

Kohl, Miriam; Naumann, Fabrice

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Redistribution policy and offshoring in general equilibrium*

Miriam Kohl[†]

Fabrice Naumann[‡]

University of Mainz

TU Dresden

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Abstract

We look at the effect of domestic redistribution policy on offshoring in an asymmetric two country model of monopolistic competition, heterogeneous firms and occupational choice. The redistribution scheme is modeled by a combination of a progressive income tax and a lump-sum transfer. We find that the redistribution scheme lowers the degree of globalization measured by the share of offshoring firms in the economy. The intuition for this result is straightforward. The progressive income tax changes the factor allocation in the economy making it more attractive to become a worker. This leads to downward pressure on the domestic wage and thereby to a fall in the cost advantage of the host country. Changes in the domestic tax rate therefore affect the domestic economy not only directly but also via changes in the amount of offshoring. This has important implications both for aggregate income and for inequality.

JEL-Classification: D31, F12, F16, H24

Keywords: Offshoring, Income Inequality, Redistribution, Heterogeneous firms

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[†]Johannes Gutenberg University Mainz, Department Law and Economics, Jakob-Welder-Weg 4, 55128 Mainz, Germany; Email: miriam.kohl@uni-mainz.de.

[‡]TU Dresden, Faculty of Business and Economics, Helmholtzstr. 10, 01069 Dresden, Germany; Email: fabrice.naumann@tu-dresden.de.

1 Introduction

Offshoring is an important aspect of globalization. At the same time the distributional effects of offshoring are controversially discussed in the public and academic debate (see [Harrison et al., 2011](#); [Geishecker et al., 2012](#); [Hummels et al., 2018](#)). Shaping globalization is therefore of first order interest. [Snower et al. \(2009\)](#) discuss how welfare states should respond to globalization and stress the challenges raised by offshoring. We contribute to this discussion by looking at the interaction between a welfare state and offshoring in general equilibrium.

We build upon a model of offshoring developed in [Egger et al. \(2015\)](#). The authors model a two country world: one country being the source country of offshoring, while the other country is the host country of offshoring.¹ In the source country individuals can choose among different occupations. They can become entrepreneurs running a firm and earning the firm's profits or they can become workers or consultants earning an economy-wide wage. There is selection into offshoring, i.e. only the most productive firms will choose to offshore part of the production to a low-wage country. We implement a welfare state into this economy. The welfare state is financed by a very stylized form of a progressive income tax and the tax revenue is redistributed in a lump-sum fashion where all individuals receive the same per capita transfer.

We look at the effects of this redistribution scheme on the offshoring decision, the factor allocation, aggregate income and different aspects of inequality. We find that an increase in the tax rate leads to a decline in the share of offshoring firms, since the redistribution scheme puts downward pressure on the gross wage in the source country thereby reducing the cost advantage of the host country. This is an interesting finding because it suggests that in the open economy domestic redistribution policy does not only directly effect the economy, but also indirectly via changes in the amount of openness (measured by the share of offshoring firms). This has important implications both for the factor allocation, aggregate income and inequality, In particular, we find that this indirect effect creates an additional channel for a tax increase to decrease aggregate income, but also to lower within country inequality. Hence, this indirect channel works as a magnification effect of the direct effects of the redistribution policy.

Our work is related to different strands of the literature. Firstly, we contribute to the literature on distributional effects of offshoring. Key theoretical contributions to the field of North-South offshoring are [Feenstra and Hanson \(1997\)](#), [Grossman and Rossi-Hansberg \(2008\)](#) and [Egger et al. \(2015\)](#). [Feenstra and Hanson \(1997\)](#) argue that foreign direct investment leads to an increase in the relative demand for skilled labor in both regions which can explain the worldwide increase in wages of skilled labor. Another seminal contribution to this literature is [Grossman and Rossi-Hansberg](#)

¹We refer to the *source country* as the *domestic economy* and use this two terms interchangeably.

(2008) modeling offshoring as trade in tasks. They decompose the overall effect of offshoring on low-skill wages in the source into three partial effects: a productivity effect, a relative-price effect and a labor-supply effect. The productivity effect benefits low-skill workers in the source country thereby working against the other two effects. Egger et al. (2015) add firm heterogeneity to the analysis, thereby providing a richer picture of the distributional effects of offshoring. The empirical literature on distributional effects of offshoring is greatly summarized in Hummels et al. (2018), where the authors distinguish between different waves of studies (industry-level data, firm-level data, worker-level data, matched worker-firm level data) pointing to a positive link between offshoring and inequality.

Secondly, our work is related to the infant but growing literature that investigates the effects of redistribution policy in the open economy exploiting heterogeneity. Egger and Kreickemeier (2009), Antràs et al. (2017), Kohl and Richter (2018), Lyon and Waugh (2018) and Kohl (2020) contribute to this literature. Yet, only Kohl and Richter (2018) address the effects of unilateral tax policy. Therefore, our paper is closely related to their work. However, Kohl and Richter (2018) look at unilateral tax policy in a model of international trade, where an increase in the tax rate leads to an increase in the share of exporting firms in the regulating country, since the exporting firms can now benefit from the relatively bigger market they are exporting to. In the case of offshoring we find that an increase in the tax leads to a decrease in the share of offshoring firms. By comparing domestic redistribution policy in the context of offshoring to domestic redistribution policy in the context of international trade we point to a crucial dimension where these two forms of globalization are different from each other. To the best of our knowledge the link between redistribution policies and offshoring is not extensively investigated in the literature so far. An exception is Keuschnigg and Ribi (2009) that look at distributional consequences of outsourcing and possibilities to redistribute. However, firms are symmetric in Keuschnigg and Ribi (2009) and only two types of labor (high-skilled and low-skilled) are considered. This is a major simplification and we argue that adding heterogeneity allows for important additional insights.

This paper is structured as follows. In Section 2 we present the economic environment. In Section 3 the welfare state is described. Section 4 shows how the equilibrium factor allocation is determined. Section 5 derives the link between the welfare state and the share of offshoring firms. In Section 6 we perform comparative statics and show how the factor allocation, aggregate income and inequality react to changes in the tax rate. Section 7 concludes.

2 Economic environment

In this section we present a model of offshoring developed in [Egger et al. \(2015\)](#). The two-country world consists of a source country of offshoring and a host country of offshoring. In the source country of offshoring individuals can choose whether to become an entrepreneur or a worker, while in the host country of offshoring all individuals are employed as workers in multinational enterprises. The source country of offshoring consists of two sectors: a final goods sector and an intermediate goods sector.

2.1 The final goods sector

Technology in the final goods sector is given by the following CES production function:

$$Y = \left[\int_{v \in V} q(v)^{\frac{\sigma-1}{\sigma}} dv \right]^{\frac{\sigma}{\sigma-1}}, \quad (1)$$

where differentiated intermediates $q(v)$ of variety v are combined to a final output Y . V is the set of intermediate goods and $\sigma > 1$ denotes the elasticity of substitution. The production technology exhibits external increasing returns to scale (see [Ethier, 1982](#)). We treat the final good as the numéraire and hence its price is normalized to one. The final goods sector is characterized by perfect competition. Profit maximization leads to the following isoelastic demand function for each variety of the intermediate good:

$$q(v) = Y p(v)^{-\sigma}. \quad (2)$$

2.2 The intermediate goods sector

In the intermediate goods sector a non-routine task (denoted by superscript n) and a routine task (denoted by superscript r) are combined. The two tasks differ in their offshorability. Only the routine task can be offshored.² The intermediate goods sector is characterized by monopolistic competition and each firm is run by an entrepreneur where the ability of the entrepreneur determines the productivity $\varphi(v)$ of the firm. The production technology is given by

$$q(v) = \varphi(v) \left[\frac{l^n(v)}{\eta} \right]^\eta \left[\frac{l^r(v)}{1-\eta} \right]^{1-\eta}, \quad (3)$$

where $l^n(v)$ and $l^r(v)$ denote labor employed for performing the respective tasks, while $\eta \in (0, 1)$ is the weight of the non-routine task in the production process. Hence, there are firms that produce using only domestic labor (denoted by superscript d) and firms that offshore the routine task

²See [Antràs and Helpman \(2004\)](#) for a similar approach and [Blinder \(2006\)](#) for a discussion on offshorability.

(denoted by superscript o). The marginal costs for the two types of firms are given by

$$c^d(v) = \frac{w}{\varphi(v)} \quad \text{and} \quad c^o(v) = \frac{w}{\varphi(v)\kappa} \quad \text{with} \quad \kappa \equiv \left(\frac{w}{\tau w^*}\right)^{1-\eta}, \quad (4)$$

where w denotes the wage rate in the source country, w^* is the wage rate in the host country and $\tau > 1$ represents the iceberg transport cost an offshoring firm faces when importing the output from the host country. Offshoring is only an equilibrium outcome if the marginal cost savings factor κ is greater than one.

With the demand function being isoelastic (cf. Eq. (2)) the prices in the intermediate goods sector are a constant markup over marginal cost, i.e.

$$p^i(v) = \frac{\sigma}{\sigma-1} c^i(v), \quad i \in \{d, o\}. \quad (5)$$

Relative operating profits π of two firms with different productivities (assume $\varphi_1 > \varphi_2$) are given by

$$\frac{\pi^i(\varphi_1)}{\pi^i(\varphi_2)} = \left(\frac{\varphi_1}{\varphi_2}\right)^{\sigma-1} \quad i \in \{d, o\}, \quad (6)$$

where we used Eqs. (2), (4) and (5). Eq. (6) shows a positive relationship between productivity and operating profits.³ Similarly, operating profits of an offshoring firm relative to operating profits of a purely domestic firm with the same productivity are given by

$$\frac{\pi^o(\varphi)}{\pi^d(\varphi)} = \kappa^{\sigma-1}. \quad (7)$$

Eq. (7) reveals that cost savings due to offshoring lead to higher profits of offshoring firms compared to purely domestic firms with the same productivity.

3 Welfare state

In order to look at the effects of domestic redistribution policy in the open economy we model a welfare state. We assume that only in the source country of offshoring there is a welfare state. The asymmetric country setup allows us to directly study unilateral tax policy changes. Generally speaking, a welfare state consists of a financing and an expenditure side. The welfare state is modeled similar to [Kohl \(2020\)](#) and [Kohl and Richter \(2018\)](#). It is financed by a proportional tax t on operating profits and the tax revenue is redistributed to individuals in the source country in a lump-sum fashion. Since entrepreneurs in this model earn the profit of the firm they are running and represent the high-income group, the tax can be interpreted as a very stylized version of a

³This result is well established in the heterogeneous firms literature that was initiated by [Melitz \(2003\)](#).

progressive income tax. The budget is balanced and hence the per-capita transfer b is given by

$$b = \frac{tM\bar{\pi}}{N}, \quad (8)$$

where $M\bar{\pi}$ are total operating profits and N denotes the mass of individuals in the source country. In the following we will treat the tax rate as exogenously given, while the transfer adjusts according to Eq. (8).

4 Equilibrium factor allocation

Individuals in the source country can choose among different occupations. They can choose to become either entrepreneurs or workers or offshoring consultants. Entrepreneurs face an additional decision, namely whether to produce using solely domestic labor or whether to offshore the routine task to a low-wage country. In the following we discuss how these decisions are made, how they are affected by the redistribution scheme, and derive the factor allocation in the source country.

4.1 Decisions

Individuals in the source country differ in their entrepreneurial ability φ . We follow the literature and assume that ability is Pareto distributed with the cumulative distribution function given by $G(\varphi) = 1 - \varphi^{-k}$.⁴ Individuals can use their entrepreneurial ability only in the role as entrepreneurs. The domestic indifference condition is given by

$$(1 - t)\pi^d(\varphi^d) = w, \quad (9)$$

where φ^d denotes the ability of the marginal entrepreneur. Hence, individuals with abilities $\varphi \geq \varphi^d$ choose to become entrepreneurs, while individuals with abilities $\varphi < \varphi^d$ are employed as workers or offshoring consultants. Inspection of Eq. (9) reveals that the tax rate directly affects the occupational choice of individuals as it distorts entry into entrepreneurship.

Offshoring involves variable iceberg transport costs since the output of the routine task needs to be imported from the host country. In addition to these variable costs, it also involves fixed offshoring costs since an offshoring consultant earning the economy-wide wage rate w needs to be hired. The offshoring indifference condition is given by

$$(1 - t)\pi^o(\varphi^o) - w = (1 - t)\pi^d(\varphi^o), \quad (10)$$

⁴We assume that the shape parameter k is greater than the elasticity of substitution σ in order to guarantee that means are positive and finite.

where φ^o is the ability of the marginal entrepreneur choosing offshoring. Eq. (10) implies that entrepreneurs with abilities $\varphi \geq \varphi^o$ choose to offshore the routine task, while entrepreneurs with abilities $\varphi < \varphi^o$ produce using solely domestic labor.

4.2 Factor allocation

The occupational choice determines the factor allocation in the aggregate. The factor allocation in the economy is derived as a function of exogenous parameters and one endogenous variable, the share of offshoring firms χ :

$$\chi \equiv \frac{1 - G(\varphi^o)}{1 - G(\varphi^d)} = \left(\frac{\varphi^d}{\varphi^o} \right)^k. \quad (11)$$

To this end we link both the profit of the marginal entrepreneur and the wage to aggregates. Average operating profits $\bar{\pi}$ are a function of the profits of the marginal firm, i.e.⁵

$$\bar{\pi} = \frac{k}{k - \sigma + 1} (1 + \chi) \pi^d(\varphi^d). \quad (12)$$

Substituting for $\bar{\pi}$ using $\sigma \bar{\pi} = Y/M$ we find:

$$\pi^d(\varphi^d) = \frac{k - \sigma + 1}{k} \frac{1}{1 + \chi} \frac{1}{\sigma} \frac{Y}{M}. \quad (13)$$

The economy-wide wage rate can be linked to aggregate variables as follows:

$$w = \gamma \frac{\sigma - 1}{\sigma} \frac{Y}{L}, \quad (14)$$

where L is the mass of production workers in the source country, $(\sigma - 1)/\sigma$ is the share of revenues that goes to labor income and γ is the fraction of labor income going to domestic workers with

$$\gamma \equiv \frac{(1 - \chi) \bar{\pi}^d + \chi \eta \bar{\pi}^o}{\bar{\pi}}. \quad (15)$$

$\bar{\pi}^d$ are average operating profits of firms producing only domestically, while $\bar{\pi}^o$ are average operating profits of firms that offshore the routine task (with cost share $1 - \eta$) to a low-wage host country of offshoring. Eq. (15) can be written as⁶

$$\gamma(\chi; \eta) = \frac{1 + \eta \chi - (1 - \eta) \chi^{\frac{k - (\sigma - 1)}{k}}}{1 + \chi} \quad (16)$$

⁵The derivation of Eq. (12) is deferred to the Appendix; see A.1.

⁶The derivation and differentiation of Eq. (16) is deferred to the Appendix; see A.2.

In the Appendix we show that γ decreases in the share of offshoring firms χ . If χ is zero, γ is at its maximum value of 1. If χ is one, γ is at its minimum value of η .

Using Eqs. (13) and (14) we can write the domestic indifference condition as follows:

$$L = \gamma \frac{(1 + \chi)}{(1 - t)} \frac{k(\sigma - 1)}{(k - \sigma + 1)} M. \quad (17)$$

Eq. (17) constitutes an upward-sloping relationship between the mass of entrepreneurs and the mass of workers. An increase in the mass of entrepreneurs leads to lower profits of the marginal entrepreneur since the marginal entrepreneur has now a lower ability. To restore indifference the wage rate has to fall as well which is achieved by an increase in the supply of workers.

The total mass of individuals in the source country is an exogenous parameter of the model and denoted by N . Individuals in the source country can choose among three occupations: entrepreneurs, workers and offshoring consultants. Therefore, the resource constraint in the economy is given by

$$L = N - (1 + \chi)M, \quad (18)$$

which gives a downward-sloping relationship between the mass of entrepreneurs and the mass of workers.

Combining the indifference condition (17) with the resource constraint (18) we can solve for the factor allocation in the source country:

$$\begin{aligned} M &= \frac{(k - \sigma + 1)(1 - t)}{(1 + \chi)[(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1)]} N \\ L &= \frac{\gamma k(\sigma - 1)}{(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1)} N. \end{aligned} \quad (19)$$

The ability of the marginal entrepreneur is implicitly given by $M = [1 - G(\varphi^d)] N$ and follows straightforwardly as

$$\varphi^d = \left\{ \frac{(1 + \chi)[(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1)]}{(k - \sigma + 1)(1 - t)} \right\}^{\frac{1}{k}}. \quad (20)$$

Having a first look how changes in the tax rate affect the factor allocation, reveals that the mass of entrepreneurs depends negatively on the tax rate, while the mass of workers depends positively on the tax rate. This is the direct effect of changes in the tax rate driven by the occupational choice as an increase in the tax rate distorts entry into entrepreneurship. However, this is not the overall effect of changes in the tax rate on the factor allocation since the factor allocation depends also on the share of offshoring firms that is an endogenous variable in the model and hence possibly dependent on the tax rate.

5 Share of offshoring firms

The share of offshoring firms is a crucial variable in the model. In a first step, we show how the share of offshoring firms is determined in equilibrium following Egger et al. (2015). In a second step, we analyze how changes in the tax rate affect the share of offshoring firms

5.1 Determining the share of offshoring firms

We can rewrite the offshoring indifference condition using Eqs. (7), (9) and (11) to get

$$\kappa = A(\chi) \equiv \left(1 + \chi \frac{\sigma-1}{k}\right)^{\frac{1}{\sigma-1}}, \quad (21)$$

establishing a positive link between the marginal cost savings factor κ and the share of offshoring firms. In Figure 1 the *offshoring indifference condition* is drawn as an upward-sloping curve. It is not affected by the welfare state.

Labor markets in both the source country and the host country need to be in equilibrium. Combining Eqs. (14) and (19) gives the labor market equilibrium in the source country:

$$w = \frac{Y}{N} \frac{(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1)}{\sigma k}. \quad (22)$$

We see that *ceteris paribus* the wage rate in the source country depends negatively on the tax rate. The intuition for this result is straightforward: The tax distorts the occupational choice, thereby affecting the factor allocation in the source country. *Ceteris paribus*, a higher tax rate increases the supply of workers and decreases the demand for workers (due to fewer firms). Both effects put downward pressure on the wage rate.

In the host country all individuals are workers. The labor market equilibrium is characterized as follows:

$$w^* = (1 - \gamma) \frac{\sigma - 1}{\sigma} \frac{Y}{N^*}. \quad (23)$$

Using the two labor market equilibria (Eqs. (22) and (23)) in Eq.(7) we get a second link between the share of exporting firms and the marginal cost savings factor, i.e.

$$\kappa = B(\chi, \tau, t) = \left[\frac{1}{\tau} \frac{N^*}{N} \frac{(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1)}{k(\sigma - 1)(1 - \gamma)} \right]^{1-\eta}. \quad (24)$$

Eq. (24) is labeled *labor market constraint* and gives a negative relationship between χ and κ . For an initial tax rate t_1 the labor market constraint is illustrated by the downward-sloping orange curve. At $\chi = 0$ the wage rate in the host country is zero and hence the marginal cost savings factor is infinite. As the share of offshoring firms increases, labor demand in the host country

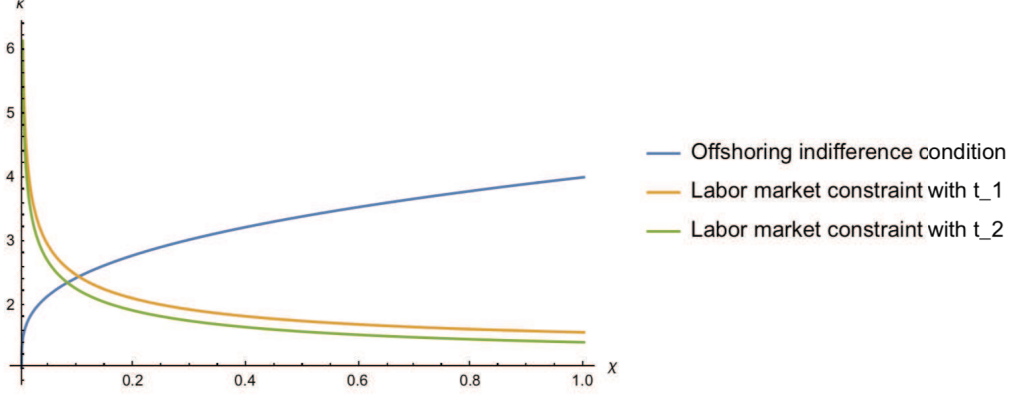


Figure 1: *Impact of progressive income tax on share of offshoring firms.*

increases leading to higher wage rates there and hence to a lower marginal cost savings factor.

An interior equilibrium exists if $B(1, \tau, t)$ is smaller than $2^{1/(\sigma-1)}$. We get the following parameter restriction for an interior equilibrium:

$$\tau > 2^{\frac{1}{(1-\sigma)(1-\eta)}} \frac{(k - \sigma + 1)(1 - t) + \eta k(\sigma - 1) \frac{N^*}{N}}{k(\sigma - 1)(1 - \eta)}. \quad (25)$$

It becomes obvious that a positive tax rate relaxes this parameter constraint.

5.2 Changes in the tax rate

How do changes in the tax rate affect the equilibrium share of offshoring firms? In Figure 1 we illustrate an increase in the tax rate from t_1 to t_2 and show how the equilibrium share of offshoring firms is affected. Figure 1 reveals that a higher tax rate leads to a downward shift in the labor market constraint and therefore to a decrease in the share of offshoring firms in equilibrium. To derive this result analytically we look at the implicit function

$$F(\chi, \tau, t) \equiv B(\chi, \tau, t) - A(\chi) = \left[\frac{1}{\tau} \frac{N^*}{N} \frac{(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1)}{k(\sigma - 1)(1 - \gamma)} \right]^{1-\eta} - (1 + \chi^{\frac{\sigma-1}{k}})^{\frac{1}{\sigma-1}} = 0. \quad (26)$$

Applying the implicit function theorem reveals $d\chi/dt < 0$.⁷

The intuition for this result is straightforward: An increase in the tax rate shifts the labor market constraint downwards since a higher tax rate leads to downward pressure on the wage rate in the source country and therefore to a decline in the marginal cost savings factor. This leads to an equilibrium adjustment of the share of offshoring firms, which declines due to the positive link between κ and χ given by the offshoring indifference condition.

⁷The differentiation is deferred to the Appendix; see A.3.

6 Comparative statics

Tax policy affects the equilibrium outcome not only directly, but also indirectly since the share of offshoring firms is also endogenously determined in the model. Having shown how the share of offshoring firms is affected by changes in the tax rate, we can now perform comparative static analyses. We look at the effects of unilateral tax policy changes on the factor allocation, aggregate income, between-country inequality as well as within-country inequality.

6.1 Factor allocation

We start by looking at how the factor allocation in the source country is affected by changes in the tax rate. The mass of workers and entrepreneurs as a function of the share of offshoring firms and model parameters is given by Eq. (19). We can decompose the effect of an increase in the tax rate on the mass of production workers as follows:

$$\frac{dL}{dt} = \underbrace{\frac{\partial L}{\partial t}}_{>0} + \underbrace{\frac{\partial L}{\partial \gamma} \frac{\partial \gamma}{\partial \chi}}_{<0} \underbrace{\frac{d\chi}{dt}}_{<0}. \quad (27)$$

The tax rate distorts the occupational choice making it more attractive *ceteris paribus* to become a worker. Therefore, the direct effect of a tax increase is positive. The mass of workers depends negatively on the share of offshoring firms. Since an increase in the tax decreases the share of offshoring firms, the indirect effect of a tax increase is also positive. Hence, we get the unambiguous result that an increase in the tax rate leads to a higher mass of workers in the source country.

We next focus on the mass of entrepreneurs. Again we can decompose the effect into a direct and an indirect effect:

$$\frac{dM}{dt} = \underbrace{\frac{\partial M}{\partial t}}_{<0} + \underbrace{\left(\frac{\partial M}{\partial \chi} + \frac{\partial M}{\partial \gamma} \frac{\partial \gamma}{\partial \chi} \right)}_{\geq 0} \underbrace{\frac{d\chi}{dt}}_{<0}. \quad (28)$$

The direct effect is negative since an increase in the tax rate distorts entry into entrepreneurship. Egger et al. (2015) show that the effect of the share of offshoring firms on the mass of entrepreneurs depends on the level of χ , where the threshold $\hat{\chi}_d$ is given by⁸

$$\hat{\chi}_d = \left[\frac{(k - \sigma + 1)(\sigma - 1)(1 - \eta)}{(k - \sigma + 1)(1 - t) + k\eta(\sigma - 1)} \right]^{\frac{k}{\sigma - 1}}. \quad (29)$$

For $\chi < \hat{\chi}_d$ the mass of entrepreneurs increases in χ implying that firms of low productivity enter the market. For $\chi > \hat{\chi}_d$ the mass of entrepreneurs decreases in χ and hence, firms of low productivity have to leave the market. This is a key result in Egger et al. (2015) pointing to a

⁸The derivation of $\hat{\chi}_d$ is deferred to the Appendix; see A.4.

crucial difference between offshoring and international trade. This implies for our analysis that the indirect effect can be either negative or positive.

For the offshoring consultants we get the following decomposition:

$$\frac{d(\chi M)}{dt} = \underbrace{\frac{\partial(\chi M)}{\partial t}}_{<0} + \underbrace{\left(\frac{\partial(\chi M)}{\partial \chi} + \frac{\partial(\chi M)}{\partial \gamma} \frac{\partial \gamma}{\partial \chi} \right)}_{>0} \underbrace{\frac{d\chi}{dt}}_{<0}. \quad (30)$$

The direct effect is negative since both the share of offshoring firms and the mass of entrepreneurs depend negatively on t . The indirect effect is also negative since the mass of offshoring consultants depends positively on the share of offshoring firms and we established a negative link between the tax rate and the share of offshoring firms. Hence, we get the overall effect that the mass of offshoring consultants decreases if there is an increase in the tax rate.

6.2 Aggregate income

Aggregate income I in the source country can be calculated as follows:

$$I = \left(\frac{1}{\sigma} + \gamma \frac{\sigma - 1}{\sigma} \right) Y, \quad (31)$$

where the first part $(1/\sigma)Y$ are operating profits and $\gamma[(\sigma - 1)/\sigma]Y$ is labor income in the source country. Using Eqs. (2), (9) and (13) we get:

$$I(\chi) = \left(\frac{1}{\sigma} + \gamma \frac{\sigma - 1}{\sigma} \right) \frac{\sigma - 1}{1 - t} (M(1 + \chi))^{\frac{\sigma}{\sigma - 1}} \left(\frac{k}{k - (\sigma - 1)} \right)^{\frac{\sigma}{\sigma - 1}} \varphi^d. \quad (32)$$

We use Eqs. (19) and (20) in order to substitute for M and φ^d , respectively. We find

$$I(\chi) = \left(\frac{1}{\sigma} + \gamma \frac{\sigma - 1}{\sigma} \right) \frac{\sigma - 1}{1 - t} \left(\frac{k(1 - t)N}{(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1)} \right)^{\frac{\sigma}{\sigma - 1}} \times \left(\frac{(1 + \chi)[(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1)]}{(k - \sigma + 1)(1 - t)} \right)^{\frac{1}{k}} \quad (33)$$

getting an expression that only depends on χ and parameters. The overall effect can be decomposed as follows:

$$\frac{dI}{dt} = \underbrace{\frac{\partial I}{\partial t}}_{\geq 0} + \underbrace{\left[\frac{\partial I}{\partial \chi} + \frac{\partial I}{\partial \gamma} \frac{\partial \gamma}{\partial \chi} \right]}_{>0} \underbrace{\frac{d\chi}{dt}}_{<0}. \quad (34)$$

The tax affects aggregate income directly and indirectly. In the Appendix⁹ we show that the direct effect can be either positive or negative. The indirect effect is unambiguously negative since an increase in the tax rate leads to a decline in the share of offshoring firms and aggregate income depends positively on the share of offshoring firms. Hence, there exists an additional channel in the open economy through which changes in the tax rate affect aggregate income. *Ceteris paribus* this channel lowers aggregate income.

6.3 Between-country inequality

Next, we look at the effects of unilateral tax policy on between-country inequality. Clearly, the decision whether to offshore or not is determined by relative gross wages. However, when looking at the effect of unilateral tax policy on between-country inequality, we think that it is more meaningful to compare net wages. Our measure for between-country inequality is therefore given by

$$\Xi \equiv \frac{w + b}{w^*}. \quad (35)$$

Using Eqs. (8), (22), (23) and noting that $\sigma\bar{\pi}M = Y$ we get

$$\Xi = \frac{(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1) + tk \frac{N^*}{N}}{k(1 - \gamma)(\sigma - 1)}. \quad (36)$$

The tax rate affects between-country inequality both directly and indirectly (via changes in χ , and hence γ). The overall effect can be decomposed as follows:¹⁰

$$\frac{d\Xi}{dt} = \underbrace{\frac{\partial \Xi}{\partial t}}_{>0} + \underbrace{\frac{\partial \Xi}{\partial \gamma}}_{>0} \underbrace{\frac{\partial \gamma}{\partial \chi}}_{<0} \underbrace{\frac{d\chi}{dt}}_{<0}. \quad (37)$$

We see that the direct effect of the tax on between-country inequality is positive. The intuition for this result is as follows: Although the gross wage differential between the source and the host country of offshoring decreases in the tax rate, we find that the net wage differential increases, since workers in the source country receive a transfer in addition to the wage and this transfer effect overcompensates the gross wage effect. The indirect effect of a tax increase is also positive: As the share of offshoring firms decreases, there is lower relative demand for labor in the host country of offshoring, which decreases the wage rate in the host country *ceteris paribus*. Hence, between-country inequality as defined in Eq. (35) increases. This argument is captured by the fact that the *labor market constraint* in Section 5 is downward-sloping in the κ, χ -space. Overall, a unilateral tax increase in the source country of offshoring increases between-country inequality.

⁹See A.5.

¹⁰The derivations are deferred to the Appendix; see A.6.

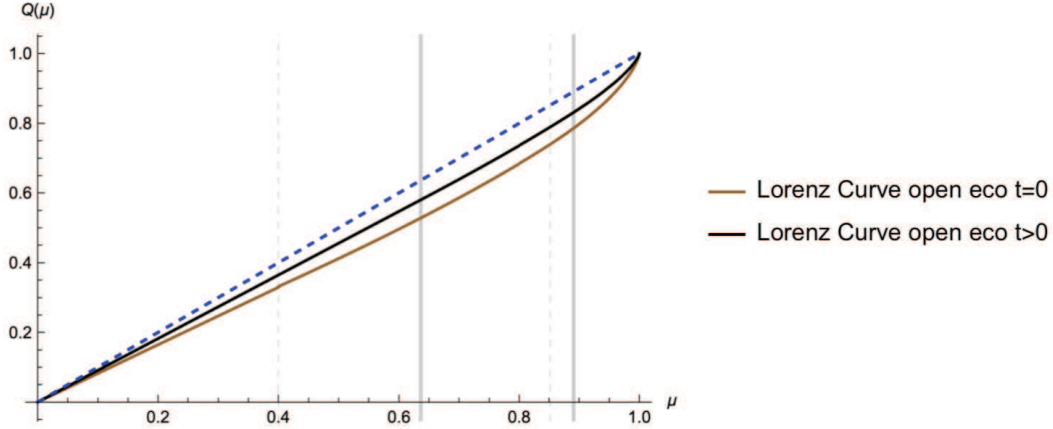


Figure 2: *Lorenz curves with different values of the tax rate.*

6.4 Within-country inequality

Within-country inequality is described by the economy-wide Lorenz curve of post tax-transfer income. The Lorenz curve $Q(\mu; \chi)$ is derived in the Appendix.¹¹ The Lorenz curve for the source country has three parts. The first part is linear and captures the income of the workers and offshoring consultants as they all earn the economy-wide wage plus the transfer. The second part is convex and describes the income distribution of the entrepreneurs that are not active in offshoring. The third part captures the income distribution of the entrepreneurs that do offshore parts of the production. In Figure 2 we compare two Lorenz curves with different values of the tax rate. The brown curve displays the Lorenz curve for $t = 0$, while the black curve shows the Lorenz curve in case of a positive tax rate. Comparing these two curves to each other shows the direct effect of the tax on within-country inequality. For the moment we are abstracting from the fact that the tax rate also affects the share of offshoring firms (this is the indirect effect that we discuss below). Simulation exercise suggests that the Lorenz curve with a positive tax displays Lorenz dominance over the economy-wide distribution with a tax rate of zero. Hence, the redistribution scheme makes the income distribution more equal.

Figure 3 compares two Lorenz curves with different values of the share of offshoring firms (without changing the tax rate). The brown curve shows the case under autarky, where the share of offshoring firms is zero. The black curve shows the income distribution in the open economy, i.e. the share of offshoring firms is positive. Simulation exercise suggests that the Lorenz curve under autarky Lorenz dominates the Lorenz curve in the open economy. Therefore, offshoring makes the income distribution more unequal in this model. In Section 5 we established the negative link between changes in the tax rate and changes in the share of offshoring firms. Figure 3 suggests

¹¹See A.7.

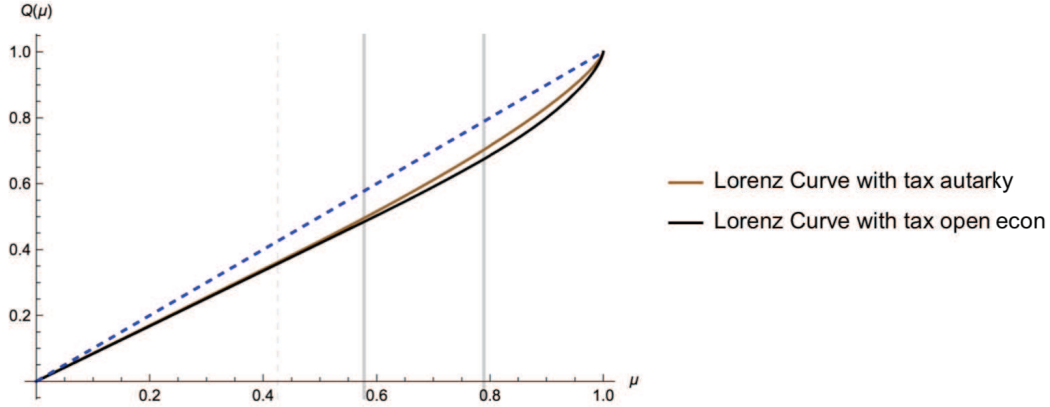


Figure 3: *Lorenz curves with different values of the share of offshoring firms.*

that a decrease in the share of offshoring firms makes the income distribution more equal. Hence, the indirect effect via the share of offshoring firms is also negative. This finding implies that in the open economy there is an additional channel through which the redistribution scheme operates.

7 Conclusion

In this paper we look at the effects of taxation on the factor allocation, aggregate income and inequality in the context of offshoring. We show that in the open economy there is an additional channel how the tax affects the economy, i.e. via changes in the share of offshoring firms. Our main finding is that the share of offshoring firms depends negatively on the tax rate, since the tax affects the occupational choice and thereby putting downward pressure on the wage in the source country of offshoring. Therefore, the cost advantage of the host country declines which makes offshoring less attractive. This is a crucial difference to the effects of taxation in the context of trade as analyzed in [Kohl and Richter \(2018\)](#). This indirect channel via changes in the share of offshoring firms lowers aggregate income *ceteris paribus*. Furthermore, the indirect channel intensifies the direct inequality decreasing effect of the redistribution scheme.

A Appendix

A.1 Derivation of Eq. (12)

Average profits are given by

$$\bar{\pi} = \bar{\pi}^{dom} + \chi \bar{\pi}^{off}, \quad (\text{A.1})$$

where $\bar{\pi}^{dom}$ are average operating profits in the hypothetical situation where all firms produce domestically and $\bar{\pi}^{off}$ are the additional average profits made through offshoring. These averages are linked to profits of the marginal firm and to additional profits of the marginal offshoring firms as follows:

$$\bar{\pi} = \frac{k}{k - \sigma + 1} \left[\pi^d(\varphi^d) + \chi \pi^{off}(\varphi^o) \right], \quad (\text{A.2})$$

with $\pi^{off}(\varphi^o) \equiv \pi^o(\varphi^o) - \pi^d(\varphi^o)$. Eq. (12) follows by using Eqs. (9) and (10) in Eq. (A.2).

A.2 Derivation and differentiation of Eq. (16)

Starting point for the derivation of Eq. (16) is Eq. (15). Next we write the averages as functions of the profits of the marginal firm. We get:

$$\begin{aligned} \bar{\pi}^o &= \frac{k}{k - \sigma + 1} \pi^o(\varphi^o) = \frac{k}{k - \sigma + 1} \left[\frac{\pi^o(\varphi^o)}{\pi^d(\varphi^o)} \right] \left[\frac{\pi^d(\varphi^o)}{\pi^d(\varphi^d)} \right] \pi^d(\varphi^d) \\ &= \frac{k}{k - \sigma + 1} \left(1 + \chi^{-\frac{\sigma-1}{k}} \right) \pi^d(\varphi^d), \end{aligned} \quad (\text{A.3})$$

where we used Eqs. (6), (7), (9), (10) and (11). Combining Eq. (15) with Eqs. (12) and (A.3) yields:

$$\bar{\pi}^d = \frac{\bar{\pi} - \chi \bar{\pi}^o}{1 - \chi} = \frac{k}{k - \sigma + 1} \frac{1 - \chi^{1 - \frac{\sigma-1}{k}}}{1 - \chi} \pi^d(\varphi^d). \quad (\text{A.4})$$

Using Eqs. (12), (A.3) and (A.4) in Eq. (15) we get Eq. (16).

Differentiation of Eq. (16) with respect to χ yields:

$$\frac{\partial \gamma}{\partial \chi} = - \frac{(k - \sigma + 1)(1 - \eta) \chi^{-\frac{\sigma-1}{k}} + k(\gamma - \eta)}{k(1 + \chi)} < 0. \quad (\text{A.5})$$

A.3 Implicit differentiation of Eq. (26)

Applying the implicit function theorem to (26) yields

$$\frac{d\chi}{dt} = - \frac{\partial F / \partial t}{\partial F / \partial \chi}, \quad (\text{A.6})$$

with

$$\frac{\partial F}{\partial t} = -(1 - \eta) \left[\frac{(k - \sigma + 1)(1 - t) + \gamma k(\sigma - 1) \frac{N^*}{N}}{\tau k(\sigma - 1)(1 - \gamma)} \right]^{-\eta} \left[\frac{k - \sigma + 1}{\tau k(\sigma - 1)(1 - \gamma)} \frac{N^*}{N} \right] < 0 \quad (\text{A.7})$$

and

$$\begin{aligned}
\frac{\partial F}{\partial \chi} &= -\frac{1}{\sigma-1} \left(1 + \chi^{\frac{\sigma-1}{k}}\right)^{\frac{1}{\sigma-1}-1} \frac{\sigma-1}{k} \chi^{\frac{\sigma-1}{k}-1} \\
&\quad - (1-\eta) \left[\frac{(k-\sigma+1)(1-t) + \gamma k(\sigma-1) \frac{N^*}{N}}{\tau k(\sigma-1)(1-\gamma)} \right]^{-\eta} \\
&\quad \times \frac{k(\sigma-1)\tau k(\sigma-1)(1-\gamma) + [(k-\sigma+1)(1-t) + \gamma k(\sigma-1)] [\tau k(\sigma-1)] \frac{N^*}{N}}{[\tau k(\sigma-1)(1-\gamma)]^2} \\
&\quad \times \frac{(k-\sigma+1)(1-\eta)\chi^{-\frac{\sigma-1}{k}} + k(\gamma-\eta)}{k(1+\chi)} \\
&< 0.
\end{aligned} \tag{A.8}$$

Using Eqs. (A.7) and (A.8) in Eq. (A.6) reveals that $d\chi/dt < 0$.

A.4 Derivation of Eq. (29)

The mass of entrepreneurs is given by Eq. (19). Differentiation with respect to χ yields

$$\begin{aligned}
\frac{dM}{d\chi} &= \frac{\partial M}{\partial \chi} + \frac{\partial M}{\partial \gamma} \frac{\partial \gamma}{\partial \chi} \\
&= -\frac{[(k-\sigma+1)(1-t)N] \left\{ (k-\sigma+1)(1-t) - [(k-\sigma+1)(1-\eta)\chi^{-\frac{\sigma-1}{k}} - k\eta] (\sigma-1) \right\}}{\{(1+\chi)[(k-\sigma+1)(1-t) + \gamma k(\sigma-1)]\}^2}.
\end{aligned} \tag{A.9}$$

Setting Eq. (A.9) equal to zero we get Eq. (29).

A.5 Aggregate income: comparative statics

Aggregate income as a function of model parameters and χ only is given by Eq. (33). The overall effect of an increase in t can be decomposed as follows:

$$\frac{dI}{dt} = \frac{\partial I}{\partial t} + \left[\frac{\partial I}{\partial \chi} + \frac{\partial I}{\partial \gamma} \frac{\partial \gamma}{\partial \chi} \right] \frac{d\chi}{dt}. \tag{A.10}$$

For the direct effect we get:

$$\begin{aligned}
\frac{\partial I}{\partial t} &= \frac{1 + \gamma(\sigma-1)}{\sigma} \frac{\sigma-1}{1-t} (1+\chi)^{\frac{1}{k}} \left[N \frac{k}{k-\sigma+1} \right]^{\frac{\sigma}{\sigma-1}} \left[\frac{(k-\sigma+1)(1-t)}{(k-\sigma+1)(1-t) + \gamma k(\sigma-1)} \right]^{\frac{k\sigma - (\sigma-1)}{k(\sigma-1)}} \\
&\quad \times \frac{1}{1-t} \left[1 - \frac{\gamma[(k-\sigma+1) + k(\sigma-1)]}{(k-\sigma+1)(1-t) + \gamma k(\sigma-1)} \right],
\end{aligned} \tag{A.11}$$

which can be either negative or positive depending on

$$\frac{t}{1-\eta} \geq \frac{\chi + \chi^{\frac{k-\sigma+1}{k}}}{1+\chi}. \tag{A.12}$$

Regarding the indirect effect we already know that $d\chi/dt < 0$ and $\partial\gamma/\partial\chi < 0$. For $\partial I/\partial\chi$ we get:

$$\frac{\partial I}{\partial \chi} = \frac{1}{k} (1+\chi)^{\frac{1}{k}-1} \frac{1 + \gamma(\sigma-1)}{\sigma} \frac{\sigma-1}{1-t} \left[N \frac{k}{k-\sigma+1} \right]^{\frac{\sigma}{\sigma-1}} \left[\frac{(k-\sigma+1)(1-t)}{(k-\sigma+1)(1-t) + \gamma k(\sigma-1)} \right]^{\frac{k\sigma - (\sigma-1)}{k(\sigma-1)}}, \tag{A.13}$$

which is unambiguously greater than zero. For $\partial I/\partial \gamma$ we get:

$$\begin{aligned} \frac{\partial I}{\partial \gamma} &= \frac{1}{\sigma} \frac{\sigma-1}{1-t} (1+\chi)^{\frac{1}{k}} \left[N \frac{k}{k-\sigma+1} \right]^{\frac{\sigma}{\sigma-1}} \left[\frac{(k-\sigma+1)(1-t)}{(k-\sigma+1)(1-t) + \gamma k(\sigma-1)} \right]^{\frac{k\sigma-(\sigma-1)}{k(\sigma-1)}} \\ &\quad \times \left[(\sigma-1) - (1+\gamma(\sigma-1)) \frac{(k-\sigma+1) + k(\sigma-1)}{(k-\sigma+1)(1-t) + \gamma k(\sigma-1)} \right], \end{aligned} \quad (\text{A.14})$$

which is unambiguously smaller than zero. Taken all this partial effects together, we find:

$$\frac{dI}{dt} = \underbrace{\frac{\partial I}{\partial t}}_{\geq 0} + \underbrace{\left[\underbrace{\frac{\partial I}{\partial \chi}}_{>0} + \underbrace{\frac{\partial I}{\partial \gamma} \frac{\partial \gamma}{\partial \chi}}_{<0} \right]}_{>0} \underbrace{\frac{d\chi}{dt}}_{<0}. \quad (\text{A.15})$$

A.6 Between-country inequality: comparative statics

The overall effect of t on Ξ is given by Eq. (37). We know that $d\chi/dt < 0$ and $\partial \gamma/\partial \chi < 0$. For $\partial \Xi/\partial t$ we get

$$\frac{\partial \Xi}{\partial t} = \frac{N^*}{k(1-\gamma)N}, \quad (\text{A.16})$$

which is greater than zero. For $\partial \Xi/\partial \gamma$ we find

$$\frac{\partial \Xi}{\partial \gamma} = \frac{k^2(\sigma-1)^2 + k(\sigma-1)(k-\sigma+1)(1-t) + k^2(\sigma-1)t}{[k(1-\gamma)(\sigma-1)]^2} \frac{N^*}{N}, \quad (\text{A.17})$$

which is greater than zero.

A.7 Lorenz curve: derivation

The Lorenz curve consists of three parts and is given by

$$Q(\mu; \chi) \equiv \begin{cases} Q_1(\mu; \chi) & \text{if } \mu \in [0, b_1(\chi)) \\ Q_2(\mu; \chi) & \text{if } \mu \in [b_1(\chi), b_2(\chi)) \\ Q_3(\mu; \chi) & \text{if } \mu \in [b_2(\chi), 1]. \end{cases} \quad (\text{A.18})$$

The first part displays the income share of workers and offshoring consultants. We get

$$Q_1(\mu; \chi) = \frac{[tk + (k-\sigma+1)(1-t) + \gamma k(\sigma-1)]}{[\gamma k(\sigma-1) + k]} \mu. \quad (\text{A.19})$$

The share of workers and consultants in the population is given by

$$b_1(\chi) \equiv 1 - M/N = \frac{(1+\chi)[(k-\sigma+1)(1-t) + \gamma k(\sigma-1)] - (k-\sigma+1)(1-t)}{(1+\chi)[(k-\sigma+1)(1-t) + \gamma k(\sigma-1)]}. \quad (\text{A.20})$$

The second segment adds the income share of the entrepreneurs that are not active in offshoring. The second segment is given by

$$Q_2(\mu; \chi) = \frac{(1-t)k \left[1 - \frac{(1-\mu)(1+\chi)[(k-\sigma+1)(1-t) + \gamma k(\sigma-1)]}{(k-\sigma+1)(1-t)} \right]^{1-\frac{\sigma-1}{k}}}{(1+\chi)[\gamma k(\sigma-1) + k]} + \frac{tk\mu(1+\chi) + \gamma k(\sigma-1)(1+\chi) + \chi(1-t)(k-\sigma+1)}{(1+\chi)[\gamma k(\sigma-1) + k]}. \quad (\text{A.21})$$

The share of all individuals except entrepreneurs that are active in offshoring relative to the total population is equal to

$$b_2(\chi) = \frac{(1+\chi)\gamma k(\sigma-1) + (k-\sigma+1)(1-t)}{(1+\chi)[\gamma k(\sigma-1) + (k-\sigma+1)(1-t)]}. \quad (\text{A.22})$$

The third segment adds the income share of entrepreneurs doing offshoring. We find

$$Q_3(\mu; \chi) = \frac{(1-t)k(1+\chi^{\frac{\sigma-1}{k}}) \left[- \left[\frac{(1-\mu)(1+\chi)[(k-\sigma+1)(1-t) + \gamma k(\sigma-1)]}{(k-\sigma+1)(1-t)} \right]^{\frac{k-\sigma+1}{k}} \right]}{(1+\chi)[\gamma k(\sigma-1) + k]} + \frac{(1-\mu)(1+\chi)[(k-\sigma+1)(1-t) + \gamma k(\sigma-1) - tk] + (1+\chi)[k + \gamma k(\sigma-1)]}{(1+\chi)[\gamma k(\sigma-1) + k]}. \quad (\text{A.23})$$

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