Offshoring Domestic Jobs
– Technical Supplement –

Hartmut Egger∗
University of Bayreuth
CESifo, GEP, and IfW

Udo Kreickemeier†
University of Tübingen
CESifo and GEP

Jens Wrona‡
University of Düsseldorf

∗University of Bayreuth, Department of Law and Economics, Universitätsstr. 30, 95447 Bayreuth, Germany; Email: hartmut.egger@uni-bayreuth.de.
†University of Tübingen, Faculty of Economics and Social Sciences, Mohlstr. 36, 72074 Tübingen, Germany; Email: udo.kreickemeier@uni-tuebingen.de.
‡University of Düsseldorf, Düsseldorf Institute for Competition Economics (DICE), Universitätsstr. 1, 40225 Düsseldorf, Germany; Email: jens.wrona@dice.hhu.de
A continuum of tasks that differ in offshorability

In this extension, we shed light on the firm-internal margin of offshorability, by considering a continuum of tasks that differ in offshorability, as suggested by Acemoglu and Autor (2011). For this purpose, we replace our production function for intermediates in Eq. (3) by

$$ q(v) = \varphi(v) \exp \int_0^1 \ln \ell(v, \tilde{\eta}) d\tilde{\eta}, \quad (S.1) $$

in which $\ell(v, \tilde{\eta})$ is the input of task $\tilde{\eta} \in [0,1]$ in the production of $q(v)$. Tasks are symmetric in the labor input they require to be performed and, as in the main text, we impose the additional assumption that one unit of labor must be employed to produce one unit of task $\tilde{\eta}$. However, as in Grossman and Rossi-Hansberg (2008), tasks differ in their offshorability and this is captured by an iceberg cost parameter $t$ that is task specific: $t(\tilde{\eta})$. An intuitive way to interpret parameter $t$ is to think of it as task-specific trade cost parameter, implying that total costs of shipping the output of a task $\tilde{\eta}$, whose production has been moved offshore, back to the source country amounts to $t(\tilde{\eta}) \tau > 1$. To facilitate the analysis, we impose the additional assumption that $t(1) = 1, t(0) = \infty$ and $t'(\tilde{\eta}) < 0$. This implies that tasks are ranked according to their offshorability and it allows us to identify a unique firm-specific $\eta(v)$, which separates the tasks performed at home, $\tilde{\eta} < \eta(v)$, from the tasks performed abroad $\tilde{\eta} \geq \eta(v)$.

Once a firm has decided to engage in offshoring, it is left with two further decisions on how to organize its production, which are taken in two consecutive stages. In stage one, the firm chooses how many tasks to move offshore and sets $\eta(v)$ accordingly, while in stage two, the firm chooses optimal employment in domestic and offshored tasks. As it is common practice, we solve this two stage problem through backward induction and first determine the profit-maximizing employment levels for a given $\eta(v)$. For this purpose, we can recollect from the main text that wages paid to domestic and foreign workers are given $w$ and $w^*$, respectively. We can write labor demand for domestic and foreign task production as follows: $l^n(v) = \int_0^{\eta(v)} \ell^n(v, \tilde{\eta}) d\tilde{\eta} = \eta(v) \ell^n(v)$ and $l^r(v) = \int_{\eta(v)}^1 t(\tilde{\eta}) \ell^r(v, \tilde{\eta}) d\tilde{\eta} = \int_{\eta(v)}^1 t(\tilde{\eta}) d\tilde{\eta} t(\tilde{\eta})$. Therefore, firm $v$’s cost minimization problem can be expressed as follows:

$$ \min_{l^n(v), l^r(v)} \omega^n(v) l^n(v) + \omega^r(v) l^r(v) \quad \text{s.t.} \quad 1 = \varphi[\eta(v)]^{1-\eta(v)} \left[ \frac{l^n(v)}{\eta(v)} \right]^{\eta(v)} \left[ \frac{l^r(v)}{1-\eta(v)} \right]^{1-\eta(v)}, \quad (S.2) $$

As in the main text, we define $l^r(v)$ such that foreign labor demand of offshoring firm $v$ is given by $\tau l^r(v)$. While this definition of $l^r(v)$ might seem awkward at a first glance, it is useful for our purpose because it allows us to directly compare the production technology in Eq. (S.2) with the respective technology in Eq. (3).
\[ \omega^n(v) = w, \omega^r(v) = \tau w^* \] hold according to the main text and

\[ \epsilon[\eta(v)] \equiv \frac{1 - \eta(v)}{\int_\eta(v) t(\tilde{\eta}) \, d\tilde{\eta}} \quad (S.3) \]

reflects the average productivity loss arising from the extra labor costs \( t(\tilde{\eta}) \), when producing a task abroad. Solving maximisation problem (S.2) gives marginal production costs \( c^o(v) = w(v) / [\varphi(v) \kappa(v)] \), where

\[ \kappa(v) \equiv \frac{w \tau w^* \epsilon[\eta(v)]}{1 - \eta(v)}. \quad (S.4) \]

At stage one, the firm sets \( \eta(v) \) to minimise its marginal cost \( c^o(v) \). Thus, for the optimal \( \eta(v) \)-level the following first-order condition must hold:

\[ \frac{\partial c^o(v)}{\partial \eta(v)} \bigg|_{\eta(v)} = 0. \]

In view of Eqs. (S.3) and (S.4), this is equivalent to

\[ \frac{\partial \ln \kappa(v)}{\partial \eta(v)} = \ln \left( \frac{w}{\tau w^* \epsilon[\eta(v)]} \right) + t[\eta(v)] \epsilon[\eta(v)] - 1 = 0. \quad (S.5) \]

Eq. (S.5) determines the same cost-minimising \( \eta \) for all firms. Since the second-order condition of the stage one cost-minimisation problem requires \( \partial^2 \ln \kappa(v) / \partial \eta(v)^2 < 0 \), while \( \partial^2 \ln \kappa(v) / \partial \eta(v) \partial \tau > 0 \) follows from inspection of Eq. (S.5), we can finally conclude that \( d\eta/d\tau > 0 \), and hence firms offshore a lower share of tasks if the costs of shipping foreign output back to the source country increase. This completes our formal discussion.

**The case of a small open economy**

Being interested to what extent the results from our model depend on the adjustment of wages in the host country of offshoring, we can look at a model variant in which the source country is a small economy. This changes the labor market constraint (LC) in our model because foreign wages are now exogenous. Starting from Eq. (12), we have \( w = \gamma[(\sigma - 1)/\sigma]Y/L \). Accounting for \( I = Y[1 + \gamma(\sigma - 1)]/\sigma \), and substituting Eqs. (13) and (22) for \( L \) and \( I \), respectively, we can compute

\[ w(\chi) = \frac{\sigma - 1}{\sigma} \left( \frac{1}{k} \right)^{\frac{1}{\chi}} \left[ \frac{k}{k - \sigma + 1} \right]^{\frac{k + \sigma - 1}{k(\sigma - 1)}} \left\{ (1 + \chi) \left[ \frac{k + \sigma - 1}{k(\sigma - 1)} \right] \right\}^{\frac{1}{\chi}}, \quad (S.6) \]

\(^2\text{It is notable that } \kappa(v) \text{ degenerates to } z\kappa(v), \text{ when considering a discrete offshoring technology, with}

\[ t(\tilde{\eta}) = \begin{cases} \infty & \forall \tilde{\eta} \in [0, \eta) \\ 1 & \forall \tilde{\eta} \in [\eta, 1] \end{cases}. \]
provided that $\varepsilon = 0$. With the foreign wage being exogenous, we lose a stabilising force in our model, and hence the interior equilibrium might become unstable. Excluding external scale economies in the production of final goods helps avoiding this problem. Furthermore, the simplification seems justified as the main purpose of this section is to see whether key results of our model, such as welfare losses for the source country of offshoring at low levels of $\chi$, extend to a model variant in which the source country is small.

Substituting Eq. (S.6) into $\kappa = (w/\bar{w}^*)^{1-\eta}$ gives the labor market constraint

$$\kappa = \left[ \frac{\sigma - 1}{\sigma} \left( k \right)^{1 - \eta} \left[ \frac{k}{k - \sigma + 1} \right]^{\frac{k + \sigma - 1}{k - \sigma + 1}} \frac{1}{\bar{w}^*} \right]^{1 - \eta},$$

where $\bar{w}^*$ is a constant. Differentiating Eq. (S.7), we obtain

$$\frac{d\kappa}{d\chi} = \frac{\kappa(1 - \eta) \{(k + \sigma - 1)[k - \sigma + 1 + \gamma k(\sigma - 1)] + k(\sigma - 1)^2(1 + \chi)\partial\gamma/\partial\chi\}}{k(\sigma - 1)(1 + \chi)[k - \sigma + 1 + \gamma k(\sigma - 1)]},$$

with

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

We can thus safely conclude that $d\kappa/d\chi >, =, < 0$ is equivalent to $\zeta(\chi) >, =, < 0$, with

$$\zeta(\chi) \equiv (k + \sigma - 1)[k - \sigma + 1 + \gamma k(\sigma - 1)] - (\sigma - 1)^2\left[\left( k - \sigma + 1 \right) (1 - \eta) \chi^{-\frac{(\sigma - 1)}{k}} + k \left( \gamma - \eta \right) \right].$$

We can compute $\lim_{\chi \to 0} \zeta(\chi) = -\infty$ and $\zeta(1) = (k + \sigma - 1)[k - \sigma + 1 + \eta k(\sigma - 1)] - (\sigma - 1)^2(k - \sigma + 1)(1 - \eta)$, where the latter is positive if $\eta \geq 1/2$. This implies that in the model variant of a small source country, LC establishes a negative link between $\chi$ and $\kappa$ for small levels of $\chi$, but a positive one if $\chi$ is close to 1. It is the positive slope of the LC locus in $(\chi, \kappa)$-space, which provides a source of instability in our setting. To see this, we can look at Figure S.1, which depicts the upward-sloping offshoring indifference curve (OC) from Eq. (17) and the u-shaped labor market constraint (LC) from Eq. (S.7). The figure is constructed such that an interior equilibrium exists. However, with an upward-sloping segment of LC at high levels of $\chi$, there are now two intersection points of OC and LC in Figure S.1. Thereby, intersection point $A$ characterizes a stable interior equilibrium because $LC$ intersects $OC$ from above. In contrast, intersection point $A'$ depicts an unstable interior equilibrium because in this point $LC$ intersects $OC$ from below. Of course, it is in general not warranted that an intersection point of $OC$ and $LC$ exists, nor is it clear that $OC$ and $LC$ intersect more than once. However, the illustration in Figure S.1 makes clear that existence and uniqueness of a stable interior equilibrium requires a detailed formal analysis. And
this is what we provide next.

Figure S.1: Stable and unstable equilibria

Let us for the moment assume that an intersection point of $LC$ and $OC$ and thus an interior equilibrium exists. Then, the interior equilibrium is stable and unique if in any intersection point the slope of $OC$ is larger than the slope of $LC$. Our aim is to identify a sufficient condition for such an outcome. For this purpose, we combine Eqs. (17) and (S.7) to the following function

$$F(\chi; \tau) \equiv \left\{ \left[ \frac{\sigma - 1}{\sigma} \left\{ 1 + \frac{1}{k} \right\} \frac{k - \sigma + 1}{k - \sigma + 1} \frac{1}{\tau w^*} \right\}^{1-\eta} \left\{ (1 + \chi) \frac{k + \sigma - 1}{\sigma - 1} [k - \sigma + 1 + \gamma k(\sigma - 1)] \right\}^{1-\eta} - \left( 1 + \chi \frac{(\sigma - 1)}{k} \right)^{(1-\eta)} \right\}.$$

with $F(\chi; \tau) = 0$ for some $\chi \in (0, 1)$ characterizing an interior equilibrium. Differentiating $F(\chi; \tau)$ with respect to $\chi$ and evaluating the resulting expression at $F(\chi; \tau) = 0$ gives

$$\left. \frac{\partial F(\cdot)}{\partial \chi} \right|_{F(\cdot) = 0} = -\frac{\kappa f(\chi)}{k(1 + \chi)^2(1 + \chi(\sigma - 1)/k)[k - \sigma + 1 + \gamma k(\sigma - 1)]},$$

with

$$f(\chi) \equiv \chi^{(\sigma - 1)/k - 1}(1 + \chi) \left\{ [k - \sigma + 1] + k(\sigma - 1)\gamma \right\} - \frac{1 - \eta}{\sigma - 1} \left( 1 + \chi \frac{(\sigma - 1)}{k} \right) \left[ (k + \sigma - 1) \right] (k - \sigma + 1) + k^2(\sigma - 1)\gamma + k(\sigma - 1)^2\eta - (1 - \eta)(\sigma - 1)^2(k - \sigma + 1)\chi^{(\sigma - 1)}.$$

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Thereby, $f(\chi) > 0$ is sufficient for the interior equilibrium to be stable and unique. To facilitate the analysis, it is worth noting that $\chi^{(\sigma-1)/k-1}(1 + \chi) \geq 1 + \chi^{(\sigma-1)/k}$ and thus $f(\chi) \geq \hat{f}(\chi)$, with

$$
\hat{f}(\chi) \equiv k - \sigma + 1 + k(\sigma - 1)\gamma - \frac{1 - \eta}{\sigma - 1}(k + \sigma - 1) + k^2(\sigma - 1)\gamma + k(\sigma - 1)^2\eta - (1 - \eta)(\sigma - 1)^2(k - \sigma + 1)\chi^{-\frac{(\sigma-1)}{k}}.
$$

Rearranging terms establishes

$$
\hat{f}(\chi) = [k - \sigma + 1 + \gamma k(\sigma - 1)] \left[ 1 - \frac{1 - \eta}{\sigma - 1}(k + \sigma - 1) \right] + (1 - \eta)k(\sigma - 1)(\gamma - \eta) + (1 - \eta)^2(\sigma - 1)(k - \sigma + 1)\chi^{-\frac{(\sigma-1)}{k}},
$$

and this is unambiguously positive if

$$
1 - \frac{1 - \eta}{\sigma - 1}(k + \sigma - 1) \geq 0 \iff \eta \geq \frac{k}{k + \sigma - 1} \equiv \eta_{SE}, \tag{S.15}
$$

where $\eta_{SE} \in (1/2, 1)$ if $k > \sigma - 1$. Taking stock, we have shown that if an interior equilibrium exists, $\eta \geq \eta_{SE}$ is sufficient for the respective equilibrium to be stable and unique.

It remains to be shown is that an interior equilibrium does exist. This is the case, if $F(0; \tau) > 0$ and $F(1; \tau) < 0$. In view of Eq. (S.11), we find that $F(0; \tau) > 0$ is equivalent to

$$
\tau \bar{w}^* < \frac{\sigma - 1}{\sigma} \left( \frac{1}{k} \right)^\frac{1}{k} \left[ \frac{k}{k - \sigma + 1} \right]^{\frac{k + \sigma - 1}{(\sigma-1)}} [k - \sigma + 1 + k(\sigma - 1)]^{\frac{1}{k}} \equiv \bar{w}_u^*
$$

whereas $F(1; \tau) < 0$ is equivalent to

$$
\tau \bar{w}^* > \frac{\sigma - 1}{\sigma} \left( \frac{1}{k} \right)^\frac{1}{k} \left[ \frac{k}{k - \sigma + 1} \right]^{\frac{k + \sigma - 1}{(\sigma-1)}} [k - \sigma + 1 + \eta k(\sigma - 1)]^{\frac{1}{k}} \equiv \bar{w}_l^*.
$$

Hence, an interior equilibrium exists if the effective foreign wage rate $\tau \bar{w}^*$ is neither too small nor too large, i.e. if it lies in interval $(\bar{w}_l^*, \bar{w}_u^*)$. Otherwise, we would end up in a corner solution with full offshoring ($\chi = 1$) if $\tau \bar{w}^* < \bar{w}_l^*$ and no offshoring ($\chi = 0$) if $\tau \bar{w}^* > \bar{w}_u^*$.

Taking stock, we have shown that the two conditions $\eta \geq \eta_{SE}$ and $\tau \bar{w}^* \in (\bar{w}_l^*, \bar{w}_u^*)$ describe a parameter domain for which a unique stable interior equilibrium exists. Crucially, starting from such an interior equilibrium, an increase in $\tau$ shifts the LC locus downwards in Figure S.1, according to Eq. (S.7), and hence it is associated with a decline in both $\chi$ and $\kappa$. The comparative static effects of changes in $\tau$ on the two offshoring variables of interest are therefore the same as in our benchmark model of two large economies, implying that the main insights from our analysis extend to a scenario with a small open economy. In particular, there are welfare losses due to a
detrimental reallocation of labor to less productive uses in the source country at early stages of offshoring (low levels of $\chi$), and the income distribution becomes more unequal with offshoring than in the absence of offshoring. To complete the discussion of the small open economy, we can finally note that our insight that the small open economy assumption does not change our results regarding the comparative static effects of changes in $\chi$ on key general equilibrium variables of interest is more generally valid and in particular also holds if $\varepsilon > 1$. Abstracting from external scale economies in final goods production is relevant for establishing a unique stable interior offshoring equilibrium, and hence for the effects of changes in $\tau$ on $\chi$ and $\kappa$ if the source country is small. However, the effects that a change in $\chi$ exerts on the general equilibrium variables of interest do not depend on whether the source country is small or large, irrespective of the size of $\varepsilon$.

A “partial equilibrium” approach

In this section we consider a partial equilibrium setting, in which we exclude income effects and at the same time assume that relative wages in the source and host country of offshoring are exogenous: $w/w^* = a > 1$. This establishes $\kappa = (a/\tau)^{1-\eta}$. The simplest way to capture this feature is to add an (agricultural) outside good, $q_0$, which is linear in labor input, produced under perfect competition, and freely tradable in the world market. We assume that the labor input coefficient is one in the source country and $a > 1$ in the host country of offshoring. Taking the outside good as numéraire and setting its price equal to one, therefore establishes $w = 1$ and $w^* = 1/a$, provided that both countries produce the outside good (which can be enforced by considering appropriate population sizes $N$ and $N^*$). We combine this technology assumption with a quasilinear upper-tier utility function. For agent $z$ from the source country, we write $u(z) = c_0(z) + c_Y(z)^\alpha$, with $\alpha \in (0,1)$, where $c_0(z)$ and $c_Y(z)$ refer to the agent’s consumption of good $q_0$ and $Y$, respectively. Maximizing $u(z)$ subject to the agent’s budget constraint, $c_0(z) + P_Y c_Y(z) = I(z)$ gives the Marshallian demand functions

$$c_0(z) = I(z) - \alpha \frac{1}{1-\alpha} \left( \frac{1}{P_Y} \right)^{\frac{\alpha}{1-\alpha}}, \quad c_Y(z) = \left( \frac{\alpha}{P_Y} \right)^{\frac{1}{1-\alpha}}.$$  \hspace{1cm} (S.18)

Substitution into $u(z)$ gives indirect utility $v(z) = I(z) + (1-\alpha) (\alpha/P_Y)^{\frac{\alpha}{1-\alpha}}$. Global consumption of good $Y$ is given by $C_Y = (N + N^*) \left( \alpha/P_Y \right)^{\frac{1}{1-\alpha}}$ and due to market clearing equals total output $Y$.

Producers of good $Y$ are also perfectly competitive and maximize profits $P_Y Y - \int_{v \in V} p(v) q(v) dv$, with $Y$ being given by Eq. (1). Solving this maximization problem establishes demand for inter-
mediate good $v$:

$$q(v) = \frac{Y}{M^{1-\varepsilon}} \left[ \frac{p(v)}{P_Y} \right]^{-\sigma}, \quad (S.19)$$

which in view of $C_Y = Y$ can be rewritten as follows:

$$q(v) = (N + N^*)\alpha \frac{1}{1-\alpha} M^{1-1} P_Y^{\sigma-1} p(v)^{-\sigma}. \quad (S.20)$$

Thereby $P_Y$ is a CES price index and equals $P_Y = M^{1-1} \left( \int_{v \in V} p(v)^{1-\sigma} dv \right)^{1-\sigma}$. Using the insights from the main text, we can write

$$P_Y = M^{1-1} \left\{ M \int_{\varphi_d} p^d(\varphi)^{1-\sigma} \frac{dG(\varphi)}{1-G(\varphi)} + M \int_{\varphi_\sigma} p^d(\varphi)^{1-\sigma} \frac{dG(\varphi)}{1-G(\varphi)} \right\}^{1-\sigma},$$

$$= M^{1-1} p^d(\varphi^d) (1 + \chi) \frac{k}{k - \sigma + 1} \left( \frac{1}{\sigma - 1} \right)^{1-\sigma}, \quad (S.21)$$

With these insights at hand, we can now look at the profits of the least productive producer. In view of Eqs. (S.20) and (S.21), these profits are given by

$$\pi^d(\varphi^d) = \frac{1}{\sigma} (N + N^*) \alpha \frac{1}{1-\alpha} M^{1-1} P_Y^{\sigma(1-\alpha)-1} p^d(\varphi^d)^{1-\sigma},$$

$$= \frac{1}{\sigma} (N + N^*) \alpha \frac{1}{1-\alpha} \left( \frac{k}{k - \sigma + 1} \right)^{1-\sigma} M^{\frac{\sigma(1-\alpha)}{(\sigma-1)(1-\alpha)}} (1 + \chi) \frac{1-\sigma}{(\sigma-1)(1-\alpha)} p^d(\varphi^d)^{1-\sigma}. \quad (S.22)$$

Substitution of $M = N(\varphi^d)^{-k}$ and $p^d(\varphi^d) = (\varphi^d)^{-1}\sigma/(\sigma - 1)$ gives

$$\pi^d(\varphi^d) = Z \left( 1 + \chi \right)^{1-\sigma} (\varphi^d)^{1-\sigma} \mu \left( \frac{1}{\sigma - 1} \right)^{1-\sigma} \mu, \quad (S.23)$$

with

$$Z \equiv \frac{1}{\sigma} (N + N^*) \alpha \frac{1}{1-\alpha} \left( \frac{k}{k - \sigma + 1} \right)^{1-\sigma} M^{\frac{\sigma(1-\alpha)}{(\sigma-1)(1-\alpha)}} (1 + \chi) \frac{1-\sigma}{(\sigma-1)(1-\alpha)} N^{\frac{\sigma(1-\alpha)}{(\sigma-1)(1-\alpha)}}. \quad (S.24)$$

Substitution of $M = N(\varphi^d)^{-k}$ and $p^d(\varphi^d) = (\varphi^d)^{-1}\sigma/(\sigma - 1)$ gives

$$\pi^d(\varphi^d) = Z \left[ (1 + \chi)^{1-\sigma} (\varphi^d)^{1-\sigma} \mu \right] \frac{1}{(\sigma-1)(1-\alpha)} \mu, \quad (S.25)$$

being two constants. Accounting for the indifference condition $\pi^d(\varphi^d) = w = 1$, we can compute

$$\varphi^d = Z \frac{1}{\mu} \left( 1 + \chi \right)^{1-\sigma} \frac{\sigma(1-\alpha)-1}{\mu}. \quad (S.26)$$
Noting that \( \chi = (\kappa^{\sigma-1} - 1)^{k/(\sigma-1)} \) from Eq. (17) remains valid in the partial equilibrium setting and accounting for \( \kappa = (a/\tau)^{1-\eta} \), Eq. (S.25) gives an explicit solution for the cutoff productivity level. A higher \( \tau \) lowers \( \kappa \) and \( \chi \), and it may have a positive or negative impact on \( \varphi^d \), depending on the ranking of \( \sigma >,=,<1/(1-\alpha) \) and \( \mu >,=,<0 \). The two rankings are not independent. We can show that \( \sigma \geq 1/(1-\alpha) \) is sufficient for \( \mu >0 \). In this case, \( \varphi^d \) increases while \( M \) decreases with the share of offshoring firms \( \chi \). Only if the elasticity of substitution between \( Y \) and \( q_0 \) in consumers’ preferences, as given by \( 1/(1-\alpha) \), is larger than the elasticity of substitution between different varieties in the production of good \( Y \), it is possible that \( \varphi^d \) shrinks, whereas \( M \) increases in \( \chi \). To put it formally, an outcome with \( d\varphi^d/d\chi < 0 \) and \( dM/d\chi > 0 \) is only possible if \( \sigma < 1/(1-\alpha) \) and \( \mu >0 \) hold simultaneously. We can in a final step determine domestic welfare by looking at utility of the representative consumer in the source country, which is given by

\[
V^S = I^S + N(1-\alpha)\left(\alpha/P_Y\right)^{\frac{\sigma}{1-\alpha}},
\]

where \( I^S \) denotes total income in the source country. Total source country income is given by \( I^S = \Pi + w[N - M(1 + \chi)] \), with \( \Pi \) being aggregate operating profits in the production of intermediates and \( L = N - M(1 + \chi) \) being total labor input. Total operating profits can be computed according to

\[
\Pi = M \int_{\varphi^o}^{\varphi^d} \pi^d(\varphi) \frac{dG(\varphi)}{1-G(\varphi^d)} + M \int_{\varphi^o}^{\infty} \pi^o(\varphi) \frac{dG(\varphi)}{1-G(\varphi^d)},
\]

\[
= M \pi^d(\varphi^d) \frac{k}{k-\sigma+1}(1+\chi).
\]

Accounting for indifference condition \( \pi^d(\varphi^d) = w = 1 \), then establishes

\[
I^S = N + M \frac{(\sigma-1)(1+\chi)}{k-\sigma+1} = N \left[ 1 + \frac{(\sigma-1)(1+\chi)\varphi^d-k}{k-\sigma+1} \right].
\]

Substitution of Eq. (S.25) further implies

\[
I^S = N \left[ 1 + \frac{(\sigma-1)}{k+\sigma-1} \left( \frac{k}{\sigma-1} \right)^{\frac{1-\alpha}{\alpha}} Z^{-\frac{k(\sigma+1)(1-\alpha)}{\alpha}} (1+\chi)^{-\frac{\alpha(k+\sigma+1)(1-\alpha)}{\mu}} \right].
\]

Total source country income \( I^S \) increases in \( \chi \) if \( \mu >0 \) and decreases in \( \chi \) if \( \mu <0 \). Furthermore, we can combine Eqs. (S.21) and (S.25) with \( M = N(\varphi^d)^{-k} \) to compute

\[
P_Y = N \frac{\varphi^d}{\alpha-1} \left( \frac{k}{k-\sigma+1} \right)^{\frac{1}{1-\alpha}} Z^{-\frac{(1-\alpha)(k+\sigma+1)}{\mu}} (1+\chi)^{-\frac{(1-\alpha)k+\sigma+1(1-\alpha)}{\mu}},
\]

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where $P_Y$ decreases in $\chi$ if $\mu > 0$ and increases in $\chi$ if $\mu < 0$. Putting together, we can thus conclude that source country welfare increases (decreases) monotonically in $\chi$ if $\mu > 0$ ($\mu < 0$). This implies that welfare losses from offshoring are only possible in the partial equilibrium setting if $\varepsilon$ is sufficiently large.

Whereas the general insight from our analysis that the source country may be worse off with offshoring than in the absence of offshoring extends to a partial equilibrium environment, the role played by external scale economies changes considerably relative to the benchmark model. To understand this difference, we can make use of insights from Pflüger and Südekum (2013) who study a model, in which heterogeneous firms are active under monopolistic competition in a differentiated goods industry, and labor is used as the only production input in this industry as well as in a linear, perfectly competitive outside sector. Pflüger and Südekum (2013) consider a quasilinear utility function and show that too few firms enter in the differentiated goods industry if $\varepsilon = 1$. This is a consequence of under-consumption of the industrial good in the presence of mark-up pricing. If $\sigma > 1/(1 - \alpha)$ holds in our setting, offshoring enforces firm exit and one may therefore be tempted to conclude that it can lower welfare in the source country due to an even stronger distortion of the decentralized entry process. However, this is not true because the strong substitutability of intermediates in the production of $Y$ implies that those varieties lost due to exit of low-productivity producers can easily be replaced by other varieties supplied by high-productivity firms. Welfare losses are only possible if $\mu < 0$, and this requires $\sigma < 1/(1 - \alpha)$ (see above). If $\sigma < 1/(1 - \alpha)$, an increase in $\chi$ also induces firm exit and thus further distorts the decentralized entry process. Without a strong substitutability of intermediates, the loss of varieties can however not be compensated by the cost reduction for newly offshoring firms. As a consequence offshoring lowers welfare if $\mu < 0$, and $\mu < 0$ is only possible if $\varepsilon$ is sufficiently large.

For $\varepsilon < 1$, insufficient firm entry due to under-consumption of industrial goods is counteracted by excessive firm entry due to lower external scale effects in the production of $Y$, and hence it is a priori not clear that too few firms enter from a social planner’s point of view at low levels of $\varepsilon$.

References


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