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# Unilateral Tax Policy in the Open Economy*

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**Abstract**

This paper examines the effects of unilateral tax policy in the open economy. We construct a general equilibrium trade model with heterogeneous agents allowing for country asymmetries. We find that in contrast to a symmetric country set-up the share of exporting firms is endogenous. We show that a unilateral increase in the tax rate affects the factor allocation in the regulating country and the trading partner country differently. We further derive the implications for aggregate income and inequality in both countries.

JEL-Classification: D31, F12, F16, H24, H25
Keywords: International trade, Income inequality, Redistribution, Heterogeneous firms

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# 1 Introduction

Distributional effects of globalisation are extremely important for the public debate. Therefore, it is vital to think about redistribution policies in the context of globalisation. In the open economy unilateral tax policy does not only affect the regulating country, but also the trading partner. We shed light on how unilateral tax policy affects the factor allocation, overall income and the income distribution in both countries.

We therefore construct an asymmetric country model in general equilibrium building on work by Egger and Kreickemeier (2012) and Kohl (2017). We look at 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. Following Kohl (2017) we introduce a redistribution policy into a trade model with firm heterogeneity. In contrast to Egger and Kreickemeier (2012) and Kohl (2017) we allow for country asymmetries.

We find that, in contrast to the symmetric country set-up, the share of exporting firms does not depend solely on the iceberg transport cost, but also on economy wide variables and is therefore influenced by changes in the tax policy. We show that a unilateral increase in the tax rate in one country affects the trading partner in various ways. The factor allocation changes such that the mass of managers increases, whereas the mass of export consultants decreases leaving the mass of workers constant. Aggregate income is not affected. However, inter-group inequality decreases suggesting that a country benefits from the redistribution policy of its trading partner. The effects of a unilateral increase in the tax rate in the regulating country are quite different. Both the mass of managers and the mass of export consultants decrease, while the mass of workers increases. A higher tax rate leads to distortions in the regulating country by reducing aggregate income, whereas the effect on inequality is not clear-cut.

Our work is related to different strands of the literature. Firstly, it is related to papers that model redistribution policies in trade models with heterogeneous firms. Egger and Kreickemeier (2009) analyse the possibility to redistribute gains from trade in a Melitz 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 (2017) introduces a welfare state into a trade model in order to look at the distributional effects of trade in the presence of a welfare state. The welfare state is characterised by a progressive income tax and a lump-sum transfer. Although the transfer endogenously increases with the level of openness, inequality is still higher in the open economy equilibrium compared to autarky. Antràs et al. (2017) also look at the possibilities to redistribute the gains from trade. They quantify the costs of this policy. Yet, all three papers use a symmetric

country set-up 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.

Secondly, we build on a literature that looks at policy in trade models with firm heterogeneity allowing for country asymmetries. Felbermayr et al. (2013) analyse the optimal tariff for a large open economy with monopolistic competition and heterogeneous firms. They are the first to solve the Melitz (2003) model for the asymmetric country case.[1] While the entry mechanism in Felbermayr et al. (2013) is as in Melitz (2003) our paper features an occupational choice mechanism determining the factor allocation in the economy. We adapt the solution strategy of Felbermayr et al. (2013) to the occupational choice framework. Kreickemeier and Richter (2014) derive the effects of unilateral trade policy on the environment. 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.

Our contribution relative to the literature is twofold. On the one hand, we are the first to solve the Egger and Kreickemeier (2012) model for asymmetric countries. It is important to stress that in Egger and Kreickemeier (2012) the entry mechanism is different to Melitz (2003). It works via an occupational choice mechanism. On the other hand, the asymmetry in our analysis is in terms of the tax policy. This is also new relative to the existing literature.

The structure of this paper is as follows. Section 2 introduces the model set-up. Section 3 derives the equilibrium conditions. Section 4 looks at the effects of unilateral tax policy. Section 5 concludes.

## 2 Model set-up

*Individuals*

We consider a world with two countries, denoted by $i$ and $j$, that are open to trade. Each country is populated by a mass of individuals, denoted by $N_i$ in country $i$ and $N_j$ in country $j$, respectively.[2] Individuals differ in their (managerial) ability $\varphi$. As is customary in this literature let the ability be Pareto distributed with the lower bound normalised to one: $G(\varphi_i) = 1 - \varphi_i^{-k}$.

*Demand*

[1] Felbermayr et al. (2013) builds on Demidova and Rodríguez-Clare (2009) that look at trade policy in the small open economy case. Moreover, Felbermayr et al. (2013) extend the Gros (1987) model to the heterogenous firms framework.

[2] One word on notation: we will use subscripts to indicate the origin perspective and superscripts to indicate the market perspective.

Preferences of a representative consumer on market $i$ are given by

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

where $q^i(v)$ denotes the demand for variety $v$ of a differentiated good, $V^i$ is the set of all available varieties on market $i$ and $\sigma > 1$ is the elasticity of substitution between the different varieties.[3]. The budget constraint in country $i$ is given by

$$\int_{v\in V^i} p^i(v) q^i(v) \mathrm{d}v = R_i, \tag{2}$$

with $p^i(v)$ indicating the price of variety $v$ on market $i$ and $R_i$ representing total income in country $i$.[4] Utility maximisation of the representative consumer subject to the budget constraint leads to the following demand function with constant price elasticity $\sigma$ for each variety:

$$q^i(v) = R_i (P^i)^{\sigma-1} p^i(v)^{-\sigma}, \tag{3}$$

where $P^i$ is the standard CES price index and given by

$$P^i = \left[\int_{v\in V^i} p^i(v)^{1-\sigma} dv\right]^{\frac{1}{1-\sigma}}. \tag{4}$$

*Domestic production*

There is a continuum of firms each producing a unique variety of the differentiated good under monopolistic competition. The mass of firms serving market $i$ is given by $M^i$. It consists of domestic producers in country $i$ (denoted by $M_i^i$) and exporters from country $j$ (denoted by $M_j^i$). In each firm there is one manager and an endogenous mass of workers. Firm productivity $\varphi$ is determined by the ability of the manager running the firm. The mass of workers per firm is proportional to output and given by $l_i(v) = q_i(v)/\varphi(v)$. The unit production cost in country i is denoted by $c_i(v) = w_i/\varphi(v)$. The price a firm from country $i$ charges for domestic varieties follows from profit maximisation and is a constant markup over marginal cost, i.e.:

$$p_i^i(v) = \frac{\sigma}{\sigma-1} c_i(v). \tag{5}$$

Combining Eqs. (3) and (5) domestic revenue $r_i^i(\varphi)$ and domestic operating profits $\psi_i^i(\varphi)$ of a firm

[3]Please note that a similar expression can be found for utility in country $j$. For readability we present only the expressions for country $i$ whenever it is possible to do so.

[4]It is assumed that individuals from country $i$ spend all their income on goods on market $i$, i.e. $R_i = E^i$, where $E^i$ denotes total expenditure on market $i$.

with productivity $\varphi$ can be expressed as follows

$$r_i^i(\varphi) = R_i(P^i)^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{w_i}{\varphi}\right)^{1-\sigma} \quad \text{and} \quad \psi_i^i(\varphi) = \frac{1}{\sigma}r_i^i(\varphi). \tag{6}$$

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:

$$\frac{q_i^i(\varphi_1)}{q_i^i(\varphi_2)} = \left(\frac{\varphi_1}{\varphi_2}\right)^{\sigma} \quad \text{and} \quad \frac{r_i^i(\varphi_1)}{r_i^i(\varphi_2)} = \frac{\psi_i^i(\varphi_1)}{\psi_i^i(\varphi_2)} = \frac{l_i^i(\varphi_1)}{l_i^i(\varphi_2)} = \left(\frac{\varphi_1}{\varphi_2}\right)^{\sigma-1}. \tag{7}$$

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, exogenously given variable trade costs in form of the standard iceberg trade costs. Accordingly, a firm from country $i$ that wants to export to country $j$ faces costs of $\tau_i^j > 1$, whereas an exporter in country $j$ faces $\tau_j^i > 1$, respectively. Second, exporting activity requires that an export consultant from the domestic population needs to be hired. The fixed exporting costs for an exporting firm from country $i$ are given as $f_i^j$ and by $f_j^i$ for an exporting firm from country $j$, respectively. The fixed exporting costs are endogenously determined in the model and we allow for $f_i^j \neq f_j^i$ due to the possible asymmetry of the two countries.

The price an exporting firm from country $i$ charges on market $j$ is therefore given as[5]

$$p_i^j(v) = \tau_i^j \frac{\sigma}{\sigma-1} c_i(v) = \tau_i^j p_i^i(v) \tag{8}$$

and it follows directly that revenues of a firm from country $i$ on market $j$ are given by

$$r_i^j(v) = p_i^j(v)q_i^j(v) = (\tau_i^j)^{1-\sigma}(p_i^i(v))^{1-\sigma}R_j(P^j)^{\sigma-1} = (\tau_i^j)^{1-\sigma}R_j(P^j)^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{w_i}{\varphi}\right)^{1-\sigma}. \tag{9}$$

*Welfare state*

Both in country $i$ and in country $j$ we model a welfare state, which redistributes income. Each country imposes a tax $t_{i,j} \in [0,1)$ on operating profits, where the two economies may differ in their tax rates, i.e. $t_i \neq t_j$ is possible. The tax revenue is assumed to be lump sum redistributed to all individuals in the respective economy with everyone getting a per capita transfer $b_{i,j} \geq 0$.

[5] The derivation is deferred to the Appendix; see A.1.

The tax rates are treated as exogenously given, whereas the per capita transfers are endogenously adjusting such that each government runs a balanced budget, i.e.:

$$b_i = \frac{t_i \Psi_i}{N_i}, \tag{10}$$

where $\Psi_i$ are aggregate operating profits of firms from country $i$.

# 3 Equilibrium

*Occupational choice*

Following Egger and Kreickemeier (2012) individuals in each economy have to make an occupational choice, i.e. they have to decide whether to become a manager running a firm or a production worker or an export consultant. This choice depends on their managerial ability, that can be used in the role as a manager, but not as a worker or consultant. The indifference condition for an individual in country $i$ looks as follows:

$$(1 - t_i)\pi_i(\varphi_i^{i^*}) + b_i = w_i + b_i = f_i^j + b_i, \tag{11}$$

where $\varphi_i^{i^*}$ denotes the managerial ability of the individual that is just indifferent. This means that individuals with a managerial ability greater than $\varphi_i^{i^*}$ will become managers of a firm, whereas individuals with an ability lower than $\varphi_i^{i^*}$ will either work as production workers or as consultants. Note the correspondence between the mass of managers in a country $M_i$ and the cutoff productivity $\varphi_i^{i^*}$ as

$$M_i = \left[1 - G(\varphi_i^{i^*})\right] N_i = (\varphi_i^{i^*})^{-k} N_i. \tag{12}$$

The occupational choice condition, Eq. (11), implies that each export consultant earns the domestic wage rate, i.e. $f_i^j = w_i$. It further implies that the transfer does not affect the occupational choice. As the marginal firm is a non-exporting firm and using Eq. (6) we can write the indifference condition as

$$(1 - t_i)\frac{r_i^i(\varphi_i^{i^*})}{\sigma} = w_i, \tag{13}$$

which in detail looks as follows:

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

An equivalent equation can be derived for country $j$.

*The decision to export*

Managers face the decision whether to be active only on the domestic market or whether to serve both markets. The marginal exporting firm with productivity $\varphi_i^{j^*}$ is just indifferent between exporting and non-exporting. The indifference condition is given by

$$(1-t_i)\frac{r_i^i(\varphi_i^{j^*})+r_i^j(\varphi_i^{j^*})}{\sigma}-f_i^j+b_i=(1-t_i)\frac{r_i^i(\varphi_i^{j^*})}{\sigma}+b_i. \tag{15}$$

Simplifying and using the fact that export consultants just earn the economy-wide wage, we can rewrite the exporting indifference condition and get

$$(1-t_i)\frac{r_i^j(\varphi_i^{j^*})}{\sigma}=w_i. \tag{16}$$

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. (9) in order to substitute for $r_i^j(\varphi_i^{j^*})$, the exporting indifference condition becomes

$$(1-t_i)\frac{1}{\sigma}(P^j)^{\sigma-1}R_j\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}(\tau_i^j)^{1-\sigma}(\varphi_i^{j^*})^{\sigma-1}=w_i^\sigma, \tag{17}$$

where an equivalent condition holds for country $j$.

Note that the share of exporting firms in country $i$ is the mass of exporting firms relative to the mass of all firms and can be determined as follows:

$$\chi_i\equiv\frac{1-G(\varphi_i^{j^*})}{1-G(\varphi_i^{i*})}=\left(\frac{\varphi_i^{i*}}{\varphi_i^{j^*}}\right)^k=\left[\frac{R_j\left(P^j\right)^{\sigma-1}}{R_i\left(P^i\right)^{\sigma-1}}\left(\tau_i^j\right)^{-(\sigma-1)}\right]^{\frac{k}{\sigma-1}}, \tag{18}$$

where the last equality follows from the division of the occupational indifference condition, Eq. (14), by the exporting indifference condition, Eq. (17). This expression shows the crucial difference between a set-up where countries are assumed to be symmetric as in Kohl (2017) and the asymmetric case which is the focus of this paper. In the symmetric case the share of exporting firms $\chi_i$ collapses to $(\tau_i^j)^{-k}$ and is thus exogenously given. In case of country asymmetries, by contrast, it is endogenous as it depends not only on the iceberg trade costs but also on the relative income levels and the relative price levels of the two countries.

*Factor allocation*

Starting point for determining the factor allocation in the economy is the occupational choice condition, Eq. (13). Due to constant mark-up pricing, total wage income in country $i$ is a constant

fraction of total revenues of firms from country $i$, i.e.:

$$w_i L_i = \frac{\sigma - 1}{\sigma} R_i, \tag{19}$$

while the remaining share goes to operating profits, i.e.:

$$\Psi_i = \frac{1}{\sigma} R_i. \tag{20}$$

Using Eq. (13), we can derive total revenues of firms from country $i$ as[6]

$$R_i = \frac{\sigma}{1 - t_i} \zeta (1 + \chi_i) M_i w_i \tag{21}$$

with $\zeta \equiv k/(k - (\sigma - 1))$.[7] Jointly with Eq. (19) this yields

$$L_i = \frac{\sigma - 1}{1 - t_i} \zeta (1 + \chi_i) M_i. \tag{22}$$

Together with the resource constraint of the economy

$$L_i + (1 + \chi_i) M_i = N_i \tag{23}$$

we get the factor allocation as follows. The mass of workers in the economy is given by

$$L_i = \frac{(\sigma - 1)\zeta}{(\sigma - 1)\zeta + 1 - t_i} N_i, \tag{24}$$

which importantly does not depend on the amount of trade openness. It depends positively on the tax rate in the domestic country. The higher the tax rate is, the more the occupational choice is distorted leading to less managers and more workers, *ceteris paribus*. This implies that for equal population sizes the country with the higher tax rate (let us assume $t_i > t_j$) has a higher mass of workers relative to the other country. This can be easily verified by looking at the following ratio

$$\frac{L_i}{L_j} = \frac{(\sigma - 1)\zeta + 1 - t_j}{(\sigma - 1)\zeta + 1 - t_i} \frac{N_i}{N_j}. \tag{25}$$

The mass of managers, in turn, can be determined as

$$M_i = \frac{1 - t_i}{(1 + \chi_i)\left[(\sigma - 1)\zeta + 1 - t_i\right]} N_i. \tag{26}$$

[6] The derivation is deferred to the Appendix; see A.2.

[7] Please note that throughout this paper we assume $k > \sigma$. Note that this assumption is stronger than $k > \sigma - 1$. It is needed in order to ensure that also average output $\bar{q}_i^i$ is finite and positive.

It depends negatively on the amount of trade openness, i.e. $\partial M_i/\partial \chi_i < 0$. The higher the share of exporting firms, the more individuals are employed as export consultants. Since the share of production workers does not depend on trade openness (see Eq. (24)) it follows directly from the resource constraint of the economy (see Eq. (23)) that the mass of managers is negatively related to the share of exporting firms. Further inspection of Eq. (26) reveals that the direct effect of an increase in the domestic tax rate is a decrease in the mass of managers, since from Eq. (13) a higher tax makes it less attractive to become a manager, *ceteris paribus*. However, this is not the overall effect of a tax increase on the mass of managers, since an increase in the domestic tax rate affects the mass of managers via a change in the share of exporting firms.

The mass of export consultants follows straightforwardly as $\chi_i M_i$. Overall, the mass of export consultants depends positively on the amount of trade openness, i.e. $\partial(\chi_i Mi)/\partial \chi_i > 0$, where the direct effect is obviously positive, while the indirect effect via the mass of managers is negative.

*Income distribution*

Having characterised the factor allocation in the economy we now want to take a closer look at the income distribution. Since export consultants are assumed to earn the economy-wide wage and the labour market is assumed to be perfectly competitive, all workers and export consultants in this economy have the same income. Each manager, however, earns the firm's profit that depends on her managerial ability. Therefore, there is income heterogeneity within the group of managers and between managers and individuals that earn the equilibrium wage. To characterise the latter, i.e. the inter-group inequality $\Xi_i$ 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,

$$\Xi_i \equiv \frac{(1-t_i)\bar{\psi}_i - w_i\chi_i + b_i}{w_i + b_i}. \tag{27}$$

As we show in the Appendix (see A.3) we can rewrite this expression as:

$$\Xi_i = \mathcal{D}_i \left(1 + \mathcal{F}_i \chi_i\right), \tag{28}$$

with

$$\mathcal{D}_i \equiv \frac{[(\sigma-1)\zeta + 1]\,\zeta}{(\sigma-1)\zeta + 1 + (\zeta-1)t_i} \qquad \text{and} \qquad \mathcal{F}_i \equiv \frac{[(\sigma-1)\zeta + (1-t_i)]\,(\zeta-1)}{[(\sigma-1)\zeta+1]\,\zeta}. \tag{29}$$

It is straightforward to show that both $\mathcal{D}_i$ and $\mathcal{F}_i$ are declining in $t_i$ leading to lower inequality, *ceteris paribus*. Yet, there is a second channel of how the tax rate affects inequality that runs via the share of exporting firms that is positively related to inter-group inequality. Importantly, this

channel is not present in a symmetric country set-up, where the share of exporting firms can be treated as a parameter following Eq. (18). Hence, the overall effect of $t_i$ on inequality crucially depends on how it affects the share of exporting firms.[8]

*Trade balance*

The trade balance condition requires that aggregate exports of country $i$ are equal to its aggregate imports from country $j$, i.e.:

$$M_i^j \bar{r}_i^j = M_j^i \bar{r}_j^i, \tag{30}$$

where $\bar{r}_i^j$ denotes the average export revenues of exporting firms from country $i$. The trade balance can be rewritten as[9]

$$N_i (\varphi_i^{j^*})^{\sigma-1-k} (\tau_i^j)^{1-\sigma} R_j (P^j)^{\sigma-1} w_i^{1-\sigma} = N_j (\varphi_j^{i^*})^{\sigma-1-k} (\tau_j^i)^{1-\sigma} R_i (P^i)^{\sigma-1} w_j^{1-\sigma}. \tag{31}$$

*System of equations*

Having laid out the optimal behaviour of individuals in the open economy we now derive the system of equations characterising the equilibrium.

First, we divide the occupational choice condition, Eq. (14), for country $i$ by the export indifference condition, Eq. (17), for country $j$ in order to substitute for the market aggregates $P^i$ and $R_i$ of country $i$. This yields

$$\frac{1-t_i}{1-t_j} (\tau_j^i)^{\sigma-1} \left( \frac{\varphi_i^{i^*}}{\varphi_j^{i^*}} \right)^{\sigma-1} = \left( \frac{w_i}{w_j} \right)^{\sigma}. \tag{32}$$

Second, combining the expression for the mass of managers, Eq. (26), with Eqs. (12) and (18) we get a link between the two cutoff productivity levels in country $i$:

$$(\varphi_i^{i^*})^{-k} + (\varphi_i^{j^*})^{-k} = \left[ (1-t_i)^{-1} \zeta(\sigma-1) + 1 \right]^{-1}. \tag{33}$$

Finally, combining the trade balance condition, Eq. (31), with the exporting indifference condition Eq. (17) for country $i$ and its analogue for country $j$ we find

$$\varphi_i^{j^*} = \left( \frac{N_i}{N_j} \frac{1-t_j}{1-t_i} \frac{w_i}{w_j} \right)^{\frac{1}{k}} \varphi_j^{i^*}. \tag{34}$$

Choosing labour in country $j$ as the numéraire, the equilibrium can be described by a system of

[8] Note that $\Xi_i$ collapses to unity for the two extremes $k \to \infty$ and $\sigma \to 1$, since $\zeta \to 1$ in these cases. Then, there is no affect of $t_i$ at all. We are, hence, focusing on intermediate cases with $\sigma$ not too small and $k$ not too large.

[9] The derivation is deferred to the Appendix; see A.4.

five equations, Eqs. (32) and (33) and their respective analogues for country $j$, as well as (34), 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

*Equilibrium conditions in percentage changes*

We are interested in analysing unilateral tax policy. Due to non-linearity the system of equations cannot be solved in levels. Our solution strategy is to express the system of equations in terms of percentage changes of endogenous variables and of exogenous variables of interest. A percentage change in variable $x$ is denoted by $\hat{x} \equiv \mathrm{d}x/x$. Without loss of generality we focus on country $i$ and look at $\hat{t}_i \neq 0$. This implies that $\hat{N}_i = \hat{N}_j = \hat{\tau}_i^j = \hat{\tau}_j^i = \hat{t}_j = 0$ by choice of the analysis and $\hat{w}_j = 0$ by choice of the numéraire.[10] Thus, log-linearising Eqs. (32) - (34) we can write the system of equations as follows:

$$\hat{\varphi}_j^{i^*} = \hat{\varphi}_i^{i^*} - \frac{\sigma}{\sigma-1}\hat{w}_i - \frac{t_i}{1-t_i}(\sigma-1)^{-1}\hat{t}_i \tag{35}$$

$$\hat{\varphi}_i^{j^*} = \hat{\varphi}_j^{j^*} + \frac{\sigma}{\sigma-1}\hat{w}_i + \frac{t_i}{1-t_i}(\sigma-1)^{-1}\hat{t}_i \tag{36}$$

$$\hat{\varphi}_i^{i^*} = -\chi_i\hat{\varphi}_i^{j^*} + \frac{t_i}{1-t_i}\mathcal{A}\hat{t}_i \tag{37}$$

$$\hat{\varphi}_j^{j^*} = -\chi_j\hat{\varphi}_j^{i^*} \tag{38}$$

$$\hat{\varphi}_i^{j^*} = \hat{\varphi}_j^{i^*} + \frac{1}{k}\hat{w}_i + \frac{1}{k}\frac{t_i}{1-t_i}\hat{t}_i, \tag{39}$$

where $\mathcal{A} \equiv \frac{1}{k}(1+\chi_i)\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]^{-1} < 2$. Next, we isolate changes in endogenous variables with respect to changes in the tax rate in country $i$, thus deriving elasticities denoted by $\hat{x}/\hat{t}_i$.

*Effects on country j*

We begin with the discussion on country $j$ to see how the trading partner is affected by changes in the tax policy in country $i$. The effect of a change in the tax rate in country $i$ on the export cutoff in country $j$ is given by[11]

$$\frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i} = \frac{t_i}{1-t_i}\left[\mathcal{A}\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right) - \frac{1+\chi_i}{k}\right]\mathcal{B}^{-1} > 0, \tag{40}$$

with $\mathcal{B} \equiv (2+\chi_i+\chi_j)\frac{\sigma}{\sigma-1} - (1-\chi_i\chi_j)\frac{1}{k} > 2$. It can be verified that this elasticity is positive.[12] This means that the export cutoff in country $j$ is increasing in the tax rate $t_i$. The domestic cutoff

[10] A more general specification allowing for changes in all variables that potentially differ across countries can be found in the Supplement; see S.1.

[11] The derivation is deferred to the Appendix; see A.5.

[12] The proof is deferred to the Appendix; see A.6.

is linked to the export cutoff via Eq. (38). Hence, we find

$$\frac{\hat{\varphi}_j^{j^*}}{\hat{t}_i} = -\chi_j \frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i} = -\chi_j \frac{t_i}{1-t_i}\left[\mathcal{A}\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)-\frac{1+\chi_i}{k}\right]\mathcal{B}^{-1} \leq 0. \tag{41}$$

There are three interesting things to note here. First, an increase in the tax rate in country $i$ leads to a decrease in the domestic cutoff in country $j$. Second, the effect of an increase in the tax rate on the domestic cutoff is smaller than the effect on the export cutoff. Third, the domestic cutoff is not affected if country $j$ is in autarky, i.e. $\chi_j = 0$. The share of exporting firms is given by Eq. (18). Written in terms of elasticities yields

$$\begin{aligned}\frac{\hat{\chi}_j}{\hat{t}_i} &= k\left(\frac{\hat{\varphi}_j^{j^*}}{\hat{t}_i}-\frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i}\right) \\ &= -k(1+\chi_j)\frac{t_i}{1-t_i}\left[\mathcal{A}\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)-\frac{1+\chi_i}{k}\right]\mathcal{B}^{-1} < 0.\end{aligned} \tag{42}$$

Hence, we see that the share of exporting firms in country $j$ decreases in the tax rate of country $i$ since both the export cutoff increases and the domestic cutoff decreases. This has important implications for the factor allocation in country $j$. The mass of managers is defined by Eq. (12). In terms of elasticities we get

$$\frac{\hat{M}_j}{\hat{t}_i} = -k\frac{\hat{\varphi}_j^{j^*}}{\hat{t}_i} = k\chi_j\frac{t_i}{1-t_i}\left[\mathcal{A}\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)-\frac{1+\chi_i}{k}\right]\mathcal{B}^{-1} \geq 0. \tag{43}$$

It is obvious that the mass of managers and hence the mass of firms in country $j$ increases in the tax rate $t_i$. Together Eqs. (40), (42) and (43) imply that the mass of export consultants decreases in the tax rate. The mass of workers $L_j$ does not depend on $t_i$ (cf. Eq. (24)), because the mass of workers does not depend on the amount of trade openness.

Next, we want to see how income in country $j$ is affected by changes in the tax policy in country $i$. Total income is given by Eq. (21). The elasticity of total income with respect to changes in $t_i$ can be calculated as

$$\frac{\hat{R}_j}{\hat{t}_i} = -\frac{k}{1+\chi_j}\left(\frac{\hat{\varphi}_j^{j}}{\hat{t}_i}+\chi_j\frac{\hat{\varphi}_j^{i}}{\hat{t}_i}\right) = 0. \tag{44}$$

*Ceteris paribus*, an increase in the export cutoff decreases aggregate income, while a decrease in the domestic cutoff increases aggregate income. Using Eqs. (40) and (41) we find that a change in the tax rate in country $i$ does not change total income in country $j$, since the changes in the cutoffs just offset each other. This result further implies that the transfer $b_j$ is not affected by changes in the tax rate $t_i$, because the transfer is proportional to operating profits (cf. Eq. (10)) and operating profits are a constant fraction of total income (cf. Eq. (20)).

While aggregate income is not affected by changes in the tax rate, there might be distributional effects of this policy. We just argued that operating profits and the transfer per capita is not affected by changes in $t_i$. The share of domestic exporting firms, by contrast, is. Given Eq. (28) we can derive the elasticity of inter-group inequality with respect to changes in the tax rate $t_i$ as

$$\frac{\hat{\Xi}_j}{\hat{t}_i} = \frac{\mathcal{F}_j \chi_j}{1 + \mathcal{F}_j \chi_j} \frac{\hat{\chi}_j}{\hat{t}_i} < 0, \tag{45}$$

where it is straightforward to show that $\mathcal{F}_j\chi_j/(1+\mathcal{F}_j\chi_j) \in (0;1/2)$. Since according to Eq. (42) the share of exporting firms in country $j$ decreases in the tax rate $t_i$, we find that the income gap between managers and workers in country $j$ shrinks if country $i$ increases its tax rate. This is a remarkable result as it suggests that a country benefits in terms of inequality reduction from the redistribution policy of its trading partner.

*Effects on country i*

We now turn to the analysis of country $i$. The effect of a change in the tax rate in country $i$ on the change in the export cutoff in country $i$ is given by[13]

$$\frac{\hat{\varphi}_i^{j^*}}{\hat{t}_i} = \frac{t_i}{1-t_i}\left[\mathcal{A}\left(\frac{\sigma}{\sigma-1}+\frac{\chi_j}{k}\right)+\frac{1+\chi_j}{k}\right]\mathcal{B}^{-1} > 0. \tag{46}$$

It is straightforward to show that the export cutoff in country $i$ increases if the tax rate in country $i$ increases. Comparing Eq. (46) to Eq. (40) we see that the effect of a unilateral increase of $t_i$ on the export cutoff in country $i$ is stronger than the effect on the export cutoff in country $j$. In order to see how the domestic cutoff changes with the tax rate we look at Eq. (37). In addition to the negative indirect effect via the export cutoff that was also present in the analysis of country $j$, there is also a direct effect of a tax change on the domestic cutoff that is positive. The direct effect works via the occupational choice of individuals. *Ceteris paribus*, a higher tax makes it less attractive to become a manager thereby increasing the domestic cutoff productivity. Clearly, under autarky only the direct effect is present and the domestic cutoff increases in the tax rate. The direct and the indirect effect are of opposite sign representing counteracting forces. Combining Eqs. (37) and (46) we get the following elasticity:

$$\frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} = -\chi_i \frac{\hat{\varphi}_i^{j}}{\hat{t}_i} + \frac{t_i}{1-t_i}\mathcal{A} = \frac{t_i}{1-t_i}\left[\frac{\mathcal{A}\left(\mathcal{B}-\chi_i\left(\frac{\sigma}{\sigma-1}+\frac{\chi_j}{k}\right)\right)-\chi_i\frac{1+\chi_j}{k}}{\mathcal{B}}\right] > 0. \tag{47}$$

It can be shown that the positive direct effect dominates the negative indirect effect. Thus, the

[13] The derivation is in analogy to A.5.

domestic cutoff in country $i$ increases in the tax rate $t_i$.[14]

The share of exporting firms is given by Eq. (18). Written in terms of elasticities we find

$$\begin{aligned}\frac{\hat{\chi}_i}{\hat{t}_i} &= k\left(\frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} - \frac{\hat{\varphi}_i^{j^*}}{\hat{t}_i}\right) = k\left[\frac{t_i}{1-t_i}\mathcal{A} - (1+\chi_i)\frac{\hat{\varphi}_i^{j^*}}{\hat{t}_i}\right] \\ &= k\frac{t_i}{1-t_i}(1+\chi_i)\left[\frac{1}{k}\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]^{-1} - \frac{\mathcal{A}\left(\frac{\sigma}{\sigma-1}+\frac{\chi_j}{k}\right)+\frac{1+\chi_j}{k}}{\mathcal{B}}\right] \\ &= \frac{t_i}{1-t_i}\left(\frac{\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]^{-1} - \left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)^{-1}}{(1+\chi_j)^{-1}\frac{\frac{\sigma}{\sigma-1}+\frac{\chi_j}{k}}{\frac{\sigma}{\sigma-1}-\frac{1}{k}} + (1+\chi_i)^{-1}}\right) > 0, \end{aligned} \tag{48}$$

where the second equality follows from using Eqs. (46) and (47); the third from using the definitions of $\mathcal{A}$ and $\mathcal{B}$. Since both the domestic cutoff and the export cutoff increase in the tax rate it is *ex ante* unclear what will happen to the share of exporting firms. We can show that the share of exporting firms is increasing in the tax rate.[15] This is an important distinction to a symmetric policy set-up. Under symmetry the change in the domestic cutoff is identical to the change in the export cutoff implying that the share of exporting firms is not changing with a symmetric increase in the tax rate.[16]

We now want to discuss how the factor allocation in country $i$ changes with an increase in the tax rate. Since the domestic cutoff is increasing in the tax rate, it follows from Eq. (12) that the mass of managers decreases in the tax rate, i.e.:

$$\frac{\hat{M}_i}{\hat{t}_i} = -k\frac{\hat{\varphi}_i^{i^*}}{\hat{t}_i} = -k\frac{t_i}{1-t_i}\left[\frac{\mathcal{A}\left(\mathcal{B} - \chi_i\left(\frac{\sigma}{\sigma-1}+\frac{\chi_j}{k}\right)\right) - \chi_i\frac{1+\chi_j}{k}}{\mathcal{B}}\right] < 0. \tag{49}$$

Combining Eqs. (46), (48) and (49) we see that the mass of export consultants also declines in the tax rate. Inspection of Eq. (24) reveals that the mass of workers increases in the tax rate. In order to see how the wage is affected we have a close look at Eq. (39). Rewritten as an elasticity yields the following expression:

$$\begin{aligned}\frac{\hat{w}_i}{\hat{t}_i} &= k\left(\frac{\hat{\varphi}_i^{j^*}}{\hat{t}_i} - \frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i}\right) - \frac{t_i}{1-t_i} \\ &= \frac{t_i}{1-t_i}\left[\frac{1}{\mathcal{B}}\left(\mathcal{A}(1+\chi_j) + (2+\chi_i+\chi_j)\right) - 1\right] < 0, \end{aligned} \tag{50}$$

[14] The proof is deferred to the Appendix; see A.7.

[15] The proof is deferred to the Appendix; see A.8. Note that in the last line the second term in parentheses is positive but smaller than one. Furthermore, the expression suggests that the elasticity is larger for initially large values of $t_i$. This might be only a direct effect, however, as $\chi_{i,j}$ depend on aggregates, where the initial level of $t_i$ is also present.

[16] This finding is supported by Kohl (2017). We discuss the case of symmetric policy changes in the Supplement; see S.2.

where the second equality is got by using Eq. (40) and (46). Again we find opposing effects: A negative direct effect of the tax and a positive indirect effect via the changes in the export cutoffs. Overall, we find that an increase in the tax rate leads to a lower wage rate in this country.[17] Total income is affected by changes in the tax policy via different channels. Writing Eq. (21) in terms of elasticities we get

$$\begin{aligned}\frac{\hat{R}_i}{\hat{t}_i} &= \frac{\hat{w}_i}{\hat{t}_i} + \frac{t_i}{1-t_i} - \frac{k}{1+\chi_i}\left(\frac{\hat{\varphi}_i^i}{\hat{t}_i} + \chi_i \frac{\hat{\varphi}_i^j}{\hat{t}_i}\right) \\ &= \frac{t_i}{1-t_i}\left[-\frac{k}{1+\chi_i}\mathcal{A} + \frac{1}{\mathcal{B}}\left(\mathcal{A}(1+\chi_j) + (2+\chi_i+\chi_j)\right)\right] < 0. \end{aligned} \tag{51}$$

It can be shown that an increase in the tax rate lowers aggregate income.[18] Hence, the tax can be called distortionary.

To see what happens to inter-group inequality we have a look at Eq. (28). We can log-linearise this expression as follows:

$$\frac{\hat{\Xi}_i}{\hat{t}_i} = \frac{1}{1+\mathcal{F}_i\chi_i}\frac{\hat{\mathcal{D}}_i}{\hat{t}_i} + \frac{\mathcal{F}_i\chi_i}{1+\mathcal{F}_i\chi_i}\left(\frac{\hat{\mathcal{D}}_i}{\hat{t}_i} + \frac{\hat{\mathcal{F}}_i}{\hat{t}_i} + \frac{\hat{\chi}_i}{\hat{t}_i}\right). \tag{52}$$

Since $\hat{\mathcal{D}}_i/\hat{t}_i < 0$, $\hat{\mathcal{F}}_i/\hat{t}_i < 0$, whereas $\hat{\chi}_i/\hat{t}_i > 0$ according to Eq. (47), the effect of $t_i$ on inter-group inequality is *ex ante* ambiguous.

## 5 Conclusion

In this paper we set up a general equilibrium model that is capable to analyse the effects of unilateral tax policy in the open economy. Therefore, we construct a trade model of monopolistic competition and heterogeneous firms allowing for country asymmetries in the policy dimension. In the asymmetric country case the share of exporting firms does not only depend on the iceberg transport costs, but also on country aggregates that are affected by the tax policy. Thus, there exists an additional channel how the tax policy affects the trading partner that is not present in the symmetric country case. We find that an increase in the tax rate in one country affects the other country in multiple ways. The marginal manager will be of lower ability, while the marginal exporter will have a higher ability level. This has important implications for the factor allocation in this country. The mass of managers will increase, the mass of export consultants will decrease, while the mass of workers stays constant. We further show that a change in the tax rate in one country does not change aggregate income and the transfer per capita in the other country since counteracting forces exactly offset each other. However, changing the tax rate in

[17] The proof is deferred to the Appendix; see A.9.
[18] The proof is deferred to the Appendix; see A.10.

one country has distributional effects in the other country. We find that inter-group inequality decreases in the tax rate of the trading partner. An increase in the tax rate in one country affects also the factor allocation in this country. We show that the mass of managers and the mass of export consultants decreases, whereas the mass of workers increases. Furthermore, we find that a higher tax decreases aggregate income in the regulating country, whereas the effect on inter-group inequality is ambiguous.

# A Appendix

## A.1 Derivation of Eq. (8)

Profits of a firm from country $i$ on market $j$ are given as

$$\begin{aligned}\pi_i^j(v) &= q_i^j(v)p_i^j(v) - q_i^j(v)c_i(v)\tau_i^j - f_i^j \\ &= R_j(P^j)^{\sigma-1}p_i^j(v)^{-\sigma}p_i^j(v) - R_j(P^j)^{\sigma-1}p_i^j(v)^{-\sigma}c_i(v)\tau_i^j - f_i^j. \end{aligned} \tag{A.1}$$

Profit maximisation leads to

$$\frac{\partial \pi_i^j(v)}{\partial p_i^j(v)} = R_j(P^j)^{\sigma-1}(1-\sigma)p_i^j(v)^{-\sigma} + \sigma R_j(P^j)^{\sigma-1}p_i^j(v)^{-\sigma-1}c_i(v)\tau_i^j \stackrel{!}{=} 0. \tag{A.2}$$

Solving for $p_i^j$ we get Eq. (8).

## A.2 Derivation of Eq. (21)

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

$$R_i = M_i \int_{\varphi_i^{i*}}^{\infty} r_i^i(\varphi)\frac{g(\varphi)}{1-G(\varphi_i^{i*})}\mathrm{d}\varphi + M_i^j \int_{\varphi_i^{j*}}^{\infty} r_i^j(\varphi)\frac{g(\varphi)}{1-G(\varphi_i^{j*})}\mathrm{d}\varphi. \tag{A.3}$$

By means of our specification of the Pareto distribution and Eqs. (6) and (9) this follows as

$$R_i = M_i\frac{k}{k-(\sigma-1)}r_i^i(\varphi_i^{i*}) + M_i^j\frac{k}{k-(\sigma-1)}r_i^j(\varphi_i^{j*}). \tag{A.4}$$

Using the occupational choice condition, Eq. (13), and the export indifference condition, Eq. (16), we can replace both $r_i^i(\varphi_i^{i*})$ and $r_i^j(\varphi_i^{j*})$. This gives

$$R_i = \frac{\sigma}{1-t_i}\frac{k}{k-(\sigma-1)}\left(M_i + M_i^j\right)w_i. \tag{A.5}$$

Replacing $M_i^j = \chi_i M_i$ and rearranging gives Eq. (21) in the main text.

## A.3 Derivation of Eq. (28)

From Eq. (6) it follows that average operating profits are a constant fraction of average revenues. Accordlingly, $\Xi_i$ in Eq. (27), follows as

$$\Xi_i = \frac{(1-t_i)\zeta w_i(1-t_i)^{-1}(1+\chi_i) - w_i\chi_i + b_i}{w_i + b_i}. \tag{A.6}$$

Using Eq. (20) we can specify the lump-sum transfer, $b_i$ from Eq. (10) as follows:

$$b_i = \frac{R_i}{\sigma}\frac{t_i}{N_i} = \frac{w_i t_i L_i}{N_i(\sigma-1)}, \tag{A.7}$$

where the second equality directly follows from Eq. (19). Replacing $b_i$ by this expression, we cam rewrite $\Xi_i$ as

$$\Xi_i = \frac{\left[\zeta(1+\chi_i) - \chi_i + t_i L_i / N_i(\sigma-1)\right] w_i}{\left[1 + t_i L_i / N_i(\sigma-1)\right] w_i} \tag{A.8}$$

Simplifying and substituting Eq. (24) for $L_i$ yields:

$$\Xi_i = \frac{\zeta + (\zeta-1)\chi_i + t_i \zeta / \left[(\sigma-1)\zeta + 1 - t_i\right]}{1 + t_i \zeta / \left[(\sigma-1)\zeta + 1 - t_i\right]}. \tag{A.9}$$

Finally, rearranging to isolate $\chi_i$ gives Eq. (28) in the main text.

### A.4 Derivation of Eq. (31)

In order to rewrite the trade balance condition Eq. (30) note first that the mass of exporting firms from country $i$ is given by

$$M_i^j = \left[1 - G(\varphi_i^{j^*})\right] N_i = (\varphi_i^{j^*})^{-k} N_i. \tag{A.10}$$

Average export revenues of an exporting firm from country $i$ can be calculated as follows:

$$\begin{aligned}
\bar{r}_i^j &= \int_{\varphi_i^{j^*}}^{\infty} r_i^j(\varphi) \frac{g(\varphi)}{1 - G(\varphi_i^{j^*})} \mathrm{d}\varphi \\
&= (\varphi_i^{j^*})^k \int_{\varphi_i^{j^*}}^{\infty} (\tau_i^j)^{1-\sigma} (p_i^i(\varphi))^{1-\sigma} R_j (P^j)^{\sigma-1} k \varphi^{-k-1} \mathrm{d}\varphi \\
&= (\varphi_i^{j^*})^k (\tau_i^j)^{1-\sigma} R_j (P^j)^{\sigma-1} k \int_{\varphi_i^{j^*}}^{\infty} \left(\frac{\sigma}{\sigma-1}\frac{w_i}{\varphi}\right)^{1-\sigma} \varphi^{-k-1} \mathrm{d}\varphi \\
&= (\varphi_i^{j^*})^k (\tau_i^j)^{1-\sigma} R_j (P^j)^{\sigma-1} k \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w_i^{1-\sigma} \left[\frac{1}{\sigma-k-1} \varphi^{\sigma-k-1}\right]_{\varphi_i^{j^*}}^{\infty} \\
&= \frac{k}{k-(\sigma-1)} (\varphi_i^{j^*})^{\sigma-1} (\tau_i^j)^{1-\sigma} R_j (P^j)^{\sigma-1} \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w_i^{1-\sigma}.
\end{aligned} \tag{A.11}$$

Following the same operations for country $j$ and combining expressions, we get Eq. (31) in the main text.

### A.5 Derivation of Eq. (40)

Eqs. (35) - (39) represent a system of five linear equations in five unknowns. We first eliminate $\hat{\varphi}_i^{i^*}$ and $\hat{\varphi}_j^{j^*}$. Substituting Eq. (37) into Eq. (35) yields

$$\hat{\varphi}_j^{i^*} = -\chi_i \hat{\varphi}_i^{j^*} - \frac{\sigma}{\sigma-1}\hat{w}_i + \frac{t_i}{1-t_i}\left(\mathcal{A} - \frac{1}{\sigma-1}\right)\hat{t}_i. \tag{A.12}$$

Substituting Eq. (38) into Eq. (36) we get

$$\hat{\varphi}_i^{j^*} = -\chi_j \hat{\varphi}_j^{i^*} + \frac{\sigma}{\sigma-1}\hat{w}_i + \frac{t_i}{1-t_i}\frac{1}{\sigma-1}\hat{t}_i. \tag{A.13}$$

We rewrite Eq. (39) slightly and find

$$\hat{\varphi}_i^{j^*} = \hat{\varphi}_j^{i^*} + \frac{1}{k}\hat{w}_i + \frac{1}{k}\frac{t_i}{1-t_i}\hat{t}_i. \tag{A.14}$$

Thus, we have a system of three equations in three unknown.

Next, we eliminate $\hat{\varphi}_i^{j^*}$. Substituting Eq. (A.14) into Eq. (A.12) we get

$$(1+\chi_i)\hat{\varphi}_j^{i^*} = -\left(\frac{\sigma}{\sigma-1}+\frac{\chi_i}{k}\right)\hat{w}_i + \frac{t_i}{1-t_i}\left(\mathcal{A}-\frac{1}{\sigma-1}-\frac{\chi_i}{k}\right)\hat{t}_i. \tag{A.15}$$

Substituting Eq. (A.14) into Eq. (A.13) we find

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

This is a system of two equations in two unknowns.

We eliminate $w_i$ by solving Eq. (A.16) for $w_i$ and substituting the expression into Eq. (A.15). Hence, we get

$$\begin{aligned}&\left[(1+\chi_i)\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)+(1+\chi_j)\left(\frac{\sigma}{\sigma-1}+\frac{\chi_i}{k}\right)\right]\hat{\varphi}_j^{i^*}\\ =&\frac{t_i}{1-t_i}\left[\left(\mathcal{A}-\frac{1}{\sigma-1}-\frac{\chi_i}{k}\right)\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)+\left(\frac{\sigma}{\sigma-1}+\frac{\chi_i}{k}\right)\left(\frac{1}{\sigma-1}-\frac{1}{k}\right)\right]\hat{t}_i,\end{aligned} \tag{A.17}$$

which can be simplified to Eq. (40).

### A.6 Proof of Eq. (40)

In order to show that

$$\frac{\hat{\varphi}_j^{i^*}}{\hat{t}_i} = \frac{t_i}{1-t_i}\left[\mathcal{A}\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)-\frac{1+\chi_i}{k}\right]\mathcal{B}^{-1} > 0, \tag{A.18}$$

it is sufficient to look at

$$\mathcal{A}\left(\frac{\sigma}{\sigma-1}-\frac{1}{k}\right)-\frac{1+\chi_i}{k} > 0, \tag{A.19}$$

since $\mathcal{B} > 0$ and $\frac{t_i}{1-t_i} > 0$ for $t_i > 0$. Using the definition of $\mathcal{A}$ and rewriting Eq. (A.19) yields

$$\frac{\sigma}{\sigma-1} > 1 + \frac{1-t_i}{\zeta(\sigma-1)} + \frac{1}{k}, \tag{A.20}$$

which can be simplified to

$$\sigma > \sigma - \left[\frac{t_i(k-(\sigma-1))}{k}\right]. \tag{A.21}$$

For $t_i > 0$ the inequality in Eq. (A.21) is fulfilled since $k > \sigma - 1$. Hence, the export cutoff in country $j$ is increasing in the tax rate $t_i$.

## A.7 Proof of Eq. (47)

In order to show that

$$\frac{\hat{\varphi}_i^{i*}}{\hat{t}_i} = \frac{t_i}{1-t_i}\left[\frac{\mathcal{A}\left(\mathcal{B} - \chi_i\left(\frac{\sigma}{\sigma-1} + \frac{\chi_j}{k}\right)\right) - \chi_i\frac{1+\chi_j}{k}}{\mathcal{B}}\right] > 0, \tag{A.22}$$

we can focus on

$$\mathcal{A}\left(\mathcal{B} - \chi_i\left(\frac{\sigma}{\sigma-1} + \frac{\chi_j}{k}\right)\right) - \chi_i\frac{1+\chi_j}{k} > 0, \tag{A.23}$$

since $\mathcal{B} > 0$ and $\frac{t_i}{1-t_i} > 0$ for $t_i > 0$. Using the definitions of $\mathcal{A}$ and $\mathcal{B}$, Eq. (A.23) can be rewritten as follows:

$$(1+\chi_i)(2+\chi_j)\frac{\sigma}{\sigma-1} > (1+\chi_i)\frac{1}{k} + \chi_i(1+\chi_j)\left[1 + \frac{1-t_i}{\zeta(\sigma-1)}\right]. \tag{A.24}$$

Since we know that $\frac{\sigma}{\sigma-1} > 1 + \frac{1-t_i}{\zeta(\sigma-1)} > \frac{1}{k}$ (cf. Eq. (A.20) and $k > \sigma$ with $\sigma > 1$) it is sufficient to show that

$$(1+\chi_i)(2+\chi_j) \geq (1+\chi_i) + \chi_i(1+\chi_j), \tag{A.25}$$

which can be simplified to

$$1 + \chi_j \geq 0. \tag{A.26}$$

Eq. (A.26) completes the proof. Hence, we can conclude that the domestic cutoff in country $i$ is increasing in the tax rate $t_i$.

## A.8 Proof of Eq. (48)

In order to show that

$$\frac{\hat{\chi}_i}{\hat{t}_i} = k\frac{t_i}{1-t_i}(1+\chi_i)\left[\frac{1}{k}\left[1 + \frac{1-t_i}{\zeta(\sigma-1)}\right]^{-1} - \frac{\mathcal{A}\left(\frac{\sigma}{\sigma-1} + \frac{\chi_j}{k}\right) + \frac{1+\chi_j}{k}}{\mathcal{B}}\right] > 0, \tag{A.27}$$

it is sufficient to look at

$$\frac{1}{k}\mathcal{B}\left[1 + \frac{1-t_i}{\zeta(\sigma-1)}\right]^{-1} - \mathcal{A}\left(\frac{\sigma}{\sigma-1} + \frac{\chi_j}{k}\right) - \frac{1+\chi_j}{k} > 0, \tag{A.28}$$

since $\mathcal{B} > 0$ and $k\frac{t_i}{1-t_i}(1+\chi_i) > 0$ for $t_i > 0$. Using the definitions of $\mathcal{A}$ and $\mathcal{B}$ we can rewrite Eq. (A.28) and get

$$\frac{\sigma}{\sigma-1} - \frac{1}{k} > 1 + \frac{1-t_i}{\zeta(\sigma-1)}, \tag{A.29}$$

which if fulfilled (as shown in A.6). Hence, the share of exporting firms in country $i$ is increasing in the tax rate $t_i$.

## A.9 Proof of Eq. (50)

We want to show that

$$\frac{\hat{w}_i}{\hat{t}_i} = \frac{t_i}{1-t_i}\left[\frac{1}{\mathcal{B}}\left(\mathcal{A}(1+\chi_j) + (2+\chi_i+\chi_j)\right) - 1\right] < 0. \tag{A.30}$$

Using the definitions of $\mathcal{A}$ and $\mathcal{B}$ yields

$$\frac{t_i}{1-t_i}\left[\frac{(2+\chi_i+\chi_j)+\frac{(1+\chi_i)(1+\chi_j)}{k\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]}}{(2+\chi_i+\chi_j)\frac{\sigma}{\sigma-1}-(1-\chi_i\chi_j)\frac{1}{k}}-1\right]<0. \tag{A.31}$$

In order for Eq. (A.31) to be fulfilled, the fraction in the squared bracket needs to be smaller than one. Hence, we need to show that

$$-(2+\chi_i+\chi_j)\frac{1}{\sigma-1}+(1-\chi_i\chi_j)\frac{1}{k}+\frac{1+\chi_i+\chi_j+\chi_i\chi_j}{k\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]}<0. \tag{A.32}$$

Eq. (A.32) can be rewritten to get

$$k>\left[\frac{1+\frac{1+\chi_i+\chi_j}{1+\frac{1-t_i}{\zeta(\sigma-1)}}}{2+\chi_i+\chi_j}-\frac{\chi_i\chi_j\left(1-\frac{1}{1+\frac{1-t_i}{\zeta(\sigma-1)}}\right)}{2+\chi_i+\chi_j}\right](\sigma-1). \tag{A.33}$$

We note that the squared bracket is smaller or equal to one. Thus, the inequality in Eq. (A.33) is always fulfilled since $k>\sigma-1$. Hence, the wage rate in country $i$ is decreasing in the tax rate $t_i$.

### A.10 Proof of Eq. (51)

We want to show that

$$\frac{\hat{R}_i}{\hat{t}_i}=\frac{t_i}{1-t_i}\left[-\frac{k}{1+\chi_i}\mathcal{A}+\frac{1}{\mathcal{B}}\left(\mathcal{A}(1+\chi_j)+(2+\chi_i+\chi_j)\right)\right]<0. \tag{A.34}$$

Using the definitions of $\mathcal{A}$ and $\mathcal{B}$ we have to prove that

$$\frac{(2+\chi_i+\chi_j)+(1+\chi_i)(1+\chi_j)\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]^{-1}\frac{1}{k}}{(2+\chi_i+\chi_j)\frac{\sigma}{\sigma-1}-(1-\chi_i\chi_j)\frac{1}{k}}<\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]^{-1}. \tag{A.35}$$

Eq. (A.35) can be rewritten as follows:

$$(1+\chi_i+\chi_j+\chi_i\chi_j)\frac{1}{k}<(2+\chi_i+\chi_j)\left(\frac{\sigma}{\sigma-1}-\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]\right)-(1-\chi_i\chi_j)\frac{1}{k}. \tag{A.36}$$

The inequality in Eq. (A.36) holds since $\frac{\sigma}{\sigma-1}-\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]>\frac{1}{k}$ (as shown in A.6). Hence, total income in country $i$ is decreasing in the tax rate $t_i$.

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# S Supplement

## S.1 Equilibrium conditions in percentage changes - more general case

We want to express the system of equations (Eqs. (32) - (34)) in terms of percentage changes of endogenous variables and of all exogenous variables that potentially differ across countries. Eqs. (32) - (34) can be written as

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

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

$$\hat{\varphi}_i^{i^*} + \chi_i\hat{\varphi}_i^{j^*} = \frac{t_i}{1-t_i}\frac{1}{k}(1+\chi_i)\left[1+\frac{1-t_i}{\zeta(\sigma-1)}\right]^{-1}\hat{t}_i \tag{S.3}$$

$$\hat{\varphi}_j^{j^*} + \chi_j\hat{\varphi}_j^{i^*} = \frac{t_j}{1-t_j}\frac{1}{k}(1+\chi_j)\left[1+\frac{1-t_j}{\zeta(\sigma-1)}\right]^{-1}\hat{t}_j \tag{S.4}$$

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

## S.2 Symmetry

In this subsection we want to look at symmetric tax policy changes, i.e. $\hat{t}_i = \hat{t}_j = \hat{t}$ in an initial symmetric equilibrium, i.e. $\chi_i = \chi_j = \chi$ and $t_i = t_j = t$. Starting point for this analysis are the equilibrium conditions in percentage changes (see S.1). The domestic cutoff in country $i$ (and hence also in country $j$ due to symmetry) is denoted as $\varphi^*$. The export cutoff in both countries is given as $\varphi_\chi^*$. The first equilibrium condition (Eq. (S.1)) collapses to

$$(\sigma-1)\hat{\varphi}^* - (\sigma-1)\hat{\varphi}_\chi^* = 0. \tag{S.6}$$

Hence, a change in the domestic cutoff is equal to a change in the export cutoff. For the symmetric case the second equilibrium condition (Eq. (S.2)) is identical to the first equilibrium condition. We can write the third equilibrium condition (Eq. (S.3)) as

$$\hat{\varphi}^* + \chi\hat{\varphi}_\chi^* = \frac{t}{1-t}\frac{1}{k}(1+\chi)\left[1+\frac{1-t}{\zeta(\sigma-1)}\right]^{-1}\hat{t}. \tag{S.7}$$

Under symmetry the fourth equilibrium condition (Eq. (S.4)) is identical to the third equilibrium condition. The fifth equilibrium condition (Eq. (S.5)) collapses to an identity. Thus, we are left with a system of two equations in two unknowns. We eliminate $\hat{\varphi}^*$ and get

$$\hat{\varphi}_\chi^* = \frac{t}{1-t}\frac{1}{k}\left[1+\frac{1-t}{\zeta(\sigma-1)}\right]^{-1}\hat{t}. \tag{S.8}$$

By Eq. (S.6) we find

$$\hat{\varphi}^* = \frac{t}{1-t}\frac{1}{k}\left[1 + \frac{1-t}{\zeta(\sigma-1)}\right]^{-1}\hat{t}. \tag{S.9}$$

We see that the elasticity of the domestic cutoff with respect to the tax rate is identical to the elasticity of the export cutoff with respect to the tax rate implying that the share of exporting firms is not affected by changes in the tax rate. This result is compatible with the finding by Kohl (2017).