_i}{d\tau_{ik}}+\frac{dt_i}{d\tau_{jk}}\right)=sign\left(3n_j+n_i-6n_k+3\left(n_j+n_k\right)\frac{\tau_{ik}-\tau_{jk}}{\alpha-w-\tau_{ik}}\right)$ and $sign\left(\frac{dt_k}{d\tau_{ik}}+\frac{dt_k}{d\tau_{jk}}\right)=sign\left(2n_k-9n_i-9n_j+\left(n_k-9n_j\right)\frac{\tau_{ik}-\tau_{jk}}{\alpha-w-\tau_{ik}}\right)$.The correction term on the right side of the two previous lines adjusts for asymmetries in trade costs. Using the assumption on the primitives that ensure positive consumption choices, $\tau_{ij}\in\left[0,\frac{\alpha-w}{3}\right]$, one may evaluate the adjustment's magnitude: $\left|\frac{\tau_{ik}-\tau_{jk}}{\alpha-w-\tau_{ik}}\right|\in\left[0,\frac{1}{2}\right]$. Therefore, even for large asymmetries in trade costs, the adjustment term is comparably small. The central intuitions carry over.

2 Proofs for Section 2.2

2.1 Proof of Proposition 2

First and similar to before, the first-order condition of the benevolent social planner in country i reads as

$$\frac{d\left(S_i+T_i\right)}{dt_i}=\Delta_i^{ij}\frac{d\gamma^{ij}}{dt_i}g^{ij}\left(\gamma^{ij}\right)+\Delta_i^{ki}\frac{d\gamma^{ki}}{dt_i}g^{ki}\left(\gamma^{ki}\right)+3-G^{ij}\left(\gamma^{ij}\right)+G^{ki}\left(\gamma^{ki}\right)+t_i\left(-g^{ij}\left(\gamma^{ij}\right)\frac{d\gamma^{ij}}{dt_i}+g^{ki}\left(\gamma^{ki}\right)\frac{d\gamma^{ki}}{dt_i}\right)=0 \tag{5}$$

which is necessary and sufficient by the second-order condition

$$\frac{d^2\left(S_i+T_i\right)}{dt_i^2}=-2g^{ij}\left(\gamma^{ij}\right)\frac{d\gamma^{ij}}{dt_i}+2g^{ki}\left(\gamma^{ki}\right)\frac{d\gamma^{ki}}{dt_i}=-\frac{1}{\overline{F}^{ij}}-\frac{1}{\overline{F}^{ki}}<0.$$

Under the symmetry assumptions (country sizes and trade costs), we can simplify the first-order condition to

$$\Delta\left(\frac{1}{2\overline{F}^{ij}}+\frac{1}{2\overline{F}^{ki}}\right)+3+t_j\frac{1}{2\overline{F}^{ij}}+t_k\frac{1}{2\overline{F}^{ki}}=t_i\left(\frac{1}{\overline{F}^{ij}}+\frac{1}{\overline{F}^{ki}}\right)$$

for every $i\in\mathscr{K}$ and $i\neq j,k$ where $\Delta:=n\left[\left(\frac{(3\alpha-3w-2\tau)^2}{32\beta}\right)-\left(\frac{(3\alpha-3w-\tau)^2}{32\beta}\right)\right]$. The intersection of the reaction functions delivers the following Nash equilibrium business tax

$$t_i=\frac{21\left(\overline{F}^{ij}\right)^2\overline{F}^{jk}\overline{F}^{ki}+24\overline{F}^{ij}\left(\overline{F}^{jk}\right)^2\overline{F}^{ki}+21\overline{F}^{ij}\overline{F}^{jk}\left(\overline{F}^{ki}\right)^2+9\left(\overline{F}^{ij}\right)^2\left(\overline{F}^{ki}\right)^2}{3\left(\overline{F}^{ij}\right)^2\left[\overline{F}^{jk}+\overline{F}^{ki}\right]+3\left(\overline{F}^{jk}\right)^2\left[\overline{F}^{ij}+\overline{F}^{ki}\right]+3\left(\overline{F}^{ki}\right)^2\left[\overline{F}^{ij}+\overline{F}^{jk}\right]+7\overline{F}^{ij}\overline{F}^{jk}\overline{F}^{ki}}+\Delta. \tag{6}$$

Now, recalling $\overline{F}^{ij}=\overline{\epsilon}^{ij}+\overline{\epsilon}$, take derivatives

$$\frac{dt_i}{d\overline{\epsilon}^{ij}}=\sigma^{-1}3\overline{F}^{ki}\left(-3\left(\overline{F}^{ij}\right)^2\left(\overline{F}^{jk}\right)^3+13\left(\overline{F}^{ij}\right)^2\left(\overline{F}^{jk}\right)^2\overline{F}^{ki}+21\left(\overline{F}^{ij}\right)^2\overline{F}^{jk}\left(\overline{F}^{ki}\right)^2+9\left(\overline{F}^{ij}\right)^2\left(\overline{F}^{ki}\right)^3+42\overline{F}^{ij}\left(\overline{F}^{jk}\right)^3\overline{F}^{ki}\right.$$
$$\left.+60\overline{F}^{ij}\left(\overline{F}^{jk}\right)^2\left(\overline{F}^{ki}\right)^2+18\overline{F}^{ij}\overline{F}^{jk}\left(\overline{F}^{ki}\right)^3+24\left(\overline{F}^{jk}\right)^4\overline{F}^{ki}+45\left(\overline{F}^{jk}\right)^3\left(\overline{F}^{ki}\right)^2+21\left(\overline{F}^{jk}\right)^2\left(\overline{F}^{ki}\right)^3\right) \tag{7}$$

and

$$\frac{dt_i}{d\overline{\epsilon}^{jk}} = \sigma^{-2}3\overline{F}^{ij}\overline{F}^{ki}\left(12\left(\overline{F}^{ij}\right)^3\overline{F}^{ki}+3\left(\overline{F}^{ij}\right)^2\left(\overline{F}^{jk}\right)^2+30\left(\overline{F}^{ij}\right)^2\overline{F}^{jk}\overline{F}^{ki}+21\left(\overline{F}^{ij}\right)^2\left(\overline{F}^{ki}\right)^2\right.$$
$$\left.+14\overline{F}^{ij}\left(\overline{F}^{jk}\right)^2\overline{F}^{ki}+30\overline{F}^{ij}\overline{F}^{jk}\left(\overline{F}^{ki}\right)^2+12\overline{F}^{ij}\left(\overline{F}^{ki}\right)^3+3\left(\overline{F}^{jk}\right)^2\left(\overline{F}^{ki}\right)^2\right) \tag{8}$$

where $\sigma^{-2} > 0$. Proposition 2 follows.

Proposition 2 (de-harmonization effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K = 3$ countries. Suppose that trade costs and country sizes are identical: $\tau := \tau_{ij} = \tau_{ik} = \tau_{jk}$ and $n := n_i = n_j = n_k$ for $i, j, k \in \mathscr{K}$.*

(a) Then, for any $i, j, k \in \mathscr{K}$ $\frac{dt_i}{d\overline{\epsilon}^{jk}} > 0$. Moreover, $\frac{dt_i}{d\overline{\epsilon}^{ij}} > 0$ for either $\overline{F}^{ij} \approx \overline{F}^{jk} \approx \overline{F}^{ki}$, or $\overline{F}^{ij} \approx 0$, or $\overline{F}^{jk} \approx 0$. However, if $\overline{F}^{ki} \approx 0$, $\frac{dt_i}{d\overline{\epsilon}^{ij}} < 0$.

(b) Suppose that i and j form an economic union, i.e. $\overline{F}^{jk} = \overline{F}^{ki} \geq \overline{F}^{ij}$. Then, $\frac{dt_i}{d\overline{\epsilon}^{jk}} + \frac{dt_i}{d\overline{\epsilon}^{ki}} > 0$, $\frac{dt_j}{d\overline{\epsilon}^{jk}} + \frac{dt_j}{d\overline{\epsilon}^{ki}} > 0$, and $\frac{dt_k}{d\overline{\epsilon}^{jk}} + \frac{dt_k}{d\overline{\epsilon}^{ki}} > 0$. Hence, the disintegration of country k raises taxes everywhere.

Therefore, $\frac{dt_i}{d\overline{\epsilon}^{jk}}$ is always positive. The sign of $\frac{dt_i}{d\overline{\epsilon}^{ij}}$ (by a resembling argument, the sign of $\frac{dt_i}{d\overline{\epsilon}^{ki}}$) depends on the relation between $\overline{F}^{ij}$, $\overline{F}^{jk}$, and $\overline{F}^{ki}$. Notice that for $\overline{F}^{ij} \approx \overline{F}^{jk} \approx \overline{F}^{ki}$, for $\overline{F}^{ij} \approx 0$, or for $\overline{F}^{jk} \approx 0$, $\frac{dt_i}{d\overline{\epsilon}^{ij}} > 0$. Indeed, there exists is a set of weaker conditions sufficient for a positive sign, e.g. $4\overline{F}^{ki} > \overline{F}^{ji}$, $14\overline{F}^{ki} > \overline{F}^{ij}$, $6\overline{F}^{jk} > \overline{F}^{ij}$, or $\overline{F}^{jk} \approx \overline{F}^{ki}$. Notice, however, that for any $\overline{F}^{ki} > 0$ with $\overline{F}^{ki} \approx 0$, we can find a $\left(\overline{F}^{ij}\right)^2\left(\overline{F}^{jk}\right)^3 > 0$ such that $\frac{dt_i}{d\overline{\epsilon}^{ij}} < 0$.

Observe that $\frac{dt_i}{d\overline{\epsilon}^{ij}} + \frac{dt_i}{d\overline{\epsilon}^{ki}}$ is always positive. Suppose that i and j form an economic union (i.e., $\overline{F}^{jk} = \overline{F}^{ki} \geq \overline{F}^{ij}$) and that k disintegrates. Then, t_k increases because $\frac{dt_j}{d\overline{\epsilon}^{jk}} + \frac{dt_j}{d\overline{\epsilon}^{ki}} > 0$. It is easy to see that the business tax in any member country i increases as well, i.e., $\frac{dt_i}{d\overline{\epsilon}^{jk}} + \frac{dt_i}{d\overline{\epsilon}^{ki}} > 0$ for $\overline{F}^{jk} = \overline{F}^{ki}$.

Corollary 2 directly follows from the expressions derived for Proposition 2. As we can see, average taxes in any two or more countries are negatively associated with firm mobility.

Corollary 2. *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K = 3$ countries. Under the symmetry assumptions of Proposition 2, average taxes between any two and among all three countries increase with a reduction in harmonization, that is, for any $i, j, k \in \mathscr{K}$, $\frac{d\frac{1}{2}(t_i+t_j)}{d\overline{\epsilon}^{ij}} > 0$, $\frac{d\frac{1}{2}(t_i+t_k)}{d\overline{\epsilon}^{ij}} > 0$, and $\frac{d\frac{1}{3}\sum_{k\in\mathscr{K}} t_k}{d\overline{\epsilon}^{ij}} > 0$.*

2.2 Proof of Proposition 3

Again, the first-order condition of the social planner in country i is described by Equation (5). Then, using $\overline{F}^{ij} - \underline{F}^{ij} = \overline{F}^{jk} - \underline{F}^{jk} = \overline{F}^{ki} - \underline{F}^{ki}$, the reaction function in country i reads as

$$t_i = \frac{1}{4}\left(\Delta_i^{ij} - \Delta_i^{ki} + 3\overline{F} - 3\underline{F} + \pi_i^{ij} + \pi_i^{ki} - \pi_j^{ij} - \pi_k^{ki} + t_j + t_k + \nu^{ij} - \nu^{ki}\right). \tag{9}$$

This set of reactions functions implies the equilibrium business tax in country i

$$t_i = \frac{3}{2}\left(\overline{F} - \underline{F}\right) + \frac{3}{10}\left(\Delta_i^{ij} - \Delta_i^{ki}\right) + \frac{1}{10}\left(\Delta_j^{jk} - \Delta_j^{ij}\right) + \frac{1}{10}\left(\Delta_k^{ki} - \Delta_k^{jk}\right) + \frac{1}{5}\left(\pi_i^{ij} + \pi_i^{ki} - \pi_j^{ij} - \pi_k^{ki} + \nu^{ij} - \nu^{ki}\right). \tag{10}$$

One can immediately observe that $\frac{dt_i}{d\nu^{ij}} = \frac{1}{5} > 0$, $\frac{dt_i}{d\nu^{ki}} = -\frac{1}{5} < 0$, and $\frac{dt_i}{d\nu^{jk}} = 0$. Proposition 3 follows.

Proposition 3 (business-friction effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K = 3$ countries. For any $i, j, k \in \mathscr{K}$ $\frac{dt_i}{d\nu^{ij}} > 0$, $\frac{dt_i}{d\nu^{ki}} < 0$, and $\frac{dt_i}{d\nu^{jk}} = 0$.*

2.3 Proof of Proposition 4

Proposition 4 follows from the comparative statics of Lemma 1.

Proposition 4 (migration effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K = 3$ countries. For any $i, j, k \in \mathscr{K}$ one can derive the following Nash equilibrium comparative statics for t_i from disintegration induced population shifts*

(a) $\frac{dt_i}{dn_i} - \frac{dt_i}{dn_j} = 30\tau_{ij}\frac{2(\alpha-w)-\tau_{ij}}{320\beta} + 3\tau_{ik}\frac{2(\alpha-w)-\tau_{ik}}{320\beta} - 9\tau_{jk}\frac{2(\alpha-w)-\tau_{jk}}{320\beta}$ *and*

(b) $\frac{dt_i}{dn_j} - \frac{dt_i}{dn_k} = 27\left(\tau_{ik} - \tau_{ij}\right)\frac{2(\alpha-w)-\left(\tau_{ik}+\tau_{ij}\right)}{320\beta}$.

Migration into an integrated area raises taxes inside the area and lowers the tax outside.

Corollary 3 regards the effect of migration from country j to i on average taxes, holding $\sum_{l\in\mathscr{K}} n_l$ and n_k fixed.

Corollary 3. *For any $i, j, k \in \mathscr{K}$ and $i \neq j, k$, the effect of population shifts on average taxes are*

(a) $\frac{d\frac{1}{2}\left(t_i+t_j\right)}{dn_i} - \frac{d\frac{1}{2}\left(t_i+t_j\right)}{dn_j} = 3\left(\tau_{ik} - \tau_{jk}\right)\frac{2(\alpha-w)-\left(\tau_{ik}+\tau_{jk}\right)}{160\beta}$, *and*

(b) $\frac{d\frac{1}{3}\sum_{k\in\mathscr{K}} t_k}{dn_i} - \frac{d\frac{1}{3}\sum_{k\in\mathscr{K}} t_k}{dn_j} = 5\left(\tau_{jk} - \tau_{ik}\right)\frac{2(\alpha-w)-\left(\tau_{jk}+\tau_{ik}\right)}{320\beta}$.

3 Proofs for Section 2.3

3.1 The K-Country Model in Section 2.3

Pre-tax profits in an ij-industry look very similar to those in the three-country case. Still, they depend on firm relocation in the following fashion

$$\pi_i^{ij}(\mu) = \begin{cases} \frac{n_i(\alpha-w+\tau_{ij})^2}{16\beta} + \frac{n_j(\alpha-w-2\tau_{ij})^2}{16\beta} + \sum_{l\in\mathscr{K}\setminus\{i,j\}} \frac{n_l(\alpha-w-2\tau_{il}+\tau_{jl})^2}{16\beta} & if\ mobile\ firm\ locates\ in\ i \\ \frac{n_i(\alpha-w+2\tau_{ij})^2}{16\beta} + \frac{n_j(\alpha-w-3\tau_{ij})^2}{16\beta} + \sum_{l\in\mathscr{K}\setminus\{i,j\}} \frac{n_l(\alpha-w-3\tau_{il}+2\tau_{jl})^2}{16\beta} & if\ mobile\ firm\ locates\ in\ j. \end{cases} \tag{11}$$

The mobile firm locates in country i if and only if $F^{ij} \geq \pi_j^{ij}(\mu) - t_j - \left(\pi_i^{ij}(\mu) - t_i\right) := \gamma^{ij}$. Again, simplifying the industry threshold becomes

$$\gamma^{ij} = (n_j - n_i)\frac{6\tau_{ij}(\alpha-w) - 3\tau_{ij}^2}{16\beta} + \sum_{l\in\mathscr{K}\setminus\{i,j\}} n_l(\tau_{il} - \tau_{jl})\frac{6(\alpha-w) - 3(\tau_{il}+\tau_{jl})}{16\beta} + t_i - t_j \tag{12}$$

and we derive partial equilibrium comparative statics as $\frac{d\gamma^{ij}}{dt_i} = 1$, $\frac{d\gamma^{ij}}{dt_j} = -1$, $\frac{d\gamma^{ij}}{d\tau_{ij}} = (n_j - n_i)\frac{3(\alpha-w-\tau_{ij})}{8\beta}$, $\frac{d\gamma^{ij}}{d\tau_{il}} = n_l\frac{3(\alpha-w-\tau_{il})}{8\beta}$, and $\frac{d\gamma^{ij}}{d\tau_{jl}} = -n_l\frac{3(\alpha-w-\tau_{jl})}{8\beta}$for $j \neq l$.

Since $\gamma^{ij} = -\gamma^{ji}$ and $G()$ is symmetric with $\overline{F} = -\underline{F}$, Lemma 2 directly follows. It will prove convenient when deriving the objective function of the government.

Lemma 2. *Consider economy $\mathscr{E}$ with $K \geq 2$. 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 $k_i := (K-1) + \frac{1}{2\overline{F}}\sum_{j\in\mathscr{K}\setminus i}\left(\overline{F} - \gamma^{ij}\right)$.*

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 $p_i^{ij}(\mu) = \frac{\alpha+3w+k_j^*(\mu)\tau_{ij}}{4}$ for $k_j^*(\mu) \in \{1,2\}$ with $j \neq i$ and $p_i^{jl}(\mu) = \frac{\alpha+3w+k_j^*(\mu)\tau_{ij}+k_l^*(\mu)\tau_{il}}{4}$ for $\left(k_j^*(\mu), k_l^*(\mu)\right) \in \{(1,2),(2,1)\}$ with $j,l \neq i$. Plug into the demand functions $x_i^{ij}(\mu) = \frac{\alpha-p_i^{ij}(\mu)}{\beta}$ and $x_i^{jl}(\mu) = \frac{\alpha-p_i^{jl}(\mu)}{\beta}$ and sum over all households in a country. The aggregate surplus in country i derived from consumption of goods in ij- and

jl-industries simplify to

$$S_i^{ij}(\mu) = n_i\left(\alpha x_i^{ij}(\mu) - \frac{\beta}{2}\left(x_i^{ij}(\mu)\right)^2 - p_i^{ij}(\mu)x_i^{ij}(\mu)\right) = \begin{cases} n_i\frac{\left(3\alpha-3w-\tau_{ij}\right)^2}{32\beta} & w/\ prob\ \left(1-G\left(\gamma^{ij}\right)\right) \\ n_i\frac{\left(3\alpha-3w-2\tau_{ij}\right)^2}{32\beta} & w/\ prob\ G\left(\gamma^{ij}\right) \end{cases},\ and \tag{13}$$

$$S_i^{jl}(\mu) = n_i\left(\alpha x_i^{jl}(\mu) - \frac{\beta}{2}\left(x_i^{jl}(\mu)\right)^2 - p_i^{jl}(\mu)x_i^{jl}(\mu)\right) = \begin{cases} n_i\frac{\left(3\alpha-3w-2\tau_{ij}-\tau_{il}\right)^2}{32\beta} & w/\ prob\ \left(1-G\left(\gamma^{jl}\right)\right) \\ n_i\frac{\left(3\alpha-3w-\tau_{ij}-2\tau_{il}\right)^2}{32\beta} & w/\ prob\ G\left(\gamma^{jl}\right) \end{cases}. \tag{14}$$

Summing over industries gives the total surplus

$$\begin{aligned} S_i = & \sum_{j\in\mathcal{K}\setminus\{i\}}\left[\left(1-G\left(\gamma^{ij}\right)\right)n_i\frac{\left(3\alpha-3w-\tau_{ij}\right)^2}{32\beta} + G\left(\gamma^{ij}\right)n_i\frac{\left(3\alpha-3w-2\tau_{ij}\right)^2}{32\beta}\right] \\ & + \frac{1}{2}\sum_{j\in\mathcal{K}\setminus\{i\}}\ \sum_{l\in\mathcal{K}\setminus\{i,j\}}\left[\left(1-G\left(\gamma^{jl}\right)\right)n_i\frac{\left(3\alpha-3w-2\tau_{ij}-\tau_{il}\right)^2}{32\beta} + G\left(\gamma^{jl}\right)n_i\frac{\left(3\alpha-3w-\tau_{ij}-2\tau_{il}\right)^2}{32\beta}\right] \\ = & \sum_{j\in\mathcal{K}\setminus\{i\}}\left[\underbrace{n_i\frac{\left(3\alpha-3w-\tau_{ij}\right)^2}{32\beta}}_{:=\delta_i^{ij}} + \frac{\gamma^{ij}-\underline{F}}{2\overline{F}}\underbrace{n_i\frac{\left(3\alpha-3w-2\tau_{ij}\right)^2-\left(3\alpha-3w-\tau_{ij}\right)^2}{32\beta}}_{:=\Delta_i^{ij}}\right] \\ & + \frac{1}{2}\sum_{j\in\mathcal{K}\setminus\{i\}}\ \sum_{l\in\mathcal{K}\setminus\{i,j\}}\left[\underbrace{n_i\frac{\left(3\alpha-3w-2\tau_{ij}-\tau_{il}\right)^2}{32\beta}}_{:=\delta_i^{jl}}\right] \\ & + \frac{1}{2}\sum_{j\in\mathcal{K}\setminus\{i\}}\ \sum_{l\in\mathcal{K}\setminus\{i,j\}}\left[\frac{\gamma^{jl}-\underline{F}}{2\overline{F}}\underbrace{n_i\frac{\left(3\alpha-3w-\tau_{ij}-2\tau_{il}\right)^2-\left(3\alpha-3w-2\tau_{ij}-\tau_{il}\right)^2}{32\beta}}_{:=\Delta_i^{jl}}\right], \end{aligned}$$

where the factor $\frac{1}{2}$ is applied to avoid double count. Therefore, consumer surplus in country i can be written as

$$S_i = \sum_{j\in\mathcal{K}\setminus\{i\}} \left[\delta_i^{ij} + \frac{\gamma^{ij} - \underline{F}}{2\overline{F}}\Delta_i^{ij}\right] + \frac{1}{2}\sum_{j\in\mathcal{K}\setminus\{i\}} \sum_{l\in\mathcal{K}\setminus\{i,j\}} \left[\delta_i^{jl} + \frac{\gamma^{jl} - \underline{F}}{2\overline{F}}\Delta_i^{jl}\right] \tag{15}$$

where Δ_i^{ij} , Δ_i^{jl}, δ_i^{ij} and δ_i^{jl} 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

$$T_i = t_i\left[(K-1) + \frac{1}{2\overline{F}}\sum_{j\in\mathcal{K}\setminus\{i\}}\left(\overline{F} - \gamma^{ij}\right)\right]. \tag{16}$$

The first-order condition is given by

$$\frac{d\left(S_i + T_i\right)}{dt_i} = \frac{1}{2\overline{F}}\sum_{j\in\mathcal{K}\setminus\{i\}}\frac{d\gamma^{ij}}{dt_i}\Delta_i^{ij} + (K-1) + \frac{1}{2\overline{F}}\sum_{j\in\mathcal{K}\setminus\{i\}}\left(\overline{F} - \gamma^{ij}\right) + t_i\frac{1}{2\overline{F}}\sum_{j\in\mathcal{K}\setminus\{i\}}\left(-\frac{d\gamma^{ij}}{dt_i}\right) = 0 \tag{17}$$

which is sufficient by the second-order condition

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

The reaction function of country i can be simplified to

$$t_i = \frac{1}{2(K-1)}\left(\sum_{j\in\mathcal{K}\setminus\{i\}}\Delta_i^{ij} + 3\overline{F}(K-1) + \sum_{j\in\mathcal{K}\setminus\{i\}}\left(\pi_i^{ij} - \pi_j^{ij}\right) + \sum_{j\in\mathcal{K}\setminus\{i\}} t_j\right). \tag{18}$$

Again, 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

$$\begin{aligned}
t_i - t_l &= \frac{1}{K-1}\left(\sum_{j\in\mathcal{K}\setminus\{i\}} \Delta_i^{ij} + 3\overline{F}(K-1) - \sum_{j\in\mathcal{K}\setminus\{i\}} \left(\pi_j^{ij} - \pi_i^{ij} + t_i - t_j\right)\right. \\
&\quad \left. - \sum_{j\in\mathcal{K}\setminus\{l\}} \Delta_l^{lj} - 3\overline{F}(K-1) + \sum_{j\in\mathcal{K}\setminus\{l\}} \left(\pi_j^{lj} - \pi_l^{lj} + t_l - t_j\right)\right) \\
&= \frac{1}{K-1}\left(\sum_{j\in\mathcal{K}\setminus\{i\}} \Delta_i^{ij} - \sum_{j\in\mathcal{K}\setminus\{l\}} \Delta_l^{lj} + \sum_{j\in\mathcal{K}\setminus\{l\}} \left(\pi_j^{lj} - \pi_l^{lj}\right) - \sum_{j\in\mathcal{K}\setminus\{i\}} \left(\pi_j^{ij} - \pi_i^{ij}\right)\right. \\
&\quad \left. + \sum_{j\in\mathcal{K}} (t_l - t_j) - (t_l - t_l) + \sum_{j\in\mathcal{K}} (t_j - t_i) - (t_i - t_i)\right) \\
&= \frac{1}{K-1}\left(\sum_{j\in\mathcal{K}\setminus\{i\}} \Delta_i^{ij} - \sum_{j\in\mathcal{K}\setminus\{l\}} \Delta_l^{lj} + \sum_{j\in\mathcal{K}\setminus\{l\}} \left(\pi_j^{lj} - \pi_l^{lj}\right) - \sum_{j\in\mathcal{K}\setminus\{i\}} \left(\pi_j^{ij} - \pi_i^{ij}\right) + K(t_l - t_i)\right) \\
&= \frac{1}{2K-1}\left(\sum_{j\in\mathcal{K}\setminus\{i\}} \Delta_i^{ij} - \sum_{j\in\mathcal{K}\setminus\{l\}} \Delta_l^{lj} + \sum_{j\in\mathcal{K}\setminus\{l\}} \left(\pi_j^{lj} - \pi_l^{lj}\right) - \sum_{j\in\mathcal{K}\setminus\{i\}} \left(\pi_j^{ij} - \pi_i^{ij}\right)\right)
\end{aligned}$$

into

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

Then, notice that

$$\sum_{j\in\mathcal{K}} \sum_{m\in\mathcal{K}\setminus\{j\}} \left(\pi_m^{jm} - \pi_j^{jm}\right) = \sum_j \sum_{m>j} \left(\pi_m^{jm} - \pi_j^{jm}\right) - \sum_j \sum_{m>j} \left(\pi_m^{jm} - \pi_j^{jm}\right) = 0 \tag{19}$$

to obtain Lemma 3.

Lemma 3. *Consider economy $\mathscr{E}$ with K countries. Suppose that $\overline{F} = -\underline{F}$. Then, the subgame-perfect Nash equilibrium of the tax competition game is given by*

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

for any $i \in \mathscr{K}$.

One can immediately see that $\frac{dt_i}{d\overline{F}} > 0$. This statement is a standard result from the literature on tax competition. A rise in $\overline{F}$ widens the range of relative fixed costs. Some industries will choose to stay in country i no matter how large the tax differential is.

We now derive further comparative statics. Since

$$\pi_i^{ij} - \pi_j^{ij} = (n_i - n_j) \frac{6\tau_{ij}(\alpha - w) - 3\tau_{ij}^2}{16\beta} - \sum_{l \in \mathscr{K} \setminus \{i,j\}} n_l \frac{6(\alpha - w)(\tau_{il} - \tau_{jl}) - 3\left(\tau_{il}^2 - \tau_{jl}^2\right)}{16\beta}, \tag{20}$$

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

$$t_i = 3\overline{F} + \frac{K}{(K-1)(2K-1)} \sum_{l \in \mathscr{K} \setminus \{i\}} \Delta_i^{il} + \frac{1}{2K-1} \sum_{l \in \mathscr{K} \setminus \{i\}} \left(\pi_i^{il} - \pi_l^{il}\right) + \frac{1}{(K-1)(2K-1)} \sum_{j \in \mathscr{K} \setminus \{i\}} \sum_{l \in \mathscr{K} \setminus \{j\}} \Delta_j^{jl} \tag{21}$$

such that

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

and

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

Furthermore, since

$$
\begin{aligned}
t_i = 3\overline{F} &+ \frac{K}{(K-1)(2K-1)} 3n_i \sum_{j\in\mathscr{K}\setminus\{i\}} \frac{\tau_{ij}^2 - 2\tau_{ij}(\alpha-w)}{32\beta} \\
&+ \frac{1}{2K-1}\sum_{j\neq i}\left((n_i - n_j)\frac{6\tau_{ij}(\alpha-w) - 3\tau_{ij}^2}{16\beta} + \sum_{l\in\mathscr{K}\setminus\{i,j\}} n_l \frac{6(\alpha-w)(\tau_{jl}-\tau_{il}) - 3\left(\tau_{jl}^2 - \tau_{il}^2\right)}{16\beta}\right) \\
&+ \frac{1}{(K-1)(2K-1)} \sum_{j\in\mathscr{K}\setminus\{i\}} \sum_{m\in\mathscr{K}\setminus\{j\}} 3n_j \frac{\tau_{jm}^2 - 2\tau_{jm}(\alpha-w)}{32\beta}, \qquad (22)
\end{aligned}
$$

the comparative statics with respect to market size are

$$
\begin{aligned}
\frac{dt_i}{dn_i} &= \frac{K}{(K-1)(2K-1)} 3 \sum_{j\in\mathscr{K}\setminus\{i\}} \frac{\tau_{ij}^2 - 2\tau_{ij}(\alpha-w)}{32\beta} + \frac{1}{2K-1}\sum_{j\in\mathscr{K}\setminus\{i\}} \frac{6\tau_{ij}(\alpha-w) - 3\tau_{ij}^2}{16\beta} \\
&= \frac{K-2}{(K-1)(2K-1)} 3 \sum_{j\in\mathscr{K}\setminus\{i\}} \tau_{ij} \frac{2(\alpha-w) - \tau_{ij}}{32\beta} \qquad (23)
\end{aligned}
$$

and

$$
\begin{aligned}
\frac{dt_i}{dn_k} &= \frac{-1}{2K-1}\frac{6\tau_{ik}(\alpha-w) - 3\tau_{ik}^2}{16\beta} + \frac{1}{2K-1}\sum_{j\in\mathscr{K}\setminus\{i,k\}} \frac{6(\alpha-w)(\tau_{jk}-\tau_{ik}) - 3\left(\tau_{jk}^2 - \tau_{ik}^2\right)}{16\beta} \\
&\quad + \frac{1}{(K-1)(2K-1)} \sum_{m\in\mathscr{K}\setminus\{k\}} 3\frac{\tau_{km}^2 - 2\tau_{km}(\alpha-w)}{32\beta} \\
&= -\frac{6(K-1)^2+3}{(K-1)(2K-1)} \frac{2\tau_{ik}(\alpha-w) - \tau_{ik}^2}{32\beta} + \frac{6(K-1)-3}{(K-1)(2K-1)} \sum_{j\in\mathscr{K}\setminus\{i,k\}} \frac{2(\alpha-w)\tau_{jk} - \tau_{jk}^2}{32\beta}. \qquad (24)
\end{aligned}
$$

Simplify these expressions to obtain Lemma 4.

Lemma 4. *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K \geq 2$ countries. Then, for any $i, j, k \in \mathscr{K}$ one can derive the following Nash equilibrium comparative statics for t_i*

(a) with respect to country sizes $\frac{dt_i}{dn_i} = \frac{3(K-2)}{(K-1)(2K-1)} \sum_{j\in\mathscr{K}\setminus\{i\}} \tau_{ij} \frac{2(\alpha-w)-\tau_{ij}}{32\beta}$ *and*

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

(b) with respect to trade costs $\frac{dt_i}{d\tau_{ij}} = \left(n_i(K-2) - 2n_j\left[(K-1)^2 + 0.5\right]\right) \frac{3}{(K-1)(2K-1)} \frac{\alpha-w-\tau_{ij}}{16\beta}$ *and* $\frac{dt_i}{d\tau_{jk}} = \left(n_j + n_k\right) \frac{3(2K-3)}{(K-1)(2K-1)} \frac{\alpha-w-\tau_{jk}}{16\beta}$.

To sum up, the intuitions from the three-country model hold. As already mentioned in the three-country setting, 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.

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, $\frac{dt_i}{d\tau_{ij}}$ will be negative if market i is not too large. Interestingly, the more countries there are, the larger market i has to be relative to j to have $\frac{dt_i}{d\tau_{ij}} > 0$.

Similar to Corollary 1, we formulate Corollary 4.

Corollary 4. *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K \geq 2$ countries. Define $\bar{t} := \frac{1}{K}\sum_{k\in\mathscr{K}} t_k$, $\bar{t}_{EU} := \frac{1}{K_{EU}}\sum_{k\in\mathscr{K}_{EU}} t_k$, and $\bar{t}_{nonEU} := \frac{1}{K-K_{EU}}\sum_{k\in\mathscr{K}\setminus\mathscr{K}_{EU}} t_k$. Then,*

(a) *for any $i,j,k \in \mathscr{K}$,* $\frac{d\frac{1}{2}\left(t_i+t_j\right)}{d\tau_{ij}} = -\frac{3[(K-1)(2K-3)+2]\left(n_i+n_j\right)}{2(K-1)(2K-1)}\frac{\alpha-w-\tau_{ij}}{16\beta}$,

$$\frac{d\frac{1}{2}\left(t_i+t_k\right)}{d\tau_{ij}} = \frac{3\left[n_i\left(3K-5\right)-n_j\left(2\left(K-1\right)\left(K-2\right)+2\right)\right]}{2\left(K-1\right)\left(2K-1\right)}\frac{\alpha-w-\tau_{ij}}{16\beta} \text{ and } \frac{d\bar{t}}{d\tau_{ij}} = -\frac{3\left(n_i+n_j\right)}{K\left(K-1\right)}\frac{\alpha-w-\tau_{ij}}{16\beta},$$

(b) *for $i,j \in \mathscr{K}_{EU}$,*

$$\frac{d\bar{t}_{EU}}{d\tau_{ij}} = -\frac{3\left[\left(K-K_{EU}+1\right)\left(2K-3\right)+2\right]\left(n_i+n_j\right)}{K_{EU}\left(K-1\right)\left(2K-1\right)}\frac{\alpha-w-\tau_{ij}}{16\beta} \text{ and } \frac{d\bar{t}_{nonEU}}{d\tau_{ij}} = \frac{3\left(2K-3\right)\left(n_i+n_j\right)}{\left(K-1\right)\left(2K-1\right)}\frac{\alpha-w-\tau_{ij}}{16\beta}.$$

(c) *for $i \in \mathscr{K}_{EU}$ and $j \in \mathscr{K}\setminus\mathscr{K}_{EU}$,*

$$\frac{d\bar{t}_{EU}}{d\tau_{ij}} = \frac{3\left(n_i\left[K-2+\left(K_{EU}-1\right)\left(2K-3\right)\right]-n_j\left[2\left(K-1\right)\left(K-K_{EU}\right)+K_{EU}\right]\right)}{K_{EU}\left(K-1\right)\left(2K-1\right)}\frac{\alpha-w-\tau_{ij}}{16\beta}$$

and

$$\frac{d\bar{t}_{nonEU}}{d\tau_{ij}} = \frac{3\left(n_j\left[K-2+\left(K-K_{EU}-1\right)\left(2K-3\right)\right]-n_i\left[2\left(K-1\right)K_{EU}+K-K_{EU}\right]\right)}{\left(K-K_{EU}\right)\left(K-1\right)\left(2K-1\right)}\frac{\alpha-w-\tau_{ij}}{16\beta}.$$

(d) *for $i,j \in \mathscr{K}\setminus\mathscr{K}_{EU}$,*

$$\frac{d\bar{t}_{EU}}{d\tau_{ij}} = \frac{3\left(2K-3\right)\left(n_i+n_j\right)}{\left(K-1\right)\left(2K-1\right)}\frac{\alpha-w-\tau_{ij}}{16\beta} \text{ and } \frac{d\bar{t}_{nonEU}}{d\tau_{ij}} = -\frac{3\left[\left(K_{EU}+1\right)\left(2K-3\right)+2\right]\left(n_i+n_j\right)}{\left(K-K_{EU}\right)\left(K-1\right)\left(2K-1\right)}\frac{\alpha-w-\tau_{ij}}{16\beta}$$

Part (a) of Corollary 4 is the K-country equivalent of Corollary 1. $(b)-(d)$ describe the effects of a rise in bilateral trade costs on average taxes. When trade between two member countries becomes more costly, members' taxes fall on average, whereas the average tax of non-member countries 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. Part (c) shows that the effects of a rise in trade costs between a member and a non-member country are unclear. They depend on relative sizes of the respective countries as well as the number of member countries.

3.2 Proof of Proposition 5

Similar to Proposition 1, we state Proposition 5.

Proposition 5 (trade-cost effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K \geq 2$ countries. Suppose that trade costs between the leaving country $l \in \mathscr{K} \backslash \mathscr{K}_{EU}$ and countries $m \in \mathscr{K}_{EU}$ are the same, $\tau = \tau_{ml}$, $\forall m \in \mathscr{K}_{EU}$, and let country l disintegrate from the member countries. This triggers the following change in the tax of*

(a) the leaving country $l \in \mathscr{K} \backslash \mathscr{K}_{EU}$

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

(b) the remaining member countries $m \in \mathscr{K}_{EU}$

$$\frac{dt_m}{d\tau_{ml}} + \sum_{j \in \mathscr{K}_{EU} \backslash \{m\}} \frac{dt_m}{d\tau_{jl}} = \frac{(K-1)\left[6K_{EU}\bar{n}_{EU} - 6n_l(K-K_{EU}) - 3n_m\right] + 3K_{EU}(n_l - \bar{n}_{EU})}{(K-1)(2K-1)} \frac{\alpha - w - \tau}{16\beta}$$

and

(c) third countries $k \in \mathscr{K} \backslash (\mathscr{K}_{EU} \cup \{l\})$

$$\sum_{j \in \mathscr{K}_{EU}} \frac{dt_k}{d\tau_{jl}} = \frac{3K_{EU}(2K-3)(\bar{n}_{EU} + n_l)}{(K-1)(2K-1)} \frac{\alpha - w - \tau}{16\beta}.$$

To show Proposition 5, we use Lemma 4. 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 $\frac{dt_l}{d\tau_{ml}}$ over all relevant country combinations (i.e., over the set $\mathscr{K}_{EU}$)

$$\sum_{m\in\mathscr{K}_{EU}} \frac{dt_l}{d\tau_{ml}} = \sum_{m\in\mathscr{K}_{EU}} \left(n_l\,(K-2) - 2n_m\left[(K-1)^2+0.5\right]\right)\frac{3}{(K-1)\,(2K-1)}\frac{\alpha-w-\tau}{16\beta}$$
$$= \left(n_l K_{EU}\,(K-2) - \sum_{m\in\mathscr{K}_{EU}} n_m\left[2\,(K-1)^2+1\right]\right)\frac{3}{(K-1)\,(2K-1)}\frac{\alpha-w-\tau}{16\beta}. \qquad (25)$$

For $n := n_m = n_n$, we obtain a simpler expression $\sum_{m=1}^{K_{EU}} \frac{dt_n}{d\tau_{mn}} = \left(5K-5-2K^2\right)\frac{3K_{EU}n}{(K-1)(2K-1)}\frac{\alpha-w-\tau}{16\beta} < 0.$

Proceed similarly to obtain the reaction of a member country $m \in \mathscr{K}_{EU}$ 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

$$\frac{dt_m}{d\tau_{ml}} + \sum_{j\in\mathscr{K}_{EU}\setminus\{m\}} \frac{dt_m}{d\tau_{jl}} = \left(n_m\,(K-2) - 2n_l\left[(K-1)^2+0.5\right]\right)\frac{3}{(K-1)\,(2K-1)}\frac{\alpha-w-\tau}{16\beta}$$
$$+ \sum_{j\in\mathscr{K}_{EU}\setminus\{m\}} \left(n_j+n_l\right)\frac{3\,(2K-3)}{(K-1)\,(2K-1)}\frac{\alpha-w-\tau}{16\beta}$$
$$= \left((K-1)\left[2\sum_{j\in\mathscr{K}_{EU}} n_j - 2n_l\,(K-K_{EU}) - n_m\right]\right.$$
$$\left. + K_{EU}\left[n_l - \frac{1}{K_{EU}}\sum_{j\in\mathscr{K}_{EU}} n_j\right]\right)\frac{3}{(K-1)\,(2K-1)}\frac{\alpha-w-\tau}{16\beta}. \qquad (26)$$

Under symmetric market size $\frac{dt_m}{d\tau_{ml}} + \sum_{j\in\mathscr{K}_{EU}\setminus\{m\}}\frac{dt_m}{d\tau_{jl}} = (4K_{EU}-2K-1)\,\frac{3n}{2K-1}\frac{\alpha-w-\tau}{16\beta}$.

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 $k \in \mathscr{K}\setminus(\mathscr{K}_{EU}\cup\{l\})$ the effect on business taxation is given by

$$\sum_{j\in\mathscr{K}_{EU}} \frac{dt_k}{d\tau_{jl}} = \sum_{j\in\mathscr{K}_{EU}} \left(n_j+n_l\right)\frac{3\,(2K-3)}{(K-1)\,(2K-1)}\frac{\alpha-w-\tau}{16\beta} = \left(\frac{1}{K_{EU}}\sum_{j\in\mathscr{K}_{EU}} n_j + n_l\right)\frac{3K_{EU}\,(2K-3)}{(K-1)\,(2K-1)}\frac{\alpha-w-\tau}{16\beta} > 0. \qquad (27)$$

As in Proposition 1, the main insights regarding market sizes carry over when dealing with asymmetries in trade costs. The positive effect on third countries' taxes (part (c)) is fully robust to the inclusion of differing trade costs. A correction term that accounts for the asymmetries adjusts the sign in part (a) as follows:

$$sign\left(\sum_{m\in\mathcal{K}_{EU}}\frac{dt_l}{d\tau_{ml}}\right)=sign\left(n_l-\frac{2(K-1)^2+1}{K-2}\bar{n}_{EU}\sum_{m\in\mathcal{K}_{EU}}\left(n_l-\frac{2(K-1)^2+1}{K-2}n_m\right)\frac{\tau-\tau_{ml}}{K_{EU}(\alpha-w-\tau)}\right) \tag{28}$$

Again, the adjustment is comparably small since $\left|\frac{\tau-\tau_{ml}}{K_{EU}(\alpha-w-\tau)}\right|\in\left[0,\frac{1}{2K_{EU}}\right]$. The larger the cardinality of the set of countries left by country l, the more negligible is this adjustment. The correction in part (b) is less straightforward

$$sign\left(\frac{dt_m}{d\tau_{ml}}+\sum_{j\in\mathcal{K}_{EU}\setminus\{m\}}\frac{dt_m}{d\tau_{jl}}\right)=sign\left(\frac{(2K-3)K_{EU}\bar{n}_{EU}-(K-1)n_m}{2(K-1)K-(2K-1)K_{EU}}-n_l+\frac{3(K-2)n_m-\left[4(K-1)^2+2\right]n_l}{6(K-1)K-(6K-3)K_{EU}}\right.$$
$$\left.\cdot\frac{\tau-\tau_{ml}}{\alpha-w-\tau}+\sum_{j\in\mathcal{K}_{EU}\setminus\{m\}}\frac{(6K-9)\left(n_j+n_l\right)}{6(K-1)K-(6K-3)K_{EU}}\frac{\tau-\tau_{jl}}{\alpha-w-\tau}\right). \tag{29}$$

The adjustment term is bounded $\left|\frac{\tau-\tau_{ml}}{\alpha-w-\tau}\frac{1}{6(K-1)K-(6K-3)K_{EU}}\right|\in\left[0,\frac{1}{6(K-1)}\right]$ and decreases in the number of countries.

In Corollary 5, we consider average effects. For this we define the world, EU, and non-EU average taxes as follows: $\bar{t}:=\frac{1}{K}\sum_{k\in\mathcal{K}}t_k$, $\bar{t}_{EU}:=\frac{1}{K_{EU}}\sum_{k\in\mathcal{K}_{EU}}t_k$, and $\bar{t}_{nonEU}:=\frac{1}{K-K_{EU}-1}\sum_{k\in\mathcal{K}\setminus(\mathcal{K}_{EU}\cup\{l\})}t_k$.

Corollary 5. *Consider the subgame-perfect Nash equilibrium of economy $\mathcal{E}$ with $K\geq 2$ countries. Suppose that trade costs between the leaving country $l\in\mathcal{K}\setminus\mathcal{K}_{EU}$ and countries $m\in\mathcal{K}_{EU}$ are the same, $\tau=\tau_{ml}$, $\forall m\in\mathcal{K}_{EU}$, and let country l disintegrate from the member countries. This disintegration triggers the following change in the average tax of*

(a) *the remaining member countries*

$$\frac{d\bar{t}_{EU}}{d\tau}=\frac{\left[(2K-3)K_{EU}-(K-1)\right]3\bar{n}_{EU}+\left[K_{EU}-2(K-1)(K-K_{EU})\right]3n_l}{(K-1)(2K-1)}\frac{\alpha-w-\tau}{16\beta}$$

(b) *third countries*

$$\frac{d\bar{t}_{nonEU}}{d\tau}=\frac{3K_{EU}(2K-3)(\bar{n}_{EU}+n_l)}{(K-1)(2K-1)}\frac{\alpha-w-\tau}{16\beta},$$

(c) *the world*

$$\frac{d\bar{t}}{d\tau}=-\frac{3K_{EU}(2K-1)\bar{n}_{EU}+3K_{EU}(K-K_{EU}-1)n_l}{K(K-1)(2K-1)}\frac{\alpha-w-\tau}{16\beta}.$$

3.3 Proof of Proposition 6

Assumption 1. *Let* $n := n_i = n_j$ *for all* $i, j \in \mathcal{K}$. *Moreover, let* $\tau^* := \tau_{ij} = \tau_{ik}$ *for all* $i, j, k \in \mathcal{K}_{EU}$ *with* $j, k \neq i$ *and* $\tau := \tau_{lm} = \tau_{ln} > \tau^*$ *for all* $l \in \mathcal{K}$ *and* $m, n \in \mathcal{K} \backslash \mathcal{K}_{EU}$ *with* $m, n \neq l$. *Let* $K_{EU} > 1$.

Under Assumption 1, the business tax of a member country $m \in \mathcal{K}_{EU}$ simplifies to

$$t_m = 3\overline{F} + 3n\frac{\tau^2 - 2\tau(\alpha - w)}{32\beta} + \frac{[(K-1)(2K - 2K_{EU} + 1) + K_{EU}](K_{EU} - 1)}{(K-1)(2K-1)} 3n(\tau - \tau^*)\frac{2(\alpha - w) - (\tau + \tau^*)}{32\beta}, \tag{30}$$

whereas the tax in a non-member country $n \in \mathcal{K} \backslash \mathcal{K}_{EU}$ reads as

$$t_n = 3\overline{F} + 3n\frac{\tau^2 - 2\tau(\alpha - w)}{32\beta} + \frac{K_{EU}(K_{EU} - 1)(2K - 3)}{(K-1)(2K-1)} 3n(\tau^* - \tau)\frac{2(\alpha - w) - (\tau + \tau^*)}{32\beta}. \tag{31}$$

First of all, note that

$$t_n - t_m = \frac{K_{EU}(2K-3) + (K-1)(2K - 2K_{EU} + 1) + K_{EU}}{(K-1)(2K-1)}(K_{EU} - 1)3n(\tau^* - \tau)\frac{2(\alpha - w) - (\tau + \tau^*)}{32\beta}.$$

Hence, $t_n < t_m$ whenever $\tau^* < \tau$ and $K_{EU} > 1$. If $K_{EU} = 1$ or $\tau^* = \tau$ (which we rule out by assumption), then $t_n = t_m$. As we can see, the size of the business tax differential between member and non-member countries depends on the degree of economic integration in the world economy. Moreover, note that as the number of countries grows large, business taxes do not diverge

$$\lim_{K \to \infty} t_m = \lim_{K \to \infty} t_n + 3n(K_{EU} - 1)(\tau - \tau^*)\frac{2(\alpha - w) - (\tau + \tau^*)}{32\beta}, \tag{32}$$

where $\lim_{K \to \infty} t_n = 3\overline{F} + 3n\frac{\tau^2 - 2\tau(\alpha - w)}{32\beta}$.

For part (b) of the Proposition, differentiate t_m with respect to the number of member countries

$$\frac{dt_m}{dK_{EU}} = \frac{(K-1)[(2K-1) - 4(K_{EU} - 1)] + 2K_{EU} - 1}{(K-1)(2K-1)} 3n\left(\frac{2(\alpha - w)(\tau - \tau^*) - (\tau^2 - \tau^{*2})}{32\beta}\right). \tag{33}$$

This expression is positive by the following argument. Firstly, note that the sign of $\frac{dt_m}{dK_{EU}}$ is the same as the sign of $\phi(K)$, where $\phi(K) := (K-1)[(2K-1) - 4(K_{EU} - 1)] + 2K_{EU} - 1$. $\phi(K)$ is positive, since $\phi(1) = 2K_{EU} - 1 > 0$ and $\phi'(K) = (4K-3) - 4(K_{EU} - 1) > 4(K-1) - 4(K_{EU} - 1) \geq 0$, $\forall K \geq K_{EU} \geq 1$.

The other derivatives are also intuitive

$$\frac{dt_m}{d\tau^*} = -\frac{1}{(K-1)(2K-1)} 6n_{K_{EU}} \left[(K-1)(2K-2K_{EU}+1)+K_{EU}\right](K_{EU}-1)\frac{\alpha-w-\tau^*}{32\beta} < 0 \tag{34}$$

and

$$\begin{aligned}
\frac{dt_m}{d\tau} &= 6n_{K_{EU}}\frac{\tau-(\alpha-w)}{32\beta} + \frac{1}{(K-1)(2K-1)} 6n_{K_{EU}} \left[(K-1)(2K-2K_{EU}+1)+K_{EU}\right](K_{EU}-1)\frac{\alpha-w-\tau}{32\beta} \\
&= \frac{1}{(K-1)(2K-1)} 6n_{K_{EU}} \left\{(K-1)\left[2K(K_{EU}-2)-2K_{EU}(K_{EU}-1)+3K_{EU}\right]+K_{EU}(K_{EU}-1)\right\}\frac{\alpha-w-\tau}{32\beta} \\
&> \frac{1}{(K-1)(2K-1)} 6n_{K_{EU}} \left\{(K-1)K_{EU}\left[2(K_{EU}-2)-2(K_{EU}-1)+3\right]+K_{EU}(K_{EU}-1)\right\}\frac{\alpha-w-\tau}{32\beta} \\
&= \frac{1}{(K-1)(2K-1)} 6n_{K_{EU}} \left\{(K-1)K_{EU}\left[-4+2+3\right]+K_{EU}(K_{EU}-1)\right\}\frac{\alpha-w-\tau}{32\beta} > 0.
\end{aligned} \tag{35}$$

The comparative statics in part (c) of Proposition 6 are given by

$$\frac{dt_n}{dK_{EU}} = \frac{(2K_{EU}-1)(2K-3)}{(K-1)(2K-1)} 3n(\tau^*-\tau)\frac{2(\alpha-w)-(\tau+\tau^*)}{32\beta} < 0,$$

$$\frac{dt_n}{d\tau} = 6n\frac{\tau-(\alpha-w)}{32\beta} + \frac{K_{EU}(K_{EU}-1)(2K-3)}{(K-1)(2K-1)} 6n\frac{\tau-(\alpha-w)}{32\beta} < 0,$$

and $\frac{dt_n}{d\tau^*} = \frac{K_{EU}(K_{EU}-1)(2K-3)}{(K-1)(2K-1)} 6n\frac{\alpha-w-\tau^*}{32\beta} > 0$. To summarize, we formulate Proposition 6.

Proposition 6 (union-size effect)**.** *Consider the subgame-perfect Nash equilibrium of economy $\mathscr{E}$ with $K > 2$ countries. Let Assumption 1 hold and suppose that $K, K_{EU} \in \mathbb{R}^+$. Then, $\forall m \in \mathscr{K}_{EU}$ and $\forall n \in \mathscr{K} \setminus \mathscr{K}_{EU}$*

(a) $t_m > t_n$, (b) $\frac{dt_m}{dK_{EU}} > 0, \frac{dt_m}{d\tau^*} < 0$, $\frac{dt_m}{d\tau} > 0$, and (c) $\frac{dt_n}{dK_{EU}} < 0$, $\frac{dt_n}{d\tau^*} > 0$, $\frac{dt_n}{d\tau} < 0$.

The average worldwide business tax $\bar{t} = \frac{K_{EU}}{K}t_m + \frac{K-K_{EU}}{K}t_n$ can be written as

$$\bar{t} = 3\overline{F} + 3n\frac{\tau^2-2\tau(\alpha-w)}{32\beta} + \frac{K_{EU}(K_{EU}-1)}{K(K-1)} 3n(\tau-\tau^*)\frac{2(\alpha-w)-(\tau+\tau^*)}{32\beta},$$

which is decreasing in the number of competing markets K.

4 Proofs for Section 2.5

Define $\mathscr{K}_{TA}$ as the set and K_{TA} as the number of countries which participate in regional trade agreements (e.g., the WTO). Let $\boldsymbol{t}^{old}$ denote the vector of tariff policies before the disintegration of country l from the integrated area/economic union abbreviated EU. That is,

$$\boldsymbol{t}^{old} = \left(\boldsymbol{t}^{old}_{EU,EU}, \boldsymbol{t}^{old}_{EU,l}, \boldsymbol{t}^{old}_{EU,TA}, \boldsymbol{t}^{old}_{l,TA}, \boldsymbol{t}^{old}_{TA,TA}, \boldsymbol{t}^{old}_{Rest}\right) \tag{36}$$

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

$$\boldsymbol{t}^{old}_{Rest} = \left(\boldsymbol{t}^{old}_{EU,Rest}, \boldsymbol{t}^{old}_{l,Rest}, \boldsymbol{t}^{old}_{TA,Rest}, \boldsymbol{t}^{old}_{,Rest,Rest}\right) \tag{37}$$

vis-à-vis countries from the rest of the world (e.g., Iran). Moreover, let

$$\boldsymbol{\tau}^{old} = \left(\boldsymbol{\tau}^{old}_{EU,EU}, \boldsymbol{\tau}^{old}_{EU,l}, \boldsymbol{\tau}^{old}_{EU,TA}, \boldsymbol{\tau}^{old}_{l,TA}, \boldsymbol{\tau}^{old}_{TA,TA}, \boldsymbol{\tau}^{old}_{Rest}\right) \tag{38}$$

denote the vector of bilateral non-tariff trade costs. A feature of an economic union is that member countries can cooperatively set these non-tariff trade costs. To begin with, we state the following lemma.

Lemma 5. *Suppose that business taxes are positive, trade taxes are small, and trade costs sufficiently similar ($\tilde{\tau}_{ml} = t_{ml} + \tau_{ml} \approx \tilde{\tau}_{np} = t_{np} + \tau_{np}$). Then, for any $i, j, k \in \mathscr{K}$, $\nabla_{t_{ij}} W_k (\boldsymbol{\tau}, \boldsymbol{t}) > 0$ and $\nabla_{\tau_{ij}} W_k (\boldsymbol{\tau}, \boldsymbol{t}) > 0$.*

Hence the cross-country welfare effects of higher trade costs are positive. In the Supplementary Online Appendix, we prove this statement.[2]

As mentioned above, countries inside the economic union choose non-tariff trade costs cooperatively. That is, $(\boldsymbol{\tau}_{EU,EU}, \boldsymbol{\tau}_{EU,l})$ is the outcome of efficient Nash bargaining. Before the disintegration of country l, $\left(\boldsymbol{\tau}^{old}_{EU,EU}, \boldsymbol{\tau}^{old}_{EU,l}\right) := \underset{(\boldsymbol{\tau}_{EU,EU}, \boldsymbol{\tau}_{EU,l})}{arg\ max} \sum_{m \in \mathscr{K}_{EU} \cup \{l\}} W_m (\cdot)$. After the disintegration, the remaining members negotiate their internal trade costs without consideration of country l's welfare $\left(\boldsymbol{\tau}^{new}_{EU,EU}\right) := \underset{(\boldsymbol{\tau}_{EU,EU})}{arg\ max} \sum_{m \in \mathscr{K}_{EU}} W_m (\cdot)$.

Do the remaining member countries integrate more with each other after the disintegration of l? In other words, how do the vectors $\boldsymbol{\tau}^{old}_{EU,EU}$ and $\boldsymbol{\tau}^{new}_{EU,EU}$ compare with each other? Consider

[2]The Supplementary Online Appendix is available at https://www.vwl.uni-mannheim.de/(...)/Janeba/Supplementary_Online_Appendix_for_A_Theory_of_Economic_Disintegration_22102021.pdf.

the first-order Taylor approximation of members' welfare in the new optimum

$$\begin{aligned}\sum_{m\in\mathscr{K}_{EU}} W_m\left(\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,EU}},\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,l}},\cdot\right) = &\sum_{m\in\mathscr{K}_{EU}} W_m\left(\boldsymbol{\tau}^{\boldsymbol{old}}_{\boldsymbol{EU,EU}},\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,l}},\cdot\right)\\ &+\sum_{m\in\mathscr{K}_{EU}} \nabla_{\boldsymbol{\tau_{EU,EU}}} W_m\left(\boldsymbol{\tau}^{\boldsymbol{old}}_{\boldsymbol{EU,EU}},\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,l}},\cdot\right)\left(\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,EU}}-\boldsymbol{\tau}^{\boldsymbol{old}}_{\boldsymbol{EU,EU}}\right)' + h.o.t.\\ &> \sum_{m\in\mathscr{K}_{EU}} W_m\left(\boldsymbol{\tau}^{\boldsymbol{old}}_{\boldsymbol{EU,EU}},\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,l}},\cdot\right) \end{aligned} \tag{39}$$

where the inequality holds by Lemma 5, and therefore implies

$$\sum_{m\in\mathscr{K}_{EU}} \nabla_{\boldsymbol{\tau_{EU,EU}}} W_m\left(\boldsymbol{\tau}^{\boldsymbol{old}}_{\boldsymbol{EU,EU}},\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,l}},\cdot\right)\left(\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,EU}}-\boldsymbol{\tau}^{\boldsymbol{old}}_{\boldsymbol{EU,EU}}\right)' > 0. \tag{40}$$

By optimality of the old solution $\sum_{m\in\mathscr{K}_{EU}\cup\{l\}} \nabla_{\boldsymbol{\tau_{EU,EU}}} W_m\left(\boldsymbol{\tau^{old}},\boldsymbol{t^{old}}\right) = 0$ and, accordingly,

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

Therefore, $-\nabla_{\boldsymbol{\tau_{EU,EU}}} W_l\left(\boldsymbol{\tau^{old}},\boldsymbol{t^{old}}\right)\left(\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,EU}}-\boldsymbol{\tau}^{\boldsymbol{old}}_{\boldsymbol{EU,EU}}\right)' > 0$ and one can conclude that, whenever $\nabla_{\boldsymbol{\tau_{EU,EU}}} W_l\left(\boldsymbol{\tau^{old}},\boldsymbol{t^{old}}\right) > 0$ (i.e., the welfare of the leaving country is increasing in two member countries' trade costs as in Lemma 5), $\boldsymbol{\tau}^{\boldsymbol{new}}_{\boldsymbol{EU,EU}} < \boldsymbol{\tau}^{\boldsymbol{old}}_{\boldsymbol{EU,EU}}$.

By the construction of the economic union as a customs union trade taxes inside the union remain prohibited $\boldsymbol{t}^{\boldsymbol{old}}_{\boldsymbol{EU,EU}} = \boldsymbol{t}^{\boldsymbol{new}}_{\boldsymbol{EU,EU}} = 0$, whereas trade taxes between the leaving country and the economic union can be anything after the disintegration. That is, $\boldsymbol{t}^{\boldsymbol{old}}_{\boldsymbol{EU,l}} = 0$ and $\boldsymbol{t}^{\boldsymbol{new}}_{\boldsymbol{EU,l}} \gtreqless 0$. 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 $\mathscr{K}_{EU}$ 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 cross 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 regional trade agreements. Recall that before the disintegration member countries solve

$$\left(\boldsymbol{\tau}_{\boldsymbol{EU,EU}}^{\boldsymbol{old}},\boldsymbol{\tau}_{\boldsymbol{EU,l}}^{\boldsymbol{old}}\right) := \underset{\left(\boldsymbol{\tau_{EU,EU}},\boldsymbol{\tau_{EU,l}}\right)}{arg\ max} \sum_{m\in\mathscr{K}_{EU}\cup\{l\}} W_m\left(\cdot\right)$$
$$subject\ to\ \left(\boldsymbol{t}_{\boldsymbol{EU,EU}}^{\boldsymbol{old}},\boldsymbol{t}_{\boldsymbol{EU,l}}^{\boldsymbol{old}}\right) = 0, \tag{41}$$

but afterwards

$$\left(\boldsymbol{\tau}_{\boldsymbol{EU,l}}^{\boldsymbol{new}},\boldsymbol{t}_{\boldsymbol{EU,l}}^{\boldsymbol{new}}\right) := \underset{\left(\boldsymbol{\tau_{EU,l}},\boldsymbol{t_{EU,l}}\right)}{arg\ max} \sum_{m\in\mathscr{K}_{EU}\cup\{l\}} W_m\left(\cdot\right)$$
$$subject\ to\ \left(\boldsymbol{t}_{\boldsymbol{EU,EU}}^{\boldsymbol{new}}\right) = 0$$
$$and\ \left(\boldsymbol{\tau}_{\boldsymbol{EU,EU}}^{\boldsymbol{new}}\right) := \underset{\left(\boldsymbol{\tau_{EU,EU}}\right)}{arg\ max} \sum_{m\in\mathscr{K}_{EU}} W_m\left(\cdot\right). \tag{42}$$

Then, our approach delivers $\sum_{m\in\mathscr{K}_{EU}\cup\{l\}} \nabla_{\boldsymbol{t_{EU,l}}} W_m\left(\boldsymbol{\tau}^{\boldsymbol{old}},\boldsymbol{t}^{\boldsymbol{old}}\right)\left(\boldsymbol{t}_{\boldsymbol{EU,l}}^{\boldsymbol{new}}\right)' > 0$.

In principle, the sign of the relevant gradient and, therefore, the sign of post-disintegration trade taxes $\boldsymbol{t}_{\boldsymbol{EU,l}}^{\boldsymbol{new}}$ are ambiguous. In our model, for example, a domestic import tariff in country l would mean higher prices and a lower consumer surplus there. At the same time, ceteris paribus some marginal firms move to country l to gain low-cost market access, which means a rise in business tax revenues in l. Moreover, country l generates tariff revenues.

Given that we have dealt with the effects of economic disintegration on the trade policies between countries l and $\mathscr{K}_{EU}$, we can now speak to the impact on regional trade agreements of the economic union and the leaving country with third countries. Fix a country $TA \in \mathscr{K}_{TA}$. Once again, observe that the objective function and the trade policy instruments of the Nash bargaining change as follows:

$$\left(\boldsymbol{t}_{\boldsymbol{EU,TA}}^{\boldsymbol{old}},\boldsymbol{t}_{\boldsymbol{l,TA}}^{\boldsymbol{old}}\right) := \underset{\left(\boldsymbol{t_{EU,TA}},\boldsymbol{t_{l,TA}}\right)}{arg\ max} \sum_{m\in\mathscr{K}_{EU}\cup\{l,TA\}} W_m\left(\cdot\right) \tag{43}$$

and

$$\left(\boldsymbol{t}_{\boldsymbol{EU,TA}}^{\boldsymbol{new}}\right) := \underset{\left(\boldsymbol{t_{EU,TA}}\right)}{arg\ max} \sum_{m\in\mathscr{K}_{EU}\cup\{TA\}} W_m\left(\cdot\right)\ and\ \left(\boldsymbol{t}_{\boldsymbol{l,TA}}^{\boldsymbol{new}}\right) := \underset{\left(\boldsymbol{t_{l,TA}}\right)}{arg\ max}\ W_l\left(\cdot\right) + W_{TA}\left(\cdot\right). \tag{44}$$

Again, consider a first-order approximation of welfare in $\mathscr{K}_{EU}$ and TA in the new optimum and use the first-order conditions of the respective optimization to show that

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

which implies together with 5 $\boldsymbol{t}^{\boldsymbol{new}}_{\boldsymbol{EU,TA}} < \boldsymbol{t}^{\boldsymbol{old}}_{\boldsymbol{EU,TA}}$. By similar arguments,

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

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

Consider, now, non-cooperative trade policies by the economic union vis-à-vis a country $Rest \in \mathcal{K} \setminus (\mathcal{K}_{TA} \cup \mathcal{K}_{EU} \cup \{l\})$. Use bold letters for trade policy instruments which are under the control of the respective government. Non-cooperative trade policies before and after the disintegration of l are given by

$$\left(\boldsymbol{t}^{\boldsymbol{old}}_{\boldsymbol{EU},Rest}, \boldsymbol{t}^{\boldsymbol{old}}_{\boldsymbol{l},Rest}\right) := \underset{\left(\boldsymbol{t_{EU}}_{,Rest}, \boldsymbol{t_l}_{,Rest}\right)}{arg\ max} \sum_{m\in\mathcal{K}_{EU}\cup\{l\}} W_m(\cdot) \tag{45}$$

and

$$\left(\boldsymbol{t}^{\boldsymbol{new}}_{\boldsymbol{EU},Rest}\right) := \underset{\left(\boldsymbol{t_{EU}}_{,Rest}\right)}{arg\ max} \sum_{m\in\mathcal{K}_{EU}} W_m(\cdot) \ and \ \left(\boldsymbol{t}^{\boldsymbol{new}}_{\boldsymbol{l},Rest}\right) := \underset{\left(\boldsymbol{t_l}_{,Rest}\right)}{arg\ max}\, W_l(\cdot)\,. \tag{46}$$

Again, linearize welfare in the new optimum and use the optimality conditions to demonstrate that

$$-\nabla_{\boldsymbol{t_{EU}}_{,Rest}} W_l\left(\tau^{\boldsymbol{old}}, \boldsymbol{t}^{\boldsymbol{old}}\right)\left(\boldsymbol{t}^{\boldsymbol{new}}_{\boldsymbol{EU},Rest} - \boldsymbol{t}^{\boldsymbol{old}}_{\boldsymbol{EU},Rest}\right)' > 0 \ and \ -\sum_{m\in\mathcal{K}_{EU}} \nabla_{\boldsymbol{t_l}_{,Rest}} W_m\left(\tau^{\boldsymbol{old}}, \boldsymbol{t}^{\boldsymbol{old}}\right)\left(\boldsymbol{t}^{\boldsymbol{new}}_{\boldsymbol{l},Rest} - \boldsymbol{t}^{\boldsymbol{old}}_{\boldsymbol{l},Rest}\right)' > 0.$$

One can conclude that $\boldsymbol{t}^{\boldsymbol{new}}_{\boldsymbol{EU},Rest} < \boldsymbol{t}^{\boldsymbol{old}}_{\boldsymbol{EU},Rest}$ and $\boldsymbol{t}^{\boldsymbol{new}}_{\boldsymbol{l},Rest} < \boldsymbol{t}^{\boldsymbol{old}}_{\boldsymbol{l},Rest}$. Therefore, the disintegration of l reduces not only cooperatively chosen tariffs but also non-cooperative tariffs.

The effects of the economic disintegration on regional TAs between countries, which are not part of the economic union, as well as non-cooperative trade policies by any third country, are of second order. The reason is that the objective functions and instruments of tariff policies remain the same. Therefore, policies are only indirectly altered. Cross derivatives of welfare functions measure the changes in these policies with respect to the respective trade policy instruments.

We summarize the insights formed in this section in Proposition 7.

Proposition 7 (endogenous trade policy responses to disintegration)**.** *Suppose that, initially, countries l and $\mathscr{K}_{EU}$ form an economic union (old optimum). In the new optimum, country l leaves the economic union. Moreover, suppose that business taxes are positive, trade taxes are small, and trade costs sufficiently similar. Then,* $\boldsymbol{\tau^{new}_{EU,EU}} < \boldsymbol{\tau^{old}_{EU,EU}}$.

If country l also leaves the customs union, $\boldsymbol{t^{new}_{EU,TA}} < \boldsymbol{t^{old}_{EU,TA}}$, $\boldsymbol{t^{new}_{l,TA}} < \boldsymbol{t^{old}_{l,TA}}$,$\boldsymbol{t^{new}_{EU,Rest}} < \boldsymbol{t^{old}_{EU,Rest}}$, *and* $\boldsymbol{t^{new}_{l,Rest}} < \boldsymbol{t^{old}_{l,Rest}}$.

In summary, non-tariff barriers inside the economic union and cooperative (non-cooperative) trade taxes of $\mathscr{K}_{EU}$ and country l vis-à-vis $\mathscr{K}_{TA}$ ($\mathscr{K} \setminus (\mathscr{K}_{TA} \cup \mathscr{K}_{EU} \cup \{l\}$), respectively) decline. Therefore, the departure of a country from an economic union leads ceteris paribus to a deeper integration of multilaterally formed institutions around the world and less protectionism.

References

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