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Unilateral Tax Policy in the Open Economy*

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Abstract

This paper examines the effects of a unilateral reform of the redistribution policy in an economy open to international trade. We set up a general equilibrium trade model with heterogeneous agents allowing for country asymmetries. We show that under international trade compared to autarky, a unilateral tax increase leads to a less pronounced decline in aggregate real income in the reforming country, while income inequality is reduced to a larger extent for sufficiently small initial tax rates. We highlight as a key mechanism a tax-induced reduction in the market size of the reforming country relative to its trading partner, resulting in a firm selection effect towards exporting. From the perspective of a non-reforming trading partner, the unilateral redistribution policy reform resembles a unilateral increase in trade costs leading to a deterioration of terms-of-trade and a decline in both aggregate real income and inequality.

JEL-Classification: D31, F12, F16, H24
Keywords: Income inequality, Redistribution, International trade, Heterogeneous firms

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1 Introduction

At least since the seminal work by Stolper and Samuelson (1941), it has been well understood by trade economists that international trade can have strong distributional effects. The recent academic literature on international trade and inequality has focused on the role played by the heterogeneity of the firm population (cf. Helpman, 2017; Helpman et al., 2010; Egger and Kreickemeier, 2012) and on trade-induced changes in local labour markets with rising unemployment (cf. Autor et al., 2013; Kim and Vogel, 2021).[1] Accordingly, welfare states need to adjust to increased international connectedness in order to reap the aggregate gains-from-trade while compensating for losses and taking care of income inequality. This is of high importance also in the public debate. Typically, redistribution policies differ between countries; they are set unilaterally. Yet, how effective can a unilateral adjustment of a welfare state be in the context of international trade and what are its costs accounting for the effects on domestic firms that compete internationally?[2] We shed new light on these questions and elaborate on the effects of a unilateral redistribution policy reform in an economy open to international trade, in which large and productive firms self-select into exporting.

We build our analysis on a general equilibrium trade model with asymmetric countries featuring intra-industry trade in horizontally differentiated goods between two countries. As in Egger and Kreickemeier (2012) an occupational choice mechanism following Lucas (1978) determines the factor allocation in the economy. Individuals with different abilities to manage a firm decide whether to become a worker or an export consultant (both earning an economy-wide wage rate) or whether to run a firm (being remunerated the after-tax firm profits). The framework generates income inequality among managers and between managers and workers. Following Kohl (2020) we introduce a redistribution scheme based on a tax on operating profits, with the revenue distributed equally among all individuals. This is a parsimonious way to model a progressive tax system as only the high-income individuals, the managers, pay a tax. It is a key feature of our framework that, in contrast to Egger and Kreickemeier (2012) and Kohl (2020), we allow for country asymmetries in order to focus on the effects of a unilateral tax policy reform on the factor allocation, aggregate real income and the income distribution, both in the reforming country and its non-reforming trading partner.

We find that the unilateral tax policy reform leads to pronounced selection effects via changes in individual occupational choice decisions in the reforming country. An increase in the tax rate induces the least productive firms to exit the market, while, importantly, the share of exporting firms rises since a tax-induced decrease in the market size of the reforming country makes it relatively more attractive to export. While all firms' profits are taxed independent of their product destination, it is the most productive (exporting) firms that are less severely hit due to their opportunity to focus on the foreign market. This is, hence, a channel that can only be present in the context of international trade and in case of uncoordinated policy reforms. The decline in the relative market size leads to a positive terms-of trade effect for the reforming country, directly

[1] The rise in nationalist movements and the outcomes of the crucial votes of 2016 on Brexit and the US president are also linked to trade-induced impacts (cf. Autor et al., 2020; Colantone and Stanig, 2018).

[2] This discussion is also of first-order importance within the European Union and has been the focus of the EU Porto Social Summit in April 2021. As pointed out by The Economist (2021): "The EU is trying to become a welfare superstate", but so far "Europe's welfare states are administered by national governments, not by the EU."

analogous to the trade policy literature (cf. Gros, 1987; Felbermayr et al., 2013; Campolmi et al., 2014), in which such a terms-of-trade effect is the result of a unilateral increase of an import tariff. This channel raises average productivity and attenuates the decline in real aggregate income in the reforming country. Accordingly, we find that, while a higher tax rate leads to a distortion and reduces real aggregate income, the income effect is less pronounced in an economy open to international trade rather than under autarky. Similarly, for sufficiently small initial tax rates (where the lower limit is above 50%, hence, presumably for all empirically relevant tax rates), a unilateral tax increase reduces income inequality in the open economy to a larger extent than under autarky.

We also analyse the effects of the unilateral tax policy reform on the non-reforming trading partner transmitted via the terms-of-trade externality. We show that the non-reforming country is affected in various ways facing firm entry of low productivity firms, and a decline of both average productivity and aggregate real income. However, also inter-group inequality decreases, suggesting that there are spillover effects from the redistribution policy of its trading partner. Overall, these effects are similar to the effects of an increase in trade costs (cf. Felbermayr et al., 2013; Egger and Kreickemeier, 2012). Yet, in our setup the non-reforming country is affected by reduced trade due to an income effect.

Our work is related to different strands of the literature. Firstly, our paper is part of a recent literature that looks at the link between international trade and redistribution policies in an environment with heterogeneous firms.[3] Egger and Kreickemeier (2009) analyse the possibility to redistribute gains from trade in a Melitz (2003) model where wage inequality occurs due to fair wages in the labour market. They show that combining trade liberalisation with an increase in the profit tax rate both higher aggregate income and more equality is possible if countries are already sufficiently open. Kohl (2020) looks at the distributional effects of trade in the presence of a welfare state redistributing income. She shows that the presence of a welfare state makes it more likely that trade leads to a Pareto improvement. Antràs et al. (2017) also investigate the possibilities to redistribute the gains from trade and quantify the costs of this policy. Yet, all three papers use a symmetric country setup implying that also the policy dimension is symmetric across countries. Thus, they are not able to look at the effects of unilateral tax policy in the open economy which is the focus of our paper. Lyon and Waugh (2018) analyse the possibility to redistribute gains from trade by modelling progressive taxation in a Ricardian trade model. They find that the optimal progressivity of the tax system should be increased with trade openness. However, Lyon and Waugh (2018) look at the case of a small open economy. We contribute to this strand of the literature by analysing the effects of uncoordinated tax policy reforms in the context of international trade between two large countries.

Secondly, our work is related to the well-established literature studying the effects of unilateral trade policy. This literature is an important anchor for our analysis as we highlight similarities between the effects of unilateral tax policy and unilateral trade policy with terms-of-trade effects being crucial for both. Influential contributions to this literature are Flam and Helpman (1987), Venables (1987) and Gros (1987) providing arguments for a strictly positive optimal tariff in the

[3] Also in case of homogeneous firms there are papers looking at redistribution policies in the open economy (see Dixit and Norman, 1980, 1986; Spector, 2001; Naito, 2006). However, allowing for heterogeneity gives a picture of inequality that is more complete with interesting margins of adjustment.

Krugman (1980) model. Campolmi et al. (2014) look at non-cooperative trade policies (wage, import and export subsidies/taxes) in a two-sector Krugman (1980) model. They show that fiscal-burden-shifting motives and terms-of-trade manipulations are the main incentives for non-cooperative trade policies. Our paper also highlights a terms-of-trade externality as in Gros (1987) and Campolmi et al. (2014), but due to unilateral tax policy. Important generalisations of the trade policy literature to heterogeneous firms are provided by Demidova and Rodríguez-Clare (2009), Felbermayr et al. (2013), Haaland and Venables (2016), Demidova (2017) and Costinot et al. (2020). Closest to our analysis is Felbermayr et al. (2013) that characterise the optimal tariff for a large open economy with monopolistic competition and heterogeneous firms as in Melitz (2003) thereby extending the Gros (1987) model.[4]

Thirdly, we contribute to the broader international economics literature modelling country asymmetries. Demidova (2008) allows for productivity differences in a heterogeneous firms model of international trade. She shows that improvements in productivity in one country have negative welfare implications for its trading partner. Pflüger and Russek (2014) discuss the effects of trade and industrial policies in the context of country asymmetries. They show that trade and industrial policies that increases productivity in one country hurt the trading partner. Contributing to the literature on trade and environment, both Kreickemeier and Richter (2014) and Egger et al. (2021) rely on country asymmetries to investigate the effects of unilateral trade and environmental policy reforms, respectively, on firm selection and the reallocation of labour across and within heterogeneous firms.

The structure of the remainder of this paper is as follows. Section 2 introduces the model, while Section 3 characterises the open economy equilibrium in the context of two large asymmetric countries. Section 4 analyses the effects of a unilateral tax policy reform on occupational choice decisions, aggregate real income, and income inequality. Section 5 concludes.

2 Model setup

Individuals

We consider a world of two large countries, denoted by i and j, that are open to international trade. Each country is populated by a mass of individuals, denoted by N_i and N_j, respectively. Individuals differ in their (managerial) ability φ. As is customary in this literature let the ability be Pareto distributed with shape parameter k and the lower bound normalised to one. Hence, the cumulative density function is defined as $G(\varphi) \equiv 1 - \varphi^{-k}$. In the following, we focus on country i, whenever appropriate, while equivalent expressions hold for country j.

Demand

Preferences of the representative consumer on market i are homothetic and represented by utility function

$$U^i = \left[\int_{v \in V^i} q^i(v)^{\frac{\sigma-1}{\sigma}} \mathrm{d}v \right]^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

where $q^i(v)$ denotes the demand for variety v of a differentiated good, V^i is the set of all available

[4] On a more technical note, we adapt the solution strategy of Felbermayr et al. (2013) to the occupational choice framework as introduced by Egger and Kreickemeier (2012).

varieties on market i, and σ is the elasticity of substitution between the different varieties with $1 < \sigma < k$.[5] We assume that individuals spend all their income R_i on varieties of the differentiated good.[6] Accordingly, the budget constraint is given by $\int_{v \in V^i} p^i(v) q^i(v) \mathrm{d}v = R_i$, with $p^i(v)$ indicating the price of variety v on market i. Utility maximisation of the representative consumer subject to the budget constraint leads to the following demand function with constant price elasticity σ for each variety:

$$q^i(v) = R_i (P^i)^{\sigma-1} p^i(v)^{-\sigma}, \tag{2}$$

where $P^i = \left[\int_{v \in V^i} p^i(v)^{1-\sigma} dv\right]^{1/(1-\sigma)}$ is the standard CES price index that satisfies $U^i = R_i/P^i$.

Domestic supply

There is a continuum of firms each producing a unique variety of the differentiated good under monopolistic competition (cf. Krugman, 1980; Melitz, 2003). The mass of firms producing in country i is given by M_i, where we denote those firms that export to country j by M_i^j. Each firm consists of one manager and an endogenous mass of workers. Firm productivity $\varphi(v)$ is determined by the ability of the manager running the firm.

The firm's output level is given by $q_i(v) = l_i(v)\varphi(v)$. Hence, unit production costs $c_i(v) = w_i/\varphi(v)$ are inversely proportional to productivity $\varphi(v)$. Since all country-i firms face the same wage rate w_i, differences in unit production costs across firms solely originate from firm differences in productivity. This extends to all other firm performance measures and, thus, firms are perfectly distinguishable by φ and we can suppress firm index v.

The profit maximising price a firm domestically charges for its variety is a constant markup over marginal costs, i.e.:

$$p_i^i(\varphi) = \frac{\sigma}{\sigma - 1} c_i(\varphi). \tag{3}$$

Combining Eqs. (2) and (3), we can express domestic revenues $r_i^i(\varphi)$ and domestic operating profits $\psi_i^i(\varphi)$ of a firm with productivity φ as

$$r_i^i(\varphi) = R_i (P^i)^{\sigma-1} \left(\frac{\sigma}{\sigma-1} \frac{w_i}{\varphi}\right)^{1-\sigma} \quad \text{and} \quad \psi_i^i(\varphi) = \frac{1}{\sigma} r_i^i(\varphi). \tag{4}$$

Comparing two arbitrary firms in country i with differing productivities, we get the familiar result that relative domestic output, revenues, operating profits, and employment only depend on relative productivity levels:

$$\frac{q_i^i(\varphi_1)}{q_i^i(\varphi_2)} = \left(\frac{\varphi_1}{\varphi_2}\right)^{\sigma} \quad \text{and} \quad \frac{r_i^i(\varphi_1)}{r_i^i(\varphi_2)} = \frac{\psi_i^i(\varphi_1)}{\psi_i^i(\varphi_2)} = \frac{l_i^i(\varphi_1)}{l_i^i(\varphi_2)} = \left(\frac{\varphi_1}{\varphi_2}\right)^{\sigma-1}. \tag{5}$$

Accordingly, a firm with higher productivity has higher domestic output, revenues, operating profits, and employment.

Exporting activity

Exporting is subject to two different types of costs. First, a firm from country i that wants to

[5] The assumption of $k > \sigma$ ensures the existence of finite and positive means for relevant model variables such as average firm production.

[6] We use subscripts to indicate the origin perspective and superscripts to indicate the destination perspective, i.e. the market of consumption.

export to country j faces exogenously given variable iceberg trade costs, $\tau_i^j > 1$. Second, exporting activity requires that an export consultant from the domestic population is hired. We denote the endogenous fixed export costs for an exporting firm from country i by f_i^j. In line with possible asymmetry of the two countries, we allow for $\tau_i^j \neq \tau_j^i$ and $f_i^j \neq f_j^i$.

Accordingly, the profit maximising price an exporting firm from country i charges for its variety on market j is determined as

$$p_i^j(\varphi) = \tau_i^j p_i^i(\varphi). \tag{6}$$

Jointly with the analogue of Eq. (2) for country j, it follows directly that export revenues and export operating profits of firm with productivity φ are given by

$$r_i^j(\varphi) = (\tau_i^j)^{1-\sigma} R_j (P^j)^{\sigma-1} \left(\frac{\sigma}{\sigma-1}\frac{w_i}{\varphi}\right)^{1-\sigma} \quad \text{and} \quad \psi_i^j(\varphi) = \frac{1}{\sigma} r_i^j(\varphi). \tag{7}$$

Welfare state

Both country i and country j redistribute income by imposing a tax $t_i \in (0,1)$ and $t_j \in (0,1)$, respectively, on operating profits where we allow the two economies to differ in their tax rates, i.e. $t_i \neq t_j$ is possible.

As will become clear below, this is a simple representation of a progressive tax system, as high-income individuals (managers) bear the tax burden and low-income individuals (workers and export consultants) pay no tax. Tax revenues are redistributed lump sum to all individuals in the respective economy with a per capita transfer of $b_i \geq 0$ and $b_j \geq 0$, respectively. While tax rates are given exogenously, per capita transfers are endogenously adjusting such that each government runs a balanced budget. Accordingly,

$$b_i = \frac{t_i M_i \bar{\psi}_i}{N_i}, \tag{8}$$

where $\bar{\psi}_i$ denotes average operating profits of firms from country i.

3 Equilibrium

Occupational choice

Individuals in each economy have to make an occupational choice (cf. Lucas, 1978), i.e. they decide whether to become a manager running a firm, a production worker, or an export consultant. As in Egger and Kreickemeier (2012) an individual's choice depends on her managerial ability φ, that can be used in the role as a manager and is positively linked to firm profits, while φ does not affect efficiency and income of a worker or export consultant. Denoting the managerial ability of the individual that is just indifferent between occupations by φ_i^{i*}, individuals with a managerial ability greater than φ_i^{i*} will become managers. By contrast, individuals with an ability lower than φ_i^{i*} will either work as production workers or as export consultants, each earning the domestic wage rate w_i. Hence, $f_i^j = w_i$.

As common in the literature (e.g. Melitz, 2003) and consistent with the empirical evidence,[7] we assume that the marginal firm is a non-exporting firm and can specify the indifference condition

[7] Initiated by Bernard and Jensen (1995, 1999), it is well established that only few firms of high productivity engage in exporting.

for an individual in country i as follows:

$$(1-t_i)\psi_i^i(\varphi_i^{i^*})+b_i=w_i+b_i, \tag{9}$$

which using Eq. (4) can be rewritten as:

$$(1-t_i)\frac{1}{\sigma}R_i(P^i)^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}(\varphi_i^{i^*})^{\sigma-1}=w_i^{\sigma}. \tag{10}$$

Intuitively, and as shown by Eq. (9), the uniform *per capita* transfer does not affect the occupational choice. Note, finally, the correspondence between the cutoff productivity $\varphi_i^{i^*}$ and the mass of managers M_i given by

$$M_i=\left[1-G(\varphi_i^{i^*})\right]N_i=(\varphi_i^{i^*})^{-k}N_i. \tag{11}$$

The decision to export

Managers face the decision whether to be active only on the domestic market or whether to serve both markets. We define $\varphi_i^{j^*}$ as the productivity level of the marginal exporting firm that is just indifferent between exporting and non-exporting. Hence, it must hold that

$$(1-t_i)\left[\psi_i^i(\varphi_i^{j^*})+\psi_i^j(\varphi_i^{j^*})\right]-f_i^j+b_i=(1-t_i)\psi_i^i(\varphi_i^{j^*})+b_i. \tag{12}$$

Simplifying and using $f_i^j=w_i$, we can rewrite the exporting indifference condition as

$$(1-t_i)\psi_i^j(\varphi_i^{j^*})=w_i. \tag{13}$$

Accordingly, for the firm that is just indifferent whether to export or not, the after tax operating profits earned on the export market have to equal the fixed costs of exporting. Using Eq. (7), the exporting indifference condition becomes

$$(1-t_i)\frac{1}{\sigma}R_j(P^j)^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}(\tau_i^j)^{1-\sigma}(\varphi_i^{j^*})^{\sigma-1}=w_i^{\sigma}. \tag{14}$$

Note that the share of exporting firms in country i is determined as follows:

$$\chi_i\equiv\frac{1-G(\varphi_i^{j^*})}{1-G(\varphi_i^{i^*})}=\left(\frac{\varphi_i^{i^*}}{\varphi_i^{j^*}}\right)^k=\left[\frac{R_j\left(P^j\right)^{\sigma-1}}{R_i\left(P^i\right)^{\sigma-1}}\right]^{\frac{k}{\sigma-1}}\left(\tau_i^j\right)^{-k}\in(0,1), \tag{15}$$

where the last equality follows from the division of the occupational indifference condition, Eq. (10), by the exporting indifference condition, Eq. (14). Accordingly, χ_i depends both on the endogenous market size of country j, $R_j\left(P^j\right)^{\sigma-1}$, relative to the market size of country i, $R_i\left(P^i\right)^{\sigma-1}$, and on the exogenous trade costs τ_i^j. In the special case of country symmetry, χ_i collapses to $(\tau_i^j)^{-k}\in(0,1)$ and is then exogenously given. To guarantee the empirically supported conditions that $\chi_i,\chi_j<1$, we assume τ_i^j and τ_j^i sufficiently large in case of substantial country asymmetries. Finally, the mass of exporting firms and, hence, of export consultants is determined by

$$M_i^j=\chi_iM_i=(\varphi_i^{j^*})^{-k}N_i. \tag{16}$$

Factor allocation and average productivity

Given the exogenous mass of individuals we get the following resource constraint for country i:

$$L_i + (1 + \chi_i)M_i = N_i. \tag{17}$$

In order to solve for the mass' of individuals sorting in the different occupations, we make use of the following link: Due to constant mark-up pricing, wage income of production workers is a constant fraction of total firm revenues, while the remaining share goes to operating profits. Accordingly,

$$L_i w_i = \frac{\sigma - 1}{\sigma} R_i \qquad \text{and} \qquad M_i \bar{\psi}_i = \frac{1}{\sigma} R_i. \tag{18}$$

As we show in Appendix A.1, we can derive total revenues of country-i firms as

$$R_i = \frac{\sigma}{1 - t_i} \zeta (1 + \chi_i) M_i w_i \tag{19}$$

with $\zeta \equiv k/[k - (\sigma - 1)] \in (1, \sigma)$. Jointly with Eqs. (17) and (18), we can derive the mass of workers as

$$L_i = \lambda_i N_i, \tag{20}$$

where $\lambda_i \equiv [1 + (1 - t_i)/(\zeta(\sigma - 1))]^{-1} \in (0, 1)$ denotes the share of workers in country i. Importantly, in equilibrium L_i does not depend on the degree of trade openness, while it depends positively on the domestic tax rate. The higher the tax rate, the more the occupational choice is distorted, leading to more workers, while fewer individuals become managers or export consultants, *ceteris paribus*.[8] This implies that for equally populated countries, the country with the higher tax rate has a higher mass of workers, i.e. $\lambda_i > \lambda_j$ for $t_i > t_j$.

From Eqs. (17) and (20) the mass of managers, in turn, can be determined as

$$M_i = \frac{1 - \lambda_i}{1 + \chi_i} N_i, \tag{21}$$

which negatively depends on the share of workers λ_i and on the amount of trade openness as proxied by the share of exporting firms χ_i. The direct negative tax effect (via λ_i) making it less attractive to become a manager according to Eq. (9) is, hence, complemented by a potential indirect effect of the tax via a change in the share of exporting firms.

Let us finally define country i's average productivity as the aggregate production per worker, $\bar{\varphi}_i \equiv M_i \bar{q}_i / L_i$. This is a measure of efficiency that directly corresponds to firm-level technology and entails the equilibrium factor allocation with $M_i/L_i = (1 - \lambda_i)/[\lambda_i(1 + \chi_i)]$.[9] As we show in Appendix A.2, average productivity can be written as function of the two country i's cutoffs and parameters only:

$$\bar{\varphi}_i = \frac{k - (\sigma - 1)}{k - \sigma} \frac{(\varphi_i^{i^*})^{1-k} + (\varphi_i^{j^*})^{1-k}}{(\varphi_i^{i^*})^{-k} + (\varphi_i^{j^*})^{-k}}. \tag{22}$$

Income distribution

At the core of our analysis there is a welfare state that redistributes income. So let us take a closer

[8] Gentry and Hubbard (2000) find a tax-induced discouragement of entrepreneurship. Tax impacts on occupational choice decisions are also highlighted by both Gentry and Hubbard (2004) and Powell and Shan (2012).

[9] This measure is different to sales-weighted average productivity as defined in Melitz (2003), or average productivity from a consumption perspective as in Egger and Kreickemeier (2012). Comparably to Demidova and Rodríguez-Clare (2009), we focus on country-i's aggregate production in the definition we employ.

look at the income distribution. Each worker and each export consultant has the same income, consisting of the equilibrium economy-wide wage and the per capita transfer. Each manager, by contrast, earns the firm's after-tax profits (that depend on her managerial ability) in addition to the universal transfer. As managerial ability differs across individuals, there is income heterogeneity within the group of managers and between managers and individuals that earn the equilibrium wage.

In order to characterise the inter-group inequality Ξ_i in country i, we look at the average net income of managers relative to the net income of a worker or an export consultant. Accordingly,

$$\Xi_i \equiv \frac{(1-t_i)\bar{\psi}_i - w_i\chi_i + b_i}{w_i + b_i}. \tag{23}$$

As we show in Appendix A.3 we can rewrite this expression as a function of the inter-group inequality under autarky, Ξ_i^{aut}. This yields

$$\Xi_i = \Xi_i^{aut}\left[1 + \lambda_i^{-1}\frac{(\zeta-1)(\sigma-1)}{\zeta(\sigma-1)+1}\chi_i\right], \tag{24}$$

with $\Xi_i^{aut} \equiv \Xi_i\big|_{\chi_i \to 0} = \zeta\left[\zeta(\sigma-1)+1\right]/[\zeta(\sigma-1)+1+(\zeta-1)t_i]$.

It is straightforward to show that, for a given level of χ_i (including autarky with $\chi_i \to 0$), an increase in t_i leads to a decline in the inter-group inequality. Yet, there might be a second channel of how a tax increase affects income inequality and this runs via the share of exporting firms that is positively related to inter-group inequality according to Eq. (24). Ultimately, the effect of t_i on inequality crucially depends on occupational choice decisions and firm selection effects.[10]

System of equations

Having laid out the optimal behaviour of individuals and determined the factor allocation, we can now derive the system of equations characterising the open economy equilibrium.

First, we divide the occupational choice condition, Eq. (10), for country i by the export indifference condition for country j, the analogue of Eq. (14), in order to substitute for the market aggregates P^i and R_i of country i. This yields

$$\left(\frac{\varphi_i^{i^*}}{\varphi_j^{i^*}}\right)^{\sigma-1} = \left(\frac{w_i}{w_j}\right)^{\sigma}\frac{1-t_j}{1-t_i}(\tau_j^i)^{1-\sigma}, \tag{25}$$

linking the composition of firms active on market i (represented by the two cutoff productivity levels) to relative wage rates, relative tax rates, and trade costs.

Second, combining the expression for the mass of managers, Eq. (21), with Eqs. (11) and (16) we get a link between the two cutoff productivity levels in country i:

$$(\varphi_i^{i^*})^{-k} + (\varphi_i^{j^*})^{-k} = 1 - \lambda_i. \tag{26}$$

Note that for a given λ_i this equation shows the negative link between $\varphi_i^{i^*}$ and $\varphi_i^{j^*}$ that is well known from Melitz (2003)-type models materialising in the free entry condition. This equivalently holds in models using the alternative entry mechanism based on occupational choice decisions such

[10] Note that Ξ_i converges to unity, with no effect of t_i, for the extreme case of homogeneous firms ($k \to \infty$).

as that which we employ following Egger and Kreickemeier (2012). However, a tax policy reform, which we are interested in, *does* affect λ_i. Hence, the relative movement of the cutoffs in response to a tax reform is *ex ante* ambiguous in our setting and needs further inspection.

Finally, we assume balanced trade between the two countries requiring that aggregate exports of country i are equal to its aggregate imports from country j. Hence, $M_i^j \bar{r}_i^j = M_j^i \bar{r}_j^i$ where $\bar{r}_i^j$ denotes the average export revenues of exporting firms from country i, while $\bar{r}_j^i$ denotes the average export revenues of exporting country-j firms, respectively. Combined with the exporting indifference condition Eq. (14) for country i and its analogue for country j, we show in Appendix A.4 how to rewrite the trade balance condition as

$$\varphi_i^{j^*} = \left(\frac{N_i}{N_j} \frac{1-t_j}{1-t_i} \frac{w_i}{w_j} \right)^{\frac{1}{k}} \varphi_j^{i^*}. \tag{27}$$

Choosing labour in country j as the numéraire, the equilibrium can be described by a system of five equations, Eqs. (25) and (26) and their respective analogues for country j as well as Eq. (27), in the five endogenous variables $\varphi_i^{i^*}, \varphi_j^{j^*}, \varphi_i^{j^*}, \varphi_j^{i^*}$, and w_i.

4 Unilateral tax policy reform

Linearised system of equilibrium conditions

We are interested in analysing the effects of a unilateral tax policy reform in the context of international trade based on the open economy equilibrium set up above. Without loss of generality, we thereby focus on an increase in the tax on operating profits raised by country i, i.e. $dt_i > 0$. Due to non-linearities, our system of five equilibrium conditions cannot be solved in levels. Hence, we follow Jones (1965), as well as Felbermayr et al. (2013) and Egger et al. (2021) in comparable settings to ours, and linearise the system of equations by totally differentiating and expressing it in terms of percentage changes. We then isolate changes in endogenous variables with respect to changes in the tax rate in country i, conditional on evaluating a change in an initial equilibrium. Denoting a percentage change in variable x by $\hat{x} \equiv \mathrm{d}x/x$, we compute the elasticity of x w.r.t. t_i by $\hat{x}/\hat{t}_i$.

Accordingly, log-linearising Eqs. (25) - (27) we can rewrite the system of equilibrium conditions as follows:

$$\hat{\varphi}_j^{i^*} = \hat{\varphi}_i^{i^*} - \frac{\sigma}{\sigma-1}\hat{w}_i - \frac{1}{\sigma-1}\frac{t_i}{1-t_i}\hat{t}_i \tag{28}$$

$$\hat{\varphi}_i^{j^*} = \hat{\varphi}_j^{j^*} + \frac{\sigma}{\sigma-1}\hat{w}_i + \frac{1}{\sigma-1}\frac{t_i}{1-t_i}\hat{t}_i \tag{29}$$

$$\hat{\varphi}_i^{i^*} = -\chi_i \hat{\varphi}_i^{j^*} + \lambda_i \frac{1+\chi_i}{k}\frac{t_i}{1-t_i}\hat{t}_i \tag{30}$$

$$\hat{\varphi}_j^{j^*} = -\chi_j \hat{\varphi}_j^{i^*} \tag{31}$$

$$\hat{\varphi}_i^{j^*} = \hat{\varphi}_j^{i^*} + \frac{1}{k}\hat{w}_i + \frac{1}{k}\frac{t_i}{1-t_i}\hat{t}_i, \tag{32}$$

where we have set $\hat{N}_i = \hat{N}_j = \hat{\tau}_i^j = \hat{\tau}_j^i = \hat{t}_j = 0$ by choice of the analysis and $\hat{w}_j = 0$ by choice of the numéraire.[11]

[11] For a more general specification of the log-linearised system of equations see the Online Appendix, Section S.1.

Effects on the factor allocation and average productivity

Let us first analyse how the outlined tax policy reform affects the decisions of individuals on their occupational choice, which, on aggregate, determine the factor allocation in the reforming country.

Intuitively, an increase in the domestic tax rate reduces net profits of domestic firms and makes it less attractive to become a manager, *ceteris paribus*. Accordingly, the indifference condition determining the marginal manager, Eq. (9), is distorted and we expect the productivity threshold to go up in response to the tax reform. However, in general equilibrium, both the wage rate (i.e. the outside option to become a manager) and the market size (i.e. the demand for an individual firm's variety) endogenously adjust. Moreover, as we assume the tax policy of the trading partner not to be altered, the decision to export will be affected differently. Accordingly, firms able to export, i.e. the comparably more productive ones, may be hit less due to an only indirectly affected demand reaction in foreign. In order to account for these direct and indirect effects, we need to solve the system of equations, Eqs. (28)-(32).

Our analysis above shows the crucial role played by the two productivity cutoff levels of each country for the factor allocation and aggregate variables. Reducing the system of equations with formal derivation details deferred to Appendix A.5, we can prove an increase in country-i's domestic cutoff in the tax rate t_i as

$$\frac{\hat{\varphi}_i^{i*}}{\hat{t}_i} = \frac{t_i}{1-t_i}\frac{1}{k}\left\{(1+\chi_i)\,\lambda_i\left[(2+\chi_j)\,\frac{\sigma}{\sigma-1}-\frac{1}{k}\right]-\chi_i(1+\chi_j)\right\}\mathcal{B}^{-1}>0, \tag{33}$$

with $\mathcal{B} \equiv (2+\chi_i+\chi_j)\sigma/(\sigma-1)-(1-\chi_i\chi_j)1/k > 0$. So indeed the individual just being indifferent between becoming a manager or not is characterised by a higher ability than in the equilibrium prior to the unilateral tax reform. Hence, the least productive firms exit. The direct negative tax effect on domestic firms' profits dominates any indirect effects. The induced change in occupational choice decisions extends to changes in the aggregate factor allocation as it directly follows from Eqs. (11) and (20) that the mass of managers decreases in the tax rate, while the mass of workers increases:

$$\frac{\hat{M}_i}{\hat{t}_i} = -k\frac{\hat{\varphi}_i^{i*}}{\hat{t}_i} < 0 \qquad \text{and} \qquad \frac{\hat{L}_i}{\hat{t}_i} = \frac{\hat{\lambda}_i}{\hat{t}_i} = t_i[\zeta(\sigma-1)+1-t_i]^{-1} > 0. \tag{34}$$

Intuitively, a larger supply of workers facing a smaller demand for labour by fewer firms leads to a lower wage rate. This is precisely what we find by computing the elasticity of w_i w.r.t. t_i as

$$\frac{\hat{w}_i}{\hat{t}_i} = \frac{t_i}{1-t_i}\left[(1+\chi_i)(1+\chi_j)\frac{\lambda_i}{k}+(2+\chi_i+\chi_j)-\mathcal{B}\right]\mathcal{B}^{-1}<0, \tag{35}$$

which is strictly negative as we show in Appendix A.6. However, this indirect wage-decreasing effect, which makes the outside option to become a manager relatively less attractive, only partly offsets the direct tax effect on the factor allocation. Similarly, despite decreasing fixed costs of exporting, as export consultants are paid the economy-wide wage rate, we find a decline in the mass of exporters (and accordingly in the mass of export consultants). Combining Eqs. (30) and (33) as shown in Appendix A.7, we get the following elasticity of country-i's export cutoff productivity w.r.t. the domestic tax:

$$\frac{\hat{\varphi}_i^{j*}}{\hat{t}_i} = \frac{t_i}{1-t_i}\frac{1}{k}\left[(1+\chi_i)\,\lambda_i\left(\frac{\sigma}{\sigma-1}+\frac{\chi_j}{k}\right)+(1+\chi_j)\right]\mathcal{B}^{-1} > 0, \tag{36}$$

which is strictly positive, corresponding to fewer, but more productive exporting firms with $\hat{M}_j^i/\hat{t}_i = -k\hat{\varphi}_i^{j^*}/\hat{t}_i < 0$.

Since both the mass of all active firms and the mass of exporters decline in the tax rate it is *ex ante* unclear how the share of exporting firms, i.e. the ratio of the two mass', is affected by the unilateral tax policy reform. Using the definition of χ_i, we can write the elasticity w.r.t. the domestic tax as

$$\frac{\hat{\chi}_i}{\hat{t}_i} = k\left(\frac{\hat{\varphi}_i^{i*}}{\hat{t}_i} - \frac{\hat{\varphi}_i^{j*}}{\hat{t}_i}\right) = \frac{t_i}{1-t_i}(1+\chi_i)(1+\chi_j)\mathcal{B}^{-1}\frac{\hat{\lambda}_i}{\hat{t}_i} > 0, \tag{37}$$

where we show in Appendix A.8 that the second equality arises from Eqs. (33) and (36). It follows that the share of exporting firms is unambiguously increasing in the tax rate. Hence, the mass of exporters is reduced by less than the mass of all active domestic firms.

Moreover, as both domestic cutoff productivity levels increase, each set of domestic firms, the entire continuum of domestic firms and the subset of exporting firms, becomes more productive on average. In order to compute the tax effect on average productivity in the reforming country i, accounting for relative shifts, we log-linearise Eq. (22) and show in the Appendix A.9 that this yields

$$\frac{\hat{\tilde{\varphi}}_i}{\hat{t}_i} = \frac{1}{1+\chi_i^{\frac{k-1}{k}}}\frac{\hat{\varphi}_i^{i*}}{\hat{t}_i} + \frac{\chi_i^{\frac{k-1}{k}}}{1+\chi_i^{\frac{k-1}{k}}}\frac{\hat{\varphi}_i^{j*}}{\hat{t}_i} + \frac{\chi_i\left(\chi_i^{-\frac{1}{k}}-1\right)}{(1+\chi_i)\left(1+\chi_i^{\frac{k-1}{k}}\right)}\frac{\hat{\chi}_i}{\hat{t}_i} > 0, \tag{38}$$

where the positive sign directly follows from $\chi_i \in (0,1)$ and from all three elasticities ($\hat{\varphi}_i^{i^*}/\hat{t}_i$, $\hat{\varphi}_i^{j^*}/\hat{t}_i$, and $\hat{\chi}_i/\hat{t}_i$) being positive according to Eqs. (33), (36), and (37). Remarkably, the unilateral increase in the tax on operating profits raises average productivity in the reforming country. This is due to a composition effect with workers being reallocated to the relatively more productive firms. From the last term in Eq. (38) it follows that the effect is enforced by the increased share of the relatively more productive exporting firms.

In order to get an intuition for these tax-induced effects in the reforming country, let us focus on the rise in the share of exporting firms. Log-linearising Eq. (15), we find the following equivalence for this increase:

$$\frac{\hat{\chi}_i}{\hat{t}_i} > 0 \qquad \Leftrightarrow \qquad \frac{\hat{R}_i + (\sigma-1)\hat{P}_i}{\hat{t}_i} < \frac{\hat{R}_j + (\sigma-1)\hat{P}_j}{\hat{t}_i}. \tag{39}$$

Hence, an increase in the domestic tax on operating profits reduces the domestic market size relative to the market size of the non-reforming country. Although less profitable than prior to the tax increase, the option to export becomes relatively more attractive. International trade then cushions the negative effect of a tax increase. It does so, however, only for those firms that are productive enough to remain active on the foreign market. [12]

[12] Note that the change in the reforming country's share of exporters depends on an asymmetric (e.g. unilateral) tax policy reform that changes the relative market size of the two trading partners. With an unchanged relative

We have shown that asymmetry in policy setting is crucial for the responses of individuals in the reforming country. Moreover, due to linkages via international trade the non-reforming country may be affected as well.

While exporting becomes relatively more attractive for firms in the reforming country ($\hat{\chi}_i/\hat{t}_i > 0$), the opposite must hold true for country j. Accordingly, from Eq. (15) it directly follows that

$$\frac{\hat{\chi}_j}{\hat{t}_i} = -\frac{\hat{\chi}_i}{\hat{t}_i} < 0. \tag{40}$$

In essence, the negative tax impact on the foreign export share comes from an income effect that transmits to the foreign country, leading to firm selection effects as exporting to the reforming country becomes relatively less attractive. While foreign exporters are not directly affected by country-i's tax, they experience relatively lower demand for their varieties in the reforming country.

Again, making use of the system of equations, Eqs. (28)-(32), as shown in Appendix A.10, we derive the effects of country i's tax policy reform on country-j's export and domestic productivity cutoffs as follows:

$$\frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i} > 0 \qquad \text{and} \qquad \frac{\hat{\varphi}_j^{j^*}}{\hat{t}_i} = -\chi_j \frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i} < 0. \tag{41}$$

Hence, an increase in the tax rate in country i leads to an increase in the productivity of the marginal foreign exporter, while it decreases the productivity of the marginal foreign non-exporter.[13] Theses changes directly correspond to changes in the factor allocation and the composition of the firm population. In terms of elasticities we get

$$\frac{\hat{M}_j}{\hat{t}_i} = -k\frac{\hat{\varphi}_j^{j^*}}{\hat{t}_i} > 0, \qquad \frac{\hat{M}_j^i}{\hat{t}_i} = -k\frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i} < 0, \qquad \text{and} \qquad \frac{\hat{L}_j}{\hat{t}_i} = \frac{\hat{\lambda}_j}{\hat{t}_i} = 0. \tag{42}$$

Accordingly, the mass of foreign firms rises, the mass of foreign exporters declines, while from Eq. (20) it follows that the mass of workers L_j does neither depend directly on country i's tax rate t_i nor indirectly via the altered χ_j. It remains unchanged. Hence, in contrast to the reforming country i, its trading partner only experiences a shift between the groups of managers and export consultants rather than a change in the mass of all three groups.

In order to learn about the effect on average productivity we can employ country j's analogue of Eq. (22). Acknowledging Eq. (26) and that λ_j is unchanged in t_i we show in Appendix A.11 that

$$\frac{\hat{\tilde{\varphi}}_j}{\hat{t}_i} = (k-1)\frac{\chi_j^{-\frac{1}{k}} - 1}{1 + \chi_j^{\frac{k-1}{k}}}\frac{\hat{\varphi}_j^{j^*}}{\hat{t}_i} < 0, \tag{43}$$

where the negative sign follows from the negative tax impact on $\varphi_j^{j^*}$, while the two other terms are positive since $k > 1$ and $\chi_j \in (0, 1)$. Average productivity in country j is, hence, reduced by the unilateral tax policy reform in trading partner i.

market size, e.g. in case of a symmetric country set-up as in Kohl (2020), χ_i is determined by variable trade costs only and, hence, constant in t_i, according to Eq. (15).

[13] These opposing effects on country$j$'s productivity cutoffs are in contrast to the co-movement of the two cutoffs in the reforming country. This goes back to the crucial difference between the third and fourth equilibrium conditions, Eqs. (30) and (31): While according to Eq. (31) the cutoff levels in country j necessarily are negatively linked, there is an additional term in Eq. (30). This is the direct effect of the tax increase working via the occupational choice decision of individuals (represented by λ_i) that ultimately leads to the co-movement in the two cutoffs in country i.

Importantly, these tax-induced effects on occupational choice decisions, factor allocation, and average productivity in country j resemble the response to an increase in trade costs, i.e. to less liberal trade (cf. Felbermayr et al., 2013). This comparison is supported by a tax-induced deterioration of country-j's terms-of-trade, where we define the terms-of-trade based on import price indices. Accordingly, from the perspective of the non-reforming country we use P_j^i/P_i^j as the terms-of-trade with $P_i^j \equiv \left[N_i \int_{\varphi_i^{j*}}^{\infty} p_i^j(\varphi)^{1-\sigma} g(\varphi)\mathrm{d}\varphi\right]^{1/(1-\sigma)}$ being the import price index of country j, and P_j^i the equivalently defined import price index of country i. As shown in Appendix A.12 we find a negative terms-of-trade effect for country j as

$$\frac{\hat{P}_j^i}{\hat{t}_i} - \frac{\hat{P}_i^j}{\hat{t}_i} = \frac{1}{k}\frac{\hat{\chi}_j}{\hat{t}_i} < 0. \tag{44}$$

Hence, from the perspective of a trading partner, the unilateral increase in the tax on operating profits is comparable to a protectionist measure. This does not come at a surprise. While in contrast to increased trade costs, which make exporting relatively less beneficial, in our analysis, it is the reduced relative market size of the unilaterally tax reforming country that reduces the demand for foreign varieties and thus the relative attractiveness for foreign export activity. [14]

We can summarize the key underlying mechanism of a unilateral tax policy reform in an open economy as follows.

Proposition 1 *A unilateral tax policy reform leads to a reduction in the market size of the reforming country relative to the market size of its trading partner. This alters firm selection into exporting in both countries. In the reforming country, the share of exporting firms increases amid a reduction to fewer, more productive exporters. In the non-reforming trading country, both the overall mass of exporters and the share of exporting firms decline in accordance with a terms-of-trade deterioration.*

Effects on real income and inequality

We have seen that country i's unilateral increase in its tax on operating profits has pronounced selection effects in the reforming country itself and in its trading partner. In particular, an induced change in the relative market size alters the attractiveness of exporting in both countries. In this section, we are interested in how aggregate (real) income is affected by these changes and whether, and, if so, to what extent a tax rise can lower inequality.

Let us first analyse the impact on aggregate real income in the reforming country. Note that aggregate real income corresponds to the standard welfare measure aggregate utility, as $R_i/P^i = U_i$ due to the definition of the price index. With the entire mass of individuals N_i being constant, aggregate real income is also proportional to average per capita real income and, hence, a first statistic describing the tax-induced change in the income distribution.

Separate inspection of both terms, nominal income and the price index, reveals that different channels are at work that relate to firm selection and factor income. From Eq. (18) we know that aggregate nominal revenues are proportional to the entire wage income of production workers.

[14] In the reforming country i the mass of exporting firms declines as well but the direct effect of the tax increase dominates leading to the relatively more attractive option to export to the non-reforming country, also seen in country-i's terms-of-trade improvement.

However, while the tax effect on the (nominal) wage rate is negative, see Eq. (35), the mass of production workers increases, see Eq. (34), jointly making the effect on aggregate nominal income *ex ante* ambiguous. Similarly, there are opposing channels determining the price index (see below). As we show in Appendix A.13 we can derive a negative elasticity of aggregate real income w.r.t. the domestic tax as

$$\frac{\hat{R}_i}{\hat{t}_i} - \frac{\hat{P}^i}{\hat{t}_i} = \frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} + \frac{t_i}{1-t_i}\left(1 - \frac{\sigma}{\sigma-1}\lambda_i\right) < 0, \tag{45}$$

which directly follows from

$$\frac{\hat{R}_i}{\hat{t}_i} = \frac{\hat{w}_i}{\hat{t}_i} + \frac{\hat{\lambda}_i}{\hat{t}_i} < 0 \qquad \text{and} \qquad \frac{\hat{P}^i}{\hat{t}_i} = \frac{\hat{w}_i}{\hat{t}_i} - \frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} + \frac{t_i}{1-t_i}\frac{1}{\sigma-1}\lambda_i > 0. \tag{46}$$

Hence, a unilateral tax rise reduces aggregate real income in country i. Quite intuitively, this reflects the tax distortion of the economy.

We can further detail this result with two observations. First, the negative tax effect on aggregate real income is less pronounced in an economy open to international trade rather than being under autarky. Note from Eq. (45) that the tax income effect consists of two opposing terms, the change in the domestic cutoff (depending on the degree of trade openness) and a collection of parameters (depending on the initial tax level but not on the degree of trade openness). Accordingly, to understand the role of trade openness on the tax income effect we need to understand the tax-induced change in the domestic cutoff. Alternatively to Eq. (33) we can express $\hat{\varphi}_i^{i^*}/\hat{t}_i$ as

$$\frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} = \frac{\hat{\varphi}_i^{i^*aut}}{\hat{t}_i} + \frac{1}{k}\frac{\chi_i}{1+\chi_i}\frac{\hat{\chi}_i}{\hat{t}_i}, \tag{47}$$

where $\varphi_i^{i^*aut}$ denotes the domestic cutoff under autarky.[15] Since $\hat{\chi}_i/\hat{t}_i > 0$ according to Eq. (37) due to the increased relative attractiveness of exporting for country-i firms, we get a more pronounced selection effect, $\hat{\varphi}_i^{i^*}/\hat{t}_i > \hat{\varphi}_i^{i^*aut}/\hat{t}_i$, and, hence, a less pronounced tax effect on real aggregate income in the open economy. This is consistent with the improvement of country-i's terms-of-trade as shown above.

Second, it becomes apparent from Eq. (46) that the real wage declines more strongly than average per capita real income. This is due to the altered factor allocation towards more production workers that leads to a smaller per worker share of the (reduced) aggregate income.

We summarize our findings on the tax-induced effects on real income as follows:

Proposition 2 *A unilateral increase in the tax on operating profits by country i leads to a decline in aggregate real income in the reforming country. This reduction is less pronounced under international trade than under autarky. The real wage declines to a larger extent than per capita real income.*

Despite the finding of a decline in the real wage and in average per capita real income, in

[15] Using Eqs. (16) and (21) we can solve for the domestic cutoff as $\varphi_i^{i^*} = \varphi_i^{i^*aut}(1+\chi_i)^{1/k}$ with $\varphi_i^{i^*aut} \equiv (1-\lambda_i)^{-1/k}$. While it directly follows that $\varphi_i^{i^*} > \varphi_i^{i^*aut}$, a finding well-established in the literature (cf. Melitz, 2003), we are interested in how the change in this cutoff in response to a unilateral tax increase differs for a country in autarky or open to international trade. Hence, the log-linearised formulation in Eq. (47). For an explicit formulation of the closed economy equilibrium see, for instance, Kohl (2020).

order to get a complete picture we look at the tax-induced changes in the income distribution. Accordingly, a decline in real income might be justifiable on grounds of reduced income inequality. In order to analyse the change in the inter-group inequality we log-linearise Eq. (24) and compute:

$$\frac{\hat{\Xi}_i}{\hat{t}_i} = \frac{\hat{\Xi}_i^{aut}}{\hat{t}_i} + \gamma_i \left(-\frac{\hat{\lambda}_i}{\hat{t}_i} + \frac{\hat{\chi}_i}{\hat{t}_i} \right), \tag{48}$$

with

$$\frac{\hat{\Xi}_i^{aut}}{\hat{t}_i} = -\frac{(\zeta-1)t_i}{\zeta(\sigma-1)+1+(\zeta-1)t_i} < 0 \quad \text{and} \quad \gamma_i \equiv \left[1 + \frac{k}{\sigma-1}\frac{\zeta(\sigma-1)+1}{\zeta(\sigma-1)+1-t_i}\chi_i^{-1}\right]^{-1} \in (0,1/2).$$

It directly follows that in the limiting case of autarky ($\chi_i \to 0$), income inequality in the reforming country unambiguously declines in response to a unilateral rise in the tax on operating profits.[16]

In an open economy, by contrast, the impact of the unilateral tax reform is more complex due to opposing partial effects with the role of $\hat{\chi}_i/\hat{t}_i > 0$ at the centre. With γ_i being positive in an initial open economy equilibrium, the term in parenthesis in Eq. (48) is crucial. If this term is negative, income inequality in an economy open to trade is reduced to a larger extent than in a closed economy. If the term in parentheses is positive, however, international trade leads to a lower tax-induced reduction or even a tax-induced increase in income inequality. Importantly, the sign and magnitude of this term depends on the initial equilibrium we are investigating a unilateral policy change at. In particular, it depends on the initial level of t_i and the role of initial trade openness and country asymmetry represented by the initial values χ_i and χ_j.

As we show in Appendix A.14, it is possible to implicitly derive a level of the initial tax rate

$$\tilde{t}_i = \left[1 + \frac{(1+\chi_i)(1+\chi_j)}{\mathcal{B}}\right]^{-1} \in (1/2, 1), \tag{49}$$

such that for $t_i < \tilde{t}_i$ international trade enforces the tax-induced reduction of income inequality, while for $t_i > \tilde{t}_i$, by contrast, there is an opposing inequality-increasing partial effect in an economy open to international trade. While the threshold level $\tilde{t}_i$ symmetrically declines in χ_i and χ_j, its lower limit is given by one half. Accordingly, for sufficiently small initial levels of the tax rate on operating profits (below a threshold level of at least 50%) the term in parentheses in Eq. (48) is negative and any tax increase leads to a reduction in income inequality with the effect being more pronounced in an economy open to international trade than under autarky.[17]

This open economy enforcement effect crucially depends on the role of per capita transfer b_i, which can best be seen by the following thought experiment. Suppose that the tax revenues were not redistributed lump-sum to every individual but thrown away. It is then straightforward to show that country-i's inter-group inequality from Eq. (23) reduces to $\Xi_i|_{b_i \overset{!}{=} 0} = \zeta + (\zeta-1)\chi_i$, which log-linearised can be written as

$$\left.\frac{\hat{\Xi}_i}{\hat{t}_i}\right|_{b_i \overset{!}{=} 0} = \frac{(\zeta-1)\chi_i}{\zeta+(\zeta-1)\chi_i}\frac{\hat{\chi}_i}{\hat{t}_i} > 0. \tag{50}$$

[16] To see this, note that for $\chi_i \to 0$ the factor γ_i converges to zero, while $\hat{\Xi}_i/\hat{t}_i \to \hat{\Xi}_i^{aut}/\hat{t}_i < 0$.

[17] As γ_i, which is multiplied to the term in parentheses in Eq. (48), monotonically increases in χ_i, the open economy enforcement effect of the tax-induced inequality reduction (for sufficiently small initial tax levels) increases in the degree of trade openness of country i.

The effect shown in Eq. (50) is a partial effect stemming from higher profit opportunities of exporting firms that lead to a rise in income inequality due to the tax-induced increase in the share of exporting firms. Accordingly, without the balancing effect of the per capita transfer, a unilateral tax increase unambiguously increases income inequality in the open economy.[18] Accounting for the per capita transfer, by contrast, for sufficiently small values of the initial tax rate ($t_i < \tilde{t}_i$), the partial effect, as shown in Eq. (50), is dominated and the decline in inequality is reinforced by international trade.

For large initial tax levels ($t_i > \tilde{t}_i$), however, the open economy effect in Eq. (48) is positive, hence inequality-increasing, which brings us to the apparent question, whether this unilateral tax increase can indeed cause an overall increase in income inequality. With formal details deferred to Appendix A.15, we show how to implicitly solve for the threshold level of the initial tax rate such that $\hat{\Xi}_i/\hat{t}_i = 0$. We compute

$$t_i^{root} = \left[1 + \frac{(1+\chi_i)(1+\chi_j)}{\mathcal{B}} \left\{1 + \frac{(\zeta-1)\left[\zeta(\sigma-1)+1-t_i\right]}{\zeta(\sigma-1)+1+(\zeta-1)t_i}\gamma_i^{-1}\right\}^{-1}\right]^{-1} \in (\tilde{t}_i, 1), \qquad (51)$$

which is necessarily larger than $\tilde{t}_i$ but indeed below unity, hence, in the allowed parameter range of t_i. Accordingly, in an open economy with large initial tax levels ($t_i > t_i^{root}$), it is indeed possible that the inequality-increasing effect dominates and a unilateral rise in the tax on operating profits increases income inequality, while lowering aggregate real income at the same time (see above).

In order to further elaborate on the tax impact on income inequality and the size of $\tilde{t}_i$ and t_i^{root} we use numerical simulations and illustrate the elasticity, decomposed into a *closed economy effect* and an *additional open economy effect* according to Eq. (48). To simplify the analysis we thereby focus on a unilateral increase in t_i given initial symmetry as the starting point. Fig. 1 shows the impact of different initial tax values ($t = t_i = t_j$ on the abscissa), where we use parameter values $\sigma = 3.8$ and $k = 4$ in line with Bernard et al. (2003) and Felbermayr et al. (2013) to depict an example with trade openness of $\chi = \chi_i = \chi_j = 0.6$ in the initial symmetric equilibrium.[19]

[18] Under autarky or with coordinated tax policy reforms there is no tax-induced effect on income inequality in the absence of the per capita transfer. Hence, it is not the tax distortion of occupational choice decisions that impacts relative income levels. It is a change in the relative market size induced by asymmetric tax reforms, causing in our case the shift towards the then relatively more attractive foreign market, that impacts income inequality via a change in the share of exporting firms.

[19] Recall from Eq. (15) that in case of initial symmetry χ_i and χ_j are determined by the parameters τ_i^j and τ_j^i only, while being independent of tax rates t_i and t_j.

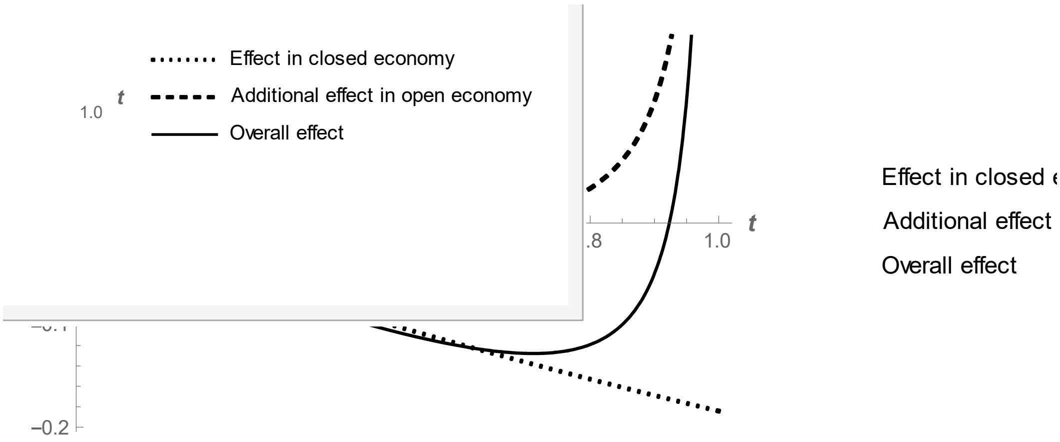

Figure 1: *Decomposed inequality effect of a unilateral increase in t_i given the initial tax $t_i = t_j = t$.*
Note: The assumed values are $\sigma = 3.8$, $k = 4$, $\chi = 0.6$.

From this illustration we can make two observations. First, the additional inequality reducing effect of international trade for values of $t_i < \tilde{t}_i$ seems rather small. Second, the threshold value t_i^{root} is close to unity (above 0.9 in the illustrated example) and, hence, a tax-induced increase in inequality an unlikely outcome.

We summarize our findings on the tax-induced effects on income inequality in the reforming country as follows:

Proposition 3 *A unilateral increase in the tax on operating profits by country i leads to a generally ambiguous effect on inter-group income inequality in the reforming country due to an inequality-increasing partial effect from the relative shift to exporting. For sufficiently small initial tax rates, with critical lower level above one half, a unilateral tax increase, however, unambiguously reduces income inequality. In this case, the inequality decreasing effect is stronger in an economy open to trade than under autarky.*

Let us finally turn once more to the reforming country's trading partner, country j, and analyse how aggregate real income and income inequality in this non-reforming country is affected through the transmission via international trade. By inspection of Eq. (46) it becomes apparent that aggregate nominal income in country j is unaffected by a change in the tax rate in country i, i.e. $\hat{R}_j/\hat{t}_i = \hat{w}_j/\hat{t}_i - \hat{\lambda}_j/\hat{t}_i = 0$. This follows from our choice of numéraire and from Eq. (42), which shows that the mass of workers in country j is unaltered. Accordingly, aggregate real income in country-j's analogue of Eq. (45) collapses to

$$\frac{\hat{R}_j}{\hat{t}_i} - \frac{\hat{P}^j}{\hat{t}_i} = -\frac{\hat{P}^j}{\hat{t}_i} = \frac{\hat{\varphi}_j^{j*}}{\hat{t}_i} < 0, \tag{52}$$

where in Appendix A.16 we derive the inverse relation of price index P^j to country-j's domestic cutoff productivity φ_j^{j*}. The non-reforming country is, hence, affected by a tax-induced decline in aggregate real income, consistent with its deteriorated terms-of-trade as shown above.

While from Eqs. (8) and (18) it then follows that aggregate operating profits, aggregate wage income, and the per capita transfer are all constant in t_i, by contrast, the share of country-j's exporting firms, according to Eq. (40), is not. It is this decline in χ_j that leads to distributional effects of country-i's tax policy reform in its trading partner j. Accordingly, we find that Eq. (48) in its analogue for j collapses to

$$\frac{\hat{\Xi}_j}{\hat{t}_i} = \gamma_j \frac{\hat{\chi}_j}{\hat{t}_i} < 0. \tag{53}$$

Hence, the income gap between managers and workers in country j shrinks if country i increases its tax rate. This is remarkable as it suggests that a country can benefit in terms of reduced income inequality from the redistribution policy of its trading partner: a positive externality (at the expensive of reduced aggregate real income). Following our discussion on the parallels between de-globalisation and the unilateral tax reform from the perspective of the non-reforming country, this result does not come as a surprise, however. It is well consistent with the finding of a rise in income inequality from the opposite event of more liberal trade (cf. Egger and Kreickemeier, 2012).

We can summarize the impact of country-i's tax policy reform on aggregate real income and income inequality in country j as follows:

Proposition 4 *A unilateral increase in the tax on operating profits by country i reduces both aggregate real income and inter-group inequality in the non-reforming trading partner j.*

5 Conclusion

In this paper we analyse the effects of a unilateral tax policy reform in an open economy, accounting for individual occupational choice decisions and firm selection effects. Our key objective is to find answers to the policy-relevant question of how effective a unilateral adjustment of a welfare state can be in the context of international trade. To this end, we set up a general equilibrium trade model featuring firm heterogeneity and country asymmetries. Our framework builds on individuals with different abilities to decide on their occupation based on income opportunities. This feature generates income inequality and allows us to analyse the tax-induced within-country distributional effects among individuals.

Our findings suggest that a unilateral tax increase leads to pronounced effects on occupational choice decisions and firm selection. In the reforming country more individuals decide to become production workers rather than managers or export consultants, the least productive firms exit, while the share of firms engaging in exporting activity increases. Importantly, this relative shift towards exporting leads to a rise in the average productivity and shows the opportunity for the most productive firms (that can afford to export) to benefit from supplying to the other market in response to a unilateral tax increase. We highlight the key mechanism of a unilateral tax policy reform underlying this result, namely an induced reduction in the market size of the reforming country relative to the market size of the non-reforming country reflecting an improvement in its terms-of-trade. Accordingly, we find that an open economy experiences a less pronounced decline in aggregate real income than it would under autarky. Furthermore, for sufficiently small initial tax rates the unilateral tax policy reform reduces income inequality to a larger extent in an economy open to international trade than under autarky.

The tax-induced change in relative market sizes depicts an important channel of unilateral policy reforms, a channel transmitting the tax impact internationally. In particular, we highlight parallels to a unilateral trade policy reform with deteriorating terms-of-trade, a reduced share of exporters, and a decline in average productivity in the non-reforming country, which additionally sees a decline in both aggregate real income and income inequality.

Since the unilateral tax policy reform creates a terms-of-trade externality as known from the unilateral trade policy literature, the seminal work by Bagwell and Staiger (1999) suggests that there could be welfare gains from coordination. In this regard, the difference between unilateral and coordinated optimal tax policy is an interesting topic subject to future research.

A Appendix

A.1 Derivation of Eq. (19)

Total revenues of producers from country i originate from domestic sales and from exporting. Accordingly, we can write R_i as

$$R_i = M_i \int_{\varphi_i^{i*}}^{\infty} r_i^i(\varphi) \frac{g(\varphi)}{1 - G(\varphi_i^{i*})} \mathrm{d}\varphi + M_i^j \int_{\varphi_i^{j*}}^{\infty} r_i^j(\varphi) \frac{g(\varphi)}{1 - G(\varphi_i^{j*})} \mathrm{d}\varphi. \tag{A.1}$$

By means of our specification of the Pareto distribution and using Eqs. (4) and (7) this can be rewritten as

$$R_i = M_i \frac{k}{k - (\sigma - 1)} r_i^i(\varphi_i^{i*}) + M_i^j \frac{k}{k - (\sigma - 1)} r_i^j(\varphi_i^{j*}). \tag{A.2}$$

Using the occupational choice condition, Eq. (9), and the export indifference condition, Eq. (13), we can replace both $r_i^i(\varphi_i^{i*})$ and $r_i^j(\varphi_i^{j*})$. This gives

$$R_i = \frac{\sigma}{1 - t_i} \frac{k}{k - (\sigma - 1)} \left(M_i + M_i^j \right) w_i. \tag{A.3}$$

Replacing $M_i^j = \chi_i M_i$ and rearranging gives Eq. (19) in the main text.

A.2 Derivation of Eq. (22)

In order to derive average productivity as given in Eq. (22) we need to compute average per firm production $\bar{q}_i \equiv \bar{q}_i^i + \chi_i \bar{q}_i^j$. This follows as

$$\bar{q}_i = \int_{\varphi_i^{i*}}^{\infty} q_i^i(\varphi) \frac{g(\varphi)}{1 - G(\varphi_i^{i*})} \mathrm{d}\varphi + \chi_i \int_{\varphi_i^{j*}}^{\infty} q_i^j(\varphi) \frac{g(\varphi)}{1 - G(\varphi_i^{j*})} \mathrm{d}\varphi, \tag{A.4}$$

which can be rewritten by means of the specified Pareto distribution as

$$\bar{q}_i = \frac{k}{k - \sigma} \left[q_i^i(\varphi_i^{i*}) + \chi_i q_i^j(\varphi_i^{j*}) \right]. \tag{A.5}$$

Substituting for domestic and export supply and using, in a next step, Eqs. (3) and (6) for prices and Eqs. (4) and (7) for revenues we get:

$$\bar{q}_i = \frac{k}{k - \sigma} \left[\frac{r_i^i(\varphi_i^{i*})}{p_i^i(\varphi_i^{i*})} + \chi_i \frac{\tau_i^j r_i^j(\varphi_i^{j*})}{p_i^j(\varphi_i^{j*})} \right] = \frac{k(\sigma - 1)}{k - \sigma} \frac{1}{1 - t_i} \left(\varphi_i^{i*} + \chi_i \varphi_i^{j*} \right). \tag{A.6}$$

Joint with M_i/L_i and recalling the definitions of ζ and χ_i, this gives Eq. (22) in the main text.

A.3 Derivation of Eq. (24)

From Eq. (18) it follows that average operating profits are a constant fraction of average revenues. Joint with Eq. (19), we can rewrite Ξ_i from Eq. (23) as

$$\Xi_i = \frac{\left[\zeta + (\zeta - 1)\chi_i\right] w_i + b_i}{w_i + b_i} = \frac{\zeta + b_i/w_i}{1 + b_i/w_i} + \frac{\zeta - 1}{1 + b_i/w_i} \chi_i. \tag{A.7}$$

By means of Eq. (18) we can specify the lump-sum transfer, b_i from Eq. (8), as follows:

$$b_i = \frac{R_i}{\sigma} \frac{t_i}{N_i} = \frac{w_i t_i L_i}{N_i(\sigma - 1)} = \frac{1}{\sigma - 1} t_i \lambda_i w_i. \tag{A.8}$$

Replacing b_i in Eq. (A.7) by this expression, we can rewrite Ξ_i as

$$\Xi_i = \frac{\zeta + (\sigma-1)^{-1} t_i \lambda_i}{1 + (\sigma-1)^{-1} t_i \lambda_i} + \frac{\zeta - 1}{1 + (\sigma-1)^{-1} t_i \lambda_i} \chi_i, \tag{A.9}$$

where w_i canceled out. Finally, rearranging and recalling the definition of λ_i gives Eq. (24) in the main text.

A.4 Derivation of Eq. (27)

Following similar steps as in Appendix A.2 for average output, average export revenues of an exporting firm from country i can be calculated as follows:

$$\begin{aligned} \bar{r}_i^j &= \int_{\varphi_i^{j^*}}^{\infty} r_i^j(\varphi) \frac{g(\varphi)}{1 - G(\varphi_i^{j^*})} \mathrm{d}\varphi \\ &= \zeta r_i^j(\varphi_i^{j^*}). \end{aligned} \tag{A.10}$$

Multiplying this expression by $M_i^j = (\varphi_i^{j^*})^{-k} N_i$ as given by Eq. (16) and following the same operations for country j, we can rewrite the trade balance condition as

$$N_i(\varphi_i^{j^*})^{-k} r_i^j(\varphi_i^{j^*}) = N_j(\varphi_j^{i^*})^{-k} r_j^i(\varphi_j^{i^*}). \tag{A.11}$$

Finally, using the export indifference condition Eq. (13) and its analogue for country j, we can express the trade balance condition by Eq. (27) in the main text.

A.5 Derivation of Eq. (33)

Let us first eliminate $\hat{\varphi}_j^{j^*}$ by substituting Eq. (31) into Eq. (29). This yields

$$\hat{\varphi}_i^{j^*} = -\chi_j \hat{\varphi}_j^{i^*} + \frac{\sigma}{\sigma-1}\hat{w}_i + \frac{1}{\sigma-1}\frac{t_i}{1-t_i}\hat{t}_i. \tag{A.12}$$

Next, using Eq. (32) we can replace $\hat{\varphi}_j^{i^*}$ in Eqs. (28) and (A.12) to get a system, joint with the unchanged Eq. (30), of three equations in three unknowns, namely in the two cutoff productivity levels of country i and the domestic wage rate:

$$\hat{\varphi}_i^{j^*} = \hat{\varphi}_i^{i^*} - \left(\frac{\sigma}{\sigma-1} - \frac{1}{k}\right)\hat{w}_i - \left(\frac{1}{\sigma-1} - \frac{1}{k}\right)\frac{t_i}{1-t_i}\hat{t}_i \tag{A.13}$$

$$(1+\chi_j)\,\hat{\varphi}_i^{j^*} = \left(\frac{\sigma}{\sigma-1} + \frac{\chi_j}{k}\right)\hat{w}_i + \left(\frac{1}{\sigma-1} + \frac{\chi_j}{k}\right)\frac{t_i}{1-t_i}\hat{t}_i \tag{A.14}$$

$$\hat{\varphi}_i^{i^*} = -\chi_i \hat{\varphi}_i^{j^*} + \lambda_i \frac{1+\chi_i}{k}\frac{t_i}{1-t_i}\hat{t}_i \tag{A.15}$$

Next, we eliminate $\hat{\varphi}_i^{j^*}$ by substituting Eq. (A.13) into Eq. (A.14) and Eq. (A.15). This gives a system of two equations in the two unknowns, $\hat{\varphi}_i^{i^*}$ and $\hat{w}_i$:

$$(1+\chi_j)\,\hat{\varphi}_i^{i^*} = \left[(2+\chi_j)\frac{\sigma}{\sigma-1} - \frac{1}{k}\right]\hat{w}_i + \left[(2+\chi_j)\frac{1}{\sigma-1} - \frac{1}{k}\right]\frac{t_i}{1-t_i}\hat{t}_i \tag{A.16}$$

$$(1+\chi_i)\,\hat{\varphi}_i^{i^*} = \chi_i\left(\frac{\sigma}{\sigma-1} - \frac{1}{k}\right)\hat{w}_i + \left[\chi_i\left(\frac{1}{\sigma-1} - \frac{1}{k}\right) + \lambda_i\frac{1+\chi_i}{k}\right]\frac{t_i}{1-t_i}\hat{t}_i \tag{A.17}$$

We can use these two equations to eliminate $\hat{w}_i$ in order to express $\hat{\varphi}_i^{i^*}$ as a function of $\hat{t}_i$. Accordingly, we compute

$$
\begin{aligned}
&\left\{(1+\chi_i)\left[(2+\chi_j)\frac{\sigma}{\sigma-1}-\frac{1}{k}\right]-(1+\chi_j)\chi_i\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)\right\}\hat{\varphi}_i^{i^*} \\
&=\frac{t_i}{1-t_i}\left\{\frac{1+\chi_i}{k}\lambda_i\left[(2+\chi_j)\frac{\sigma}{\sigma-1}-\frac{1}{k}\right]+\left[(2+\chi_j)\frac{\sigma}{\sigma-1}-\frac{1}{k}\right]\chi_i\left(\frac{1}{\sigma-1}-\frac{1}{k}\right)\right. \\
&\qquad\left.-\left[(2+\chi_j)\frac{1}{\sigma-1}-\frac{1}{k}\right]\chi_i\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)\right\}\hat{t}_i, \qquad \text{(A.18)}
\end{aligned}
$$

which rearranged yields Eq. (33) in the main text. In order to show that $\hat{\varphi}_i^{i^*}/\hat{t}_i > 0$, we need to prove that the term in curly brackets in Eq. (33) is positive. Rearranged we can compute this condition as

$$
(1+\chi_j)\lambda_i\frac{\sigma}{\sigma-1}+(1+\chi_i)\lambda_i\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)+\chi_i(1+\chi_j)\left(\lambda_i\frac{\sigma}{\sigma-1}-1\right)>0. \qquad \text{(A.19)}
$$

As we know that $\sigma/(\sigma-1) > 1/k$, the positive sign depends on $\lambda_i\sigma/(\sigma-1) > 1$. To see that this is satisfied note that

$$
\lambda_i^{-1}=\frac{\sigma}{\sigma-1}-\frac{1}{k}-\frac{t_i}{(\sigma-1)\zeta}>1, \qquad \text{(A.20)}
$$

and, hence, $\lambda_i > (\sigma-1)/\sigma$. This completes the proof and we can safely conclude that the domestic cutoff in country i is increasing in the tax rate t_i.

A.6 Derivation of Eq. (35)

Making use of the reduced system of equations, Eqs. (A.16) and (A.17), from Appendix A.5, we can solve for $\hat{w}_i$ as a function of $\hat{t}_i$, which can be rewritten as Eq. (35) in the main text. In order to proof the negative sign of $\hat{w}_i/\hat{t}_i$, it is sufficient to show that the term in squared brackets in Eq. (35) is negative. Using the definition of $\mathcal{B}$ we can rewrite this condition as

$$
(1+\chi_i)(1+\chi_j)\lambda_i\frac{1}{k}-(2+\chi_i+\chi_j)\frac{1}{\sigma-1}+(1-\chi_i\chi_j)\frac{1}{k}<0, \qquad \text{(A.21)}
$$

which is equivalent to

$$
k>\left[\frac{1+(1+\chi_i+\chi_j)\lambda_i}{2+\chi_i+\chi_j}-\frac{\chi_i\chi_j(1-\lambda_i)}{2+\chi_i+\chi_j}\right](\sigma-1), \qquad \text{(A.22)}
$$

where the term in squared brackets is smaller than one (and converting to one for $\lambda_i \to 1$). Since $k > \sigma - 1$ the inequality in Eq. (A.22) is then always fulfilled and, hence, the wage rate in country i is decreasing in the tax rate t_i.

A.7 Derivation of Eq. (36)

Substituting for $\hat{\varphi}_i^{i*}/\hat{t}_i$ from Eq. (33) in (30) gives

$$
-\chi_i\frac{\hat{\varphi}_i^{j^*}}{\hat{t}_i}=\frac{t_i}{1-t_i}\frac{1}{k}\left\{(1+\chi_i)\lambda_i\left[(2+\chi_j)\frac{\sigma}{\sigma-1}-\frac{1}{k}-\mathcal{B}\right]-\chi_i(1+\chi_j)\right\}\mathcal{B}^{-1}. \qquad \text{(A.23)}
$$

Making use of its definition we can replace $\mathcal{B}$ in the squared brackets and end up with Eq. (36) in the main text after slight rearrangements.

A.8 Derivation of Eq. (37)

Making use of Eqs. (33) and (36) and rearranging terms gives

$$\frac{\hat{\chi}_i}{\hat{t}_i} = k\left(\frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} - \frac{\hat{\varphi}_i^{j^*}}{\hat{t}_i}\right) = \frac{t_i}{1-t_i}(1+\chi_i)(1+\chi_j)\mathcal{B}^{-1}\left[\lambda_i\left(\frac{\sigma}{\sigma-1} - \frac{1}{k}\right) - 1\right]. \tag{A.24}$$

From the definition of λ_i it follows that the term in squared brackets reduces to $\lambda_i t_i/[(\sigma-1)\zeta]$. Noting that this term is equal to $\hat{\lambda}_i/\hat{t}_i$ we directly get Eq. (36) in the main text. Since all terms are positive, the derived elasticity is positive as well.

A.9 Derivation of Eq. (38)

Log-linearising Eq. (22) leads to

$$\frac{\hat{\bar{\varphi}}_i}{\hat{t}_i} = (1-k)\left(\frac{1}{1+\chi_i^{\frac{k-1}{k}}}\frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} + \frac{\chi_i^{\frac{k-1}{k}}}{1+\chi_i^{\frac{k-1}{k}}}\frac{\hat{\varphi}_i^{j^*}}{\hat{t}_i}\right) + k\left[\frac{1}{1+\chi_i}\frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} + \frac{\chi_i}{1+\chi_i}\frac{\hat{\varphi}_i^{j^*}}{\hat{t}_i}\right]. \tag{A.25}$$

Rearranging, we can compute this elasticity as

$$\frac{\hat{\bar{\varphi}}_i}{\hat{t}_i} = \frac{1}{1+\chi_i^{\frac{k-1}{k}}}\frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} + \frac{\chi_i^{\frac{k-1}{k}}}{1+\chi_i^{\frac{k-1}{k}}}\frac{\hat{\varphi}_i^{j^*}}{\hat{t}_i} + \left(\frac{1}{1+\chi_i} - \frac{1}{1+\chi_i^{\frac{k-1}{k}}}\right)k\left(\frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} - \frac{\hat{\varphi}_i^{j*}}{\hat{t}_i}\right). \tag{A.26}$$

By means of the definition of χ_i, we can reformulate the last term and end up with Eq. (38).

A.10 Derivation of Eq. (41)

Following equivalent steps as in Appendix A.5, we can derive the change in country-j's productivity cutoff levels from the system of equilibrium conditions, Eqs. (28)-(32). This gives

$$\frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i} = \frac{t_i}{1-t_i}\frac{1}{k}(1+\chi_i)\left[\lambda_i\left(\frac{\sigma}{\sigma-1} - \frac{1}{k}\right) - 1\right]\mathcal{B}^{-1} > 0 \qquad \text{and} \qquad \frac{\hat{\varphi}_j^{j^*}}{\hat{t}_i} = -\chi_j\frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i} < 0, \tag{A.27}$$

where the indicated signs directly follow from $\lambda_i\left[\sigma/(\sigma-1) - 1/k\right] > 1$ according to Eq. (A.20).

A.11 Derivation of Eq. (43)

Making use of Eq. (31) it directly follows that the last term in the analogue of Eq. (A.25) for country j drops and the expressions reduces to

$$\frac{\hat{\bar{\varphi}}_j}{\hat{t}_i} = (1-k)\left(\frac{1}{1+\chi_j^{\frac{k-1}{k}}}\frac{\hat{\varphi}_j^{j^*}}{\hat{t}_i} + \frac{\chi_j^{\frac{k-1}{k}}}{1+\chi_j^{\frac{k-1}{k}}}\frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i}\right). \tag{A.28}$$

This is due to the absence of any distortions of the occupational choice decisions in country j from a tax rise in country i and expressed by the constant share of production workers λ_j. Again making use of Eq. (31) to substitute for $\hat{\varphi}_j^{i^*}/\hat{t}_i$ we arrive at Eq. (43) in the main text.

A.12 Derivation of Eq. (44)

Country-j's import price index P_i^j, as defined in the main text, is given by

$$(P_i^j)^{1-\sigma} = N_i\int_{\varphi_i^{j^*}}^{\infty} p_i^j(\varphi)^{1-\sigma}g(\varphi)\mathrm{d}\varphi. \tag{A.29}$$

Making use of Eq. (6) as well as recalling the specified Pareto distribution we can rewrite P_i^j as

$$\begin{aligned}(P_i^j)^{1-\sigma} =& N_i \int_{\varphi_i^{j*}}^{\infty} \left(\tau_i^j \frac{w_i}{\varphi} \frac{\sigma}{\sigma-1}\right)^{1-\sigma} g(\varphi)\mathrm{d}\varphi \\ =& \zeta(\tau_i^j)^{1-\sigma} N_i w_i^{1-\sigma} \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} (\varphi_i^{j*})^{\sigma-1-k}. \end{aligned} \tag{A.30}$$

By means of the two equilibrium conditions Eqs. (25) and (27) we can rewrite Eq. (A.30) as follows:

$$(P_i^j)^{1-\sigma} = \zeta N_j w_j^{1-\sigma} \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \left(\varphi_j^{j*}\right)^{\sigma-1-k} \chi_j. \tag{A.31}$$

Log-linearising Eq. (A.30) yields

$$\hat{P}_i^j = \hat{w}_i + \frac{k-(\sigma-1)}{\sigma-1} \hat{\varphi}_i^{j*}. \tag{A.32}$$

Log-linearising Eq. (A.31) we find

$$\hat{P}_i^j = \hat{w}_j - \hat{\varphi}_j^{j*} + \frac{k}{\sigma-1} \hat{\varphi}_j^{i*}. \tag{A.33}$$

Subtracting Eq. (A.33) from country-i's equivalent of Eq. (A.32) finally yields Eq. (44) in the main text.

A.13 Derivation of Eqs. (45) and (46)

In order to prove Eqs. (45) and (46) let us first derive the change in aggregate nominal income and the change in the price index separately, and finally combine expressions to reach aggregate real income as given in Eq. (45).

First, the derivation of $\hat{R}_i/\hat{t}_i$ as given in Eq. (46) directly follows from log-linearising the first expression in Eq. (18) and dividing terms by $\hat{t}_i$. In order to proof the negative sign of $\hat{R}_i/\hat{t}_i$ we first replace $\hat{w}_i/\hat{t}_i$ by Eq. (35) and note that $\hat{\lambda}_i/\hat{t}_i = (1-\lambda_i)t_i/(1-t_i)$. Jointly, this yields

$$\frac{\hat{R}_i}{\hat{t}_i} = \frac{t_i}{1-t_i} \left[(1+\chi_i)(1+\chi_j)\frac{\lambda_i}{k} + (2+\chi_i+\chi_j) - \lambda_i \mathcal{B}\right] \mathcal{B}^{-1} \tag{A.34}$$

Using the definition of $\mathcal{B}$ it is straightforward to rewrite the term in squared brackets to get

$$\frac{\hat{R}_i}{\hat{t}_i} = \frac{t_i}{1-t_i} \left\{(2+\chi_i+\chi_j) \left[1 - \left(\frac{\sigma}{\sigma-1} - \frac{1}{k}\right) \lambda_i\right]\right\} \mathcal{B}^{-1}, \tag{A.35}$$

which is negative since $\lambda_i \left[\sigma/(\sigma-1) - 1/k\right] > 1$. Hence, aggregate nominal income R_i is decreasing in the tax rate t_i.

Second, to derive $\hat{P}^i/\hat{t}_i$ as given in Eq. (46), we first need to find a suitable expression of the domestic price index in levels. For country i it is defined as

$$(P^i)^{1-\sigma} = N_i \int_{\varphi_i^{i*}}^{\infty} p_i^i(\varphi)^{1-\sigma} g(\varphi)\mathrm{d}\varphi + N_j \int_{\varphi_j^{i*}}^{\infty} p_j^i(\varphi)^{1-\sigma} g(\varphi)\mathrm{d}\varphi. \tag{A.36}$$

Making use of Eq. (3) and the analogue for country j of Eq. (6) as well as recalling the specified

Pareto distribution we can rewrite P^i as

$$\begin{aligned}(P^i)^{1-\sigma} =& N_i \int_{\varphi_i^{i*}}^{\infty} \left(\frac{w_i}{\varphi}\frac{\sigma}{\sigma-1}\right)^{1-\sigma} g(\varphi)\mathrm{d}\varphi + N_j \int_{\varphi_j^{i*}}^{\infty} \left(\tau_j^i \frac{w_j}{\varphi}\frac{\sigma}{\sigma-1}\right)^{1-\sigma} g(\varphi)\mathrm{d}\varphi \\ =& \zeta N_i w_i^{1-\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} (\varphi_i^{i*})^{\sigma-1-k} + \zeta(\tau_j^i)^{1-\sigma} N_j w_j^{1-\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} (\varphi_j^{i*})^{\sigma-1-k} \\ =& \zeta N_i w_i^{1-\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} (\varphi_i^{i*})^{\sigma-1-k}\left[1+(\tau_j^i)^{1-\sigma}\frac{N_j}{N_i}\left(\frac{w_j}{w_i}\right)^{1-\sigma}\left(\frac{\varphi_j^{i*}}{\varphi_i^{i*}}\right)^{\sigma-1-k}\right]. \end{aligned} \tag{A.37}$$

By means of the two equilibrium conditions Eqs. (25) and (27) we can simplify the term in squared brackets in Eq. (A.37) to $(1+\chi_i)$ and thus find

$$(P^i)^{1-\sigma} = \zeta N_i w_i^{1-\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left(\varphi_i^{i*}\right)^{\sigma-1-k}(1+\chi_i)\,. \tag{A.38}$$

Log-linearising this term yields:

$$\begin{aligned}(1-\sigma)\hat{P}^i &= (1-\sigma)\hat{w}_i + \frac{1}{1+\chi_i}(\sigma-1-k)\,\hat{\varphi}_i^{i^*} + \frac{\chi_i}{1+\chi_i}\left[(\sigma-1)\,\hat{\varphi}_i^{i^*} - k\hat{\varphi}_i^{j^*}\right] \\ &= (1-\sigma)\hat{w}_i + \left[(\sigma-1) - k\frac{1}{1+\chi_i}\right]\hat{\varphi}_i^{i^*} - k\frac{\chi_i}{1+\chi_i}\hat{\varphi}_i^{j^*}. \end{aligned} \tag{A.39}$$

Making use of equilibrium condition Eq. (30) to substitute for $\hat{\varphi}_i^{j^*}$ and rearranging gives Eq. (46) in the main text. In order to prove the positive sign of $\hat{P}^i/\hat{t}_i$ we first substitute Eq. (35) for $\hat{w}_i/\hat{t}_i$ and replace $\hat{\varphi}_i^{i^*}/\hat{t}_i$ by Eq. (33). This gives:

$$\begin{aligned}\frac{\hat{P}^i}{\hat{t}_i} =& \frac{t_i}{1-t_i}\Bigg\{(1+\chi_i)(1+\chi_j)\frac{\lambda_i}{k} + (2+\chi_i+\chi_j) - \mathcal{B} - (1+\chi_i)\frac{\lambda_i}{k}\left[(2+\chi_j)\frac{\sigma}{\sigma-1} - \frac{1}{k}\right] \\ &+ \frac{1}{k}\chi_i(1+\chi_j) + \frac{1}{\sigma-1}\lambda_i\mathcal{B}\Bigg\}\mathcal{B}^{-1}. \end{aligned} \tag{A.40}$$

Making use of the definition of $\mathcal{B}$ and rearranging terms in the curly brackets, we end up with

$$\begin{aligned}\frac{\hat{P}_i}{\hat{t}_i} =& \frac{t_i}{1-t_i}\frac{1}{\sigma-1}\Bigg\{\left[\lambda_i\left(\frac{\sigma-1}{k}\frac{1}{k} + \frac{\sigma}{\sigma-1} - \frac{\sigma}{k} - \frac{1}{k}\right) + \frac{\sigma-1}{k} - 1\right](1+\chi_i) \\ &+ \left[\lambda_i\left(\frac{\sigma}{\sigma-1} - \frac{1}{k}\right) - 1\right](1+\chi_j)\Bigg\}\mathcal{B}^{-1}, \end{aligned} \tag{A.41}$$

where both terms in squared brackets are positive following the definition of λ_i. Making use of Eq. (A.20), we can rewrite the first term in squared brackets, which is multiplied by $(1+\chi_i)$, as $\lambda_i t_i[k-(\sigma-1)]/[k\zeta(\sigma-1)]$, where the positive sign directly follows from $k > \sigma > 1$. The second term in squared brackets, which is multiplied by $(1+\chi_j)$, is positive as $\lambda_i[\sigma/(\sigma-1) - 1/k] > 1$ according to Eq. (A.20)

Finally, recall that $\hat{\lambda}_i/\hat{t}_i = (1-\lambda_i)t_i/(1-t_i)$ to end up with the expression for $\hat{R}_i/\hat{t}_i - \hat{P}_i/\hat{t}_i$ in Eq. (45) in the main text.

A.14 Derivation of Eq. (49)

In order to derive $\tilde{t}_i$ we first make use of Eq. (37) to rewrite the term in parentheses of Eq. (48) as $-\hat{\lambda}_i/\hat{t}_i[1 - t_i/(1-t_i)(1+\chi_i)(1+\chi_j)/\mathcal{B}]$. With $\hat{\lambda}_i/\hat{t}_i > 0$ it directly follows that $\tilde{t}_i$ is the implicit solution for a root of this expression, since $(1+\chi_i)(1+\chi_j)/\mathcal{B}$ is bounded by zero and one. That

$(1+\chi_i)(1+\chi_j)/\mathcal{B} < 1$ can be seen from the equivalent inequality

$$\left[(1+\chi_j)^{-1}\left(\frac{\sigma}{\sigma-1}+\frac{\chi_j}{k}\right)+(1+\chi_i)^{-1}\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)\right]^{-1} < 1, \tag{A.42}$$

which follows from the rewritten $\mathcal{B} = (1+\chi_i)[\sigma/(\sigma-1)+\chi_j/k]+(1+\chi_j)[\sigma/(\sigma-1)-1/k]$ and where the inequality holds due to $\chi_i, \chi_j \in (0,1)$ and $k > \sigma$. Moreover, from Eq. (A.42) it becomes apparent that $(1+\chi_i)(1+\chi_j)/\mathcal{B}$ increases in χ_i, χ_j reaching a maximum level of $(\sigma-1)/\sigma$ for $\chi_{i,j} \to 1$. Hence, the decline of $\tilde{t}_i$ in χ_i, χ_j.

A.15 Derivation of Eq. (51)

Note first that we can rewrite $\hat{\Xi}_i^{aut}/\hat{t}_i$ as a function of $\hat{\lambda}_i/\hat{t}_i$ which gives:

$$\frac{\hat{\Xi}_i^{aut}}{\hat{t}_i} = -\frac{\hat{\lambda}_i}{\hat{t}_i}\frac{(\zeta-1)\left[\zeta(\sigma-1)+1-t_i\right]}{\zeta(\sigma-1)+1+(\zeta-1)t_i}, \tag{A.43}$$

where importantly the second fraction (the term multiplied by $-\hat{\lambda}_i/\hat{t}_i$) is positive and between $\zeta-1$ and $(\zeta-1)(\sigma-1)/\sigma$. Joint with Eq. (37) for $\hat{\chi}_i/\hat{t}_i$ we can next rewrite Eq. (48) by factoring out $-\hat{\lambda}_i/\hat{t}_i$. Accordingly,

$$\frac{\hat{\Xi}_i}{\hat{t}_i} = -\frac{\hat{\lambda}_i}{\hat{t}_i}\left\{\frac{(\zeta-1)\left[\zeta(\sigma-1)+1-t_i\right]}{\zeta(\sigma-1)+1+(\zeta-1)t_i}+\gamma_i\left(1-\frac{t_i}{1-t_i}\frac{(1+\chi_i)(1+\chi_j)}{\mathcal{B}}\right)\right\}. \tag{A.44}$$

In order to analyse whether this elasticity can be positive, we derive the root, $\hat{\Xi}_i/\hat{t}_i = 0$, by focussing on the term in curly brackets. Rearranging this term we can define t_i^{root} as in Eq. (51) and show that this root is indeed between $\tilde{t}_i$ and unity. This range follows from the term in curly brackets in Eq. (51) being strictly larger than one, since $\zeta > 1$ and $\gamma_i < 1$ and due to the parameter restrictions on t_i and σ. Note that this term depends on t_i and it is not possible to explicitly solve for the root of $\hat{\Xi}_i/\hat{t}_i$. However, as both the fraction in curly brackets and γ_i are clearly positive, we can safely postulate the critical initial level of t_i implicitly. Note further that an increase in both χ_i and χ_j leads to a decline in t_i^{root}, while the effect is more pronounced from χ_i via its additional effect on γ_i.

A.16 Derivation of Eq. (52)

In order to derive the change in P^j we use the analogue of Eq. (A.39) for country j. Noting that $\hat{w}_j = 0$ by choice of the numéraire and making use of equilibrium condition Eq. (31) it is straightforward to compute Eq. (52) in the main text, where the sign directly follows from Eq. (41).

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Online Appendix for

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by Miriam Kohl and Philipp M. Richter

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S.1 Log-linearised system of equations in general form

We want to express the system of equations, Eqs. (25)-(27), in terms of percentage changes of endogenous variables and of all exogenous variables that potentially differ across countries. Log-linearising Eqs. (25)-(27) yields:

$$\hat{\varphi}_j^{i^*} = \hat{\varphi}_i^{i^*} - \frac{\sigma}{\sigma-1}\left(\hat{w}_i - \hat{w}_j\right) - \frac{1}{\sigma-1}\left(\frac{t_i}{1-t_i}\hat{t}_i - \frac{t_j}{1-t_j}\hat{t}_j\right) + \hat{\tau}_j^i \tag{S.1}$$

$$\hat{\varphi}_i^{j^*} = \hat{\varphi}_j^{j^*} + \frac{\sigma}{\sigma-1}\left(\hat{w}_i - \hat{w}_j\right) + \frac{1}{\sigma-1}\left(\frac{t_i}{1-t_i}\hat{t}_i - \frac{t_j}{1-t_j}\hat{t}_j\right) + \hat{\tau}_i^j \tag{S.2}$$

$$\hat{\varphi}_i^{i^*} = -\chi_i\hat{\varphi}_i^{j^*} + \lambda_i\frac{1+\chi_i}{k}\frac{t_i}{1-t_i}\hat{t}_i \tag{S.3}$$

$$\hat{\varphi}_j^{j^*} = -\chi_j\hat{\varphi}_j^{i^*} + \lambda_j\frac{1+\chi_j}{k}\frac{t_j}{1-t_j}\hat{t}_j \tag{S.4}$$

$$\hat{\varphi}_i^{j^*} = \hat{\varphi}_j^{i^*} + \frac{1}{k}\left(\hat{w}_i - \hat{w}_j\right) + \frac{1}{k}\left(\frac{t_i}{1-t_i}\hat{t}_i - \frac{t_j}{1-t_j}\hat{t}_j\right) + \frac{1}{k}\left(\hat{N}_i - \hat{N}_j\right). \tag{S.5}$$