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Abstract

We develop a model of international trade with a monopsonistically competitive labour market in which firms employ skilled labour for headquarter tasks and unskilled workers to conduct a continuum of production tasks. Firms can enter foreign markets through exporting and through offshoring, and we show that due to monopsonistic competition our model makes sharply different predictions, both at the firm level and at the aggregate level, about the respective effects of the export of goods and the offshoring of tasks. At the firm-level, exporting leads to higher wages and employment, while offshoring of production tasks reduces the wages paid to unskilled workers as well as their domestic employment. At the aggregate level, trade in goods is unambiguously welfare increasing since domestic resources are reallocated to large firms with high productivity, and firms with low productivities exit the market. This reduces the monopsony distortion present in autarky, where firms restrict employment to keep wages low, resulting in too many firms that are on average too small. Offshoring on the other hand gives firms additional scope for exercising their monopsony power by reducing their domestic size, and as a consequence the resources spent on it can be wasteful from a social planner's point of view, leading to a welfare loss.

JEL-Codes: F120, F160, F230.

Keywords: monopsonistic labour markets, exporting, two-way offshoring, tasks, heterogeneous firms, wages, employment.

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1 Introduction

> "*It is ignorance, heterogeneous preferences, and mobility costs that are the most plausible sources of frictions in the labour market. The consequence of these frictions is that employers who cut wages do not immediately lose all their workers. [...] The labour supply curve facing the firm is, as a result, not infinitely elastic.*"
>
> — Manning (2003, p. 4)

In this paper, we develop a new model of international trade and offshoring with a monopsonistically competitive labour market. In the presence of monopsony power firms face upward sloping labour supply functions, and we show that as a direct consequence exporting of goods and offshoring of tasks have potentially very different effects both at the firm level and at the aggregate level. Key to this difference is a hitherto unexplored motive for offshoring that arises if firms have market power in the labour market: By moving offshore part of their tasks firms can reduce domestic employment, and thereby the wage rates they have to pay at home, without having to reduce their output. In contrast, if a firm chooses to export it has to increase its domestic employment, and therefore the wage it pays its domestic workers necessarily goes up. This finding is strongly supported by the evidence reported in Hummels et al. (2014, 2018), who show that employment and wages of unskilled workers increase through exporting and decrease due to offshoring. The important insight that firms can use their monopsonistic power in the labour market to lower domestic wages by reducing their domestic employment also provides a rationale for the somewhat counterintuitive finding of Alfaro and Charlton (2009) that the major part of vertical foreign direct investment is observed between similar economies.[1]

Building on recent contributions to labour economics (see Manning, 2003; Ashenfelter et al., 2010), we associate monopsonistic competition with an upward-sloping, firm-specific labour supply curve. We provide a microfoundation for this supply curve in a general equilibrium framework, by utilising a discrete choice mechanism, giving workers independently and identically distributed preferences over a continuum of firms (see McFadden, 1976; Thisse and Toulemonde, 2010; Card et al., 2018). Facing upward-sloping labour supply curves, firms that aim to hire more workers must pay higher wages to compensate the marginal worker of a now larger workforce for the utility loss from giving up alternative workplace options. As a consequence, larger firms pay higher wages – well in line with the rich evidence on firm-size wage premia (see Oi and Idson, 1999, for an overview).

To study the differential effects of exporting and offshoring, we embed our model of the labour market into a general equilibrium trade model with heterogeneous firms. Firms draw their pro-

[1] Hummels et al. (2018) give an excellent overview of the vast empirical evidence on the quantitative importance of offshoring between developed countries.

ductivity levels from a common distribution as in Melitz (2003), and they hire skilled workers for performing headquarter tasks and unskilled workers for performing a continuum of production tasks. Both exporting and offshoring are subject to fixed and variable trade costs. Assuming – similar to Armenter and Koren (2015) and Antrás et al. (2017) – that firms differ in their fixed costs of foreign market entry, we obtain a model in which domestic producers, exporters, offshorers, and offshoring exporters coexist over wide ranges of the productivity distribution, in line with the evidence reported by Tomiura (2007), Hallak and Sivadasan (2013), and Antràs and Yeaple (2014). In the baseline specification of our model, we consider an open economy with two identical countries and assume similar to Antràs and Helpman (2004) that only production tasks can be offshored. We impose these specific assumptions, which are relaxed in an extension, to highlight in the simplest possible way that our model can explain the finding of Alfaro and Charlton (2009) that a major part of vertical foreign direct investment is observed between similar economies as well as the finding of Hummels et al. (2014) that, in contrast to exporting, firm-level employment and wage effects of offshoring on skilled and unskilled workers are asymmetric.

The monopsonistic structure of the labour market not only gives firms an incentive to offshore, but also provides a natural constraint for the *extent* of offshoring since moving (additional) tasks offshore drives up the wage a firm has to pay to its foreign workers along the upward-sloping supply curve it faces abroad. With identical countries, no firm will therefore put offshore more than half the production tasks, and in the presence of positive variable costs for trading tasks internationally the share is strictly lower than one half. The availability of offshoring effectively gives firms access to a technology that allows them – at a cost – to reduce the wage they pay to unskilled workers. As a result, offshoring firms reduce their overall skill intensity. There is an induced general equilibrium effect that increases in the relative wage of unskilled workers, affecting all firms in manufacturing, including those that do not offshore, as well as the service sector, which provides the fixed input for exporting and offshoring using skilled and unskilled labour with the same cost shares as in manufacturing. Due to this general equilibrium effect, the skill intensity of the service sector rises relative to autarky, and so does the skill intensity of non-offshoring firms in manufacturing. In contrast to offshoring of tasks, the export of goods leaves the skill intensity in the two sectors unaffected.

Both forms of globalisation are also very different regarding the welfare effects. Exporting is unambiguously welfare increasing since domestic resources are reallocated to large firms with high productivity, and firms with low productivities exit the market. This reduces the monopsony distortion present in autarky, where firms restrict employment to keep wages low, resulting in too many firms that are on average too small.[2] The reduction in the monopsony distortion adds

[2]This insight is not new and has already been discussed by Robinson (1933). In a first thorough analysis of labour

to the positive welfare effects associated with market exit of the least productive firms and with access to foreign product varieties that are well known from other models featuring heterogeneous firms. Offshoring on the other hand gives firms additional scope for exercising their monopsony power by reducing their domestic size, and as a consequence the resources spent on it can be wasteful from a social planner's point of view, potentially leading to a loss in aggregate welfare. The aggregate welfare loss is not certain, however, since also with offshoring domestic labour is reallocated towards high-productivity producers, in this case including the domestic production facilities of foreign offshorers, which by itself is beneficial to social welfare. We also show that, in contrast to exporting, offshoring affects skilled and unskilled workers asymmetrically, and that it improves the relative welfare position of unskilled workers.

There exists a small theoretical literature that provides possible explanations for the existence of vertical foreign direct investment between similar countries, as described by Alfaro and Charlton (2009). In an influential contribution to this literature, Grossman and Rossi-Hansberg (2012) develop a model with external increasing returns to scale at the task level. The framework of Grossman and Rossi-Hansberg (2012) generates multiple equilibria, and vertical foreign direct investment between identical countries is possible in their model due to the benefits of producing a task in an already large foreign market. By contrast, the models developed by Burstein and Vogel (2010) and Antrás et al. (2017) explain global sourcing of firms by input-specific productivity differences between countries. We show that monopsonistic competition in the labour market can be an alternative engine of trade in tasks and that the market power that firms have over segments of the labour market provides a powerful motive for two-way offshoring between symmetric countries.[3]

Our paper also contributes to a sizeable literature discussing the effects of trade on the wages paid by heterogeneous firms. Examples for studying the effects of exporting are Helpman et al. (2010, 2017), Davis and Harrigan (2011), and Egger and Kreickemeier (2012), whereas Amiti and Davis (2012) consider exports of final goods and imports of intermediates in an integrated framework. Although differing in their specific microfoundations, all of these studies generate a firm-size wage premium due to rent sharing between firms and workers. In the models of Sampson (2014) and Grossman et al. (2017) a firm-size wage premium is the result of positive assortative matching between workers of differing ability and firms that differ in productivity.[4] Our model

market monopsonies, she noted that "*[i]f the supply of labour to individual firms is less than perfectly elastic and if profits are normal the firms will be of less than optimum size [...]*" (p. 296).

[3]The international business literature (cf. Roza et al., 2011) has found that gaining access to qualified personnel is one of the most important motives for large and medium-sized firms to move parts of their production offshore (see also Schmeisser, 2013, for a literature review).

[4]Eckel and Yeaple (2017) present a model in which firms can screen applicants in order to learn about their abilities. Since screening involves fixed costs, it is only attractive for high-tech firms that make high profits. These firms pay their workers wages that reflect their true abilities, whereas low-tech firms, lacking information on the ability of their workers offer a uniform wage that is on average lower than the wage paid by high-tech firms. Eckel

differs from the literature by showing the important difference between trade in goods and trade in tasks for wages and employment at the firm level. Costinot and Vogel (2010) consider a model with firm-specific wages, trade, and offshoring in a North-South context. In contrast to our approach, firms in Costinot and Vogel (2010) only produce in one country, making the offshoring decision a binary choice. The emphasis on the firm-internal margin of offshoring and its consequences for domestic wages and employment relates our analysis to the North-South trade model of Egger et al. (2016).[5]

Our modelling of a monopsonistically competitive labour market with firm-specific labour supply functions is well grounded in the recent empirical literature, which estimates labour supply elasticities to the firm. Following Manning (2003), this empirical literature has gained momentum, covering various developed and developing countries, different occupations and time periods. The empirical strategies range from reduced form estimates (with and without an IV-strategy or natural experiment) to semistructural and structural estimates.[6] The vast majority of studies finds evidence in favour of firm-specific upward-sloping labour supply curves, with – on average – relatively low labour supply elasticities that are consistent with monopsonistic competition and inconsistent with an infinitely elastic labour supply under perfect competition (cf. Hirsch et al., 2010; Falch, 2011; Naidu and Wang, 2016).

In the international trade literature the effects of demand-side distortions in the labour market have been largely overlooked. An exception is MacKenzie (2018), who considers trade between two countries with many segmented, industry-location specific labour markets. The assumption of a finite number of competitors in the product market and a finite number of competitors in each labour market segment gives firms simultaneously oligopolistic as well as oligopsonistic market power. Similar to our setting, this model produces an inefficient resource allocation with the distortion mitigated in the open economy, because trade leads to an increases in the market shares of highly productive firms. Quantifying the effects of trade with plant-level data from India, MacKenzie (2018) shows that the main source of welfare gain in this model is due to a reduction of the oligopoly power of firms in the product market, with the reduction of their oligopsonistic power in the labour market providing a further welfare stimulus. By looking at the effects of trade

and Yeaple (2017) show that wage offers by firms lead to a selection equilibrium with positive assortative matching between high-ability workers and high-tech firms and to excessive screening from a social planner's point of view. Exporting in this model makes screening attractive for more firms, leads to exit of low-tech firms, and may be welfare decreasing.

[5]There is a small literature studying sourcing strategies of firms facing unionised labour markets. Skaksen (2004) distinguishes the wage and employment effects of potential (non-realised) and realised offshoring, and shows that in both cases employment and wage effects go into opposite directions. Eckel and Egger (2009) show that with cooperative bargaining firms have an incentive to invest in a symmetric partner country, in order to improve their threat point in the wage negotiation with the local union. This model can explain negative employment and wage effects of horizontal but not of vertical foreign investment.

[6]See Manning (2011) for a detailed literature review and Sokolova and Sorensen (2018) for a meta-analysis of estimations of firm-specific labour supply elasticities.

in goods only, MacKenzie (2018) misses the important difference between trade in goods and trade in tasks in an environment, in which firms have market power in their product as well as their labour market.[7]

The rest of this paper is organised as follows. In Section 2, we outline the basic structure of our model and solve the firm's problem in partial equilibrium. In Section 3, we consider the general equilibrium, discuss the economy-wide labour allocation, and study the effects of exporting and offshoring on welfare in a setting with two symmetric countries. In Section 4, we give up restrictive assumptions regarding the considered parameter domain, discuss offshoring of headquarter tasks, and consider asymmetric countries. The last section concludes with a summary of the most important results.

2 The model: basics

In this section, we outline a model featuring monopolistic competition in the product market and monopsonistic competition in the labour market. We consider a one-sector economy in which firms use skilled and unskilled labour as inputs into the production of differentiated goods. Firms have access to foreign consumers through exporting, and they have access to foreign workers through offshoring.

2.1 Technology and production

Production combines skilled labour (indexed h) and unskilled labour (indexed l), using a Cobb-Douglas technology, where we follow Antràs and Helpman (2004) in associating skilled labour input with the provision of headquarter tasks and unskilled labour input with the performance of production tasks. As in Acemoglu and Autor (2011), we consider a continuum of production tasks indexed $\tilde{\eta} \in [0, 1]$. Firm ω's output, $q(\omega)$, is assembled according to

$$q(\omega) = \beta\varphi(\omega)\ell_h(\omega)^{\alpha_h} \left\{ \exp\left[\int_0^1 \ln \ell_l(\omega, \tilde{\eta}) d\tilde{\eta} \right] \right\}^{\alpha_l}, \quad \alpha_h + \alpha_l = 1, \quad \alpha_h, \alpha_l > 0, \tag{1}$$

where β is a positive constant further discussed below, $\varphi(\omega) > 0$ is a technology parameter that captures the firm's total labour productivity, $\ell_h(\omega)$ is skilled labour input in the performance of headquarter tasks, and $\ell_l(\omega, \tilde{\eta})$ is the task-specific *effective* unskilled labour input in the perfor-

[7] Heiland and Kohler (2018) discuss the consequences of monopsonistic labour markets in a setting with trade and migration. Monopsonistic power of firms exists in their model because worker skills are assumed to be firm-specific. Due to this specificity, trade – by making firms bigger – reduces match quality, whereas migration – by expanding labour supply – increases match quality. Similar to Heiland and Kohler (2018), Macedoni and Tyazhelinikov (2018) discuss the differential effects of product and input market integration in a setting with oligopolistic and oligopsonistic market power of firms.

mance of production tasks. Skilled labour for headquarter services has to be hired in the home country, while the unskilled labour input into the performance of production tasks is provided either by domestic or by foreign workers, depending on whether the respective task is kept at home or put offshore. One unit of effective labour input is needed to produce one unit of each task.

In the case of offshoring, production tasks must be imported to the home country, incurring an iceberg-type trade cost that is common to all tasks and captured by parameter $\tau_o > 1$. Effective labour input per unit of unskilled labour hired abroad is therefore given by $1/\tau_o$, whereas effective labour input per unit of unskilled labour hired at home is 1. Since production tasks are symmetric in all respects, firms are indifferent between which ones to put offshore, and we can rank them without loss of generality such that tasks with a lower index are offshored first. Under the sufficient condition that some but not all production tasks are offshored this gives a unique threshold $\eta(\omega) \in (0,1)$ that separates tasks put offshore, $\tilde{\eta} < \eta(\omega)$, from tasks performed at home, $\tilde{\eta} \geq \eta(\omega)$. Accordingly, $\eta(\omega)$ gives the share of production tasks put offshore by firm ω.

2.2 The firms' problem

Firms hire workers on a monopsonistically competitive labour market, with their market power following from firm-specific upward-sloping supply curves for skilled and unskilled labour. Supplies of skilled and unskilled labour facing firm ω are given by $h_S(\omega) = A_h w_h(\omega)^{\frac{1-\theta}{\theta}}$ and $l_S(\omega) = A_l w_l(\omega)^{\frac{1-\theta}{\theta}}$, respectively, where subscript S is used to indicate a supply-side variable, A_h, A_l are supply shifters that are exogenous for the individual firm but endogenous in general equilibrium, and $\theta \in (0, 1/2)$ is a constant that is inversely related to the wage elasticity of labour supply. A microfoundation for the labour supply curves based on a discrete choice mechanism is given in Section 3. For the goods market, we impose the commonplace assumption of iso-elastic demand, which for firm ω is given by $q_D(\omega) = A_q p(\omega)^{-\sigma}$, $\sigma > 1$, with A_q being a demand shifter that is exogenous to the firm but endogenous in general equilibrium. A microfoundation for the demand curve is also given in Section 3.

We denote by $f_m, f_d, f_e(\omega), f_o(\omega)$ the fixed factor inputs needed for market entry, production, exporting, and offshoring, respectively. These factor inputs are purchased from a perfectly competitive service sector at a common price s per unit. As discussed in detail below, we allow the fixed cost of exporting and offshoring to be firm-specific. Furthermore, we use $\tau_e > 1$ to capture iceberg-type trade costs for exporting and introduce indicator functions $I_e(\omega)$, $I_o(\omega)$ to distinguish exporters (with $I_e(\omega) = 1$) from non-exporters, and offshorers (with $I_o(\omega) = 1$) from non-offshorers, using an asterisk to indicate foreign variables. Then, the firm's problem is to maximise profits

$$\begin{aligned} p(\omega)q_S(\omega) + \frac{I_e(\omega)}{\tau_e}p^*(\omega)q_S^*(\omega) - w_h\ell_h(\omega) - \tau_o w_l^*(\omega)\int_0^{I_o(\omega)\eta(\omega)} \ell_l(\omega,\tilde{\eta})d\tilde{\eta} \\ - w_l(\omega)\int_{I_o(\omega)\eta(\omega)}^1 \ell_l(\omega,\tilde{\eta})d\tilde{\eta} - I_e(\omega)sf_e(\omega) - I_o(\omega)sf_o(\omega) - sf_d - sf_m, \end{aligned} \tag{2}$$

subject to the usual non-negativity constraints as well as *(i)* the market clearing conditions for the monopsonistically competitive labour markets, which are given by $\ell_h(\omega) = A_h w_h(\omega)^{\frac{1-\theta}{\theta}}$, $\tau_o \int_0^{I_o(\omega)\eta(\omega)} \ell_l(\omega,\tilde{\eta})d\tilde{\eta} = A_l^* w_l^*(\omega)^{\frac{1-\theta}{\theta}}$, and $\int_{I_o(\omega)\eta(\omega)}^1 \ell_l(\omega,\tilde{\eta})d\tilde{\eta} = A_l w_l(\omega)^{\frac{1-\theta}{\theta}}$; *(ii)* the market clearing conditions for the monopolistically competitive goods markets, given by $q_S(\omega) = A_q p(\omega)^{-\sigma}$ and $q_S^*(\omega)\tau_e^{-1} = A_q^* p^*(\omega)^{-\sigma}$ in the case of exporting; *(iii)* the requirement that the firm's market-specific output levels must add up to its aggregate production level, $q_S(\omega) + I_e(\omega)q_S^*(\omega) = q(\omega)$; and *(iv)* the production function in Eq. (1).

Profit maximisation can be represented as a five-stage problem. At stage one, firms decide upon market entry and draw their total labour productivity $\varphi(\omega)$ as well as their fixed factor input requirements for exporting and offshoring, $f_e(\omega), f_o(\omega)$, from common distributions. At stage two, firms decide conditional on the lottery outcome on whether to produce and on whether to export and/or offshore. At stage three, offshoring firms decide upon how many tasks to perform at home and abroad by setting $\eta(\omega)$. At stage four, firms choose their output level $q(\omega)$, and the employment of skilled and unskilled labour, $\ell_h(\omega)$ and $\ell_l(\omega,\hat{\eta})$, necessary to achieve it. Finally, at stage five firms choose the production output sold at home and abroad by splitting their total output $q(\omega)$ into $q_S(\omega)$ and $q_S^*(\omega)$.

Together, stages three to five represent the *intensive firm margin*, in that they sum up firms' optimal decisions along three firm-internal margins highlighted in the trade literature (cf. Egger et al., 2016; Fernandes et al., 2018): the intensive margin of exporting (stage five), the intensive task margin (stage four), and the extensive task margin (stage three). The intensive firm margin is conditional on the decisions regarding entry as well as taking up production, exporting, and offshoring at the *extensive firm margin*. Representing the extensive firm margin as the solution of a two-stage problem follows Melitz (2003) and acknowledges the important role of uncertainty in the market entry decision of firms. We solve the maximisation problem through backward induction. In doing so, we take a partial equilibrium perspective, treating parametrically supply shifters A_l, A_h, A_l^*, A_h^*, demand shifters A_q, A_q^* and the price for the service input s.

2.3 Profit maximisation at the intensive firm margin

The stage five decision is the solution to a simple allocation problem, and profit-maximisation establishes $q_S(\omega) = q(\omega)$ for non-exporters and $q_S^*(\omega) = \frac{A_q^*}{A_q}\tau_e^{1-\sigma}q_S(\omega)$, $q_S(\omega) = q(\omega)\left(1+\frac{A_q^*}{A_q}\tau_e^{1-\sigma}\right)^{-1}$

for exporters. Substitution into product demand allows us to express the revenues of firm ω as

$$r(\omega) \equiv p(\omega)q_S(\omega) + I_e(\omega)\tau_e^{-1}p^*(\omega)q_S^*(\omega) = A_q^{\frac{1}{\sigma}}\left[\kappa_e(\omega)q(\omega)\right]^{\frac{\sigma-1}{\sigma}}, \tag{3}$$

where

$$\kappa_e(\omega) \equiv \left(1 + \frac{A_q^*}{A_q}\tau_e^{1-\sigma}\right)^{\frac{I_e(\omega)}{\sigma-1}} \tag{4}$$

measures the relative differential of overall to domestic market size, which is equal to one for non-exporters and equal to $\hat{\kappa}_e \equiv \left(1 + \frac{A_q^*}{A_q}\tau_e^{1-\sigma}\right)^{\frac{1}{\sigma-1}} > 1$ for exporters.

In order to solve the stage-four problem of finding the profit maximising level of output, given the share of offshored tasks $\eta(\omega)$, we proceed in two steps. First, we derive the cost minimising input ratio for skilled and unskilled labour, and second we use the cost function derived in step one to determine the profit maximising output level. Substituting Eq. (1) and the market clearing conditions for skilled and unskilled labour, we can write the stage-four problem of choosing cost-minimising labour inputs as follows:

$$\min_{\ell_h(\omega),\{\ell_l(\omega,\tilde{\eta})\}} c(\omega) \equiv A_h^{-\frac{\theta}{1-\theta}}\ell_h(\omega)^{\frac{1}{1-\theta}} + (A_l^*)^{-\frac{\theta}{1-\theta}}\left[\tau_o\int_0^{I_o(\omega)\eta(\omega)}\ell_l(\omega,\tilde{\eta})d\tilde{\eta}\right]^{\frac{1}{1-\theta}} + A_l^{-\frac{\theta}{1-\theta}}\left[\int_{I_o(\omega)\eta(\omega)}^{1}\ell_l(\omega,\tilde{\eta})d\tilde{\eta}\right]^{\frac{1}{1-\theta}},$$

$$\text{s.t.} \qquad \beta\varphi(\omega)\ell_h(\omega)^{\alpha_h}\left\{\exp\left[\int_0^1 \ln \ell_l(\omega,\tilde{\eta})d\tilde{\eta}\right]\right\}^{\alpha_l} \geq \bar{q}. \tag{5}$$

The first-order conditions with respect to ℓ_h and $\ell_l(\omega,\tilde{\eta})$ can be written as

$$\alpha_h c(\omega) = w_h(\omega)\ell_h(\omega) \tag{6}$$

and

$$\alpha_l c(\omega) = \begin{cases} w_l(\omega)\ell_l(\omega,\tilde{\eta}) & \text{if the task is performed at home} \\ w_l^*(\omega)\tau_o\ell_l(\omega,\tilde{\eta}) & \text{if the task is performed abroad} \end{cases}, \tag{7}$$

respectively. Combining Eqs. (6) and (7) with the respective labour market clearing conditions for firm ω leads to expressions for relative demand at the firm level for the two types of labour:

$$\frac{\ell_l(\omega,\tilde{\eta})}{\ell_h(\omega)} = \begin{cases} \left(\frac{\alpha_l}{\alpha_h}\right)^{1-\theta}\left(\frac{A_l}{A_h}\right)^{\theta}\left[\frac{1}{1-I_o(\omega)\eta(\omega)}\right]^{\theta} & \text{if the task is performed at home} \\ \frac{1}{\tau_o}\left(\frac{\alpha_l}{\alpha_h}\right)^{1-\theta}\left(\frac{A_l^*}{A_h}\right)^{\theta}\left[\frac{1}{\eta(\omega)}\right]^{\theta} & \text{if the task is performed abroad} \end{cases}. \tag{8}$$

Substituting Eq. (8) into Eq. (1), solving for $\ell_h(\omega)$, substituting the resulting expression into first-order condition (6), and setting $\beta \equiv \prod_{j=h,l} \alpha_j^{-\alpha_j(1-\theta)}$ to get rid of uninteresting constants, we get the cost function

$$c(\omega) = \prod_{j=h,l} A_j^{-\alpha_j \frac{\theta}{1-\theta}} \{\kappa[\eta(\omega)]\varphi(\omega)\}^{-\frac{1}{1-\theta}} q(\omega)^{\frac{1}{1-\theta}}, \tag{9}$$

with

$$\kappa[\eta(\omega)] \equiv \left\{\left[\left(\frac{1}{\tau_o}\right)^{\frac{1}{\theta}} \frac{A_l^*}{A_l}\frac{1-\eta(\omega)}{\eta(\omega)}\right]^{\eta(\omega)} \frac{1}{1-\eta(\omega)}\right\}^{I_o(\omega)\alpha_l\theta}.$$

For $I_o(\omega) = 0$, we have $\eta(\omega) = 0$ and thus $\kappa[\eta(\omega)] = 1$. If $I_o(\omega) = 1$, $\kappa[\eta(\omega)]$ is hump-shaped. Its value is equal to one at $\eta(\omega) = 0$ and smaller than one at $\eta(\omega) = 1$ if $A_l^*\tau_o^{-\frac{1}{\theta}} < A_l$ (see below). Changes in $\kappa[\eta(\omega)]$ have an impact on the cost of production that is qualitatively similar to changes in the total factor productivity $\varphi(\omega)$. This is why the cost saving from offshoring that is realised if $\kappa[\eta(\omega)] > 1$ is commonly referred to as a productivity effect (cf. Grossman and Rossi-Hansberg, 2008).

The profit maximising output level, given the share of offshored tasks, now follows by simply maximising operating profits

$$\pi(\omega) \equiv r(\omega) - c(\omega) = A_q^{\frac{1}{\sigma}}\Big[\kappa_e(\omega)q(\omega)\Big]^{\frac{\sigma-1}{\sigma}} - \prod_{j=h,l} A_j^{-\alpha_j\frac{\theta}{1-\theta}}\{\kappa[\eta(\omega)]\varphi(\omega)\}^{-\frac{1}{1-\theta}} q(\omega)^{\frac{1}{1-\theta}}$$

with respect to $q(\omega)$. We get, of course, the standard first order condition $dr(\omega)/dq(\omega) = dc(\omega)/dq(\omega)$, where it is easily checked that in our model marginal revenue und marginal cost are linked to average revenue and average variable cost by

$$\frac{r(\omega)}{q(\omega)} = \frac{\sigma}{\sigma-1}\frac{dr(\omega)}{dq(\omega)} \qquad \text{and} \qquad \frac{c(\omega)}{q(\omega)} = (1-\theta)\frac{dc(\omega)}{dq(\omega)},$$

respectively. Hence, the price charged by firm ω, which is identical to its average revenue, is related to its marginal revenue by the standard markup $\sigma/(\sigma-1)$, reflecting the firm's monopoly power in the goods market. In addition, the average variable cost paid by firm ω, which is a Cobb-Douglas index of the skilled and unskilled wage rate, is a mark-down $1-\theta$ on its marginal cost, reflecting the firm's monopsony power in the labour market. The relative difference between the price and the average variable cost corresponds to the product of the price markup and the wage markdown and it is independent of the output level because product demand and labour supply are iso-elastic. The output of firm ω as an explicit function of its offshored task range $\eta(\omega)$ follows as

$$q(\omega) = \left\{\gamma^{1-\theta} A_q^{-\frac{1-\gamma}{\sigma-1}} A\kappa_e(\omega)^\gamma \kappa[\eta(\omega)]\varphi(\omega)\right\}^{\frac{1}{1-\gamma}}, \quad \text{where} \quad A \equiv A_q^{\frac{1}{\sigma-1}} \prod_{j=h,l} A_j^{\alpha_j\theta} \tag{10}$$

is a composite of the economy-wide aggregates A_q, A_l, A_h, and $\gamma \equiv (1-\theta)(\sigma-1)/\sigma$ is the inverse of the product of price markup and wage markdown.

In order to find the profit maximising task range $\eta(\omega)$ conditional on offshoring, stage three of the profit-maximisation problem, we substitute $q(\omega)$ from Eq. (10) into Eq. (3) and use the well-established result that with constant-elasticity demand firm-level operating profits $\pi(\omega)$ are proportional to firm-level revenues (in our case, a fraction $1-\gamma$ of revenues). We can then express $\pi(\omega)$ as an increasing function of $\kappa[\eta(\omega)]$, and an offshoring firm's profit-maximising choice of $\eta(\omega)$ follows by setting $\kappa'[\eta(\omega)] = 0$. Applying the envelope theorem and taking into account that $\eta(\omega) = 0$ if $I_o(\omega) = 0$, we can compute

$$\eta(\omega) = 1 - \left(1 + \frac{A_l^*}{A_l}\tau_o^{-\frac{1}{\theta}}\right)^{-I_o(\omega)} \qquad \kappa[\eta(\omega)] = \left(1 + \frac{A_l^*}{A_l}\tau_o^{-\frac{1}{\theta}}\right)^{I_o(\omega)\alpha_l\theta} \equiv \kappa_o(\omega). \tag{11}$$

This shows that as a consequences of monopsonistic competition in the labour market an offshoring firm splits its task production between the two markets, $\eta(\omega) \in (0,1)$, and the profit-maximising task allocation ensures cost savings from offshoring, due to $\kappa_o(\omega) = \left(1 + \frac{A_l^*}{A_l}\tau_o^{-\frac{1}{\theta}}\right)^{\alpha_l\theta} \equiv \hat{\kappa}_o > 1$ if $I_o(\omega) = 1$. Eq. (11) furthermore shows that in the case of identical countries ($A_l = A_l^*$) firms offshore at most half their tasks (if $\tau_o = 1$), and that this share is decreasing in the variable offshoring cost.

Using the solution for $\kappa_o(\omega)$, we can express $r(\omega)$ in logarithmic form as follows:

$$\ln r(\omega) = (1-\theta)\xi \ln\gamma + \xi \ln A + \xi \ln\varphi(\omega) + \xi \ln\kappa_e(\omega) + \xi \ln\kappa_o(\omega). \tag{12}$$

The elasticity of revenues with respect to total labour productivity $\varphi(\omega)$ is given by $\xi \equiv \frac{\sigma-1}{\sigma(1-\gamma)} = \frac{\sigma-1}{1+\theta(\sigma-1)}$, lower than $\sigma - 1$, which is the corresponding elasticity in Melitz-style models with a perfectly competitive labour market. The elasticity is smaller in our model since more productive and therefore larger firms have to pay higher wages, which mitigates their advantage in terms of marginal production costs. Since $\kappa_e(\omega)$ and $\kappa_o(\omega)$ also affect firm-level revenues with elasticity ξ, their values can be interpreted as the productivity equivalents of offshoring and exporting, respectively, on firm-level revenues.

In analogy to firm-level revenues, we can in a further step determine the impact of exporting and offshoring on domestic firm-level employment and wages. Denoting by $\ell_l(\omega) \equiv [1-\eta(\omega)]\ell_l(\omega, \tilde{\eta})$ total unskilled labour input used for the performance of production tasks at home, we can express domestic wages and domestic employment for labour of type $j = h, l$ in logarithmic form as follows:

$$\ln w_j(\omega) = \theta \ln \alpha_j + \theta[1 + (1-\theta)\xi] \ln \gamma - \theta \ln A_j + \theta\xi \ln A \\ + \theta\xi \ln \varphi(\omega) + \theta\xi \ln \kappa_e(\omega) + \theta\xi\varepsilon_j \ln \kappa_o(\omega), \tag{13}$$

$$\ln \ell_j(\omega) = (1-\theta) \ln \alpha_j + (1-\theta)[1 + (1-\theta)\xi] \ln \gamma + \theta \ln A_j + (1-\theta)\xi \ln A \\ + (1-\theta)\xi \ln \varphi(\omega) + (1-\theta)\xi \ln \kappa_e(\omega) + (1-\theta)\xi\varepsilon_j \ln \kappa_o(\omega). \tag{14}$$

Eqs. (13) and (14) reveal the important role of parameter θ in our model. It determines how percentage changes in the wage bill, which are identical to the percentage changes in revenues derived above, are split into changes in employment and changes in wages, with θ denoting the share of a change in the wage bill that is reflected in wage changes rather than employment changes. Finally, ε_j captures the skill-specific impact of offshoring at the firm level, which as discussed by Egger et al. (2015) and Egger et al. (2016) is the result of a *relocation effect* and a *productivity effect*. The relocation effect captures the domestic employment loss in those tasks moved offshore and in those tasks performed at home at a now higher relative cost, while the productivity effect captures the demand stimulus for domestic labour input in all tasks performed at home because offshoring makes the firm more competitive.[8] Since in the benchmark version of our model in this section we assume that headquarter tasks are not offshorable, we have $\varepsilon_h \equiv 1$. In contrast, for domestic unskilled labour input we get $\varepsilon_l \equiv 1 - (\alpha_l\theta\xi)^{-1} < 0$, which gives a first important result.

Proposition 1 *Whereas exporting increases domestic firm-level employment and wages of both skill types, offshoring increases domestic employment and wages of skilled labour and reduces domestic employment and wages of unskilled labour.*

Proof The proposition follows from Eqs. (13) and (14) and the analysis in the text.

In contrast to models in which wage differences follow from a rent-sharing mechanism (cf. Egger and Kreickemeier, 2009, 2012; Amiti and Davis, 2012; Helpman et al., 2010), wages in our model depend positively not on the economic success of the firm but – via the upward sloping labour supply curve – on its local employment. This difference is important in the case of offshoring, where a decrease in local employment of the offshoring firm occurs for production workers, while operating profits increase. Hence our model cannot only explain that exporters are exceptional producers that are larger and pay higher wages than non-exporters (see Bernard and Jensen, 1995,

[8] The relocation of labour is associated with a labour supply effect in the spirit of Grossman and Rossi-Hansberg (2008). However, due to the assumption of monopsonistic market power, the supply effect in our model is firm-specific and not the same for all producers.

1999; Frías et al., 2018) but it also provides a plausible explanation for the more nuanced picture about the firm-level employment and wage effects of offshoring reported by Hummels et al. (2014). More specifically, our model accords with the evidence for Danish firms that offshoring leads to an increase in the wage and employment of skilled workers and to a decrease in the domestic wage and employment of unskilled workers.[9]

2.4 Profit maximisation at the extensive firm margin

With the solutions from the previous subsection at hand, we now turn to firm ω's stage-two problem of choosing its *modus operandi*. This involves three different decisions. On the one hand, the firm, having entered the market, decides on whether to start production, in which case it has to pay a fixed cost sf_d. On the other hand, it chooses its offshoring and export status. Exporting requires the payment of a fixed cost $sf_e(\omega)$, while offshoring requires the payment of a fixed cost $sf_o(\omega)$. We distinguish four different firm types: *domestic producers* are firms that only employ domestic workers and only serve domestic consumers; *exporters* are firms that only employ domestic workers, but serve domestic as well as foreign consumers; *offshorers* are firms that employ domestic and foreign workers, while selling all their output at home; *offshoring exporters* are firms that employ domestic and foreign workers and serve domestic and foreign consumers.

For a given offshoring and export status, revenues in Eq. (12) increase with a firm's total labour productivity. This implies that firms with higher levels of $\varphi(\omega)$ can more easily bear the fixed costs of production, exporting, and offshoring. To generate an outcome with selection of firms by their $\varphi(\omega)$-levels, we impose three additional assumptions. First, we assume that the fixed factor input f_d is high enough to make domestic production and local sales unattractive for firms with an unfavourable draw of $\varphi(\omega)$. We discuss a sufficient condition for this outcome at the end of this section. Second, we assume that the fixed input for exporting, $f_e(\omega)$, and the fixed input for offshoring, $f_o(\omega)$, are not lower than the fixed input of production, $f_e(\omega), f_o(\omega) \geq f_d$. Third, we assume that $\tau_e^{1-\sigma} A_q^* < A_q$ and $\tau_o^{-\frac{1}{\theta}} A_\ell^* < A_\ell$, so that $1 < \hat{\kappa}_e^\xi, \hat{\kappa}_o^\xi$ and $\hat{\kappa}_e^\xi \hat{\kappa}_o^\xi < 2$. Together, these three assumptions ensure that the least productive firms stay out of the market, whereas the least productive producers do not export or offshore.

Denoting the operating profits of domestic firms, exporters, offshorers and offshoring exporters by $\pi_d(\omega)$, $\pi_e(\omega)$, $\pi_o(\omega)$ and $\pi_{eo}(\omega)$, respectively, we can formulate indifference conditions that determine productivity thresholds separating for each firm different modes of operation. With fixed production cost being the same for all firms, indifference condition $\pi_d(\omega) = sf_d$ defines a cutoff productivity level $\varphi_d > 0$ that separates firms with $\varphi(\omega) \geq \varphi_d$, choosing to produce, from firms

[9] It is easily checked in Eqs. (13) and (14) that in our model the negative wage and employment effects also occur in firms that increase the extent of offshoring incrementally as a consequence of a small reduction in τ_o.

with $\varphi(\omega) < \varphi_d$, choosing to remain inactive. In contrast, since the fixed costs of exporting and offshoring are firm-specific, so are the productivity thresholds related to any form of international activity. Condition $\pi_i(\omega) - \pi_d(\omega) = sf_i(\omega)$ determines the productivity threshold $\varphi_i(\omega)$, $i \in \{e, o\}$ that renders a firm with a total labour productivity equal to the threshold indifferent between domestic production and exporting if $\varphi(\omega) = \varphi_e(\omega)$ or between domestic production and offshoring if $\varphi(\omega) = \varphi_o(\omega)$. Similarly, indifference condition $\pi_{eo}(\omega) - \pi_d(\omega) = s[f_e(\omega) + f_o(\omega)]$ characterises the productivity threshold $\varphi_{eo}^d(\omega)$ that makes firms with a total labour productivity equal to the threshold indifferent between domestic production and exporting plus offshoring. The three productivity thresholds are proportional to φ_d and given by

$$\varphi_e(\omega) = \varphi_d \left[\frac{f_e(\omega)}{f_d} \frac{1}{\hat{\kappa}_e^{\xi} - 1}\right]^{\frac{1}{\xi}}, \qquad \varphi_o(\omega) = \varphi_d \left[\frac{f_o(\omega)}{f_d} \frac{1}{\hat{\kappa}_o^{\xi} - 1}\right]^{\frac{1}{\xi}},$$
$$\varphi_{eo}^d(\omega) = \varphi_d \left[\frac{f_e(\omega) + f_o(\omega)}{f_d} \frac{1}{\hat{\kappa}_e^{\xi}\hat{\kappa}_o^{\xi} - 1}\right]^{\frac{1}{\xi}}. \tag{15}$$

For a full characterisation of all possible alternatives and their relative attractiveness, we finally compare the operating profits of exporters and offshorers with the operating profits of offshoring exporters. This determines the two conditions $\pi_{eo}(\omega) - \pi_e(\omega) = sf_o(\omega)$ and $\pi_{eo}(\omega) - \pi_o(\omega) = sf_e(\omega)$, which we can use to characterise the productivity thresholds $\varphi_{eo}^e(\omega)$ and $\varphi_{eo}^o(\omega)$. A firm with total labour productivity equal to $\varphi_{eo}^e(\omega)$ is indifferent between exporting and exporting plus offshoring, while a firm with a productivity level equal to $\varphi_{eo}^o(\omega)$ is indifferent between offshoring and offshoring plus exporting. The productivity thresholds thus described are given by[10]

$$\varphi_{eo}^e(\omega) = \varphi_d \left[\frac{f_o(\omega)}{f_d} \frac{1}{\hat{\kappa}_e^{\xi}(\hat{\kappa}_o^{\xi} - 1)}\right]^{\frac{1}{\xi}}, \qquad \varphi_{eo}^o(\omega) = \varphi_d \left[\frac{f_e(\omega)}{f_d} \frac{1}{\hat{\kappa}_o^{\xi}(\hat{\kappa}_e^{\xi} - 1)}\right]^{\frac{1}{\xi}}. \tag{16}$$

We now show, as a function of fixed export requirement $f_e(\omega)$, which firm types can arise in equilibrium. As we discuss more formally in the Appendix, there are three parameter domains:

1. For firms with $f_e(\omega) \leq \frac{\hat{\kappa}_e^{\xi}-1}{\hat{\kappa}_o^{\xi}-1}\frac{f_o(\omega)}{\hat{\kappa}_e^{\xi}}$, we have $\varphi_e(\omega) \leq \varphi_{eo}^d(\omega) < \varphi_o(\omega)$ and $\varphi_e(\omega) < \varphi_{eo}^e(\omega)$. In this group of firms, domestic firms with $\varphi(\omega) \in [\varphi_d, \varphi_e(\omega))$, exporters with $\varphi(\omega) \in [\varphi_e(\omega), \varphi_{eo}^e(\omega))$, and offshoring exporters with $\varphi(\omega) \geq \varphi_{eo}^e(\omega)$ coexist.

2. For firms with $\frac{\hat{\kappa}_e^{\xi}-1}{\hat{\kappa}_o^{\xi}-1}\frac{f_o(\omega)}{\hat{\kappa}_e^{\xi}} < f_e(\omega) < \frac{\hat{\kappa}_o^{\xi}-1}{\hat{\kappa}_e^{\xi}-1} f_o(\omega)\hat{\kappa}_o^{\xi}$, we have $\varphi_{eo}^d(\omega) < \min\{\varphi_o(\omega), \varphi_e(\omega)\}$. In this group of firms, domestic firms with $\varphi(\omega) \in [\varphi_d, \varphi_{eo}^d(\omega))$ and offshoring exporters with $\varphi(\omega) \geq \varphi_{eo}^d(\omega)$ coexist.

[10] Depending on the parameter configuration there may exist a further condition equalising the profits of exporters and offshorers. However, since the respective cutoff (if it exists) is not required for our analysis, we do not further elaborate on it.

3. For firms with $f_e(\omega) \geq \frac{\hat{\kappa}_o^\xi - 1}{\hat{\kappa}_e^\xi - 1} f_o(\omega)\hat{\kappa}_o^\xi$, we have $\varphi_o(\omega) \leq \varphi_{eo}^d(\omega) < \varphi_e(\omega)$ and $\varphi_o(\omega) < \varphi_{eo}^o(\omega)$. In this group of firms, domestic firms with $\varphi(\omega) \in [\varphi_d, \varphi_o(\omega))$, offshorers with $\varphi(\omega) \in [\varphi_o(\omega), \varphi_{eo}^o(\omega))$, and offshoring exporters with $\varphi \geq \varphi_{eo}^o(\omega)$ coexist.

Since we have shown above that firm-level revenues increase in total labour productivity, higher levels of $\varphi(\omega)$ are associated with a higher degree of internationalisation. As a consequence, offshoring exporters always exist for sufficiently high realisations of total labour productivity. Furthermore, our model supports coexistence of exporters and offshorers if firms in parameter ranges 1. and 3. exist, i.e. if there is sufficient heterogeneity in the firm population regarding the relative size of fixed offshoring costs and fixed exporting costs.

We finally turn to the market entry decision at stage one. Similar to Melitz (2003), we assume that market entry requires a fixed cost investment of sf_m that gives access to a lottery. The lottery gives a single draw of total labour productivity $\varphi(\omega)$ from the Pareto distribution $G(\varphi) = 1 - \varphi^{-g}$, with $g > \xi$. In addition, firms also draw the fixed factor input requirements for exporting and offshoring, $f_e(\omega), f_o(\omega)$. In the interest of analytical tractability, we model $f_i(\omega)$, $i = e, o$, as the product of a common element $f(\omega)$ and a type-specific component $\mu_i(\omega)$: $f_i(\omega) \equiv \mu_i(\omega) f(\omega)$. We associate the common element $f(\omega)$ with a firm's general ability to become an international producer and assume that it is distributed according to the continuously differentiable function $F(f)$ with support on interval $[f_d, \infty)$. The type-specific component $\mu_i(\omega)$ captures whether it is easier for firm ω to become an exporter or an offshorer. We assume that $\mu_i(\omega)$ is a binary variable that can take values 1 or $\mu > 1$. We capture the lottery assigning $\mu_i(\omega)$ to firms by an urn-ball model. There are two types of balls in the urn, one with label e and one with label o. Firms draw a ball from the urn and place it back afterwards. If the ball is labelled e, they have $\mu_e(\omega) = 1$ and $\mu_o(\omega) = \mu$. If the ball is labelled o, they have $\mu_e(\omega) = \mu$ and $\mu_o(\omega) = 1$. If $\mu \neq 1$, this means that firms are either relatively good exporters or relatively good offshorers. The relative frequency of balls labelled e is given by $\rho \in (0, 1)$.

With these assumptions at hand, we can formulate the following proposition.

Proposition 2 *If* $\mu > \max\left\{\hat{\kappa}_e^\xi \frac{\hat{\kappa}_o^\xi - 1}{\hat{\kappa}_e^\xi - 1}, \hat{\kappa}_o^\xi \frac{\hat{\kappa}_e^\xi - 1}{\hat{\kappa}_o^\xi - 1}\right\} \equiv \overline{\mu}$, *there is coexistence of domestic producers, exporters, offshorers, and offshoring exporters, and an overlap of the four producer types in the productivity distribution. Under the sufficient condition of* $\mu > \hat{\kappa}_e^\xi > \hat{\kappa}_o^\xi$, *our model produces the following ranking of productivity cutoffs:* $\varphi_d < \min\{\varphi_e(\omega)\} < \min\{\varphi_o(\omega)\} < \min\left\{\varphi_{eo}^e(\omega), \varphi_{eo}^o(\omega)\right\}$.

Proof See the Appendix.

The coexistence of different types of producers and their overlap in the productivity and revenue distributions is a stylised fact reported for instance by Tomiura (2007), Hallak and Sivadasan

(2013), and Antràs and Yeaple (2014). Armenter and Koren (2015) and Capuano et al. (2017) show that models of the Melitz (2003)-type can be made consistent with this evidence when adding additional sources of firm heterogeneity. In contrast to previous theoretical work, we distinguish three types of international producers, namely exporters, offshorers, and offshoring exporters, address the complementarity of different forms of foreign market entry (in the spirit of Yeaple, 2003), and show that for $\mu > \hat{\kappa}_e^\xi > \hat{\kappa}_o^\xi$ the productivity rankings of exporters, offshorers, and offshoring exporters, captured by their productivity cutoffs, are in line with the evidence reported by Tomiura (2007) for Japanese firms.

Under the parameter constraint $\mu > \overline{\mu}$, we can determine the fractions of exporters, offshorers, and offshoring exporters in the overall population of active firms.[11] With formal details deferred to the Appendix, we compute for the fraction of exporters and offshorers

$$\chi_e \equiv \rho \left[\frac{f_d}{\tilde{f}\mu} \hat{\kappa}_e^\xi \left(\hat{\kappa}_o^\xi - 1 \right) \right]^{\frac{g}{\xi}} \left[\left(\frac{\hat{\kappa}_e^\xi - 1}{\hat{\kappa}_o^\xi - 1} \frac{\mu}{\hat{\kappa}_e^\xi} \right)^{\frac{g}{\xi}} - 1 \right], \tag{17}$$

$$\chi_o \equiv (1-\rho) \left[\frac{f_d}{\tilde{f}\mu} \hat{\kappa}_o^\xi \left(\hat{\kappa}_e^\xi - 1 \right) \right]^{\frac{g}{\xi}} \left[\left(\frac{\hat{\kappa}_o^\xi - 1}{\hat{\kappa}_e^\xi - 1} \frac{\mu}{\hat{\kappa}_o^\xi} \right)^{\frac{g}{\xi}} - 1 \right], \tag{18}$$

where

$$\tilde{f} \equiv \left[\int_{f_d}^{\infty} f^{-\frac{g}{\xi}} dF(f) \right]^{-\frac{\xi}{g}} \tag{19}$$

is a weighted average of the firm-specific fixed cost parameter $f(\omega)$ and $\chi_e, \chi_o > 0$ follow from condition $\mu > \overline{\mu}$. The fraction of offshoring exporters is given by $\chi_{eo} \equiv \chi_{eo}^e + \chi_{eo}^o$, with

$$\chi_{eo}^e \equiv \rho \left[\frac{f_d}{\tilde{f}\mu} \hat{\kappa}_e^\xi \left(\hat{\kappa}_o^\xi - 1 \right) \right]^{\frac{g}{\xi}}, \qquad \chi_{eo}^o \equiv (1-\rho) \left[\frac{f_d}{\tilde{f}\mu} \hat{\kappa}_o^\xi \left(\hat{\kappa}_e^\xi - 1 \right) \right]^{\frac{g}{\xi}}. \tag{20}$$

Differentiation of χ_e, χ_o, and χ_{eo} gives the intuitive result that the fraction of exporters and offshoring exporters increases in the relative market size of the foreign economy, $d\chi_e/d\hat{\kappa}_e > 0$ and $d\chi_{eo}/d\hat{\kappa}_e > 0$. In contrast, the fraction of offshorers decreases in the relative market size of the foreign economy, $d\chi_o/d\hat{\kappa}_e < 0$, because for some offshorers exporting becomes attractive. Similarly, a lower relative cost of performing tasks abroad increases the fraction of offshorers and offshoring exporters, $d\chi_o/d\hat{\kappa}_o > 0$ and $d\chi_{eo}/d\hat{\kappa}_o > 0$, whereas the fraction of exporters decreases, $d\chi_e/d\hat{\kappa}_o < 0$, because some exporters begin to offshore.

[11] There are three other parameter configurations. If $\mu < \min\left\{ \hat{\kappa}_e^\xi \frac{\hat{\kappa}_o^\xi - 1}{\hat{\kappa}_e^\xi - 1}, \hat{\kappa}_o^\xi \frac{\hat{\kappa}_e^\xi - 1}{\hat{\kappa}_o^\xi - 1} \right\} \equiv \underline{\mu}$, there are no exporters or offshorers, only national firms and offshoring exporters. Intuitively, this is because with μ close to one the fixed costs of exporting and offshoring for each firm are similar, and hence each firm chooses either both forms of internationalisation or none. We briefly discuss this case in Section 4 below. In the intermediate case of $\mu \in [\underline{\mu}, \overline{\mu}]$, national firms and offshoring exporters coexist either with exporters or with offshorers, depending on the ranking of $\hat{\kappa}_e^\xi$ and $\hat{\kappa}_o^\xi$. There are no exporters if $\hat{\kappa}_o^\xi > \hat{\kappa}_e^\xi$ and there are no offshorers if $\hat{\kappa}_e^\xi > \hat{\kappa}_o^\xi$.

Firms enter the productivity lottery as long as under the veil of uncertainty the expected profits of doing so exceed the fixed cost of market entry sf_m. The expected profits of potential entrants are denoted $\mathrm{E}[\psi]$, derived in the Appendix, and given by

$$\mathrm{E}[\psi] = [1 - G(\varphi_d)] \frac{\xi s f_d}{g - \xi} \Delta\left(\hat{\kappa}_e, \hat{\kappa}_o\right) - s f_m, \tag{21}$$

where

$$\Delta\left(\hat{\kappa}_e, \hat{\kappa}_o\right) \equiv 1 + \frac{\overline{f}}{f_d} \left(\frac{\tilde{f}}{\overline{f}}\right)^{\frac{g}{\xi}} \left[\chi_e + \chi_o + (1+\mu)\left(\chi_{eo}^e + \chi_{eo}^o\right)\right] \tag{22}$$

denotes the ratio of operating profits in the open and the closed economy and

$$\overline{f} \equiv \left[\int_{f_d}^{\infty} f^{\frac{\xi - g}{\xi}} dF(f)\right]^{\frac{\xi}{\xi - g}} \tag{23}$$

is another weighted average of the firm-specific fixed cost parameter $f(\omega)$ that is different from $\tilde{f}$. Substituting $1 - G(\varphi_d) = \varphi_d^{-g}$ and setting $\mathrm{E}[\psi] = 0$, we can derive a solution for cutoff productivity φ_d, which is larger than one and therefore supports selection at the lower bound of the productivity distribution for arbitrary levels of χ_e, χ_o, and χ_{eo} if $f_m < f_d \frac{\xi}{g - \xi}$.

3 General Equilibrium

We now embed the firm-level analysis into a general equilibrium framework. In our benchmark model, we consider trade between two identical countries, each endowed with $N_l > 0$ unskilled and $N_h > 0$ skilled workers. Workers supply one unit of labour of the respective skill type and can seek employment in the monopsonistically competitive labour market of the manufacturing sector, earning firm-specific wages there, or they can seek employment in a perfectly competitive service sector. The service sector provides the fixed factor input for market entry, production, exporting, and offshoring. In the spirit of Bernard et al. (2007), we assume that service production requires both types of labour and uses a Cobb-Douglas technology with the same cost shares as manufacturing. We normalise this technology to get rid of uninteresting constants and write the average cost and thus the price of one unit of service input as $s = s_h^{\alpha_h} s_l^{\alpha_l}$, where s_h, s_l are the wages of skilled and unskilled labour in the service sector. Using Shephard's lemma, we can determine the demand for skilled and unskilled labour per unit of service input as $\ell_h^s = \alpha_h (s_l/s_h)^{\alpha_l}$ and $\ell_l^s = \alpha_l (s_h/s_l)^{\alpha_h}$, respectively.

3.1 Microfoundations for goods demand and labour supply

Following Ethier (1982), we think of manufacturing firms as intermediate goods producers that provide differentiated inputs for the production of a homogeneous final output, Y, using a linear homogeneous technology that features a constant elasticity of substitution, $\sigma > 1$, between the respective intermediates: $Y = \left[\int_{\omega\in\Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} \mathrm{d}\omega\right]^{\frac{\sigma}{\sigma-1}}$, where Ω is the continuous set of available intermediates. Assuming that final good Y is freely tradable at zero trade costs and choosing Y as our numéraire, we get the standard iso-elastic demand curve introduced above, with the demand shifter in the goods market equal to economy-wide output: $A_q = Y$.

Turning to the microfoundation for labour supply, we assume that from the perspective of workers, manufacturing firms are heterogeneous in two dimensions: they pay different wages and they provide a worker-firm-specific return in the form of an amenity, which captures the worker's valuation of any non-pecuniary job aspects such as the firm's working culture (see Thisse and Toulemonde, 2010; Card et al., 2018, for a similar assumption). The amenity level of worker ν from working at firm ω, $a(\nu, \omega)$, is known to the worker but not to the firm and is drawn by each individual from the Fréchet extreme value distribution $F(a) = \exp\left(-a^{-\frac{1-\theta}{\theta}}\right)$, which is the same for all firms and common to all workers ν. The indirect utility of worker ν with skill type $j = h, l$ from employment in firm ω is given by

$$v_j(\nu, \omega) = \frac{w_j(\omega) a(\nu, \omega)}{\max\{\mathrm{E}_j[a(\nu, \omega)]\}}, \tag{24}$$

where $\mathrm{E}_j[a(\nu, \omega)]$ is the expected amenity level of type-j worker ν at firm ω, conditional on accepting a job at this firm, or alternatively the firm-level amenity average of type-j workers. Since all workers have the same ex-ante view of how attractive it is to work at firm ω, $\mathrm{E}_j[a(\nu, \omega)]$ – in contrast to $a(\nu, \omega)$ – only depends on ω, but not on the individual worker ν. $\mathrm{E}_j[a(\nu, \omega)]$ is higher for low-wage firms, since these firms are only chosen by workers for whom the non-monetary benefits of working there is high.[12] In Eq. (24), we divide by the economy-wide maximum of firm-specific averages, $\max\{\mathrm{E}_j[a(\nu, \omega)]\}$, in order to close a labour market externality and to make the average economy-wide amenity level independent of the total mass of firms.

Since workers have to choose a single employer, the allocation of workers to firms can be understood as the solution to a discrete choice problem, as in McFadden (1976). The assumption of a continuous choice set, makes our problem akin to Ben-Akiva et al. (1985); Dagsvik (1994); Thisse and Toulemonde (2010). As we show in an online supplement, the probability of type-j worker ν to (weakly) prefer a job in firm ω promising utility $v_j(\nu, \omega)$ over all alternatives $\omega' \neq \omega$

[12] In an online supplement, we derive the explicit solution $\mathrm{E}_j[a(\nu, \omega)] = \Gamma\left(\frac{1-2\theta}{1-\theta}\right) \frac{W_j}{w_j(\omega)}$, where $\Gamma(\cdot)$ is the Gamma function.

is given by[13]

$$\text{Prob}[v_j(\nu,\omega) \geq \max\{v_j(\nu,\omega')\}] = \frac{w_j(\omega)^{\frac{1-\theta}{\theta}}}{\int_{\omega\in\Omega} w_j(\omega)^{\frac{1-\theta}{\theta}} d\omega}. \tag{25}$$

The probability of a worker to choose firm j depends positively on the wage paid by this firm, $w_j(\omega)$, and negatively on a weighted economy-wide aggregate of all wages paid by manufacturing firms, $W_j \equiv \left[\int_{\omega\in\Omega} w_j(\omega)^{\frac{1-\theta}{\theta}} d\omega\right]^{\frac{\theta}{1-\theta}}$. The supply of type j-labour for firm ω is then determined by the total labour input of this type in manufacturing, L_j^m, multiplied by the firm-specific probability of hiring a given worker $[w_j(\omega)/W_j]^{\frac{1-\theta}{\theta}}$, and it is given by $l_S(\omega) = A_j w_j(\omega)^{\frac{1-\theta}{\theta}}$, where $A_j \equiv L_j^m/W_j^{\frac{1-\theta}{\theta}}$. The sensitivity of labour supply to changes in wages $w_j(\omega)$ depends on the shape parameter $(1-\theta)/\theta$, which is an inverse measure of the heterogeneity of workers' job preferences. In the limiting case of $\theta = 0$, workers perceive the amenity level to be the same at all firms, and therefore labour supply for each firm becomes perfectly elastic. In this case, the labour market is perfectly competitive, with all firms paying the same skill-specific wage.

3.2 Factor allocation

Prior to the entry of firms, skilled and unskilled workers make a sectoral choice and decide upon seeking employment in manufacturing or the service sector. The sectoral choice of workers is irreversible, because the fixed factor input of services is employed prior to the hiring of production workers, and it is made under uncertainty about the realisation of amenities and wages in the sector of manufacturing. Being risk-neutral, workers choose the alternative that promises the highest expected utility. Therefore, in equilibrium the service sector wage s_j needs to be equal to the expected utility from working in manufacturing, which we denote by $\bar{v}_j$. Since all workers are indifferent between manufacturing firms ex ante, $\bar{v}_j$ is also equal to the expected utility $\mathrm{E}[v_j(\nu,\omega)]$. Since firm-level wages are known with certainty, we have

$$\bar{v}_j = \frac{w_j(\omega)\mathrm{E}_j[a(\nu,\omega)]}{\max\{\mathrm{E}_j[a(\nu,\omega)]\}} = \frac{\min\{w_j(\omega)\}\max\{\mathrm{E}_j[a(\nu,\omega)]\}}{\max\{\mathrm{E}_j[a(\nu,\omega)]\}} = \min\{w_j(\omega)\},$$

where the first equality sign follows from Eq. (24), and the second equality sign follows from the fact that the firm with the highest expected amenity level must be the firm that pays the lowest wage rate. Accordingly, the expected utility of employment as a production worker is given by the lowest wage paid by manufacturing firms. As formally shown in the Appendix, for both skill types the lowest wage is paid by the domestic producer with productivity φ^d. Denoting the wage paid

[13] Ben-Akiva et al. (1985) provide an analysis for the case of a continuum of alternatives when the random utility components are extreme value Gumbel distributed. Mattsson et al. (2014) show that if a variable x is Gumbel distributed, then $\exp[x]$ is Fréchet distributed. This allows us to apply the solution concept from Ben-Akiva et al. (1985) to our problem.

by this firm by w_j^d, $j = h, l$, we therefore obtain $\overline{v}_j = w_j^d$.[14]

The allocation of skilled and unskilled workers to manufacturing and services is determined by the indifference condition $w_j^d = s_j$, which then determines the cost of the fixed factor input as $s = (w_h^d)^{\alpha_h} (w_l^d)^{\alpha_l}$, whereas skilled and unskilled labour demand per unit of fixed service input is given by $\ell_h^s = \alpha_h (s_l/s_h)^{\alpha_l}$ and $\ell_l^s = \alpha_l (s_h/s_l)^{\alpha_h}$, respectively. Denoting by ℓ_j^d the labour input of skill type j in the domestic firm with total labour productivity φ_d, we can link ℓ_j^d and ℓ_j^s by

$$\ell_j^d = \frac{\gamma}{1-\gamma} \frac{\alpha_j \pi_d}{w_j^d} = \frac{\gamma}{1-\gamma} \frac{\alpha_j s f_d}{w_j^d} = \frac{\gamma}{1-\gamma} f_d \ell_j^s. \tag{26}$$

The first equality sign follows from applying first-order conditions (6) and (7) to the least productive domestic producer, the second equality sign uses the zero-profit condition $\pi_d = s f_d$, and the third equality sign uses indifference condition $w_j^d = s_j$.

We make use of the relationship between ℓ_j^d and ℓ_j^s established by Eq. (26) to link sector-wide employment in manufacturing and services. To determine sector-wide employment in services, we can substitute Eq. (21) into the free entry condition $\mathrm{E}[\psi] = 0$ and compute

$$\frac{f_m}{1 - G(\varphi_d)} = \frac{\xi}{g - \xi} f_d \Delta\left(\hat{\kappa}_e, \hat{\kappa}_o\right),$$

where $f_d \Delta\left(\hat{\kappa}_e, \hat{\kappa}_o\right)$ is the average fixed factor input of active firms for production, exporting, and offshoring, while $f_m/[1 - G(\varphi_d)]$ is the fixed factor input for market entry per active firm, taking into account that some firms enter the lottery but do not start production. Denoting the mass of active firms by M, we then compute for sector-wide employment of skill type $j = h, l$ in services:

$$L_j^s = \frac{g}{g - \xi} \Delta\left(\hat{\kappa}_e, \hat{\kappa}_o\right) f_d \ell_j^s M. \tag{27}$$

Sector-wide employment in manufacturing can be computed by aggregating employment from Eq. (14) over all firms. As formally shown in the Appendix, this gives for skill type $j = h, l$

$$L_j^m = \frac{g}{g - (1-\theta)\xi} \Lambda_j\left(\hat{\kappa}_e, \hat{\kappa}_o\right) \ell_j^d M, \tag{28}$$

with $\Lambda_h(\cdot) < \Lambda_l(\cdot)$ and $\Lambda_h(\cdot) < \Delta(\cdot)$. Thereby, $\frac{g}{g-(1-\theta)\xi}\Lambda_j(\cdot)$ gives the ratio of domestic type-j employment in the average and the marginal firm, with $\Lambda_j(1,1) = 1$ and $\Lambda_j\left(\hat{\kappa}_e, \hat{\kappa}_o\right) > 1$ if $\hat{\kappa}_e > 1$ and/or $\hat{\kappa}_o > 1$.

Eqs. (27) and (28) link sector-level employment to the mass of firms, which is itself endogenous.

[14] Since firms cannot observe the amenity draws of their applicants, they pay the same wage to all their workers. As a consequence, workers differ in their ex post utility levels from employment because they differ in their amenity level from working for a firm. From an ex post perspective, this generates rent sharing between the firm and its infra-marginal workers, similar to Card et al. (2018).

In the Appendix, we show how to find closed-form solutions in terms of model parameters for these variables as well as for the relative wage rate paid by the least productive firm. We get

$$L_j^s = \frac{\Delta(\cdot)}{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)} N_j, \qquad L_j^m = \frac{\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)}{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)} N_j, \tag{29}$$

$$\frac{w_h^d}{w_l^d} = \frac{\alpha_h}{\alpha_l}\frac{N_l}{N_h}\frac{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_h(\cdot)}{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_l(\cdot)}, \tag{30}$$

as well as

$$M = \frac{g-\xi}{gf_d}\prod_{j=l,h}\left[\frac{N_j/\alpha_j}{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)}\right]^{\alpha_j}. \tag{31}$$

Eqs. (29) to (31) characterize the open economy general equilibrium of symmetric countries. In this equilibrium, we have $\hat{\kappa}_e = (1+\tau_e^{1-\sigma})^{\frac{1}{\sigma-1}} > 1$, $\hat{\kappa}_o = \left(1+\tau_o^{-\frac{1}{\theta}}\right)^{\alpha_l\theta} > 1$, and the relative revenue increase from exporting and offshoring must therefore be the same in the two symmetric countries. From Eqs. (17), (18), and (20) it then follows that χ_e, χ_o, and χ_{eo} are all positive for the parameter domain in Proposition 2. This establishes the following proposition.

Proposition 3 *In the open economy with two symmetric countries, our model features two-way exporting and two-way offshoring. In comparison to autarky, offshoring leads to an increase in the skill intensity in services and to a decrease in the average skill intensity in manufacturing, while exporting leaves the skill intensity of services and manufacturing unchanged.*

Proof See the Appendix.

Our result of the prevalence of two-way offshoring between identical countries is well in line with the evidence reported by Alfaro and Charlton (2009) that vertical multinational activity predominantly exists between symmetric countries. The induced changes in average skill intensities at the sector level have a straightforward intuition. Start with the case of exclusive offshoring, where the intuition is easiest seen by distinguishing between a *direct* and an *indirect* wage effect. The availability of offshoring effectively gives firms access to a technology that allows them – at a cost – to reduce the wage they pay to unskilled workers. This is what we call the direct wage effect. As a consequence, there is an increase in demand for unskilled workers by those firms that choose to offshore, reducing overall skill intensity of offshoring firms. For each firm the additional demand for unskilled workers arises in its offshore location, but this does not matter for our argument since the countries are identical, and therefore the aggregate effect on the demand for unskilled labour is the same in both markets. The positive demand shock for unskilled labour leads to an increase in the relative wage of unskilled workers in general equilibrium, affecting all firms in manufacturing, including those that do not offshore, as well as the service sector. This is the indirect wage effect. As a consequence of the indirect effect, the skill intensity of the service sector rises, and so does the skill intensity of non-offshoring firms in manufacturing. For the offshoring firms, the indirect wage effect partially reverses the direct wage effect, but does not fully offset it.[15] Due to labour market clearing, the increase in the skill intensity for the service sector and the non-offshoring manufacturing firms must be matched exactly by the lower skill intensity in offshoring firms, such that the average skill intensity in the economy remains constant.

With exclusive exporting, none of these changes happens. In this case, the reallocation of labor is solely between domestic establishments of manufacturing firms and between manufacturing and services, and since all firms in manufacturing employ the same ratio of skilled and unskilled labour, which furthermore matches the employment ratio within services, the average skill intensity in each sector is left unchanged. Although the intuition is not as straightforward, we show in the Appendix that the effect of exclusive offshoring on sectoral skill intensities from Proposition 3 carries over to the transition from autarky to an open economy equilibrium with both trade in goods and trade in tasks.

3.3 Market efficiency and welfare

For the welfare analysis, we take a utilitarian perspective. Since for both skill types expected utility from employment is equalised across sectors, $s_j = \overline{v}_j$, and since this expected utility is equal to the wage paid by the domestic firm with total labour productivity φ_d, $\overline{v}_j = w_j^d$, social welfare can be expressed as

$$V = \sum_{j=h,l} \frac{N_j}{N} w_j^d, \tag{32}$$

where

$$w_j^d = T\Delta(\cdot)^{\frac{1}{g}} \left(\frac{\Delta(\cdot)N_j/\alpha_j}{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)} \right)^{-1} \left[\prod_{j=l,h} \left(\frac{\Delta(\cdot)N_j/\alpha_j}{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)} \right)^{\alpha_j} \right]^{\frac{\sigma}{\sigma-1}} \tag{33}$$

is derived in the Appendix and $T \equiv \gamma\beta^{-\frac{\theta}{1-\theta}} \left(\frac{1}{f_d}\right)^{\frac{1}{\sigma-1}} \left[\frac{\xi}{g-\xi}\frac{f_d}{f_m}\right]^{\frac{1}{g}}$ is a constant. With the welfare function in Eq. (32), we take an ex ante perspective and make use of the fact that firms pay wages that equalise the expected utility of workers from employment in all possible jobs. Due to this, the welfare function does not depend on individual realisations of amenities, which makes the welfare

[15] Relative wages can move in opposite directions in different firms within manufacturing due to the monopsonistic market structure, which makes worker mobility between firms imperfect.

effects discussed below accessible to empirical research.[16]

The welfare analysis is more involved than in Melitz (2003), because having monopsonistic competition in the labour market adds a distortion to the model. We illustrate the resulting inefficiency in an online supplement, where we analyse for the closed economy a social planner who can set the same proportional tax rate on the fixed cost of market entry, sf_m, and the fixed cost of production, sf_d, and redistribute the tax revenue in a lump-sum fashion. If $\theta = 0$, the labour market is perfectly competitive, and in this case the social planner sets the tax rate equal to zero because the market outcome is (constrained) efficient (see Benassy, 1996; Dhingra and Morrow, 2019). If $\theta > 0$, firms reduce their output and use their monopsony power to decrease wages. This leads to lower labour demand than in an otherwise identical model with a competitive labour market (see Eq. (14)). With lower employment per firm, there is excessive firm entry. The social planner corrects for the inefficient resource allocation by setting a positive tax rate in order to make firm entry less attractive.

From the theory of second best (see Lipsey and Lancaster, 1956), we would conjecture that gains from trade exist in our model if the distortion in the labour market is reduced in the open economy, while losses from trade may exist if the distortion is increased. Exporting leads to additional employment in highly productive firms and induces exit of firms with low levels of total labour productivity. Since the autarky equilibrium has too many firms, and these firms are too small, exporting works against the initial labour market distortion, and we therefore expect gains from trade in goods. Furthermore, these gains should equally accrue to skilled and unskilled workers since in autarky all firms within manufacturing pay the same skill premium, which equals the skill premium paid in the service sector, and this skill premium is unaffected by the transition to exporting.

Things are different in the case of trade in tasks. First, offshoring potentially reduces welfare since the monopsony distortion is aggravated. This is because the only motive for firms to engage in offshoring is to exploit their monopsony power in the labour market, and this can in turn make the resources invested for offshoring wasteful from a social planner's point of view.[17] Second, the welfare of skilled and unskilled workers is affected differently by offshoring. As discussed above, offshoring works like a positive demand shock for unskilled labour, and therefore welfare of

[16] Although workers' expected utility is equalised across all employment options, our model features wage differentiation between firms, and therefore can be used to rationalise the increase in residual wage inequality between observationally identical workers through trade liberalisation (cf. Amiti and Davis, 2012; Egger et al., 2013; Helpman et al., 2017). In an online supplement, which is available from the authors upon request, we discuss the differential effects of trade in goods and trade in tasks on residual wage inequality.

[17] To see this, one can consider a simplified version of our model with homogeneous firms (due to $g \to \infty$) without trade in goods (due to $\tau_e \to \infty$) and no selection into offshoring (due to $f_o(\omega) = 0$). In this case, offshoring lacks the benefit of shifting labour towards high-productivity firms and hence spending resources for it is always wasteful and to the detriment of social welfare. In the setting with heterogeneous firms and selection into offshoring, a negative welfare effect exists if the resource costs for offshoring outweigh the benefits from a more favourable production structure.

unskilled workers rises relative to the welfare of skilled workers. In the service sector, this change in relative welfare is tantamount to the increase in the relative wage of unskilled workers. In manufacturing, the welfare of workers also depends on amenities provided by their employers, and therefore the relative welfare of skilled and unskilled workers and their relative wage can move in opposite directions, and this is exactly what happens in offshoring firms.

We summarise these insights in the following proposition.

Proposition 4 *Whereas exporting affects the two skill groups symmetrically and increases social welfare, offshoring benefits unskilled relative to skilled workers and can make both skill groups worse-off, thereby lowering social welfare.*

Proof Formal proof in the Appendix.

Regarding the effect of offshoring, Proposition 4 shows a superficial similarity to the welfare result from Egger et al. (2015) in that it highlights the possibility that offshoring can lead to welfare losses. The mechanisms leading to this result are, however, different. In Egger et al. (2015) losses from offshoring to a low-wage host country can exist only for a high-wage source country if offshoring is confined to highly productive firms and leads to reallocation of workers from high-productivity to low-productivity producers, thereby magnifying a pre-existing distortion of the autarky equilibrium. In the current setting, offshoring occurs between identical countries, and the welfare loss can occur despite the reallocation of workers from low-productivity to high-productivity producers.

4 Discussion

In this section, we discuss how our results change if we consider a regime in which not all firm types coexist (Section 4.1), allow for offshoring of headquarter and production tasks (Section 4.2), or account for country asymmetries to capture the idea of North-South offshoring (Section 4.3).

4.1 Limited coexistence of firm types

So far, we have focussed on a parameter domain that delivers the empirically observed coexistence of domestic producers, exporters, offshorers, and offshoring exporters. However, the main insights from our analysis regarding the differential effect of offshoring on high- and unskilled workers and the existence of offshoring between symmetric countries are not the result of restricting attention to the specific parameter space characterised in Proposition 2. When discussing the welfare effects of exporting and offshoring, we have already considered model variants with exclusive exporting and exclusive offshoring, thereby eliminating the existence of offshoring exporters. To complete the picture of possible coexistence patterns, we now consider a parameter domain of $\mu < \min\left\{\hat{\kappa}_e^{\xi}\frac{\hat{\kappa}_o^{\xi}-1}{\hat{\kappa}_e^{\xi}-1}, \hat{\kappa}_o^{\xi}\frac{\hat{\kappa}_e^{\xi}-1}{\hat{\kappa}_o^{\xi}-1}\right\} \equiv \underline{\mu}$. In this case, we have $\varphi_{eo}^d(\omega) < \varphi_e(\omega), \varphi_o(\omega)$ for all producers. As a consequence, there are neither pure exporters nor pure offshorers, and only domestic producers and offshoring exporters coexist. Accounting for the definition of φ_{eo}^d in Eq. (15) and the definition of $\tilde{f}$ in Eq. (19), the fraction of firms choosing to become offshoring exporters is given by

$$\chi_{eo} = \int_{f_d}^{\infty}\int_{\varphi_{eo}^d(\omega)}^{\infty} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) = \left[\frac{1}{1+\mu}\frac{f_d}{\tilde{f}}\left(\hat{\kappa}_e^{\xi}\hat{\kappa}_o^{\xi}-1\right)\right]^{\frac{g}{\xi}}, \tag{34}$$

and this fraction can be decomposed into the share of offshoring exporters with a cost advantage in exporting or offshoring according to $\chi_{eo}^e = \rho\chi_{eo}$, $\chi_{eo}^o = (1-\rho)\chi_{eo}$, respectively.

Following the derivation steps from above, we can in a next step express the expected profits of potential entrants by an expression identical to Eq. (21), with $\Delta(\hat{\kappa}_e, \hat{\kappa}_o)$ now given by

$$\Delta(\hat{\kappa}_e, \hat{\kappa}_o) \equiv 1 + \frac{\bar{f}}{f_d}\left(\frac{\tilde{f}}{\bar{f}}\right)^{\frac{g}{\xi}}(1+\mu)\chi_{eo}. \tag{35}$$

Furthermore, aggregating employment over all firms gives an expression identical to Eq. (28), with the new solution for $\Lambda_j(\hat{\kappa}_e, \hat{\kappa}_o)$ derived in analogy to the main text and given by

$$\Lambda_j(\hat{\kappa}_e, \hat{\kappa}_o) \equiv 1 + \left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g-(1-\theta)\xi}{\xi}}\left\{\hat{\kappa}_e^{(1-\theta)\xi}\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_j}\left[1+\left(\hat{\kappa}_o^{\xi(1-\varepsilon_j)}-1\right)^{1-\theta}\right]-1\right\}(\chi_{eo})^{\frac{g-(1-\theta)\xi}{g}}, \tag{36}$$

where $\hat{f} = \left[\int_{f_d}^{\infty} f^{-\frac{g-(1-\theta)\xi}{\xi}} dF(f)\right]^{-\frac{\xi}{g-(1-\theta)\xi}}$ (see Eq. (A.15) in the Appendix). Similar to the benchmark model, we find that $\Lambda_h(\cdot) < \Lambda_l(\cdot)$ and $\Lambda_h(\cdot) < \Delta(\cdot)$, implying that the rankings of these key aggregators are preserved in the model variant supporting coexistence of only two types of firms. Since the effects of trade in goods and trade in tasks on the wages paid by the least productive domestic producers in Eq. (33) are channeled through adjustments in $\Delta(\cdot)$ and $\Lambda_j(\cdot)$, it is immediate that the welfare analysis from the main text remains qualitatively intact for the alternative parameter domain considered here. In particular, it remains true that both trade in goods and trade in tasks lead to a reallocation of labour towards high-productivity firms, whereas the positive welfare implications from this reallocation are counteracted by an efficiency loss materialising in the case of offshoring because the scope for firms to exercise their monopsony power increases.

4.2 Offshoring of headquarter and production tasks

In our benchmark model in the first part of the paper, we assumed that only unskilled production tasks are offshorable, which gave us a simple framework that is compatible with the empirically observed differential impact of offshoring on firm-level employment and wages of skilled and unskilled workers (see Hummels et al., 2014). However, this assumption is not necessary to obtain such a differential effect. To see this, we now consider an alternative production technology that allows for the simultaneous offshoring of skilled headquarter tasks and unskilled production tasks:

$$q(\omega) = \beta\varphi(\omega) \prod_{j=h,l} \left\{ \exp\left[\int_0^1 \ln \ell_j(\omega, \tilde{\eta}_j) \mathrm{d}\tilde{\eta}_j \right] \right\}^{\alpha_j}. \tag{37}$$

In the limiting case in which the offshoring costs for skilled headquarter services are prohibitive, the production function in (37) collapses to the production function in Eq. (1). We allow the variable costs of offshoring to be skill-specific and denote them by $\tau_{jo} > 1$. To determine the profit-maximising levels of labour input, we can follow the analysis in the main text and derive the cost function

$$c(\omega) = \prod_{j=h,l} A_j^{-\alpha_j \frac{\theta}{1-\theta}} \left\{ \prod_{j=h,l} \kappa_j[\eta_j(\omega)]\varphi(\omega) \right\}^{-\frac{1}{1-\theta}} q(\omega)^{\frac{1}{1-\theta}}, \tag{38}$$

which is an expression similar to Eq. (9) with $\kappa[\eta(\omega)]$ replaced by $\prod_{j=h,l} \kappa_j[\eta_j(\omega)]$ and

$$\kappa_j[\eta_j(\omega)] \equiv \left\{ \left[\left(\frac{1}{\tau_{jo}} \right)^{\frac{1}{\theta}} \frac{A_j^*}{A_j} \frac{1-\eta_j(\omega)}{\eta_j(\omega)} \right]^{\eta_j(\omega)} \frac{1}{1-\eta_j(\omega)} \right\}^{I_o(\omega)\alpha_j\theta}.$$

Then, setting $dr(\omega)/dq(\omega) = dc(\omega)/d\omega$ we obtain the profit-maximising output level, which is given by an expression similar to Eq. (10) with $\prod_{j=h,l} \kappa_j[\eta_j(\omega)]$ substituted for $\kappa[\eta(\omega)]$. Setting $\kappa_j'[\eta_j(\omega)] = 0$ finally allows us to solve for

$$\eta_j(\omega) = 1 - \left(1 + \frac{A_j^*}{A_j} \tau_{jo}^{-\frac{1}{\theta}} \right)^{-I_o(\omega)} \qquad \kappa_j[\eta_j(\omega)] = \left(1 + \frac{A_j^*}{A_j} \tau_{jo}^{-\frac{1}{\theta}} \right)^{I_o(\omega)\alpha_j\theta} \equiv \kappa_{jo}(\omega). \tag{39}$$

With the solution to the firm's problem at the intensive margin, we can then determine domestic firm-level wages and employment of the two skill types according to

$$\begin{aligned} \ln w_j(\omega) = {} & \theta \ln \alpha_j + \theta[1 + (1-\theta)\xi] \ln \gamma - \theta \ln A_j + \theta\xi \ln A + \theta\xi \ln \varphi(\omega) \\ & + \theta\xi \ln \kappa_e(\omega) + \theta\xi\varepsilon_j \ln \kappa_{jo}(\omega) + \theta\xi \ln \kappa_{\hat{j}o}(\omega), \end{aligned} \tag{40}$$

$$\begin{aligned} \ln \ell_j(\omega) = {} & (1-\theta) \ln \alpha_j + (1-\theta)[1 + (1-\theta)\xi] \ln \gamma + \theta \ln A_j + (1-\theta)\xi \ln A + (1-\theta)\xi \ln \varphi(\omega) \\ & + (1-\theta)\xi \ln \kappa_e(\omega) + (1-\theta)\xi\varepsilon_j \ln \kappa_{jo}(\omega) + (1-\theta)\xi \ln \kappa_{\hat{j}o}(\omega), \end{aligned} \tag{41}$$

where $j, \hat{j} \in \{h, l\}$, $j \neq \hat{j}$, and $\varepsilon_j \equiv 1 - (\alpha_j\theta\xi)^{-1} < 0$. If skilled headquarter tasks as well as unskilled production tasks can be performed abroad, offshoring can have positive or negative domestic firm-level wage and employment effects. Whereas similar to the benchmark model discussed above the direct effect of offshoring induces domestic wages and employment of the skill type performing the offshored task to fall, there is an indirect wage and employment stimulus from offshoring tasks performed by the other skill type. This positive indirect effect exists due to a complementarity of the two skill types in the production of intermediates.

To align the predictions from our model with the empirical evidence reported by Hummels et al. (2014) that offshoring exhibits negative firm-level wage and employment effects for unskilled workers and positive firm-level wage and employment effects for skilled workers, we have to impose two parameter constraints, ensuring that the direct effect dominates the indirect effect for unskilled workers and vice versa for skilled workers. Defining $\hat{\kappa}_{jo} \equiv \left(1+\frac{A_j^*}{A_j}\tau_{jo}^{-\frac{1}{\theta}}\right)^{\alpha_j\theta}$, it follows from Eqs. (40) and (41) that this requires $\hat{\kappa}_{lo}^{\varepsilon_l}\hat{\kappa}_{ho} < 1$ and $\hat{\kappa}_{ho}^{\varepsilon_h}\hat{\kappa}_{lo} > 1$ to hold simultaneously. In the case of symmetric countries, the intended result is achieved under the following parameter constraint:

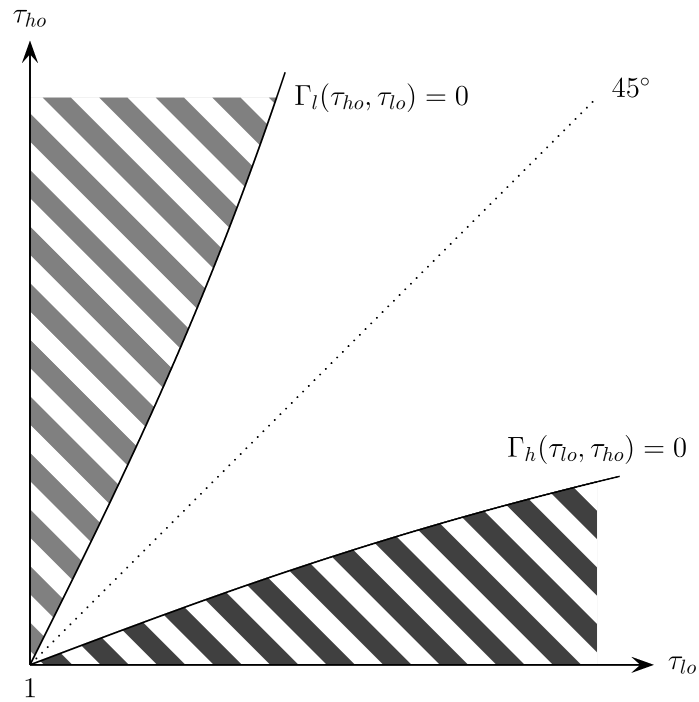
$$\left(1+\tau_{lo}^{-\frac{1}{\theta}}\right)^{1-\alpha_l\theta\xi} > \left(1+\tau_{ho}^{-\frac{1}{\theta}}\right)^{\alpha_h\theta\xi} \quad \text{and} \quad \left(1+\tau_{ho}^{-\frac{1}{\theta}}\right)^{1-\alpha_h\theta\xi} < \left(1+\tau_{lo}^{-\frac{1}{\theta}}\right)^{\alpha_l\theta\xi}. \tag{42}$$

Figure 1 gives an illustration of the possible outcomes. There, we draw the implicit functions

$$\Gamma_j(\tau_{\hat{j}o},\tau_{jo}) \equiv \left(1+\tau_{jo}^{-\frac{1}{\theta}}\right)^{1-\alpha_j\theta\xi} - \left(1+\tau_{\hat{j}o}^{-\frac{1}{\theta}}\right)^{\alpha_j\theta\xi} = 0 \tag{43}$$

in offshoring cost space.

Figure 1: *Firm-level Employment and Wage Effects of Offshoring*



The shaded regions above $\Gamma_l(\tau_{ho}, \tau_{lo}) = 0$ and below $\Gamma_h(\tau_{lo}, \tau_{ho}) = 0$ refer to trade cost combinations for which the direct effects dominate the indirect effects. To be more specific, in the light-gray shaded region above $\Gamma_l(\tau_{ho}, \tau_{lo}) = 0$ offshoring costs are comparably high for headquarter tasks and comparably low for production tasks. In this case, the direct effect of offshoring dominates the indirect effect for unskilled workers and vice versa for skilled workers. As a consequence, offshoring lowers wages and employment of unskilled workers and increases wages and employment of skilled workers at the firm level. The opposite is true in the dark-gray shaded region below $\Gamma_h(\tau_{lo}, \tau_{ho}) = 0$. Due to low offshoring costs for headquarter tasks and high offshoring costs for production tasks, offshoring induces firm-level wages and employment to increase for skilled workers and to decrease for unskilled workers. In the cone spanned by $\Gamma_l(\tau_{ho}, \tau_{lo}) = 0$ and $\Gamma_h(\tau_{lo}, \tau_{ho}) = 0$ offshoring costs for headquarter and production tasks are similar, and in this case firm-level wages and employment of both skill types increase due to offshoring. From Figure 1, we can therefore conclude that offshoring cannot have at the same time negative firm-level wage and employment effects for both skill types. We also see that the extended model considered here is capable to explain the empirical findings of Hummels et al. (2014) if the costs of offshoring skilled headquarter tasks are sufficiently high compared to the costs of offshoring unskilled production tasks.[18]

4.3 The case of asymmetric countries

In this section, we apply our model to the case of North-South offshoring. We thereby follow Egger et al. (2015), associate the foreign economy with an unskilled labour reservoir for the performance of tasks offshored by domestic firms and assume that the foreign economy lacks the endowment of skilled workers as well as the technology needed to produce intermediate or final goods. Despite this strong asymmetry of countries, the model has all the features necessary for a general equilibrium analysis, and it acknowledges in particular the requirements of balanced trade by allowing the two economies to exchange tasks (exported by the foreign country) for final goods (exported by the home country). Since the foreign economy does not produce the homogeneous final good, there is no trade in differentiated intermediates, and therefore we have $\hat{\kappa}_e = 1$. Due to the absence of exporters, the draw for fixed export costs becomes redundant, and we therefore set $\rho = 0$ in the following.

Preserving all other assumptions from our benchmark model, we can determine the ratio of

[18] In an online supplement, which is available upon request, we solve the model with offshoring of both tasks in general equilibrium and show that key insights from the benchmark model remain valid in the more sophisticated model considered here, as long as the costs of offshoring headquarter services are sufficiently high.

foreign relative to domestic labour market aggregators for unskilled workers according to

$$\frac{A_\ell^*}{A_\ell} = \frac{N_l^*}{L_l^m}\left(\frac{W_l}{W_l^*}\right)^{\frac{1-\theta}{\theta}}, \tag{44}$$

where N_l^* denotes the foreign endowment with unskilled labour. Combining Eq. (8) with the labour supply schedules $\tau_o \int_0^{I_o(\omega)\eta(\omega)} \ell_l(\omega,\tilde{\eta})d\tilde{\eta} = A_l^* w_l^*(\omega)^{\frac{1-\theta}{\theta}}$ and $\int_{I_o(\omega)\eta(\omega)}^1 \ell_l(\omega,\tilde{\eta})d\tilde{\eta} = A_l w_l(\omega)^{\frac{1-\theta}{\theta}}$, we can link foreign to domestic wages by

$$w_l^*(\omega) = w_l(\omega)\left(\frac{A_l}{A_l^*}\frac{\eta(\omega)}{1-\eta(\omega)}\right)^{\theta}.$$

Accounting for Eqs. (11) and (13), we can then compute

$$\left(\frac{W_l}{W_l^*}\right)^{\frac{1-\theta}{\theta}} = \left(\frac{A_\ell^*}{A_\ell}\right)^{1-\theta} \frac{1+\left(\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_l}-1\right)\left[\frac{f_d}{\hat{f}}\left(\hat{\kappa}_o^{\xi}-1\right)\right]^{\frac{g-(1-\theta)\xi}{\xi}}}{\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{1-\theta}\left[\frac{f_d}{\hat{f}}\left(\hat{\kappa}_o^{\xi}-1\right)\right]^{\frac{g-(1-\theta)\xi}{\xi}}}. \tag{45}$$

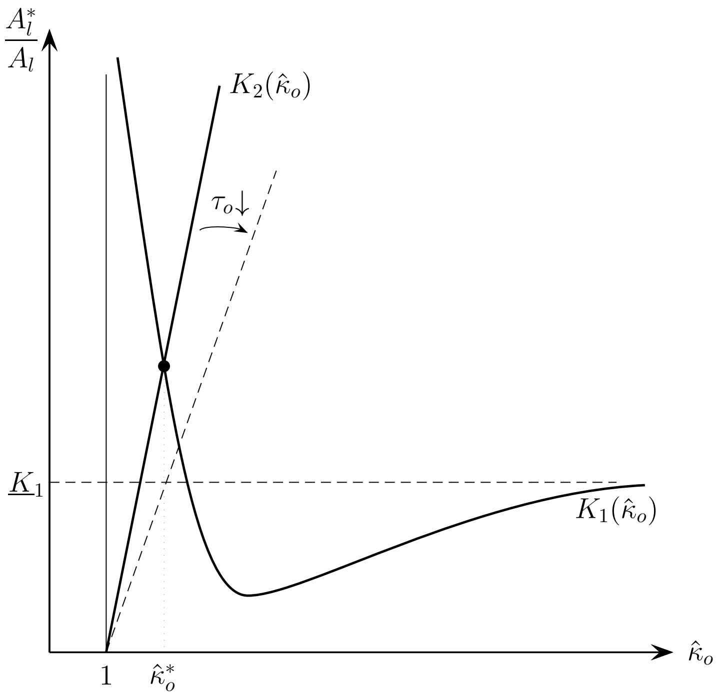
Furthermore, following the derivation steps from the case of symmetric countries analysed above, we can determine the mass of domestic workers of skill type $j = h, l$ employed in manufacturing, L_j^m, by an expression that is structurally identical to the one in Eq. (29), with

$$\Lambda_j(\hat{\kappa}_o) \equiv 1+\left(\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_l}-1\right)\left[\frac{f_d}{\hat{f}}\left(\hat{\kappa}_o^{\xi}-1\right)\right]^{\frac{g-(1-\theta)\xi}{\xi}}. \tag{46}$$

Eqs. (44) to (46) give a relationship between $\hat{\kappa}_o$ and A_l^*/A_l that is derived from labour market equilibrium and can be expressed as $A_l^*/A_l \equiv K_1(\hat{\kappa}_o)$. A second relationship between these two variables follows from the profit-maximising choice of the task margin in Eq. (11), and we capture this second relationship by $A_l^*/A_l \equiv K_2(\hat{\kappa}_o)$. The open economy equilibrium is then determined by these two relationships as depicted in Figure 2.

From Eq. (11), we know that profit-maximisation establishes a positive link between A_l^*/A_l and $\hat{\kappa}_o$. A higher value of A_l^*/A_l reflects a downward shift of the foreign unskilled labour supply curve relative to the domestic one. This implies larger cost savings from offshoring, leading to a higher value of $\hat{\kappa}_o$ (and thus to a larger fraction of tasks put offshore by offshoring firms). As a consequence, locus $K_2(\hat{\kappa}_o)$ is upward sloping in Figure 2. Things are less clear regarding the shape of locus $K_1(\hat{\kappa}_o)$. On the one hand, a higher cost saving from offshoring $\hat{\kappa}_o$ induces an increase in offshoring at the intensive and the extensive firm margin, thereby increasing the average foreign relative to the average domestic wage paid in manufacturing according to Eq. (45). This relative wage change shifts the foreign unskilled labour supply curve upwards relative to the domestic one,

Figure 2: *Open economy equilibrium with asymmetric countries*



ultimately resulting in a lower value of A_l^*/A_l. On the other hand, we observe an overall decrease in manufacturing employment at home, leaving the overall effect of a higher $\hat{\kappa}_o$ on A_l^*/A_l unclear in general. However, noting that

$$\lim_{\kappa_o \to 1} K_1(\hat{\kappa}_o) = \infty \quad \text{and} \quad \lim_{\kappa_o \to \infty} K_1(\hat{\kappa}_o) = \left[\frac{N_j^*}{N_j} \frac{1-\gamma}{\gamma} \left(\frac{\hat{f}}{f_d} \right)^{\frac{g-(1-\theta)\xi}{\xi}} \left(\frac{f_d}{\hat{f}} \right)^{\frac{g-\xi}{\xi}} \right]^{\frac{1}{\theta}} \equiv \underline{K}_1,$$

it follows that $K_1(\hat{\kappa}_o) = K_2(\hat{\kappa}_o)$ has a solution in $\hat{\kappa}_o > 1$.[19] Noting further that $K_2(\hat{\kappa}_o)$ rotates counter-clockwise if τ_o increases and that $\lim_{\tau_o \to \infty} K_2(\hat{\kappa}_o)$ gives a vertical line at $\hat{\kappa}_o = 1$, we can safely conclude that for sufficiently high variable offshoring costs, the open economy equilibrium depicted by the intersection point of $K_1(\hat{\kappa}_o)$ and $K_2(\hat{\kappa}_o)$ in Figure 2 is unique.

With the open economy equilibrium given by Figure 2, we can now turn to the welfare effects of offshoring. Following the derivation steps from above, we find that the expected profits of potential entrants are given by an expression that is structurally identical to Eq. (21), with

$$\Delta = 1 + (\hat{\kappa}_o^\xi - 1) \left[\frac{f_d}{\hat{f}} \left(\hat{\kappa}_o^\xi - 1 \right) \right]^{\frac{g-\xi}{\xi}}. \tag{47}$$

The welfare consequences of offshoring are then determined by Eqs. (30), (32), and (33), and they

[19] Whereas determining the exact shape of the $K_1(\hat{\kappa}_o)$ locus is tedious and not necessary for our analysis, we find a form similar to the one depicted by Figure 2, when setting specific, admissible parameter values.

crucially depend on the ranking of $\Lambda_h(\cdot)$, $\Lambda_l(\cdot)$, and $\Delta(\cdot)$. Accounting for $\varepsilon_l < 0$ and $\varepsilon_h = 1$, Eq. (46) establishes $\Lambda_l(\cdot) < 1 < \Lambda_h(\cdot)$. Since there is no offshoring by foreign firms, the negative relocation effect on domestic employment of unskilled workers at the firm level translates into an aggregate job loss for this skill group in manufacturing. As a consequence, unskilled workers now lose relative to skilled workers when offshoring becomes an option for domestic firms. However, since $\Lambda_h(\cdot) < \Delta(\cdot)$ is preserved from the model with symmetric countries, both skill types gain from offshoring in absolute terms. With the cost saving from offshoring more pronounced, our model therefore shows that, different from the case of symmetric countries and despite an increase in the scope of high-productivity firms to exercise their monopsony power, offshoring to the South is beneficial for the North.

5 Conclusions

In this paper, we have introduced monopsonistic competition in the labour market into a new trade model with heterogeneous firms. Production requires skilled workers for performing headquarter tasks and unskilled workers for performing a continuum of production tasks. Crucial for the existence of monopsony power, firms face upward-sloping labour supply curves because they offer workplaces that are horizontally differentiated from the perspective of workers. We show that due to monopsonistic competition in the labour market for skilled and unskilled workers the predictions of our model regarding the effects of trade in goods and trade in tasks differ sharply from each other, both at the firm level and at the aggregate level.

At the firm level, the export of goods increases domestic employment and domestic wages of both skill types, whereas offshoring of production tasks lowers domestic employment and domestic wages of unskilled workers but increases domestic employment and domestic wages of skilled workers. This finding is well in line with recent evidence on the differential impact of exporting and offshoring on firm-level wages and firm-level employment. Moreover, since a wage-dampening effect of offshoring on unskilled workers also exists in the case of symmetric countries, the assumption of monopsonistically competitive labour markets makes our model suitable for explaining puzzling evidence on the prevalence of offshoring between similar economies.

At the aggregate level, our model produces novel and interesting welfare results. As a consequence of their monopsonistic market power, firms choose sub-optimally low employment levels to keep their wages low. Therefore, monopsonistic competition in the labour market leads to a misallocation of resources and to the entry of too many and too small firms. Trade in goods constitutes a partial remedy for this source of inefficiency, because, in a model with selection of firms into exporting by productivity, it gives larger market share to high-productivity firms and induces exit of low-productivity firms, with the welfare stimulus from these effects augmented by access to new, foreign varieties of the differentiated good. As a result, there are gains from trade in goods between symmetric countries.

The welfare effects of offshoring are – by contrast – not unambiguously positive. Gaining access to foreign labour, offshoring firms use their monopsonistic power in the labour market to reduce their domestic employment, and hence the wages they have to pay to their domestic workers. Due to the labour market distortion, the resources spent on offshoring can be wasteful from a social planner's point of view. With total (domestic plus foreign) labour demand increased by the offshoring firms, trade in tasks is accompanied by a shift of labour towards high-productivity firms, which by itself is beneficial to social welfare. However, it is not guaranteed that the positive reallocation effect is strong enough to dominate the efficiency loss from the increase in monopsony power, and trade in tasks unlike trade in goods can therefore lead to an aggregate welfare loss.

In an extension we show that the important trade-off between an efficiency gain from the reallocation of labour towards high-productivity firms and the efficiency loss arising because offshoring increases the scope for these firms to exercise their monopsony power also exists if all offshoring firms are at the same time exporters. Furthermore, the key insight that, unlike trade in goods, trade in tasks between symmetric countries can lower welfare remains valid when allowing for offshoring of production as well as headquarter tasks. However, trade in tasks is unambiguously beneficial if countries are strongly asymmetric and the foreign economy does not produce goods itself but serves as an unskilled labour reservoir for the performance of tasks offshored by domestic producers. Capturing the case of North-South offshoring, the cost-saving effect of offshoring in this model variant is sufficiently large to dominate any efficiency loss from increasing the scope for high-productivity firms to exercise their monopsony power.

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A Appendix

A.1 Deriving the parameter domains for coexistence of different firms

To determine the parameter domains listed in the main text, we first introduce three auxiliary variables which allow us to distinguish all possible rankings of the five cutoff productivities in Eqs. (15) and (16) by ranking $f_e(\omega)$ relative to these auxiliary variables. We define *(i)* $f_e^1(\omega) \equiv \frac{f_o(\omega)}{\hat{\kappa}_e^\xi}\frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$, *(ii)* $f_e^2(\omega) \equiv f_o(\omega)\frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$, and *(iii)* $f_e^3(\omega) \equiv f_o(\omega)\hat{\kappa}_o^\xi\frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$, with $f_e^1(\omega) < f_e^2(\omega) < f_e^3(\omega)$. This allows us to determine the following rankings of productivity cutoffs: If $f_e(\omega) \leq f_e^1(\omega)$, then $\varphi_e(\omega) \leq \varphi_{eo}^d(\omega) < \varphi_o(\omega)$ and $\varphi_e < \varphi_{eo}^e$. This establishes parameter domain one in the main text. If $f_e(\omega) \in (f_e^1(\omega), f_e^3(\omega))$, then $\varphi_{eo}^d(\omega) < \varphi_o(\omega), \varphi_e(\omega)$, which establishes parameter domain two in the main text.[20] If $f_e(\omega) \geq f_e^3(\omega)$, then $\varphi_o(\omega) \leq \varphi_{eo}^d(\omega) < \varphi_o(\omega)$ and $\varphi_o(\omega) < \varphi_{eo}^o(\omega)$. This establishes parameter domain three in the main text and completes the proof.

A.2 Proof of Proposition 2

Let $f_i(\omega) = \mu_i(\omega)f(\omega)$ for $i = e, o$. Then, setting $\mu_e(\omega) = 1$ and $\mu_o(\omega) = \mu$ for firms drawing a ball with label e, we compute $f_e(\omega) >,=,< f_e^1(\omega)$ if $1 >,=,< \frac{\mu}{\hat{\kappa}_e^\xi}\frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$, $f_e(\omega) >,=,< f_e^2(\omega)$ if $1 >,=,< \mu\frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$, and $f_e(\omega) >,=,< f_e^3(\omega)$ if $1 >,=,< \mu\hat{\kappa}_o^\xi\frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$. Setting $\mu > \hat{\kappa}_e^\xi\frac{\hat{\kappa}_o^\xi-1}{\hat{\kappa}_e^\xi-1}$ therefore implies $f_e(\omega) < f_e^1(\omega)$ and thus $\varphi_o(\omega) \leq \varphi_{eo}^d(\omega) < \varphi_{eo}^o(\omega)$ and $\varphi_e(\omega) \leq \varphi_{eo}^e(\omega)$. This implies that firms drawing a ball labelled e choose domestic production if $\varphi(\omega) \in [\varphi_d, \varphi_e(\omega))$, exporting if $\varphi(\omega) \in [\varphi_e, \varphi_{eo}^e)$ and exporting plus offshoring if $\varphi(\omega) \geq \varphi_{eo}^e$. Similarly, for firms drawing a ball with label o, we compute $f_e(\omega) >,=,< f_e^1(\omega)$ if $\mu >,=,< \frac{1}{\hat{\kappa}_e^\xi}\frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$, $f_e(\omega) >,=,< f_e^2(\omega)$ if $\mu >,=,< \frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$, and $f_e(\omega) >,=,< f_e^3(\omega)$ if $\mu >,=,< \hat{\kappa}_o^\xi\frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$. Setting $\mu > \hat{\kappa}_o^\xi\frac{\hat{\kappa}_e^\xi-1}{\hat{\kappa}_o^\xi-1}$ then implies that firms drawing a ball labelled o are domestic producers if $\varphi(\omega) \in [\varphi_d, \varphi_o(\omega))$, pure offshorers if $\varphi(\omega) \in [\varphi_o, \varphi_{eo}^o(\omega))$ and offshoring exporters if $\varphi(\omega) \geq \varphi_{eo}^o(\omega)$. This completes the first part of the proof.

To determine the rankings of $\varphi_d, \min\{\varphi_e(\omega)\}$, and $\min\{\varphi_o(\omega)\}$, we first note that, by assumption, the least productive firms do neither export nor offshore. Second, we can note that there exist unique threshold values $\min\{\varphi_e(\omega)\} = \varphi_e(\omega)$ if $f_e(\omega) = f_d$ and $\min\{\varphi_o(\omega)\} = \varphi_o(\omega)$ if $f_o(\omega) = f_d$. Then, contrasting productivity cutoffs $\varphi_e(\omega), \varphi_o(\omega)$ in Eq. (15) for $\hat{\kappa}_e^\xi > \hat{\kappa}_o^\xi$ establishes $\min\{\varphi_e(\omega)\} < \min\{\varphi_o(\omega)\}$. Furthermore, from the formal analysis in Appendix A.1 we know that under the considered parameter domain $\varphi_e(\omega) < \varphi_{eo}^e(\omega)$ and $\varphi_o(\omega) < \varphi_{eo}^o(\omega)$. However this does not restrict the ranking of $\min\{\varphi_o(\omega)\}$ and $\min\{\varphi_{eo}^e(\omega)\}$. From Eqs. (15) and (16) we compute $\min\{\varphi_{eo}^e(\omega)\} >,=,< \min\{\varphi_o(\omega)\}$ if $\mu >,=,< \hat{\kappa}_e^\xi$. This completes the second part of the proof

[20] We further have $\varphi_o(\omega) >,=,< \varphi_e(\omega)$ if $f(\omega) >,=,< f_e^2(\omega)$, but this is irrelevant because in the respective parameter domain pure exporters and pure offhorers do not exist.

with the two parts together establishing Proposition 2.

A.3 Derivation details for Eqs. (17) to (20)

The ex ante probability of drawing a ball with label e and becoming an offshoring exporter conditional on drawing a productivity not lower than φ_d is denoted χ_{eo}^e and given by

$$\chi_{eo}^e = \rho \int_{f_d}^{\infty} \int_{\varphi_{eo}^e(\omega)}^{\infty} \frac{dG(\varphi)}{1 - G(\varphi_d)} dF(f). \tag{A.1}$$

Combining the threshold $\varphi_{eo}^e(\omega)$ from Eq. (16) with our assumption that $f_i(\omega) = \mu_i(\mu)f(\omega)$ for $i = e, o$, we can compute $\int_{\varphi_{eo}^e(\omega)}^{\infty} \frac{dG(\varphi)}{1-G(\varphi_d)} = \left[\frac{\mu f(\omega)}{f_d} \frac{1}{\hat{\kappa}_e^{\xi}(\hat{\kappa}_o^{\xi}-1)}\right]^{-\frac{g}{\xi}}$. Substituting this expression into Eq. (A.1) and accounting for the definition of $\tilde{f}$ in Eq. (19), allows us to solve for χ_{eo}^e as given in Eq. (20).

The ex ante probability of drawing a ball with label o and becoming an offshoring exporter conditional on drawing a productivity not lower than φ_d is denoted χ_{eo}^o and given by

$$\chi_{eo}^o = (1-\rho) \int_{f_d}^{\infty} \int_{\varphi_{eo}^o(\omega)}^{\infty} \frac{dG(\varphi)}{1 - G(\varphi_d)} dF(f). \tag{A.2}$$

Combining the threshold $\varphi_{eo}^o(\omega)$ from Eq. (16) with our assumption that $f_i(\omega) = \mu_i(\omega)f(\omega)$ for $i = e, o$, we can compute $\int_{\varphi_{eo}^o(\omega)}^{\infty} \frac{dG(\varphi)}{1-G(\varphi_d)} = \left[\frac{\mu f(\omega)}{f_d} \frac{1}{\hat{\kappa}_o^{\xi}(\hat{\kappa}_e^{\xi}-1)}\right]^{-\frac{g}{\xi}}$. Substituting this expression into Eq. (A.2) and accounting for the definition of $\tilde{f}$in Eq. (19), allows us to solve for χ_{eo}^o as given in Eq. (20).

The ex ante probability of drawing a ball with label e and becoming exporter conditional on drawing a productivity not lower than φ_d and given by

$$\chi_e = \rho \int_{f_d}^{\infty} \int_{\varphi_e(\omega)}^{\infty} \frac{dG(\varphi)}{1 - G(\varphi_d)} dF(f) - \chi_{eo}^e. \tag{A.3}$$

Combining the threshold $\varphi_e(\omega)$ from Eq. (15) with our assumption that $f_i(\omega) = \mu_i(\mu)f(\omega)$ for? $i = e, o$, we can compute $\int_{\varphi_e(\omega)}^{\infty} \frac{dG(\varphi)}{1-G(\varphi_d)} = \left[\frac{f(\omega)}{f_d} \frac{1}{\hat{\kappa}_e^{\xi}-1}\right]^{-\frac{g}{\xi}}$. Substituting this expression into Eq. (A.3) and accounting for the definition of $\tilde{f}$ in Eq. (19), while replacing χ_{eo}^e by the respective expression in Eq. (20), allows us to solve for χ_e as given in Eq. (17).

The ex ante probability of drawing a ball with label o and becoming exporter conditional on drawing a productivity not lower than φ_d and given by

$$\chi_o = (1-\rho) \int_{f_d}^{\infty} \int_{\varphi_o(\omega)}^{\infty} \frac{dG(\varphi)}{1 - G(\varphi_d)} dF(f) - \chi_{eo}^o. \tag{A.4}$$

Combining the threshold $\varphi_o(\omega)$ from Eq. (15) with our assumption that $f_i(\omega) = \mu_i(\omega)f(\omega)$ for

$i = e, o$, we compute $\int_{\varphi_o(\omega)}^{\infty} \frac{dG(\varphi)}{1-G(\varphi_d)} = \left[\frac{f(\omega)}{f_d}\frac{1}{\hat{\kappa}_o^{\xi}-1}\right]^{-\frac{g}{\xi}}$. Substituting this expression into Eq. (A.4) and accounting for the definition of $\tilde{f}$ in Eq. (19), while replacing χ_{eo}^{e} by the respective expression in Eq. (20), allows us to solve for χ_o as given in Eq. (18). This completes the proof.

A.4 Derivation details for Eq. (21)

The expected operating profits of active producers are given by $\tilde{\pi} = (1-\gamma)[\rho\zeta_e + (1-\rho)\zeta_o]$, with

$$\begin{aligned}\zeta_e \equiv & \int_{f_d}^{\infty}\int_{\varphi_d}^{\varphi_e(\omega)} r(\omega)\frac{dG(\varphi)}{1-G(\varphi_d)}dF(f) + \int_{f_d}^{\infty}\int_{\varphi_e(\omega)}^{\varphi_{eo}^{e}(\omega)} r(\omega)\frac{dG(\varphi)}{1-G(\varphi_d)}dF(f) \\ & + \int_{f_d}^{\infty}\int_{\varphi_{eo}^{e}(\omega)}^{\infty} r(\omega)\frac{dG(\varphi)}{1-G(\varphi_d)}dF(f), \end{aligned} \quad (A.5)$$

$$\begin{aligned}\zeta_o \equiv & \int_{f_d}^{\infty}\int_{\varphi_d}^{\varphi_o(\omega)} r(\omega)\frac{dG(\varphi)}{1-G(\varphi_d)}dF(f) + \int_{f_d}^{\infty}\int_{\varphi_o(\omega)}^{\varphi_{eo}^{o}(\omega)} r(\omega)\frac{dG(\varphi)}{1-G(\varphi_d)}dF(f) \\ & + \int_{f_d}^{\infty}\int_{\varphi_{eo}^{o}(\omega)}^{\infty} r(\omega)\frac{dG(\varphi)}{1-G(\varphi_d)}dF(f). \end{aligned} \quad (A.6)$$

We refer to r_d as the revenues of the domestic producer with the lowest labour productivity $\varphi(\omega) = \varphi_d$ and substitute the thresholds $\varphi_e(\omega)$ and $\varphi_o(\omega)$ from Eq. (15) and the thresholds $\varphi_{eo}^{e}(\omega)$ and $\varphi_{eo}^{o}(\omega)$ from Eq. (16) to solve for

$$\zeta_e = r_d\frac{g}{g-\xi}\int_{f_d}^{\infty}\left\{1 + \left[\frac{f(\omega)}{f_d}\frac{1}{\hat{\kappa}_e^{\xi}-1}\right]^{1-\frac{g}{\xi}}(\hat{\kappa}_e^{\xi}-1) + \left[\mu\frac{f(\omega)}{f_d}\frac{1}{\hat{\kappa}_e^{\xi}(\hat{\kappa}_o^{\xi}-1)}\right]^{1-\frac{g}{\xi}}\hat{\kappa}_e^{\xi}(\hat{\kappa}_o^{\xi}-1)\right\}dF(f),$$

$$\zeta_o = r_d\frac{g}{g-\xi}\int_{f_d}^{\infty}\left\{1 + \left[\frac{f(\omega)}{f_d}\frac{1}{\hat{\kappa}_o^{\xi}-1}\right]^{1-\frac{g}{\xi}}(\hat{\kappa}_o^{\xi}-1) + \left[\mu\frac{f(\omega)}{f_d}\frac{1}{\hat{\kappa}_o^{\xi}(\hat{\kappa}_e^{\xi}-1)}\right]^{1-\frac{g}{\xi}}\hat{\kappa}_o^{\xi}(\hat{\kappa}_e^{\xi}-1)\right\}dF(f).$$

Using the definition of $\bar{f}$ in Eq. (23) together with χ_{eo}^{e} and χ_{eo}^{o} from Eq. (20), χ_e from Eq. (17), as well as χ_o from Eq. (18), allows us to solve for

$$\tilde{\pi} = \frac{gsf_d}{g-\xi}\Delta(\hat{\kappa}_e, \hat{\kappa}_o), \quad (A.7)$$

in which

$$\begin{aligned}\Delta(\hat{\kappa}_e, \hat{\kappa}_o) \equiv 1 + \left(\frac{\tilde{f}}{\bar{f}}\right)^{\frac{g-\xi}{\xi}} \Bigg[& \rho\left(\hat{\kappa}_e^{\xi}-1\right)\left(\frac{\chi_e+\chi_{eo}^{e}}{\rho}\right)^{\frac{g-\xi}{g}} + (1-\rho)\left(\hat{\kappa}_o^{\xi}-1\right)\left(\frac{\chi_o+\chi_{eo}^{o}}{1-\rho}\right)^{\frac{g-\xi}{g}} \\ & + \rho\hat{\kappa}_e^{\xi}\left(\hat{\kappa}_o^{\xi}-1\right)\left(\frac{\chi_{eo}^{e}}{\rho}\right)^{\frac{g-\xi}{g}} + (1-\rho)\hat{\kappa}_o^{\xi}\left(\hat{\kappa}_e^{\xi}-1\right)\left(\frac{\chi_{eo}^{o}}{\rho}\right)^{\frac{g-\xi}{g}}\Bigg] \end{aligned} \quad (A.8)$$

can be alternatively expressed as in Eq. (22).

The average fixed cost expenditures of active firms for production, exporting, and offshoring are given by $sf_d + s\rho\widetilde{F}_e + s(1-\rho)\widetilde{F}_o$, with

$$\widetilde{F}_e \equiv \int_{f_d}^{\infty} f(\omega)\left[\frac{\varphi_e(\omega)}{\varphi_d}\right]^{-g} dF(f) + \mu\int_{f_d}^{\infty} f(\omega)\left[\frac{\varphi_{eo}^e(\omega)}{\varphi_d}\right]^{-g} dF(f),$$
$$\widetilde{F}_o \equiv \int_{f_d}^{\infty} f(\omega)\left[\frac{\varphi_o(\omega)}{\varphi_d}\right]^{-g} dF(f) + \mu\int_{f_d}^{\infty} f(\omega)\left[\frac{\varphi_{eo}^o(\omega)}{\varphi_d}\right]^{-g} dF(f).$$

Substituting $\varphi_e(\omega), \varphi_o(\omega)$ from Eq. (15) and $\varphi_{eo}^e(\omega), \varphi_{eo}^o(\omega)$ from Eq. (16), using the definition of $\bar{f}$ from Eq. (23) and accounting for the fraction of exporters, offshorers, and offshoring exporters in Eqs. (17)-(20) allows us to solve for

$$sf_d + s\rho\widetilde{F}_e + s(1-\rho)\widetilde{F}_o = sf_d\Delta(\hat{\kappa}_e, \hat{\kappa}_o). \tag{A.9}$$

Together the Eqs. (A.7) and (A.9) can be used to solve for the ex ante expected profits of potential entrants $[1 - G(\varphi_d)][\tilde{\pi} - sf_d + s\rho\tilde{F}_e + s(1-\rho)\tilde{F}_o] - sf_m$, which take the same form as in Eq. (21). This completes the proof.

A.5 Determining the lowest skilled and unskilled wages in home

From Eq. (13), we know that skilled wages increase in $\varphi(\omega)$, $\kappa_e(\omega)$, and $\kappa_o(\omega)$. Due to the selection of firms into exporting and offshoring, this is sufficient to ensure that the firm with a total labour productivity $\varphi(\omega) = \varphi_d$ pays the lowest wage for skilled workers (among the firms that employ skilled workers at home). Since unskilled wages also increase with $\varphi(\omega)$ and $\kappa_e(\omega)$, it is clear that the domestic firm with a total labour productivity equal to φ_d pays lower wages than domestic firms with higher productivity or pure exporters. Also, the pure offshorer with the lowest productivity, which, according to Eq. (15), is given by $\varphi_o \equiv \varphi_d(\hat{\kappa}_o^{\xi} - 1)^{-\frac{1}{\xi}}$ pays lower wages than all offshoring exporters, which are more productive and serve the domestic as well as the foreign market. Accordingly, the firm paying the lowest unskilled wage can either be the domestic producer with a total labour productivity equal to φ_d or the offshoring firm with a total labour productivity equal to $\varphi_o > \varphi_d$. Thereby, we have to distinguish offshoring plants of domestic and foreign producers, which in a symmetric equilibrium belong to firms with the same cutoff productivity φ_o.

Let us denote the unskilled wages of the local and the foreign plant of a domestic offshoring firm with total labour productivity φ_o by w_l^o, w_l^{o*}, respectively. We can infer from derivations similar to those leading to Eq. (13) that $w_l^{o*} = w_l^o\left[\hat{\kappa}_o^{\xi(1-\varepsilon_l)} - 1\right]^{\theta}$. Noting from Eq. (11) that $A_l^*\tau_o^{-\frac{1}{\theta}} < A_l$ establishes $\hat{\kappa}_o^{\xi(1-\varepsilon_l)} \in (1,2)$, it follows that $w_l^{o*} < w_l^o$. With the unskilled wage of the domestic firm with total labour productivity φ_d given by w_l^d, we moreover have $w_l^{o*} >,=,< w_d$ if $\left(\frac{\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi} - 1}\right)^{\theta} >,=,< 1$, where $\frac{\varphi_o}{\varphi_d} = (\hat{\kappa}_o^{\xi} - 1)^{-\frac{1}{\xi}}$ has been acknowledged. Noting that $\varepsilon_l < 0$

establishes $\hat{\kappa}_o^{\xi\varepsilon_l} < 1$, we can safely conclude that $w_l^{o*} > w_l^d$. This completes the proof.

A.6 Derivation and discussion of Eq. (28)

We can first note that total domestic plus foreign type-j employment of pure offshorers and offshoring exporters are given by

$$\ell_j^o(\omega) = \ell_d^j \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \hat{\kappa}_o^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_o^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\}, \tag{A.10}$$

and

$$\ell_j^{eo}(\omega) = \ell_d^j \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \hat{\kappa}_e^{(1-\theta)\xi} \hat{\kappa}_o^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_o^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\}, \tag{A.11}$$

respectively, where ℓ_d^j denotes type-j employment by a domestic producer with total labour productivity φ_d. With two symmetric countries sector-wide manufacturing employment equals $L_j^m \equiv \rho\lambda_{je} + (1-\rho)\lambda_{jo}$, with

$$\begin{aligned}
\lambda_{je} \equiv\ & M\ell_j^d \int_{f_d}^{\infty} \int_{\varphi_d}^{\varphi_e(\omega)} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) \\
&+ M\ell_j^d \hat{\kappa}_e^{(1-\theta)\xi} \int_{f_d}^{\infty} \int_{\varphi_e(\omega)}^{\varphi_{eo}^e(\omega)} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) \\
&+ M\ell_j^d \hat{\kappa}_e^{(1-\theta)\xi} \hat{\kappa}_o^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_o^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\} \int_{f_d}^{\infty} \int_{\varphi_{eo}^e(\omega)}^{\infty} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f),
\end{aligned}$$

and

$$\begin{aligned}
\lambda_{jo} \equiv\ & M\ell_j^d \int_{f_d}^{\infty} \int_{\varphi_d}^{\varphi_o(\omega)} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) \\
&+ M\ell_j^d \hat{\kappa}_o^{(1-\theta)\xi\varepsilon_j} \left[1 + \left(\hat{\kappa}_o^{\xi(1-\varepsilon_j)} - 1\right)^{1-\theta}\right] \int_{f_d}^{\infty} \int_{\varphi_o(\omega)}^{\varphi_{eo}^o(\omega)} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) \\
&+ M\ell_j^d \hat{\kappa}_e^{(1-\theta)\xi} \hat{\kappa}_o^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_o^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\} \int_{f_d}^{\infty} \int_{\varphi_{eo}^o(\omega)}^{\infty} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f).
\end{aligned}$$

We further compute

$$\int_{f_d}^{\infty} \int_{\varphi_d}^{\infty} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) = \frac{g}{g-(1-\theta)\xi}, \tag{A.12}$$

and

$$\int_{f_d}^{\infty} \int_{\varphi_e(\omega)}^{\infty} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) = \frac{g}{g-(1-\theta)\xi} \left(\frac{\chi_e + \chi_{eo}^e}{\rho}\right)^{\frac{g-(1-\theta)\xi}{g}} \left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g-(1-\theta)\xi}{\xi}}, \tag{A.13}$$

as well as

$$\int_{f_d}^{\infty}\int_{\varphi_{eo}^{e}(\omega)}^{\infty}\left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}dF(f)=\frac{g}{g-(1-\theta)\xi}\left(\frac{\chi_{eo}^{e}}{\rho}\right)^{\frac{g-(1-\theta)\xi}{g}}\left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g-(1-\theta)\xi}{\xi}}, \quad \text{(A.14)}$$

where

$$\hat{f}\equiv\left[\int_{f_d}^{\infty}f^{-\frac{g-(1-\theta)\xi}{\xi}}dF(f)\right]^{-\frac{\xi}{g-(1-\theta)\xi}}. \quad \text{(A.15)}$$

In a similar vein, we can compute

$$\int_{f_d}^{\infty}\int_{\varphi_{o}(\omega)}^{\infty}\left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}dF(f)=\frac{g}{g-(1-\theta)\xi}\left(\frac{\chi_o+\chi_{eo}^{o}}{1-\rho}\right)^{\frac{g-(1-\theta)\xi}{g}}\left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g-(1-\theta)\xi}{\xi}}, \quad \text{(A.16)}$$

and

$$\int_{f_d}^{\infty}\int_{\varphi_{eo}^{o}(\omega)}^{\infty}\left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}dF(f)=\frac{g}{g-(1-\theta)\xi}\left(\frac{\chi_{eo}^{o}}{1-\rho}\right)^{\frac{g-(1-\theta)\xi}{g}}\left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g-(1-\theta)\xi}{\xi}}. \quad \text{(A.17)}$$

Substituting Eqs. (A.12) to (A.17) into $L_j^m\equiv\rho\lambda_{je}+(1-\rho)\lambda_{jo}$ yields L_j^m as given in Eq. (28), with

$$\begin{aligned}\Lambda_j(\hat{\kappa}_e,\hat{\kappa}_o)\equiv 1+\left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g-(1-\theta)\xi}{\xi}}&\left(\rho\left\{\left[\hat{\kappa}_e^{(1-\theta)\xi}-1\right]\left(\frac{\chi_e+\chi_{eo}^{e}}{\rho}\right)^{\frac{g-(1-\theta)\xi}{g}}\right.\right.\\&\left.+\hat{\kappa}_e^{(1-\theta)\xi}\left[\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_j}\left\{1+\left[\hat{\kappa}_o^{\xi(1-\varepsilon_j)}-1\right]^{1-\theta}\right\}-1\right]\left(\frac{\chi_{eo}^{e}}{\rho}\right)^{\frac{g-(1-\theta)\xi}{g}}\right\}\\&+(1-\rho)\left\{\hat{\kappa}_e^{(1-\theta)\xi}\left[\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_j}\left\{1+\left[\hat{\kappa}_o^{\xi(1-\varepsilon_j)}-1\right]^{1-\theta}\right\}-1\right]\left(\frac{\chi_o+\chi_{eo}^{o}}{1-\rho}\right)^{\frac{g-(1-\theta)\xi}{g}}\right.\\&\left.\left.+\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_j}\left\{1+\left[\hat{\kappa}_o^{\xi(1-\varepsilon_j)}-1\right]^{1-\theta}\right\}\left[\hat{\kappa}_e^{(1-\theta)\xi}-1\right]\left(\frac{\chi_{eo}^{o}}{1-\rho}\right)^{\frac{g-(1-\theta)\xi}{g}}\right\}\right).\end{aligned} \quad \text{(A.18)}$$

Noting that $\varepsilon_h=1$ and $\varepsilon_l=1-\frac{1}{\alpha_l\theta}<0$, we find that $\Lambda_h(\cdot)<\Lambda_l(\cdot)$ because $\hat{\kappa}_o^{\xi(1-\varepsilon_j)(1-\theta)}-1<[\hat{\kappa}_o^{\xi(1-\varepsilon_j)}]^{1-\theta}$. Moreover, using the alternative way to express $\Delta(\cdot)$ from Eq. (A.8) we find that $\Delta(\hat{\kappa}_e,\hat{\kappa}_o)>\Lambda_h(\hat{\kappa}_e,\hat{\kappa}_o)$ is implied by $\tilde{f}>\hat{f}>\bar{f}$. Also, note that the ranking of $\Delta(\hat{\kappa}_e,\hat{\kappa}_o)$ and $\Lambda_l(\hat{\kappa}_e,\hat{\kappa}_o)$ is *a priori* not clear. This completes the proof.

A.7 Derivation details for Eqs. (29) to (31)

Using our technology in Eq. (1), we get for the domestic producer with a total factor productivity of φ_d, $\pi_d/(1-\gamma)=A_q^{\frac{1}{\sigma}}\left[\beta\varphi_d(\ell_h^d)^{\alpha_h}(\ell_l^d)^{\alpha_l}\right]^{\frac{\sigma-1}{\sigma}}\equiv r_d$. Substituting $A_q=Y=\frac{g}{g-\xi}\Delta(\cdot)Mr_d$ (from

Appendix A.4) and accounting for $\ell_j^d = \alpha_j \gamma r_d / w_j^d$ from Eqs. (6) and (7), we can compute

$$r_d = \left[\frac{g}{g-\xi}\Delta(\cdot)Mr_d\right]^{\frac{1}{\sigma}} \left[\beta\varphi_d \left(\frac{\alpha_h}{w_h^d}\right)^{\alpha_h} \left(\frac{\alpha_l}{w_l^d}\right)^{\alpha_l} \gamma r_d\right]^{\frac{\sigma-1}{\sigma}}. \tag{A.19}$$

Accounting for $\beta = \prod_{j=h,l} \alpha_j^{-\alpha_j(1-\theta)}$, $\ell_l^s = \alpha_l \left(w_h^d / w_l^d\right)^{\alpha_h}$, and substituting $\alpha_j \pi_d = w_j^d \ell_j^s f_d$, we obtain

$$\pi_d = \gamma f_d \varphi_d \beta^{-\frac{\theta}{1-\theta}} \left[\frac{g}{g-\xi}\Delta(\cdot)M\right]^{\frac{1}{\sigma-1}} = \frac{1}{\alpha_j} w_j^d \ell_j^s f_d. \tag{A.20}$$

Furthermore, accounting for $\ell_j^d = \frac{\gamma}{1-\gamma}\ell_j^s f_d$ from Eq. (26) and combining Eqs. (27), (28) with the labour market-clearing condition $L_j^s + L_j^m = N_j$, we can solve for

$$f_d \ell_j^s = \frac{g-\xi}{g} N_j \left\{\left[\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)\right] M\right\}^{-1}. \tag{A.21}$$

Substitution into Eq. (A.20), then gives

$$w_j^d = \frac{\alpha_j}{N_j}\left[\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)\right] \frac{\gamma f_d \varphi_d}{\Delta(\cdot)} \beta^{-\frac{\theta}{1-\theta}} \left[\frac{g}{g-\xi}\Delta(\cdot)M\right]^{\frac{\sigma}{\sigma-1}} \tag{A.22}$$

Dividing w_h^d by w_l^d establishes Eq. (30). Substituting Eq. (30) into $\ell_h^s = \alpha_h \left(w_l^d / w_h^d\right)^{\alpha_l}$, and $\ell_l^s = \alpha_l \left(w_h^d / w_l^d\right)^{\alpha_h}$, we further obtain

$$\ell_j^s = \frac{N_j}{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)} \prod_{j=h,l} \left[\frac{N_j/\alpha_j}{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_h(\cdot)}\right]^{-\alpha_j} \tag{A.23}$$

Substituting Eq. (A.23) into Eq. (A.21), we can solve for the mass of firms in Eq. (31). Multiplying Eqs. (A.23) and (31) and substituting the resulting expression into Eq. (27) gives L_j^s in Eq. (29). Finally, L_j^m follows from the resource constraint $L_j^s + L_j^m = N_j$. This completes the proof.

A.8 Derivation of Eq. (33)

Substituting Eq. (21) into zero-profit condition $\mathrm{E}[\psi] = 0$, we compute

$$\varphi_d = \left[\frac{\xi}{g-\xi}\frac{f_d}{f_m}\Delta(\cdot)\right]^{\frac{1}{g}}. \tag{A.24}$$

Substituting φ_d from Eq. (A.24) and M from Eq. (31) into Eq. (A.22), we obtain Eq. (33). This completes the proof.

A.9 Proof of Proposition 3

From the observation that χ_e, χ_o, and χ_{eo} are identical in the two economies, we can infer that both exporting and offshoring are two-way in our model. Furthermore, the effects of openness on the skill intensities in services and manufacturing are derived for the limiting cases of exclusive exporting and exclusive offshoring, respectively. Capturing exclusive exporting by the limiting case of $\hat{\kappa}_o \to 1$, we can infer from Eqs. (17), (22), and (A.18) that[21]

$$\Delta(\hat{\kappa}_e, 1) = 1 + \left(\frac{\overline{f}}{f_d}\right)\left(\frac{\tilde{f}}{\overline{\overline{f}}}\right)^{\frac{g}{\xi}} \chi_e \quad \text{and} \quad \Lambda_j(\hat{\kappa}_e, 1) = 1 + \left(\frac{\hat{f}}{f_d}\right)^{1-\theta}\left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g}{\xi}} \frac{\hat{\kappa}_e^{(1-\theta)\xi} - 1}{(\hat{\kappa}_e^{\xi} - 1)^{1-\theta}}\chi_e. \quad (A.25)$$

This establishes $\Lambda_h(\hat{\kappa}_e, 1) = \Lambda_l(\hat{\kappa}_e, 1)$ and implies that $L_h^s/L_l^s = L_h^m/L_l^m = N_h/N_m$ from the closed economy continues to hold in an open economy with identical countries and exclusive exporting.

With exclusive offshoring due to $\hat{\kappa}_e \to 1$ we obtain[22]

$$\Delta(1, \hat{\kappa}_o) = 1 + \left(\frac{\overline{f}}{f_d}\right)\left(\frac{\tilde{f}}{\overline{\overline{f}}}\right)^{\frac{g}{\xi}} \chi_o \quad \text{and} \quad \Lambda_h(1, \hat{\kappa}_o) = 1 + \left(\frac{\hat{f}}{f_d}\right)^{1-\theta}\left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g}{\xi}} \frac{\hat{\kappa}_o^{(1-\theta)\xi} - 1}{(\hat{\kappa}_o^{\xi} - 1)^{1-\theta}}\chi_o,$$
$$\Lambda_l(1, \hat{\kappa}_o) = 1 + \left(\frac{\hat{f}}{f_d}\right)^{1-\theta}\left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g}{\xi}} \frac{\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_l}\left\{1 + \left[\hat{\kappa}_o^{\xi(1-\varepsilon_l)} - 1\right]^{1-\theta}\right\} - 1}{\left(\hat{\kappa}_o^{\xi} - 1\right)^{1-\theta}}\chi_o \quad (A.26)$$

from Eqs. (18), (22) and (A.18). Eq. (A.26) shows that the ranking of $\Lambda_h(\cdot) < \Lambda_l(\cdot)$ extends to the limiting case of exclusive offshoring. In this case, we have $L_h^s/L_l^s > N_h/N_l > L_h^m/L_l^m$. Of course, the factor intensity ranking of the two sectors extends to positive levels of exporting, because $\Lambda_h(\cdot) < \Lambda_l(\cdot)$ is not restricted to the limiting case of $\hat{\kappa}_e \to 1$. This completes the proof of Proposition 3.

A.10 Proof of Proposition 4

Proposition 4 is derived for the limiting cases of exclusive exporting and exclusive offshoring. Capturing exclusive exporting by $\hat{\kappa}_e \to 1$, we can infer $\Delta(\hat{\kappa}_e, 1) > \Lambda_j(\hat{\kappa}_e, 1)$ from Eq. (A.25) and the observations that $\hat{\kappa}_e^{\xi(1-\theta)} - 1 < (\hat{\kappa}_e^{\xi} - 1)^{1-\theta}$ and that $\hat{f}^{(1-\theta)-\frac{g}{\xi}} - f_d^{-\theta}\bar{f}^{1-\frac{g}{\xi}} < 0$ (see Eqs. (23) and (A.15)). This is sufficient for $w_j^d > (w_j^d)^a$, according to Eq. (33), where index a is used to indicate an autarky variable with $\Delta(\cdot) = \Lambda_j(\cdot) = 1$.

Let us now consider the case of exclusive offshoring, due to $\hat{\kappa}_e \to 1$. For the purpose of easier tractability, we impose the assumption that fixed cost parameter f is Pareto distributed over

[21] From the Parameter constraint in Proposition 2, we can infer that $\hat{\kappa}_o \to 1$ establishes $\mu \to \infty$ and thus $\chi_{eo}^o = 0$ along with $\chi_o = \chi_{eo}^e = 0$.

[22] From the Parameter constraint in Proposition 2, we can infer that $\hat{\kappa}_e \to 1$ establishes $\mu \to \infty$ and thus $\chi_{eo}^e = 0$ along with $\chi_e = \chi_{eo}^o = 0$.

interval $[f_d, \infty)$ with shape parameter g and compute for this specification

$$\tilde{f} = \left(\frac{\xi}{1+\xi}\right)^{-\frac{\xi}{g}} f_d, \quad \bar{f} = \left[\frac{\xi g}{g(1+\xi)-\xi}\right]^{\frac{\xi}{\xi-g}} f_d, \quad \text{and} \quad \hat{f} = \left[\frac{\xi g}{g(1+\xi)-(1-\theta)\xi}\right]^{\frac{\xi}{(1-\theta)\xi-g}} f_d. \tag{A.27}$$

Substituting $\tilde{f}$, $\bar{f}$, and $\hat{f}$ from above into Eq. (A.26) and accounting for $\chi_o = (1-\rho)(f_d/\tilde{f})^{\frac{g}{\xi}}(\hat{\kappa}_o^{\xi} - 1)^{\frac{g}{\xi}}$ allows us to solve for

$$\Delta(1,\hat{\kappa}_o) = 1 + \frac{\xi g(1-\rho)}{g(1+\xi)-\xi}\left(\hat{\kappa}_o^{\xi}-1\right)^{\frac{g}{\xi}}, \quad \Lambda_h(1,\hat{\kappa}_o) = 1 + \frac{\xi g(1-\rho)}{g(1+\xi)-(1-\theta)\xi}\frac{\hat{\kappa}_o^{(1-\theta)\xi}-1}{\left(\hat{\kappa}_o^{\xi}-1\right)^{1-\theta}}\left(\hat{\kappa}_o^{\xi}-1\right)^{\frac{g}{\xi}},$$

$$\Lambda_l(1,\hat{\kappa}_o) = 1 + \frac{\xi g(1-\rho)}{g(1+\xi)-(1-\theta)\xi}\frac{\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_l}\left\{1+\left[\hat{\kappa}_o^{\xi(1-\varepsilon_l)}-1\right]^{1-\theta}\right\}-1}{\left(\hat{\kappa}_o^{\xi}-1\right)^{1-\theta}}\left(\hat{\kappa}_o^{\xi}-1\right)^{\frac{g}{\xi}}.$$

In the two limiting cases $\varepsilon_l \to 0$ and $\varepsilon_l \to -\infty$, we compute $\Lambda_l(1,\hat{\kappa}_o) < \Delta(1,\hat{\kappa}_o)$, and in these cases $w_j^d > (w_j^d)^a$ follows from Eq. (33). To see this, we can note from the main text that $\Lambda_h(\cdot) < \Lambda_l(\cdot)$ holds for all finite values of ε_l, whereas $\Lambda_h(\cdot) = \Lambda_l(\cdot)$ is obtained if $\varepsilon_l \to -\infty$. Furthermore, we can infer from Eq. (30) that $w_h^d/w_l^d < \left(w_h^d/w_l^d\right)^a$ if $\Lambda_h(\cdot) < \Lambda_l(\cdot)$ and that $w_h^d/w_l^d = \left(w_h^d/w_l^d\right)^a$ if $\Lambda_h(\cdot) = \Lambda_l(\cdot)$. Evaluating Eq. (33) for $j = h$, we obtain

$$\frac{w_h^d}{(w_h^d)^a} \geq \Delta(\cdot)^{\frac{1}{g}}\left[\prod_{j=l,h}\left(\frac{\Delta(\cdot)\left[1+\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\right]}{\Delta(\cdot)+\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)}\right)^{\alpha_j}\right]^{\frac{1}{\sigma-1}},$$

with the inequality holding strictly if $\Lambda_h(\cdot) < \Lambda_l(\cdot)$. In the limiting cases $\varepsilon_l \to 0$ and $\varepsilon_l \to -\infty$, we have $\Lambda_h(\cdot), \Lambda_l(\cdot) < \Delta(\cdot)$ implying that the right-hand side of the inequality is larger than one.

To show that losses from offshoring are possible for intermediate values of ε_l, we can note from the main text that in the open economy unskilled workers gain relative to skilled workers. This makes $w_l^d < (w_l^d)^a$ sufficient for losses of both skill groups. From Eq. (33), we compute

$$\frac{w_l^d}{(w_l^d)^a} = \Delta(\cdot)^{\frac{1}{g}}\left\{\frac{\Delta(\cdot)\left[1+\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\right]}{\Delta(\cdot)+\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_l(\cdot)}\right\}^{-1}\left[\prod_{j=l,h}\left\{\frac{\Delta(\cdot)\left[1+\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\right]}{\Delta(\cdot)+\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_j(\cdot)}\right\}^{\alpha_j}\right]^{\frac{\sigma}{\sigma-1}}. \tag{A.28}$$

In the limiting case of $\alpha_h \to 0$, this establishes $w_l^d/(w_l^d)^a \equiv Z(\hat{\kappa}_o)$, with

$$Z(\hat{\kappa}_o) \equiv \Delta(\cdot)^{\frac{1}{g}}\left\{\frac{\Delta(\cdot)\left[1+\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\right]}{\Delta(\cdot)+\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_l(\cdot)}\right\}^{\frac{1}{\sigma-1}}. \tag{A.29}$$

Differentiating $Z(\hat{\kappa}_o)$, we obtain $Z'(\hat{\kappa}_o) = [\Delta(\cdot) - 1] \frac{g\hat{\kappa}_o^{\xi-1}}{\hat{\kappa}_o^{\xi}-1} Z(\hat{\kappa}_o) z(\hat{\kappa}_o)$, with

$$z(\hat{\kappa}_o) \equiv \frac{1}{g\Delta(\cdot)} + \frac{1}{\sigma-1}\left\{\frac{1}{\Delta(\cdot)} - \frac{1 + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\frac{g(1+\xi)-\xi}{g(1+\xi)-(1-\theta)\xi}\left[\hat{z}_1(\hat{\kappa}_o) + \hat{z}_2(\hat{\kappa}_o)(1-\theta)\xi/g\right]}{\Delta(\cdot) + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\Lambda_l(\cdot)}\right\},$$

$$\hat{z}_1(\hat{\kappa}_o) \equiv \frac{\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_l}\left\{1 + \left[\hat{\kappa}_o^{\xi(1-\varepsilon_l)} - 1\right]^{1-\theta}\right\} - 1}{\left(\hat{\kappa}_o^{\xi} - 1\right)^{1-\theta}}, \tag{A.30}$$

and $\hat{z}_2(\hat{\kappa}_o) \equiv \varepsilon_l \hat{\kappa}_o^{\xi[(1-\theta)\varepsilon_l-1]}(\hat{\kappa}_o^{\xi}-1)^{\theta}\left\{1 + \left[\hat{\kappa}_o^{\xi(1-\varepsilon_l)} - 1\right]^{1-\theta}\right\} + (1-\varepsilon_l)\left[\frac{\hat{\kappa}_o^{\xi}-1}{\hat{\kappa}_o^{\xi(1-\varepsilon_l)}-1}\right]^{\theta}\hat{\kappa}_o^{-\theta\xi\varepsilon_l} - \hat{z}_1(\hat{\kappa}_o)$. Accounting for $\lim_{\hat{\kappa}_o\to 1}\hat{z}_1(\hat{\kappa}_o) = (1-\varepsilon_l)^{1-\theta}$ and $\lim_{\hat{\kappa}_o\to 1}\hat{z}_2(\hat{\kappa}_o) = 0$, using $\frac{\gamma}{1-\gamma} = (1-\theta)\xi$, and noting that $1-\varepsilon_l = (\theta\xi)^{-1}$ if $\alpha_h \to 0$, we compute

$$\lim_{\hat{\kappa}_o\to 1} z(\hat{\kappa}_o) = \frac{1}{g} + \frac{1}{\sigma-1}\frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}\frac{1 - \frac{g(1+\xi)-\xi}{g(1+\xi)-(1-\theta)\xi}\left(\frac{1}{\theta\xi}\right)^{1-\theta}}{1 + \frac{\gamma}{1-\gamma}\frac{g-\xi}{g-(1-\theta)\xi}} \equiv \bar{z}(g), \tag{A.31}$$

with $\lim_{g\to\infty}\bar{z}(g) = \frac{1-\theta}{\sigma}\left[1 - (\theta\xi)^{\theta-1}\right] < 0$, due to $\theta\xi = \frac{\theta(\sigma-1)}{1+\theta(\sigma-1)} < 1$. This shows that unskilled workers can be worse off with offshoring than in the closed economy if g is high, ε_l has an intermediate value, and α_h is small, which completes the proof of Proposition 4.

Supplement

(Not intended for publication)

S.1 Derivation details for Eq. (25)

We first study the assignment of a continuum of worker (indexed by ν) of type j to a discrete number of firms (with index ω) and later consider the case of a continuum of producers. Denoting by $v_j(\nu,\omega) = w_j(\omega)a(\nu,\omega)$ the utility of of worker ν from employment in firm ω, a worker prefers a job in firm ω over all other jobs if $v_j(\nu,\omega) \geq \max\{v_j(\nu,\omega')\}$ for all $\omega' \neq \omega$. The conditional probability of worker ν to end up with firm ω when observing $a(\nu,\omega)$ is then given by:

$$\begin{aligned}
\text{Prob}\Big[v_j(\nu,\omega) \geq \max_{\omega'\neq\omega}\{v_j(\nu,\omega')\}\Big|a(\nu,\omega)\Big] &= \prod_{\omega'\neq\omega} \text{Prob}\left[v_j(\nu,\omega) \geq v_j(\nu,\omega')\right] \\
&= \prod_{\omega'\neq\omega} \text{Prob}\left[a(\nu,\omega') \leq a(\nu,\omega)\frac{w_j(\omega)}{w_j(\omega')}\right] \\
&= \prod_{\omega'\neq\omega} \exp\left\{\left[-a(\nu,\omega)\frac{w_j(\omega)}{w_j(\omega')}\right]^{-\frac{1-\theta}{\theta}}\right\},
\end{aligned}$$

where the third equality sign makes use of our assumption that amenities are extreme value Fréchet distributed according to $F(a) = \exp\left(-a^{-\frac{1-\theta}{\theta}}\right)$, with $\theta \in [0, 1/2)$. We can compute the total probability that individual ν chooses firm ω as follows

$$\begin{aligned}
\text{Prob}\Big[v_j(\nu,\omega) \geq \max_{\omega'\neq\omega}\{v_j(\nu,\omega')\}\Big] &= \int_0^\infty \text{Prob}\Big[v_j(\nu,\omega) \geq \max_{\omega'\neq\omega}\{v_j(\nu,\omega')\}\Big|a\Big]dF(a) \\
&= \int_0^\infty \prod_{\omega'\neq\omega} \exp\left\{\left[-a\frac{w_j(\omega)}{w_j(\omega')}\right]^{-\frac{1-\theta}{\theta}}\right\}\frac{1-\theta}{\theta}a^{-\frac{1}{\theta}}da \\
&= \int_0^\infty \exp\Big[-a^{-\frac{1-\theta}{\theta}}w_j^{-\frac{1-\theta}{\theta}}\sum_{\omega'} w_j(\omega')^{\frac{1-\theta}{\theta}}\Big]\frac{1-\theta}{\theta}a^{-\frac{1}{\theta}}da \\
&= \frac{w_j(\omega)^{\frac{1-\theta}{\theta}}}{\sum_\omega w_j(\omega)^{\frac{1-\theta}{\theta}}}. \qquad \text{(S.1)}
\end{aligned}$$

To solve for the case of continuous choice, we can interpret $\sum_\omega w_j(\omega)^{\frac{1-\theta}{\theta}}$ as an approximation of the total area under a function $f(\omega) = w_j(\omega)^{\frac{1-\theta}{\theta}}$ defined on interval $[\omega_0, \omega_n]$. Dividing this interval into n subintervals of equal length and denoting by ω_{j-1} and ω_j, $j = 1, .., n$ the lower and upper bounds of these subintervals, we can approximate the respective area by $\sum_{j=1}^n w_j(\omega)^{\frac{1-\theta}{\theta}}\hat{\Delta}_j$, with $\hat{\Delta}_j = \omega_j - \omega_{j-1}$, with this sum corresponding to $\sum_\omega w_j(\omega)^{\frac{1-\theta}{\theta}}$ if $\hat{\Delta}_j = 1$. Noting from the definition of the Riemann integral that

$$\lim_{n\to\infty}\sum_{j=1}^n w_j(\omega)^{\frac{1-\theta}{\theta}}\hat{\Delta}_j = \int_{\omega_0}^{\omega_n} w_j(\omega)^{\frac{1-\theta}{\theta}}d\omega. \qquad \text{(S.2)}$$

Substituting Eq. (S.2) into (S.1) and associating interval $[\omega_0, \omega_n]$ with the continuous set Ω, we obtain Eq. (25). This completes the proof.

S.2 Derivation details for $\mathrm{E}_j[a(\nu, \omega)]$

The expected amenity level of type-j worker ν at firm ω, conditional on accepting a job at this firm is given by

$$\begin{aligned}\mathrm{E}_j[a(\nu,\omega)] &= \frac{1}{\mathrm{Prob}[v_j(\nu,\omega) \geq \max\{v_j(\nu,\omega')\}]} \int_0^\infty a\mathrm{Prob}\Big[v_j(\nu,\omega) \geq \max_{\omega'\neq\omega}\{v_j(\nu,\omega')\}\Big|a\Big] dF(a) \\ &= \frac{W_j^{\frac{1-\theta}{\theta}}}{w_j(\omega)^{\frac{1-\theta}{\theta}}} \int_0^\infty \exp\left[-a^{-\frac{1-\theta}{\theta}} w_j^{-\frac{1-\theta}{\theta}} \sum_{\omega'} w_j(\omega')^{\frac{1-\theta}{\theta}}\right] \frac{1-\theta}{\theta} a^{-\frac{1-\theta}{\theta}} da = \Gamma\left(\frac{1-2\theta}{1-\theta}\right) \frac{W_j}{w_j(\omega)},\end{aligned}$$

where the second equality sign follows from Eq. (25), the definition of W_j and our assumption that amenities are extreme value Fréchet distributed according to $F(a) = \exp\left(-a^{-\frac{1-\theta}{\theta}}\right)$, with $\theta \in [0, 1/2)$, whereas the third equality sign follows for the limiting case of a continuous choice set when applying the definition of the Gamma function.

S.3 Inefficient resource allocation in the closed economy

To show that the resource allocation in the closed economy is inefficient, we consider the problem of a social planner who can tax (or subsidise) fixed costs sf_d and sf_m at the same rate $t > -1$. The tax revenue is then redistributed in a lump-sum fashion giving the same transfer to all workers. This tax changes the the zero profit condition to $\pi_d = (1+t)sf_d$, and the free entry condition to $[1 - G(\varphi_d)]\frac{\xi}{g-\xi} sf_d(1+t) = sf_m(1+t)$. Hence, with the same proportional tax rate applied to both types of fixed costs, the cutoff productivity level remains unchanged. However, the existence of the tax rate changes the relationship between ℓ_j^d and ℓ_j^s to

$$\ell_j^d = \frac{\gamma}{1-\gamma} \frac{\alpha_j \pi_d}{w_j^d} = \frac{\gamma}{1-\gamma} \frac{\alpha_j (1+t) sf_d}{w_j^d} = \frac{\gamma}{1-\gamma}(1+t) f_d \ell_j^s, \tag{S.3}$$

while aggregating employment in services and manufacturing establishes Eqs. (27) and (28), evaluated for the closed economy and thus $\Delta(\cdot) = \Lambda_j(\cdot) = 1$. Combining Eqs. (27), (28), and (S.3), we can derive the explicit solutions for sector-wide employment of skilled and unskilled workers in the closed economy with taxation:

$$L_j^s = \frac{N_j}{1 + \frac{\gamma(1+t)}{1-\gamma} \frac{g-\xi}{g-(1-\theta)\xi}}, \qquad L_j^m = \frac{N_j \frac{\gamma(1+t)}{1-\gamma} \frac{g-\xi}{g-(1-\theta)\xi}}{1 + \frac{\gamma(1+t)}{1-\gamma} \frac{g-\xi}{g-(1-\theta)\xi}}. \tag{S.4}$$

Using the technology assumption from Eq. (1) and $A_q = Y = \frac{g}{g-\xi} M r_d$ in $r(\omega) = A_q^{\frac{1}{\sigma}} q(\omega)^{\frac{\sigma-1}{\sigma}}$, we can compute for the least-productive firm

$$r_d = \left(\frac{g}{g-\xi} M r_d\right)^{\frac{1}{\sigma}} \left[\beta \varphi_d \ell_h^d \left(\frac{\ell_l^d}{\ell_h^d}\right)^{\alpha_l}\right]^{\frac{\sigma-1}{\sigma}}. \tag{S.5}$$

Accounting for $\ell_h^d = \gamma \alpha_h r_d / w_h^d$ from Eq. (S.3) and the observation that $\pi_d = (1-\gamma) r_d$ and making use of

$$\frac{\ell_h^d}{\ell_l^d} = \frac{\ell_h^s}{\ell_l^s} = \frac{N_h}{N_\ell} = \frac{\alpha_h}{\alpha_l} \frac{w_l^d}{w_h^d}, \tag{S.6}$$

from Eqs. (S.3), (S.4), and (6), (7), we can solve Eq. (S.5) for

$$w_j^d = \gamma \beta^{-\frac{\theta}{1-\theta}} \left(\frac{\xi}{g-\xi} \frac{f_d}{f_m}\right)^{\frac{1}{g}} \left(\frac{N_j}{\alpha_j}\right)^{-1} \prod_{j=h,l} \left(\frac{N_j}{\alpha_j}\right)^{\alpha_j} \left(\frac{g}{g-\xi} M\right)^{\frac{1}{\sigma-1}}, \tag{S.7}$$

by substituting for φ_d from Eq. (A.24). From $\ell_h^s = \alpha_h \left(\frac{w_l^d}{w_h^d}\right)^{\alpha_l}$ and $\ell_l^s = \alpha_l \left(\frac{w_h^d}{w_l^d}\right)^{\alpha_h}$, we further obtain $\ell_j^s = N_j \Pi_{j=h,l} \left(\frac{N_j}{\alpha_j}\right)^{-\alpha_j}$. This allows us to compute

$$M = \frac{g-\xi}{g} \frac{N_j}{1 + \frac{\gamma(1+t)}{1-\gamma} \frac{g-\xi}{g-(1-\theta)\xi}} \frac{1}{f_d \ell_j^s} = \frac{g-\xi}{g f_d} \frac{1}{1 + \frac{\gamma(1+t)}{1-\gamma} \frac{g-\xi}{g-(1-\theta)\xi}} \prod_{j=h,l} \left(\frac{N_j}{\alpha_j}\right)^{\alpha_j}, \tag{S.8}$$

where the first equality sign makes use of Eqs. (27) and (S.4), whereas the second equality sign acknowledges the solution for ℓ_j^s. Substituting M into Eq. (S.7) gives

$$w_j^d = \gamma \beta^{-\frac{\theta}{1-\theta}} \left(\frac{\xi}{g-\xi} \frac{f_d}{f_m}\right)^{\frac{1}{g}} \left(\frac{1}{f_d}\right)^{\frac{1}{\sigma-1}} \left[\frac{1}{1 + \frac{\gamma(1+t)}{1-\gamma} \frac{g-\xi}{g-(1-\theta)\xi}}\right]^{\frac{1}{\sigma-1}} \left(\frac{N_j}{\alpha_j}\right)^{-1} \prod_{j=h,l} \left(\frac{N_j}{\alpha_j}\right)^{\alpha_j \frac{\sigma}{\sigma-1}}. \tag{S.9}$$

This reveals that w_j^d decreases (increases) if the social planner sets $t > (<) 0$. However, there is an additional effect on welfare from the lump-sum transfer. The total transfer budget equals

$$T \equiv tM \left(s f_d + s f_m \varphi_d^k\right) = \frac{g}{g-\xi} t M s f_d = \frac{N_j}{\alpha_j} \frac{t w_j^d}{1 + \frac{\gamma(1+t)}{1-\gamma} \frac{g-\xi}{g-(1-\theta)\xi}}, \tag{S.10}$$

where the second equality sign follows from applying the free entry condition, and the third euqality sign makes use of Eq. (S.8) and $s = w_j^d \frac{N_j}{\alpha_j} \prod_{j=h,l} \left(\frac{N_j}{\alpha_j}\right)^{-\alpha_j}$. The social planner therefore chooses M to maximise $\sum_{j=h,l} \frac{N_j}{N} w_j^d \left\{1 + t\left[1 + \frac{\gamma(1+t)}{1-\gamma} \frac{g-\xi}{g-(1-\theta)\xi}\right]^{-1}\right\}$ and this is equivalent to maximising

$$V(t) = \left[(1+t)^{-\frac{\sigma-1}{\sigma}} + \frac{\gamma}{1-\gamma} \frac{g-\xi}{g-(1-\theta)\xi} (1+t)^{\frac{1}{\sigma}}\right]^{-1}, \tag{S.11}$$

which has a unique solution $t_{\rm sp} = \{[1+\theta(\sigma-1)]/(1-\theta)\}\{[g-(1-\theta)\xi]/(g-\xi)\} - 1$, taking a value of $t_{\rm sp} = 0$ for $\theta = 0$ and a value of $t_{\rm sp} > 0$ for $\theta > 0$. This completes the proof.

Lorenz curve for the wage distribution of skilled workers in manufacturing

We determine the Lorenz curve for the wage distribution of skilled workers in manufacturing for the case of exclusive offshoring, due to $\tau_e \to \infty$ and $\rho = 0$,[23] and we impose for tractability reasons the assumption that the fixed cost parameter $f(\omega)$ is Pareto distributed with shape parameter g_f. For the limiting case of $g_f \to \infty$ the fixed costs of offshoring are then equal to f_d and the same for all producers. This corresponds to the case usually discussed in the literature and constitutes the scenario, we are focussing on in the supplement. We can infer for this case from Eq. (13) and (14) that wages and employment of skilled workers in an offshoring firm with productivity $\varphi(\omega)$ are equal to wages and employment in a domestic firm with productivity $\varphi(\omega)\hat{\kappa}_o$. With this insight at hand, we can now determine the fraction of skilled manufacturing workers with a wage lower than $\bar{w} = w_d\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\theta\xi}$. Assuming $\bar{\varphi} \le \varphi_o = \varphi_d(\hat{\kappa}_o^\xi - 1)^{-\frac{1}{\xi}}$ all of these workers are employed by domestic firms and we compute

$$\lambda_h = \frac{M\ell_h^d}{L_h^m}\int_{\varphi_d}^{\bar{\varphi}}\left(\frac{\varphi}{\varphi_d}\right)^{(1-\theta)\xi}\frac{dG(\varphi)}{1-G(\varphi_d)} = \frac{1}{\Lambda_h}\left[1-\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{(1-\theta)\xi-g}\right]. \tag{S.12}$$

Furthermore, we can determine for the same group of workers the total wage income, $W_h^1(\varphi)$, relative to the total skilled wage bill in manufacturing, $W_h^m = \alpha_h\gamma\Delta(\cdot)Mr_d$ according to

$$\frac{W_h^1(\varphi)}{W_h^m} = \frac{\alpha_h\gamma M r_d}{W_h^m}\int_{\varphi_d}^{\bar{\varphi}}\left(\frac{\varphi}{\varphi_d}\right)^{\xi}\frac{dG(\varphi)}{1-G(\varphi_d)} = \frac{1}{\Delta(\cdot)}\left[1-\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\xi-g}\right]. \tag{S.13}$$

Then, solving Eq. (S.12) for $\frac{\bar{\varphi}}{\varphi_d}$ and substituting the resulting expression into Eq. (S.13) gives the first segment of the Lorenz curve

$$\psi_h^1(\lambda_h) = \frac{1}{\Delta(\cdot)}\left[1-(1-\Lambda_h\lambda_h)^{\frac{g-\xi}{g-(1-\theta)\xi}}\right], \tag{S.14}$$

which is relevant if $\lambda_h \le \Lambda_h^{-1}\left[1-\left(\hat{\kappa}_o^\xi - 1\right)^{\frac{g-(1-\theta)\xi}{\xi}}\right] \equiv \lambda_h^1$.

To determine the fraction of skilled workers receiving a wage lower than $\bar{w} = w_d\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\theta\xi}$ with $\bar{\varphi} > \varphi_o$, we can note that firms with total labour productivity $\varphi > \varphi_o$ are offshoring producers

[23] Setting $\rho = 0$ is not necessary for our results, but it eliminates uninteresting cases, and thus improves the readability of our analysis. Furthermore, we do not discuss the case of exclusive exporting, because the effects of exporting on the Lorenz curve measuring wage dispersion of skilled and unskilled workers can be derived in total analogy to the Lorenz curve measuring wage dispersion of skilled workers in the case of offshoring.

and compute

$$\lambda_h = \lambda_h^1 + \frac{M\ell_h^d}{L_h^m}\hat{\kappa}_o^{(1-\theta)\xi}\int_{\varphi_o}^{\bar{\varphi}}\left(\frac{\varphi}{\varphi_d}\right)^{(1-\theta)\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}$$
$$= 1 - \frac{1}{\Lambda_h}\left(\frac{\hat{\kappa}_o^\xi}{\hat{\kappa}_o^\xi - 1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\hat{\kappa}_o^g\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{(1-\theta)\xi-g}. \tag{S.15}$$

The fraction of wages received by these workers can then be computed according to

$$\frac{W_h^2(\varphi)}{W_h^m} = \frac{W_h^1(\varphi)}{W_h^m} + \frac{\alpha\gamma M r_d}{W_h^m}\hat{\kappa}_o^\xi\int_{\varphi_o}^{\bar{\varphi}}\left(\frac{\varphi}{\varphi_d}\right)^{\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}$$
$$= 1 - \frac{1}{\Delta(\cdot)}\left(\frac{\hat{\kappa}_o^\xi - 1}{\hat{\kappa}_o^\xi}\right)^{\frac{g-\xi}{\xi}}\hat{\kappa}_o^g\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\xi-g}. \tag{S.16}$$

Solving Eq. (S.15) for $\frac{\bar{\varphi}}{\varphi_d}$ and substituting the resulting expression into Eq. (S.16) gives the second segment of the Lorenz curve

$$\psi_h^2(\lambda_h) \equiv 1 - \frac{1}{\Delta(\cdot)}\hat{\kappa}_o^{g\frac{\theta\xi}{g-(1-\theta)\xi}}\Lambda_h^{\frac{g-\xi}{g-(1-\theta)\xi}}(1-\lambda_h)^{\frac{g-\xi}{g-(1-\theta)\xi}}, \tag{S.17}$$

which is relevant if $\lambda_h^2 < \lambda_h$.

The two segments $\psi_h^1(\lambda_h)$ and $\psi_h^2(\lambda_h)$ characterise the Lorenz curve of skilled wage distribution in manufacturing:

$$\psi_h(\lambda_h) = \begin{cases}\psi_h^1(\lambda_h) & \text{if} \quad \lambda_h \leq \lambda_h^1 \\ \psi_h^2(\lambda_h) & \text{if} \quad \lambda_h > \lambda_h^1\end{cases} \tag{S.18}$$

To understand the effect of offshoring on the wage dispersion of skilled workers, we can contrast the Lorenz curve in (S.18) with the respective Lorenz curve under autarky, which is given by $\psi_h^a(\lambda_h) = 1-(1-\lambda_h)^{\frac{g-\xi}{g-(1-\theta)\xi}}$. This gives for the first segment

$$D\psi_h^1(\lambda_h) \equiv \psi_h^1(\lambda_h) - \psi_h^a(\lambda_h) = \frac{1}{\Delta(\cdot)}\left\{1-\Delta(\cdot)+\Delta(\cdot)(1-\lambda_h)^{\frac{g-\xi}{g-(1-\theta)\xi}} - [1-\Lambda_h(\cdot)\lambda_h]^{\frac{g-\xi}{g-(1-\theta)\xi}}\right\}. \tag{S.19}$$

Twice differentiating $D\psi_h^1(\lambda_h)$, we obtain

$$\frac{dD\psi_h^1(\lambda_h)}{d\lambda_h} = \frac{g-\xi}{g-(1-\theta)\xi}[1-\lambda_h\Lambda_h(\cdot)]^{-\frac{\theta\xi}{g-(1-\theta)\xi}}\left\{\frac{\Lambda_h(\cdot)}{\Delta(\cdot)} - \left[\frac{1-\lambda_h\Lambda_h(\cdot)}{1-\lambda_h}\right]^{\frac{\theta\xi}{g-(1-\theta)\xi}}\right\} \tag{S.20}$$

and

$$\left.\frac{d^2 D\psi_h^1(\lambda_h)}{d\lambda_h^2}\right|_{\frac{dD\psi_h^1(\lambda_h)}{d\lambda_h}=0} = \frac{(g-\xi)\theta\xi}{[g-(1-\theta)\xi]^2}\left[1-\lambda_h\Lambda_h(\cdot)\right]^{-\frac{\theta\xi}{g-(1-\theta)\xi}}$$
$$\times\left[\frac{1-\lambda_h\Lambda_h(\cdot)}{1-\lambda_h}\right]^{\frac{\theta\xi}{g-(1-\theta)\xi}}\frac{\Lambda_h(\cdot)-1}{\left[1-\lambda_h\Lambda_h(\cdot)\right](1-\lambda_h)}. \qquad \text{(S.21)}$$

This reveals that $dD\psi_h^1(0)/d\lambda_h < 0$ and that an extremum of $D\psi_h^1(\lambda_h)$ on interval $0 < \lambda_h \le \lambda_h^1$ (if one exists) must be a minimum. Turning to the second segment, we can define

$$D\psi_h^2(\lambda_h) \equiv \psi_h^2(\lambda_h) - \psi_h^a(\lambda_h) = \left[\Delta(\cdot) - \hat{\kappa}_o^{g\frac{\theta\xi}{g-(1-\theta)\xi}}\Lambda_h(\cdot)^{\frac{g-\xi}{g-(1-\theta)\xi}}\right]\frac{1}{\Delta(\cdot)}(1-\lambda_h)^{\frac{g-\xi}{g-(1-\theta)\xi}}, \qquad \text{(S.22)}$$

and $dD\psi_h^2(\lambda_h)/d\lambda_h >,=,< 0$ if $0 >,=,< \Delta(\cdot) - \hat{\kappa}_o^{g\frac{\theta\xi}{g-(1-\theta)\xi}}\Lambda_h(\cdot)^{\frac{g-\xi}{g-(1-\theta)\xi}}$. Setting $a \equiv \frac{g}{\xi} > 1$, $b \equiv 1-\theta < 1$, and $x \equiv \hat{\kappa}_o^{\xi} \in [1,2)$, we have $dD\psi_h^2(\lambda_h)/d\lambda_h >,=,< 0$ if $\tilde{F}(b) >,=,< 0$, with

$$\tilde{F}(b) \equiv \left[\frac{1+\frac{x^b-1}{(x-1)^b}(x-1)^a}{x^a}\right]^{\frac{a-1}{a-b}} - \frac{1+(x-1)^a}{x^a} < \left[\frac{1+(x-1)^a}{x^a}\right]^{\frac{a-1}{a-b}} - \frac{1+(x-1)^a}{x^a}$$
$$= \left\{\left[\frac{1+(x-1)^a}{x^a}\right]^{\frac{b-1}{a-b}} - 1\right\}\frac{1+(x-1)^a}{x^a}.$$

Noting that $1+(x-1)^a < x^a$ holds for all $a > 1$, we find that $\tilde{F}(b) > 0$ and thus $dD\psi_h^2(\lambda_h)/d\lambda_h > 0$. Accounting for $D\psi_h^2(1) = 0$, this implies that $D\psi_h^2(\lambda_h) < 0$ holds for all $\lambda_h > \lambda_h^1$. Recollecting the properties of $D\psi_h^1(\lambda_h)$, it follows from the continuity of $\psi_h^1(\lambda_h)$ and $\psi_h^a(\lambda_h)$ that the dispersion of skilled wages in manufacturing under autarky Lorenz dominates the respective dispersion under offshoring.

Lorenz curve for the wage distribution of unskilled workers in manufacturing

We determine the Lorenz curve for the wage distribution of unskilled workers in manufacturing for the case of exclusive offshoring, due to $\tau_e \to \infty$ and $\rho = 0$,[24] and we impose for tractability reasons the assumption that the fixed cost parameter $f(\omega)$ is Pareto distributed with shape parameter g_f. For the limiting case of $g_f \to \infty$ the fixed costs of offshoring are then equal to f_d and the same for all producers. This corresponds to the case usually discussed in the literature and constitutes the scenario, we are focussing on in the supplement. We can infer for this case from Eqs. (13) and (14) that domestic wages and employment of unskilled workers in an offshoring firm with productivity $\varphi(\omega)$ are equal to wages and employment in a domestic firm with productivity $\varphi(\omega)\hat{\kappa}_o^{\varepsilon_l}$. Similarly,

[24]Setting $\rho = 0$ is not necessary for our results, but it eliminates uninteresting cases, and thus improves the readability of our analysis.

foreign wages and employment of unskilled workers in an offshoring firm with productivity $\varphi(\omega)$ are equal to wages and employment in a domestic firm with productivity $\varphi(\omega)\hat{\kappa}_o^{\varepsilon_l}\left[\hat{\kappa}_o^{\xi(1-\varepsilon_l)}-1\right]^{\frac{1}{\xi}}$. With these insight at hand, we can distinguish four segments of the Lorenz curve and begin with determining the fraction of unskilled manufacturing workers with a wage lower than $\bar{w}=w_d\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\theta\xi}$, with $\bar{\varphi}\leq\varphi_o\hat{\kappa}_o^{\varepsilon_l}\left[\hat{\kappa}_o^{\xi(1-\varepsilon_l)}-1\right]^{\frac{1}{\xi}}\equiv\varphi_o^1$. Noting that $\varphi_o^1>\varphi_d$ follows from $\varphi_o=\varphi_d(\hat{\kappa}_o^{\xi}-1)^{-\frac{1}{\xi}}$, all of these workers must be employed in domestic firms, and we compute

$$\lambda_l=\frac{M\ell_l^d}{L_l^m}\int_{\varphi_d}^{\bar{\varphi}}\left(\frac{\varphi}{\varphi_d}\right)^{(1-\theta)\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}=\frac{1}{\Lambda_l(\cdot)}\left[1-\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{(1-\theta)\xi-g}\right]. \tag{S.23}$$

Furthermore, we can determine for the same group of workers the the total wage income, $W_l^1(\varphi)$, relative to the total unskilled wage bill in manufacturing, $W_l^m=\alpha_l\gamma\Delta(\cdot)Mr_d$ according to

$$\frac{W_l^1(\varphi)}{W_l^m}=\frac{\alpha_l\gamma Mr_d}{W_h^m}\int_{\varphi_d}^{\bar{\varphi}}\left(\frac{\varphi}{\varphi_d}\right)^{\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}=\frac{1}{\Delta(\cdot)}\left[1-\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\xi-g}\right]. \tag{S.24}$$

Then, solving Eq. (S.23) for $\frac{\bar{\varphi}}{\varphi_d}$ and substituting the resulting expression into Eq. (S.24) gives the first segment of the Lorenz curve

$$\psi_l^1(\lambda_l)=\frac{1}{\Delta(\cdot)}\left\{1-[1-\Lambda_l(\cdot)\lambda_l]^{\frac{g-\xi}{g-(1-\theta)\xi}}\right\}, \tag{S.25}$$

which is relevant if $\lambda_l\leq\Lambda_l^{-1}\left[1-\left(\frac{\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\right]\equiv\lambda_l^1$.

We now determine the fraction of unskilled workers receiving a wage lower than $\bar{w}=w_d\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\theta\xi}$ with $\bar{\varphi}\in(\varphi_o^1,\varphi_o^2]$ and $\varphi_o^2\equiv\varphi_o\hat{\kappa}_o^{\varepsilon_l}$. These workers are either employed by domestic firms with total labour productivity $\varphi\leq\varphi_o^2$ or by foreign offshoring firms with total labour productivity $\varphi\leq\varphi_o^2\left[\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right]^{-\frac{1}{\xi}}$. We compute

$$\begin{aligned}\lambda_l&=\lambda_l^1+\frac{M\ell_l^d}{L_l^m}\int_{\varphi_o^1}^{\bar{\varphi}}\left(\frac{\varphi}{\varphi_d}\right)^{\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}\\&\quad+\frac{M\ell_l^d}{L_l^m}\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{1-\theta}\int_{\varphi_o}^{\bar{\varphi}\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}}\left(\frac{\varphi}{\varphi_d}\right)^{(1-\theta)\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}\\&=\frac{1}{\Lambda_l}\left[1-\left(\frac{\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\right.\\&\qquad\left.+\frac{1}{\Lambda_l}\left(\frac{\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\left[1+\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]\left[1-\left(\frac{\bar{\varphi}}{\varphi_o^1}\right)^{(1-\theta)\xi-g}\right]\right].\end{aligned} \tag{S.26}$$

The fraction of wages received by these workers can then be computed according to

$$\frac{W_l^2(\varphi)}{W_l^m} = \frac{W_l^1(\varphi)}{W_l^m} + \frac{\alpha_l \gamma M r_d}{W_l^m} \int_{\varphi_o^1}^{\bar{\varphi}} \left(\frac{\varphi}{\varphi_d}\right)^{\xi} \frac{dG(\varphi)}{1-G(\varphi_d)}$$

$$+ \frac{\alpha_l \gamma M r_d}{W_l^m} \left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right) \int_{\varphi_o}^{\bar{\varphi}\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}} \left(\frac{\varphi}{\varphi_d}\right)^{\xi} \frac{dG(\varphi)}{1-G(\varphi_d)}$$

$$= \frac{1}{\Delta(\cdot)} \left[1 - \left(\frac{\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi} - 1}\right)^{\frac{\xi-g}{\xi}}\right] + \frac{1}{\Delta(\cdot)} \left(\frac{\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi} - 1}\right)^{\frac{\xi-g}{\xi}} \left[1 + \left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right] \left[1 - \left(\frac{\bar{\varphi}}{\varphi_o^1}\right)^{\xi-g}\right]. \tag{S.27}$$

Solving Eq. (S.26) for $\frac{\bar{\varphi}}{\varphi_o^1}$ and substituting the resulting expression into Eq. (S.27) gives the second segment of the Lorenz curve

$$\psi_l^2(\lambda_h) \equiv \frac{1}{\Delta(\cdot)} \left(1 + \left(\frac{\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi} - 1}\right)^{\frac{\xi-g}{\xi}} \left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}} - \left[1 + \left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]^{\frac{\theta\xi}{g-(1-\theta)\xi}} \right.$$
$$\left. \times \left\{\left(\frac{\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi} - 1}\right)^{(1-\theta)} \left(\hat{\kappa}_o^{\xi} - 1\right)^{\frac{g}{\xi}} + [1 - \Lambda_l(\cdot)\lambda_l]\right\}^{\frac{g-\xi}{g-(1-\theta)\xi}}\right), \tag{S.28}$$

which is relevant if $\lambda_l^1 < \lambda_l < \lambda_l^2$, with

$$\lambda_l^2 \equiv \frac{1}{\Lambda_l(\cdot)} \left\{1 + \left(\frac{\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi} - 1}\right)^{\frac{(1-\theta)\xi-g}{\xi}} \left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}} - \left(\frac{\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi} - 1}\right)^{\frac{(1-\theta)\xi-g}{\xi}} \left[1 + \left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]\right\}.$$

In a third step, we determine the fraction of unskilled workers receiving a wage lower than $\bar{w} = w_d\left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\theta\xi}$ with $\bar{\varphi} \in (\varphi_o^2, \varphi_o]$. These workers are either employed by domestic firms with total labour productivity $\varphi \leq \varphi_o$ or by foreign offshoring firms with total labour productivity $\varphi \leq \varphi_o\left[\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right]^{-\frac{1}{\xi}}$, or by domestic offshoring firms with total labour productivity $\varphi \leq \varphi_o \hat{\kappa}_o^{-\varepsilon_l}$. We compute

$$\lambda_l = \lambda_l^2 + \frac{M\ell_l^d}{L_l^m} \int_{\varphi_o^2}^{\bar{\varphi}} \left(\frac{\varphi}{\varphi_d}\right)^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} + \frac{M\ell_l^d}{L_l^m} \left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{1-\theta} \int_{\varphi_o^2\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}}^{\bar{\varphi}\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}} \left(\frac{\varphi}{\varphi_d}\right)^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)}$$
$$+ \frac{M\ell_l^d}{L_l^m} \hat{\kappa}_o^{(1-\theta)\xi\varepsilon_l} \int_{\varphi_o}^{\bar{\varphi}\hat{\kappa}_o^{-\varepsilon_l}} \left(\frac{\varphi}{\varphi_d}\right)^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)}.$$

Solving the integrals, we obtain

$$\lambda_l = \frac{1}{\Lambda_l}\left\{1+\left(\frac{\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}-\left(\frac{\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\left[1+\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]\right.$$
$$\left.+\left(\frac{\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\left[1+\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}+\left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]\left[1-\left(\frac{\bar{\varphi}}{\varphi_o^2}\right)^{(1-\theta)\xi-g}\right]\right\}. \tag{S.29}$$

The fraction of wages received by these workers can then be computed according to

$$\frac{W_l^3(\varphi)}{W_l^m} = \frac{W_l^2(\varphi)}{W_l^m} + \frac{\alpha_l\gamma M r_d}{W_l^m}\int_{\varphi_o^2}^{\bar{\varphi}}\left(\frac{\varphi}{\varphi_d}\right)^{\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}$$
$$+\frac{\alpha_l\gamma M r_d}{W_l^m}\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)\int_{\varphi_o^2\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}}^{\bar{\varphi}\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}}\left(\frac{\varphi}{\varphi_d}\right)^{\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}$$
$$+\frac{\alpha_l\gamma M r_d}{W_l^m}\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)\int_{\varphi_o}^{\bar{\varphi}\hat{\kappa}_o^{-\varepsilon_l}}\left(\frac{\varphi}{\varphi_d}\right)^{\xi}\frac{dG(\varphi)}{1-G(\varphi_d)}.$$

This establishes

$$\frac{W_l^3(\varphi)}{W_l^m} = \frac{1}{\Delta(\cdot)}\left\{1+\left(\frac{\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{\xi-g}{\xi}}\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}-\left(\frac{\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{\xi-g}{\xi}}\left[1+\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]\right.$$
$$\left.+\left(\frac{\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{\xi-g}{\xi}}\left[1+\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}+\left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]\left[1-\left(\frac{\bar{\varphi}}{\varphi_o^2}\right)^{\xi-g}\right]\right\}. \tag{S.30}$$

Solving Eq. (S.29) for $\frac{\bar{\varphi}}{\varphi_o^1}$ and substituting the resulting expression into Eq. (S.30) gives the third segment of the Lorenz curve

$$\psi_l^3(\lambda_h) \equiv \frac{1}{\Delta(\cdot)}\left(1+\left(\frac{\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{\xi-g}{\xi}}\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}+\left(\frac{\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{\xi-g}{\xi}}\left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}-\left[1+\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}+\left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]^{\frac{\theta\xi}{g-(1-\theta)\xi}}\right.$$
$$\left.\times\left\{\left(\frac{\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{(1-\theta)}\left(\hat{\kappa}_o^{\xi}-1\right)^{\frac{g}{\xi}}+\left(\frac{\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{\xi-g}{\xi}}\left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}+\left[1-\Lambda_l(\cdot)\lambda_l\right]\right\}^{\frac{g-\xi}{g-(1-\theta)\xi}}\right), \tag{S.31}$$

which is relevant if $\lambda_l^2 < \lambda_l < \lambda_l^3$, with

$$\lambda_l^3 \equiv \frac{1}{\Lambda_l(\cdot)}\left\{1+\left(\frac{\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}+\left(\frac{\hat{\kappa}_o^{\xi\varepsilon_l}}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right.$$
$$\left.-\left(\frac{1}{\hat{\kappa}_o^{\xi}-1}\right)^{\frac{(1-\theta)\xi-g}{\xi}}\left[1+\left(\hat{\kappa}_o^{\xi}-\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}+\left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]\right\}.$$

In a final step, we determine the fraction of unskilled workers receiving a wage lower than $\bar{w} = w_d \left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\theta\xi}$ with $\bar{\varphi} > \varphi_o$. Taking into account that firms with total labour productivity higher than φ_o are offshoring firms, we compute

$$\lambda_l = \lambda_l^3 + \frac{M\ell_l^d}{L_l^m}\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{1-\theta} \int_{\varphi_o\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}}^{\bar{\varphi}\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}} \left(\frac{\varphi}{\varphi_d}\right)^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} + \frac{M\ell_l^d}{L_l^m}\hat{\kappa}_o^{(1-\theta)\xi\varepsilon_l} \int_{\varphi_o\hat{\kappa}_o^{-\varepsilon_l}}^{\bar{\varphi}\hat{\kappa}_o^{-\varepsilon_l}} \left(\frac{\varphi}{\varphi_d}\right)^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)}.$$

Solving the integrals, we obtain

$$\lambda_l = 1 - \frac{1}{\Lambda_l(\cdot)}\left(\frac{1}{\hat{\kappa}_o^{\xi} - 1}\right)^{\frac{(1-\theta)\xi - g}{\xi}} \left[\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}} + \left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right] \left(\frac{\bar{\varphi}}{\varphi_d}\right)^{(1-\theta)\xi - g}. \tag{S.32}$$

The fraction of wages received by these workers can then be computed according to

$$\frac{W_l^4(\varphi)}{W_l^m} = \frac{W_l^3(\varphi)}{W_l^m} + \frac{\alpha_l\gamma M r_d}{W_l^m}\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right) \int_{\varphi_o\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}}^{\bar{\varphi}\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{-\frac{1}{\xi}}} \left(\frac{\varphi}{\varphi_d}\right)^{\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} + \frac{\alpha_l\gamma M r_d}{W_l^m}\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right) \int_{\varphi_o\hat{\kappa}_o^{-\varepsilon_l}}^{\bar{\varphi}\hat{\kappa}_o^{-\varepsilon_l}} \left(\frac{\varphi}{\varphi_d}\right)^{\xi} \frac{dG(\varphi)}{1-G(\varphi_d)}.$$

This establishes

$$\frac{W_l^4(\varphi)}{W_l^m} = 1 - \frac{1}{\Delta(\cdot)}\left(\frac{1}{\hat{\kappa}_o^{\xi} - 1}\right)^{\frac{\xi - g}{\xi}} \left[\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}} + \left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right] \left(\frac{\bar{\varphi}}{\varphi_d}\right)^{\xi - g}. \tag{S.33}$$

Solving Eq. (S.32) for $\frac{\bar{\varphi}}{\varphi_d}$ and substituting the resulting expression into Eq. (S.33) gives the fourth segment of the Lorenz curve

$$\psi_l^4(\lambda_l) \equiv 1 - \frac{1}{\Delta(\cdot)}\left[\left(\hat{\kappa}_o^{\xi} - \hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}} + \left(\hat{\kappa}_o^{\xi\varepsilon_l}\right)^{\frac{g}{\xi}}\right]^{\frac{\theta\xi}{g-(1-\theta)\xi}} \Lambda_l(\cdot)^{\frac{g-\xi}{g-(1-\theta)\xi}} (1-\lambda_l)^{\frac{g-\xi}{g-(1-\theta)\xi}}. \tag{S.34}$$

The four segments characterise the Lorenz curve for wage dispersion of unskilled workers in manufacturing. Contrasting this Lorenz curve with the respective for the closed economy, $\psi_l^a = 1-(1-\lambda_l)^{\frac{g-\xi}{g-(1-\theta)\xi}}$, we compute for the first segment that

$$D\psi_l^1(\lambda_l) \equiv \psi_l(\lambda_l) - \psi_l(\lambda_l) = \frac{1}{\Delta(\cdot)}\left\{1 - \Delta(\cdot) + \Delta(\cdot)(1-\lambda_l)^{\frac{g-\xi}{g-(1-\theta)\xi}} - \left[1 - \Lambda_l(\cdot)\lambda_l\right]^{\frac{g-\xi}{g-(1-\theta)\xi}}\right\}. \tag{S.35}$$

Twice differentiating $D\psi_l^1(\lambda_l)$, we obtain

$$\frac{dD\psi_l^1(\lambda_l)}{d\lambda_l} = \frac{g-\xi}{1-(1-\theta)\xi}\left[1-\lambda_l\Lambda_l(\cdot)\right]^{-\frac{\theta\xi}{g-(1-\theta)\xi}}\left[\frac{\Lambda_l}{\Delta(\cdot)} - \left(\frac{1-\lambda_l\Lambda_l}{1-\lambda_l}\right)^{\frac{\theta\xi}{g-(1-\theta)\xi}}\right], \tag{S.36}$$

and

$$\left.\frac{d^2D\psi_l^1(\lambda_l)}{d\lambda_l^2}\right|_{\frac{dD\psi_l^1(\lambda_l)}{d\lambda_l}=0} = \frac{(g-\xi)\theta\xi}{[1-(1-\theta)\xi]^2}\left[1-\lambda_l\Lambda_l(\cdot)\right]^{-\frac{\theta\xi}{g-(1-\theta)\xi}}$$
$$\times\left[\frac{1-\lambda_l\Lambda_l(\cdot)}{1-\lambda_l}\right]^{\frac{\theta\xi}{g-(1-\theta)\xi}}\frac{\Lambda_l(\cdot)-1}{\left[1-\lambda_l\Lambda_l(\cdot)\right](1-\lambda_l)}. \tag{S.37}$$

This reveals that $dD\psi_l^1(0)/d\lambda_l >,=,< 0$ if $\Lambda_l(\cdot) >,=,< \Delta(\cdot)$. If $\Lambda_l(\cdot) < \Delta(\cdot)$, we can conclude that if $D\psi_l^1(\lambda_l)$ has an extremum on interval $0 < \lambda_l \leq \lambda_l^1$, this extremum must be a minimum. Crucially, the minimum can be arbitrarily close to $\lambda_l = 0$, leading to the conjecture that the Lorenz curves in the open and the closed economy can intersect. This can be shown numerically by choosing the following parametrisation: $\alpha = \theta = 0.25$, $\sigma = g = 6$, and $\tau = 1.01$.

Offshoring of headquarter and production tasks

Making use of the results in Section 4.2, we can determine firm-level revenues in logs:

$$\ln r(\omega) = (1-\theta)\xi\ln\gamma + \xi\ln A + \xi\ln\varphi(\omega) + \xi\ln\kappa_e(\omega) + \xi\ln\kappa_o(\omega), \tag{S.38}$$

where $\kappa_e(\omega)$ is defined as in the main text and $\kappa_o(\omega) \equiv \prod_{j=h,l}\kappa_{jo}$. Contrasting Eqs. (12) and (S.38) gives the important insight that with the small redefinition of $\kappa_o(\omega)$ revenues in the benchmark and the more sophisticated model variant are structurally identical. Due to this important insight, we can therefore conclude that the solutions for the cutoff productivities in Eqs. (15) and (16) as well as the solutions for the shares of firms choosing to export, offshore or both in Eqs. (17), (18), and (20) remain unaffected by allowing for offshoring of headquarter tasks. Also, the expected profits of potential entrants $\mathrm{E}[\psi]$ and the revenue aggregator function $\Delta(\hat{\kappa}_e, \hat{\kappa}_o)$ remain to be given by Eqs. (21) and (22), respectively.

To determine the general outcome, we have to aggregate employment over all firms, add employment from the service sector, and set the sum equal to economy-wide labour supply. The aggregation of employment over firms allows us to $\Lambda_j(\cdot)\ \forall\ j \in \{h, l\}$, which plays a prominent role in pinning down the welfare effects of exporting and offshoring. Making use of Eq. (41), we can first note that the sum of domestic and foreign type-j employment for offshorers and offshoring exporters can be expressed as

$$\ell_j^o(\omega) = \ell_j^d \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \hat{\kappa}_{\hat{j}o}^{(1-\theta)\xi} \hat{\kappa}_{jo}^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_{jo}^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\}, \tag{S.39}$$

$$\ell_j^{eo}(\omega) = \ell_j^d \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \hat{\kappa}_e^{(1-\theta)\xi} \hat{\kappa}_{\hat{j}o}^{(1-\theta)\xi} \hat{\kappa}_{jo}^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_{jo}^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\}, \tag{S.40}$$

where $j, \hat{j} \in \{h, l\}$ and $j \neq \hat{j}$. With two symmetric countries, sector-wide manufacturing employment equals $L_j^m \equiv \rho\lambda_{je} + (1-\rho)\lambda_{jo}$, with

$$\begin{aligned}\lambda_{je} \equiv & M\ell_j^d \int_{f_d}^{\infty} \int_{\varphi_d}^{\varphi_e(\omega)} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) \\ & + M\ell_j^d \hat{\kappa}_e^{(1-\theta)\xi} \int_{f_d}^{\infty} \int_{\varphi_e(\omega)}^{\varphi_{eo}^e(\omega)} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) \\ & + M\ell_j^d \hat{\kappa}_e^{(1-\theta)\xi} \hat{\kappa}_{\hat{j}o}^{(1-\theta)\xi} \hat{\kappa}_{jo}^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_{jo}^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\} \int_{f_d}^{\infty} \int_{\varphi_{eo}^o(\omega)}^{\infty} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f).\end{aligned} \tag{S.41}$$

and

$$\begin{aligned}\lambda_{jo} \equiv & M\ell_j^d \int_{f_d}^{\infty} \int_{\varphi_d}^{\varphi_o(\omega)} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) \\ & + M\ell_j^d \hat{\kappa}_{\hat{j}o}^{(1-\theta)\xi} \hat{\kappa}_{jo}^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_{jo}^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\} \int_{f_d}^{\infty} \int_{\varphi_o(\omega)}^{\varphi_{eo}^o(\omega)} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f) \\ & + M\ell_j^d \hat{\kappa}_e^{(1-\theta)\xi} \hat{\kappa}_{\hat{j}o}^{(1-\theta)\xi} \hat{\kappa}_{jo}^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_{jo}^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\} \int_{f_d}^{\infty} \int_{\varphi_{eo}^o(\omega)}^{\infty} \left[\frac{\varphi(\omega)}{\varphi_d}\right]^{(1-\theta)\xi} \frac{dG(\varphi)}{1-G(\varphi_d)} dF(f).\end{aligned} \tag{S.42}$$

Following the derivation steps in Appendix A.6, we arrive at

$$L_j^m = M\ell_j^d \Lambda_j(\hat{\kappa}_e, \hat{\kappa}_{jo}, \hat{\kappa}_{\hat{j}o}) \frac{g}{g-(1-\theta)\xi}, \tag{S.43}$$

with

$$\begin{aligned}\Lambda_j(\hat{\kappa}_e, \hat{\kappa}_{ho}, \hat{\kappa}_{lo}) \equiv 1 + \left(\frac{\tilde{f}}{\hat{f}}\right)^{\frac{g-(1-\theta)\xi}{g}} & \Bigg\{\rho \left[\hat{\kappa}_e^{(1-\theta)\xi} - 1\right] \left(\frac{\chi_e + \chi_{eo}^e}{\rho}\right)^{\frac{g-(1-\theta)\xi}{g}} \\ & + \rho\hat{\kappa}_e^{(1-\theta)\xi} \left[\hat{\kappa}_{\hat{j}o}^{(1-\theta)\xi} \hat{\kappa}_{jo}^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_{jo}^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\} - 1\right] \left(\frac{\chi_{eo}^e}{\rho}\right)^{\frac{g-(1-\theta)\xi}{g}} \\ & + (1-\rho) \left[\hat{\kappa}_{\hat{j}o}^{(1-\theta)\xi} \hat{\kappa}_{jo}^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_{jo}^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\} - 1\right] \left(\frac{\chi_o + \chi_{eo}^o}{1-\rho}\right)^{\frac{g-(1-\theta)\xi}{g}} \\ & + (1-\rho) \left[\hat{\kappa}_e^{(1-\theta)\xi} \hat{\kappa}_{\hat{j}o}^{(1-\theta)\xi} \hat{\kappa}_{jo}^{(1-\theta)\xi\varepsilon_j} \left\{1 + \left[\hat{\kappa}_{jo}^{\xi(1-\varepsilon_j)} - 1\right]^{1-\theta}\right\} - 1\right] \left(\frac{\chi_{eo}^o}{1-\rho}\right)^{\frac{g-(1-\theta)\xi}{g}} \Bigg\}.\end{aligned} \tag{S.44}$$

Because $\hat{\kappa}_{jo}^{(1-\theta)\xi(\varepsilon_j-1)}\{1 + [\hat{\kappa}_{jo}^{\xi(1-\varepsilon_j)} - 1]^{1-\theta}\}$ is increasing in $\hat{\kappa}_{jo}$ it follows that $\Lambda_h(\hat{\kappa}_e, \hat{\kappa}_{ho}, \hat{\kappa}_{lo}) \gtreqless$

$\Lambda_l(\hat{\kappa}_e, \hat{\kappa}_{lo}, \hat{\kappa}_{ho})$ if $\hat{\kappa}_{ho} \gtreqless \hat{\kappa}_{lo}$. Finally, the ranking of $\Delta(\hat{\kappa}_e, \hat{\kappa}_{ho}, \hat{\kappa}_{lo})$ and $\Lambda_j(\hat{\kappa}_e, \hat{\kappa}_{jo}, \hat{\kappa}_{jo})$ from the main text remains valid if τ_{ho} is sufficiently high (and close to infinity) and so do our findings regarding differential effect of trade in goods and trade in tasks on social welfare. This completes the formal discussion in this supplement.