Abstract

We present a model in which monitoring costs determine firms’ outsourcing and offshoring decisions. We predict that the most productive firms outsource in the South, while the least productive produce in-house in the North. Within the range of intermediate productivities, firms with lower productivity outsource in the North, and those with higher productivity perform in-house production in the South. Offshoring gives rise to higher average world productivity, but an overall loss of variety. Exit of Southern firms following offshoring is sufficient to offset any change in the number of Northern firms producing ex post. Inequality between Northern entrepreneurs and Northern workers rises, while that between Northern workers and Southern workers falls. Inequality between Northern entrepreneurs and everyone else rises.
1 Introduction

Firms face a number of trade-offs in choosing the organisational form and location in which to produce. A powerful source of such trade-offs identified in the literature is the existence of transaction costs, which arise in economic environments of incomplete information. Where the costs of transacting in an arm’s length relationship are high, firms may choose to integrate production vertically. Two key drivers of this choice are the desire of firms to avoid the problem of ‘hold-up’, originating in non-contractible, relationship specific investments, and the problem of monitoring and incentive provision. The literature on offshoring and fragmentation has to date stressed the former over the latter.

Holmstrom and Roberts (1998) write that “firms are complex mechanisms for coordinating and motivating individuals’ actions. They have to deal with a much richer variety of problems than simply the provision of investment incentives and the resolution of hold ups”. In what follows we apply this reasoning to the modelling of firms’ outsourcing and offshoring decisions. In particular we consider a setting in which entrepreneurs, acting as Principals, seek to contract with workers, acting as Agents, for whom effort is imperfectly observable and output is subject to shocks. The combination of imperfectly observable effort and risk aversion on the part of (at least) the worker gives the entrepreneur a non-trivial mechanism design problem, in which (s)he must trade off risk and incentives in writing the optimal wage contract. In positing differences in the effectiveness of monitoring across organisational forms, we seek to explain which firms choose to outsource or offshore, and why.

Jabbour (2005) provides some evidence to suggest that firms regard the ability to monitor output to be an important factor in making the offshoring decision. Of a sample of 2,723 French industrial firms, 63% ‘perfectly agree’ or ‘agree’ that control over the quality of production is a motive favouring vertically integrated supply. 60% choose internalisation to ensure stability of supply. Similarly, Feenstra and Hanson (2004), in an analysis of Chinese export processors, find that the disintegration of ownership of production facilities from control over input sourcing is more common in Southern coastal provinces, where there exist thick export markets and relatively efficient courts, in comparison to interior and northern provinces, where integration is more likely. Their approach admits both incentive system and property-rights interpretations: by the former, one might regard the increased prevalence and earlier establishment of export processing in the Southern region as more conducive to better monitoring, e.g. through better established common working practices and access to communications technology. Navaretti and Venables (2004) cite the example of Rowntree, a well known British producer of confectionary, which expanded into South Africa in 1900. Distribution was subsequently licensed to a local agent, which undertook a low cost, low effort marketing strategy, in contrast to the wishes of headquarters. In 1950 then, Rowntree acquired majority control over the venture in South Africa, strengthening its own ability at monitoring and control. In taking an incentive system approach in what follows therefore, we stress the importance of this kind of influence, thought of as the ability to ‘monitor’, or the ‘riskiness’ of production,
in determining firms’ outsourcing and offshoring decisions. We suggest that these considerations might be particularly significant in firms’ North-South offshoring decisions, where distance, language and common work practices may provide particular barriers to low cost monitoring. Moreover the North-South setting appears to be an important one both empirically and in contemporary policy debate.

We model the trade-offs associated with the choice of organisational form as follows. We assume in-house production to be easier to monitor than outsourced production, and that production in the home country is easier to monitor than production abroad. The former is supposed to be driven by the added difficulty of monitoring the effort of workers in outsourced production plants, while the latter is supposed to be driven by a lack of knowledge of foreign business practices, different languages, local contingencies, and so on. In addition to this, we assume entrepreneurs, having invented a technology, enjoy an efficiency gain associated with outsourcing production per se, owing to their inferior ability to organise production, ensure compliance with legal standards, perform marketing, and so on. Finally, where the South is sufficiently labour abundant, it has a lower wage in equilibrium, providing a factor cost motive for offshoring by Northern firms, but preventing offshoring by Southern firms.

Under these conditions, different organisational forms are associated with different levels of ‘riskiness’ of production, where riskiness increases as monitoring effort gets harder. We find that the least productive firms engage in in-house production at home, the least risky organisational form, while the most productive firms engage in outsourced production abroad, the most risky organisational form. In the intermediate productivity range, firms first outsource at home, and then produce in-house abroad as productivity rises. The intuition for the result that only the most productive firms can engage in the riskiest organisational form is that only these firms can generate revenues large enough to compensate their entrepreneurs for the higher risk.

Further, we use our model to examine the impact of offshoring on productivity, welfare and inequality. As offshoring increases, average world productivity rises as a result of Northern firms making cost savings associated with foreign outsourcing and cheaper Southern labour. This leads to lower average prices. The efficiency gains however also lead to firm exit via greater competition, giving an overall loss of variety. These two effects oppose each other in their impact on welfare. The model suggests that the net exit of firms is achieved in particular by the exit of Southern firms, which offsets any change in the number of

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1 Imperfect monitoring and ‘risky’ production are two sides of the same coin in what follows. Imperfect monitoring implies the entrepreneur can distinguish imperfectly between two possible causes of low output: low worker input and independent adverse shocks to production. In this sense production characterised by imperfect monitoring is also ‘riskier’ in observational terms than production subject to perfect monitoring. Workers risk having adverse production shocks being mistaken for low effort, and entrepreneurs risk mistaking low effort for adverse production shocks.

2 While the outflows of FDI continue to originate predominantly from advanced countries, an increasing share is flowing into developing economies. Navaretti and Venables (2004) for example cite UNCTAD data illustrating that 90% of FDI outflows in 2002-4 originated in advanced economies, while inflows into advanced economies accounted for only 65% of global flows, with 35% flowing into developing and transition economies in that year. Moreover, the share flowing to developing and transition economies has been growing, up from 26% in 1970-3.
Northern firms that might raise firm numbers in total.

Welfare effects depend overall on the combined impact of offshoring on prices and nominal incomes. We find a sufficient condition for all agents to be made better off as a result of offshoring is for Northern workers to be made better off following offshoring. These workers face a fall in their nominal incomes as a result of Northern firms moving production offshore; if prices fall by enough to offset this, they also fall enough to make all Southern agents (whose nominal incomes do not change) and Northern entrepreneurs (whose nominal incomes rise) better off as well. Northern entrepreneurs are the only group whose nominal incomes rise after the adjustment to offshoring.

A further result of this is that inequality between Northern entrepreneurs and Northern workers must rise following an increase in offshoring. Inequality between Northern and Southern workers must fall. Finally, there is a rise in inequality between Northern entrepreneurs and all other agents.

This paper relates to the existing literature as follows. Numerous authors have documented the recent trend towards increasingly fragmented patterns of production across countries. In tandem with these empirical stylised facts, a number of recent papers have sought to establish the theoretical basis for these observed changes. Most papers have, following Antras (2003), taken a ‘hold-up’ approach, stressing the provision of investment incentives in supplier-producer relationships. Grossman and Helpman (2004) take an incentive system approach, though their model is hard to relate to heterogeneous firm monopolistic competition models a la Melitz (2003), and predicts that the least productive firms engage in FDI and Southern outsourcing, which appears at odds with the existing evidence.

The emergent empirical evidence concerning firm heterogeneity and organisational form is, however, in its infancy. There is great heterogeneity among the extant empirical approaches, including issues of definition, data coverage, and organisational forms under study. While some studies appear to confirm selected predictions of the existing ‘hold-up’ approach, others obscure the picture by providing apparently contradictory evidence. While Tomiura (2007) finds an organisational form ordering pattern similar to that of Antras and Helpman (2004) for a sample of Japanese firms, the study does not distinguish between Northern and Southern offshoring, nor does it appear to include domestic outsourcing as a possible organisational form, limiting its use as supportive of the hold-up model. By contrast Jabbour (2005) finds evidence to suggest the ordering of organisational forms in productivity proposed by existing theories is not fully supported in data on French multinationals. A related problem is that existing

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3 See in particular Feenstra (1998) and Hummels, Ishii and Yi (2001). The former, for example, documents growth in the share of imported to domestic intermediate inputs for a selection of advanced countries from 1970s to the 1990s. For the UK this share grew from 13.4% in 1974 to 21.6% in 1993 for all manufacturing industries. For the US, the share doubled from 4.1% in 1974 to 8.2% in 1993. The latter documents growth in vertical specialisation across 10 OECD and four emerging markets of 30% between 1970 and 1990.


5 In particular, for component intensive sectors, she finds that an increase in productivity is associated with a higher
studies do not fully address the underlying causes of observed organisational form orderings.

2 The Model

There are two regions, North (N) and South (S). They trade freely. Each region contains labour, $L_k$, $k = N, S$ which earns income and consumes goods. We specify consumption and production as follows.

2.1 Preferences

Each agent seeks to maximise the following utility function which depends on consumption of goods from the North and the South according to

$$U = Q_N^{\eta_N} Q_S^{\eta_S}$$

where $\eta_N + \eta_S = 1$. Each $Q_k$, indexed by country $k = N, S$, is a CES consumption index given by $Q_k = \left[ \int_{\gamma \in \Gamma_k} q(\gamma) \rho d\gamma \right]^{\frac{1}{\rho}}$, where $0 < \rho < 1$. In words, consumers spend shares $\eta_k$ of their income on goods from country $k$. Goods are horizontally differentiated, indexed by their ‘variety’ $\gamma \in \Gamma_k$. We may perform two stage budgeting to give demand for an individual firm in a given country as

$$q_k(\gamma) = \theta_k p(\gamma)^{-\sigma}$$

where $\theta_k = \frac{\eta_k E}{P_k}$, in which $E$ is world expenditure and $P_k$ is country $k$’s ideal price index, defined by $P_k = \left[ \int_{\gamma \in \Gamma_k} p(\gamma)^{1-\sigma} d\gamma \right]^{\frac{1}{1-\sigma}}$.

2.2 The Structure of Production

In each economy, entrepreneurs are drawn from the pool of labour. Entrepreneurs invent ideas, or technologies. Technologies are heterogeneous, indexed by an associated productivity level $\varphi$, and are drawn independently from the identical cumulative distribution function $G(\varphi)$ defined over finite support $[0, \bar{\varphi}]$, with associated probability distribution function $g(\varphi)$. Entrepreneurs run firms which produce probability of Northern outsourcing than Southern outsourcing, in contrast to the predictions of Antras and Helpman (2004). Similarly, for headquarter intensive sectors, the ordering of country location in productivity is found to be the reverse of that of the model. Note this finding is also contrary to the predictions of Grossman and Helpman (2004) who take an incentive system approach, which in their case predicts outsourcing by both the lowest and highest productivity firms. There is a problem however in viewing Jabbour’s evidence as directly relevant to Antras and Helpman (2004)’s model, as her data is truncated to exclude firms which operate only domestically.

6The results that follow do not depend on this separability. The assumption is made to simplify algebra; in particular, with this set-up, each country has its own ideal price index.

7For example, for consistency with existing work on trade and heterogeneous firms, one might use a Generalised Pareto Distribution, which allows for a finite support, though this is by no means the only admissible distribution function for what follows.
final goods using the technology they have invented. The firms which entrepreneurs run therefore vary according to their technology level, or productivity, and produce a unique variety, which we may index by $\varphi$.

Their costs depend both on this, and on their choice of organisational form. We assume two dimensions along which organisational form may vary. The first is whether production takes place inside the firm (‘in-house’) or outside the firm (‘outsourced’). The second is whether production takes place in the North or the South. Each of these choices involves a trade off.

2.2.1 In-house versus Outsourcing

Consider first the choice to produce in-house or outsource. We assume that entrepreneurs are not the most efficient organisers of production. Their comparative advantage lies in the invention of new technologies, not in managing production lines, ensuring compliance with safety standards, marketing, and so on. We model this by assuming that there is a per unit efficiency gain $\alpha < 1$ associated with outsourcing.

There is an additional cost associated with this however: that of monitoring production. In particular, we assume that in outsourcing production, the entrepreneur’s ability to monitor worker effort falls. We model this monitoring problem by positing a reduced form Principal-Agent problem, which we seek to embed in the entrepreneur’s cost function. In particular, we assume the efficiency saving associated with outsourcing depends on worker effort $e$, such that $\alpha = \alpha(e)$, where $\alpha' < 0$, or higher effort lowers unit input requirements. While it is not necessary for the results that follow, it is helpful to assume a functional form for $\alpha$, which we take here to be $\alpha = \alpha(e)$.

We assume further however that $\alpha(e)$ is not perfectly observed by the entrepreneur under outsourced production. Letting subscript ‘o’ denote outsourcing, she receives a noisy signal $x_o = \alpha(e) + \epsilon_o$, where $\epsilon_o \sim N(0, v_o)$, which contains information about unit costs, and therefore effort. The variance of the shock to the entrepreneur’s signal $v$ can be thought of as noise; a rise in $v$ indicates a noisier signal, or harder monitoring. The entrepreneur may use this signal to incentivise effort, by making worker pay $W$ a function of $x$. Doing so however exposes the worker to income risk. Since utility is concave in this model, all agents are risk averse. This implies the entrepreneur faces a contract design problem in which she must trade off worker ‘incentives’ against worker income ‘insurance’.

To render the problem tractable when embedded in our general equilibrium model, I posit a reduced form wage contract $W$. We want this contract to display the following features of the canonical Principal-Agent model\(^8\), in which

1. The worker must receive at least her outside option. In this model, we will assume this is given by the wage paid associated with employment in–house, $w_k$;

2. The worker must receive a payment incentivising them to exert effort;

3. The worker must receive a risk premium, demanded to compensate them for the risk to which they are exposed by having pay depend in some way on the noisy signal. Further, we assume a competitive labour market. This implies the total payment a worker receives under any organisational form must give them the same certainty equivalent utility. In particular, the utility value of the wage paid to workers in outsourced production must be equal to that under in–house production, implying that workers’ participation constraints bind.

$W$ is what entrepreneurs who employ workers in outsourced relationships must pay per unit of labour hired. According to points (1) and (2), we assume this to be some premium over workers’ outside option $w$. By point (3), in a competitive labour market it must be that for a worker $u(w) = u[CE(W)]$, where $CE(.)$ denotes certainty equivalent.

In incorporating these features we assume the entrepreneur offers a contract $W$ which takes the form $W = ws(x)$, where $s(.) \geq 1$ is a premium paid under outsourced production. Since the signal $(x)$ is a function of both effort $(e)$ and noise $(v)$, we may write the premium workers in outsourced relationship must receive as $s(x) = s(e, v)$. We assume that $s(.)$ has derivatives $s_e > 0$ and $s_v > 0$. These two conditions imply that (a) the premium a worker must be paid to exert higher effort is increasing in the effort level, and (b) the risk premium which workers demand is increasing in the noisiness of the signal entrepreneurs receive, i.e. increasing as monitoring gets harder. Finally, we will also assume that the cross derivative is positive $ds_{ev} > 0$, implying that as monitoring gets harder, the ‘marginal cost’ of incentivising greater effort is higher. As with the $\alpha$ function, a functional form is convenient, though not necessary for the results the follow. We use $s(e, v) = \exp(ev)$, which has the properties $s_e > 0$, $s_v > 0$ and $s_{ev} > 0$ that we want.

We make the difference in monitoring between in-house and outsourced production extreme by assuming monitoring to be perfect in-house. We assume fixed costs $f$ under each organisational form, giving expected cost functions for in-house and outsourced production for a firm from country $k$ locating production in country $k$ and producing output $q$ as

$$c^i_k(\varphi) = \frac{w_k}{\varphi}q - fw_k$$  \hspace{1cm} (3)

$$c^o_k(\varphi) = \frac{\alpha(e)s(e, v_o)w_k}{\varphi}q - fw_k$$  \hspace{1cm} (4)

2.2.2 ‘Onshoring’ versus Offshoring

Now consider the choice to locate production at home or abroad. We assume that production abroad incurs monitoring difficulties over and above those associated with production at home. For example,\[9\] our results do not depend on this, but do require that monitoring in-house be better than that under outsourcing.\[10\] Again, this may be generalised, for discussion of which see later. It is worth noting now however that we do not necessarily need any fixed costs for the results that follow. But if we are to assume non-zero fixed costs, we will require there to be some bounds on their relative size across organisational forms, for which see later.
different languages, business practices, and knowledge about the extent of local contingencies makes monitoring production which takes place in another region inherently difficult. In other words, there is a negative ‘border effect’ on the ease with which effort may be monitored across countries. Offset against this are potential cost savings associated with lower wage costs in other countries. In particular, if the South is sufficiently labour abundant, we later show that the equilibrium wage rate in the South will be less than that in the North. A corollary of this is that Southern firms will never find it optimal to offshore, since they incur both high monitoring costs from doing so, and make no factor cost saving. Only Northern firms will do so, and only when the wage cost saving in the South is sufficient to offset the additional border costs associated with poorer monitoring there.

Formally, unit input requirements for in-house production abroad and outsourcing abroad are $1/e$ and $\alpha/e$ respectively. That is, they share exactly the same per unit input requirements as in-house production and outsourced production at home. But we assume that the effort signal entrepreneurs receive when production is located overseas is noisier than that received when production is at home. That is, for signals $x_{ins} = \frac{2}{e} + \epsilon_{ins}$ and $x_{os} = \frac{2}{e} + \epsilon_{os}$ in which $\epsilon_{ins} \sim N(0, v_{ins}), \epsilon_{os} \sim N(0, v_{os})$, we assume that $v_{o} < v_{ins} < v_{os}$, where ‘in*’ and ‘o*’ denote in-house abroad and outsourcing abroad respectively.

Accordingly, expected cost functions for Northern firms offshoring to the South are

$$c_{in}^{os} (\varphi) = \frac{s(e, v_{ins}) w_{S}}{\varphi} - f w_{S}$$  \hspace{1cm} (5) \\
$$c_{in}^{os} (\varphi) = \frac{\alpha(e)s(e, v_{os}) w_{S}}{\varphi} - f w_{S}$$  \hspace{1cm} (6) \\

for in-house production in the South and outsourcing in the South respectively.

In summary, unit costs for the different organisational forms are:

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<tr>
<th></th>
<th>In-house</th>
<th>Outsourced</th>
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<tbody>
<tr>
<td>Home (k)</td>
<td>$\frac{w_{k}}{\varphi}$</td>
<td>$\frac{\alpha(e, v_{o}) w_{k}}{\varphi}$</td>
</tr>
<tr>
<td>Abroad (l)</td>
<td>$\frac{s(e, v_{ins}) w_{l}}{\varphi}$</td>
<td>$\frac{\alpha(s(e, v_{os}) w_{l}}{\varphi}$</td>
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2.2.3 Entrepreneurial risk aversion

Finally, since entrepreneurs have concave utility, they are also risk averse. They therefore require a risk premium to operate in risky environments; alternatively, for a given level of profit, an increase in riskiness reduces the certainty equivalent (i.e. utility value) of that profit, which is what entrepreneurs ultimately care about. We have assumed in-house production to be risk-free — input costs (and therefore output) are perfectly monitored — and so certainty equivalent profit is equal to total profit for in-house producers. Not so if entrepreneurs choose to outsource at home or offshore. This exposes them to shocks to output, which reduces the certainty equivalent value of any profits earned. The size of this reduction is increasing as monitoring gets harder, and is given by $S(v_{i}) > 0, i = o, ins*, os*$, where the derivative $S_{v} > 0$. Given

\[ S(v_{i}) w_{k} \] enters entrepreneurs’ profit functions. This assumption is made for convenience, and does not qualitatively change

\[ S(v_{i}) w_{k} \]
this, the expected value of a risky profit \( \hat{\pi} \) has certainty equivalent value 
\[ \pi = \hat{\pi} - S(v) \]

### 2.2.4 Profit maximisation

Assuming monopolistic competition, and taking the competitive environment, organisational form, and worker effort as given, entrepreneurs then choose prices to maximise certainty equivalent profits. The problems for Northern and Southern firms are analogous, so we may write profit functions for country \( k \) entrepreneurs as

\[
\begin{align*}
\pi_{in}^k(\varphi) &= pq - c_{in}^k(\varphi) \\
\pi_{in}^o(\varphi) &= pq - c_{in}^o(\varphi) - S(v_o)w_k \\
\pi_{in}^{*}(\varphi) &= pq - c_{in}^{*}(\varphi) - S(v_{in*})w_k \\
\pi_{in}^{o*}(\varphi) &= pq - c_{in}^{o*}(\varphi) - S(v_{o*})w_k
\end{align*}
\]

which after substituting for demand, and standard arguments, gives equilibrium prices of

\[
\begin{align*}
p_{in}^k &= \frac{w_k}{\rho \varphi} \\
p_{o}^k &= \frac{\alpha s(e, v_o)w_k}{\rho \varphi} \\
p_{in}^{*} &= \frac{s(e, v_{in*})w_{l}}{\rho \varphi} \\
p_{o}^{*} &= \frac{\alpha s(e, v_{o*})w_{l}}{\rho \varphi}
\end{align*}
\]

where \( \rho \equiv \frac{\sigma}{\sigma - 1} \). Thus with lower unit input requirements \( \alpha < 1 \), firms which outsource tend to charge lower prices, while the premium \( s(e, v) \) associated with incentivising effort works to increase prices whenever monitoring is imperfect. Substituting in equilibrium prices and quantities gives profits for each mode of production as

\[
\begin{align*}
\pi_{in}^k &= \theta_k \tilde{\rho} w_k^{1-\sigma} \varphi^{\sigma-1} - f w_k \\
\pi_{o}^k &= \theta_k \tilde{\rho} \left[ \frac{\alpha}{e} s(e, v_o)w_k \right]^{1-\sigma} \varphi^{\sigma-1} - f w_k - S(v_o)w_k \\
\pi_{in}^{*} &= \theta_k \tilde{\rho} \left[ \frac{1}{e} s(e, v_{in*})w_{l} \right]^{1-\sigma} \varphi^{\sigma-1} - f w_{l} - S(v_{o*})w_k \\
\pi_{o}^{*} &= \theta_k \tilde{\rho} \left[ \frac{\alpha}{e} s(e, v_{o*})w_{l} \right]^{1-\sigma} \varphi^{\sigma-1} - f w_{l} - S(v_{o*})w_k
\end{align*}
\]

where \( \tilde{\rho} \equiv (1 - \rho)\rho^{\sigma-1} \).

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12 This takes the standard certainty equivalent form: an expected value of some random variable less some function of that variable’s variance.
2.2.5 Optimal effort

Given the above profit functions, what is the optimal amount of worker effort for entrepreneurs who cannot perfectly monitor production? The derivative of the profit function with respect to effort captures the net marginal benefit to entrepreneurs of inducing higher effort. This of course depends on the balance between the lower input requirements that higher effort brings about, and the cost through incentive payments of so doing. Clearly, optimising entrepreneurs wish to set \( \frac{d\pi_i}{de} = 0 \), which defines optimal effort \( e^*(v_i) \). Setting the derivative of profit with respect to effort equal to zero implies that optimal effort must satisfy

\[
\frac{\alpha_e}{\alpha(e)} = -\frac{s_e}{s(e, v_i)} \tag{19}
\]

for \( i = o, in*, o* \). Using our functional forms, this gives optimal effort as

\[
e^*(v_i) = \frac{1}{v_i} \quad i = o, in*, o* \tag{20}
\]

That is, optimal effort is decreasing as monitoring gets harder (as \( v_i \) increases). The driver of this result is the assumption that \( s_{ev} > 0 \) – or that the marginal cost of incentivising higher effort rises as monitoring gets harder. Note also that optimal effort is determined solely by model parameters, and not by any endogenous variables. Intuitively, both the costs of higher effort (through higher \( s(e) \)) and benefits of higher effort (through lower \( \alpha(e) \)) are multiplied by the same ‘constant’ comprising endogenous variables, which are taken as given by the firm. So for given monitoring technology, entrepreneurs choose a unique effort level \( e^*(v_i) \), which in turn determines the unit labour requirements \( \alpha(v_i) \), and the size of the premium \( s[e^*(v_i), v_i] = s(v_i) \). Note that inserting optimal effort (20) into our functional form for \( s(.) \) ‘fixes’ the wage premium in outsourcing as \( s[e^*(v_i), v_i] = \exp[e^*(v_i)v_i] = \exp(1) \equiv s \). Then, accounting for optimal effort, we may write the profit functions for outsourcing at home, in-house abroad and outsourcing abroad as

\[
\pi_k^o = \theta_k \tilde{\rho}[\alpha v_o s w_k]^{1-\sigma} \varphi^{\sigma-1} - f w_k - S(v_o)w_k \tag{21}
\]
\[
\pi_k^{in*} = \theta_k \tilde{\rho}[v_{in*} s w_l]^{1-\sigma} \varphi^{\sigma-1} - f w_l - S(v_{in*})w_k \tag{22}
\]
\[
\pi_k^{o*} = \theta_k \tilde{\rho}[\alpha v_o s w_l]^{1-\sigma} \varphi^{\sigma-1} - f w_l - S(v_{o*})w_k \tag{23}
\]

2.2.6 Organisational forms and productivity: home production only

From the above profit functions, consider first the case in which production is constrained to take place at home only. Plotting \( \pi_k^{in} \) and \( \pi_k^o \) in (adjusted) productivity \( \varphi^{\sigma-1} \), as in Figure 1, it is immediately apparent that only the most productive firms will choose to outsource as long as \( \alpha v_o s < 1 \), or that the variable cost savings from outsourcing \( \alpha \) are sufficient to offset the additional costs associated with monitoring output and incentivising effort \( v_o \). When this is the case, \( \pi_k^o \) has steeper slope than \( \pi_k^{in} \). Further, \( \pi_k^o \)
must cut $\pi^i_k$ from below owing to the term $S(v_o) > 0$, which arises out of entrepreneurs’ aversion to imperfect monitoring, which implies risky output. The outsourcing cut-off, or the productivity level at which entrepreneurs are just indifferent between outsourcing and in-house production, $\varphi^o_k$, is defined by

$$\pi^i_k(\varphi^o_k) = \pi^o_k(\varphi^o_k)$$

(24)

Similarly, entrepreneurs which invent sufficiently unproductive technologies find it in their interests to exit. This exit cut-off $\varphi_k$ is defined by

$$\pi^i_k(\varphi_k) = 0$$

(25)

We then have the following proposition

**Proposition 1** When production is constrained to take place at home only, the least productive firms exit, and the most productive firms choose to outsource. In the intermediate productivity range, firms produce in-house.

The intuition for this result is as follows. Only the firms with the most productive technologies can generate profits sufficient to compensate their entrepreneurs for the additional risk associated with outsourcing. Firms with less productive technologies generate smaller profits, which are insufficient to compensate for a riskier organisational form. As well as using a less efficient technology, they are therefore constrained also to produce under a less efficient organisational form, under which variable costs are higher.

In equilibrium, we will show that Southern firms choose to produce only domestically. The sorting pattern described here is then relevant to Southern firms even when production abroad is possible, which we consider next.

2.2.7 Organisational forms and productivity: Offshoring

Performing the analogous exercise when offshore production is also possible gives rise to further organisational form cut-offs. In particular, in addition to $\pi^i_k$ and $\pi^o_k$ we plot the profit curves for production abroad $\pi^{in*}_k$ and $\pi^{on*}_k$ in adjusted productivity space. The slopes of the profit curves are increasing in riskiness (or decreasing as monitoring improves) as long as $w_k > \alpha v_o w_k > v_{ins} w_l > \alpha v_{os} w_l$. Equivalently, the variable cost saving $\alpha$ must be sufficiently small, as must the foreign wage rate $w_l$. When this is the case we have Figure 2. In addition to exit and home outsourcing cut-offs, we now have cut-offs for in-house production abroad and outsourced production abroad defined by

$$\pi^{in*}_k(\varphi^{in*}_k) = \pi^{in*}_k(\varphi^{in*}_k)$$

$$\pi^{in*}_k(\varphi^{on*}_k) = \pi^{on*}_k(\varphi^{on*}_k)$$

The profit curves associated with production abroad cut those for production at home once from below by the assumptions that $S_v > 0$ and $v_o < v_{ins} < v_{os}$, or that monitoring gets worse as production is
moved outside the firm, and is worse abroad than at home, together with entrepreneurs’ risk premia increasing as monitoring deteriorates. Then we have

**Proposition 2** When production can take place at home or abroad, the least productive firms exit. As productivity rises, firms choose to produce at home, first by producing in-house at home, and then by outsourcing. As productivity rises still further, firms choose to offshore. They do so first by producing in-house abroad, and then by outsourcing abroad.

The intuition is analogous to the case of domestic production above. As firms employ more productive technologies, they generate higher profits, which they may use to compensate their entrepreneurs for the additional riskiness associated with production in organisational forms with worse monitoring. In doing so, entrepreneurs with more productive technologies also produce under organisational forms with lower variable costs, arising from efficiency gains due to better organised production, and cheaper labour abroad.

How do these predictions differ from those of Antras and Helpman (2004)? Like the hold-up approach, our model predicts the largest firms choose to locate production offshore. Unlike that approach however, the largest firms outsource abroad (engage in the ‘riskiest’ organisational form), whereas in Antras and Helpman (2004)’s ‘headquarter intensive sectors’ the largest firms produce in-house abroad. Similarly,
in both approaches it is the least productive firms that retain production at home. In our model, among these firms the smallest, least productive produce in-house, whereas for Antras and Helpman (2004) they outsource. The differences in these predictions are driven by the different ‘microfoundations’ underlying organisational form decisions. In our approach, the riskiness induced by poor monitoring is the key driver of firm organisation. The trade-off between riskier production and lower costs discourages small, unproductive firms from fragmenting production beyond their own boundaries, whereas the most productive generate profits high enough to offset the utility cost to entrepreneurs of riskier organisational forms.

2.3 Equilibrium without offshoring

For both Northern and Southern firms, equilibrium may be fully described once we know the exit productivity cut-off in each market \( \varphi_k \), from which we may derive each market’s average productivity, \( \bar{\varphi}_k \), a ‘sufficient statistic’ for the market in question. Consider first the case where firms may produce at home only. The average productivity level is defined by

\[
\bar{\varphi}_k^{\sigma-1} = \frac{1}{1 - G(\varphi_k)} \left\{ \int_{\varphi_k}^{\varphi_o} \varphi^{\sigma-1} g(\varphi) d\varphi + \int_{\varphi_k}^{\varphi_o} (\alpha v_o s)^{1-\sigma} \varphi^{\sigma-1} g(\varphi) d\varphi \right\} \tag{28}
\]

Note that when domestic outsourcing diminishes to zero, this reduces to the model of Melitz (2003) with homogeneous organisational forms. Denoting average productivity in this case (with in-house production...
only) by $\hat{\varphi}$, we may then write average productivity with outsourcing as

$$\hat{\varphi}_k^{-1} = \varphi^{-1} + \lambda_o \int_{\hat{\varphi}_k}^{\varphi} \varphi'^{-1} \frac{g(\varphi)}{1 - G(\hat{\varphi}_k)} d\varphi$$

where $\lambda_o \equiv (\alpha v_o s)^{1-\sigma} - 1$ \hfill (29)

Thus, compared to the model with homogeneous organisational forms, positive amounts of outsourcing add to average sector productivity whenever $\lambda_o > 0$, or $\alpha v_o s$ is not too big. Equivalently monitoring must be sufficiently good, allowing firms to incentivise high effort, and hence to enjoy the variable cost savings of outsourcing. Just as in the homogeneous organisational forms case, average sector productivity is increasing in the exit cut-off in the presence of domestic outsourcing as well.

From (24) we may write the outsourcing cut-off $\varphi^o_k$ as a function of exogenous parameters and the exit cut-off alone (see appendix), giving $\varphi^o_k = \Lambda^o_k \varphi_k$, $\Lambda^o_k > 1$. Then the average sector level productivity is fully determined by the exit cut-off. Given the cut-off for exit, it will also be convenient to define the ex-post distribution of productivities $\mu_k(\varphi)$ by $\mu_k(\varphi) \equiv \frac{g(\varphi)}{1 - G(\varphi)}$. We then follow the familiar approach of Melitz (2003) in determining sector level equilibrium, by deriving (i) a zero profit cut-off and (ii) a free entry condition, both in terms of average profits adjusted for risk, or certainty equivalent average profits.

First, we assume that for entry each firm requires one entrepreneur. With a cut-off of $\varphi_k$, the probability of successful entry is $[1 - G(\varphi_k)]$. If firms make certainty equivalent profits $\pi_k$ on average, free entry ensures that the expected certainty equivalent profit must equal entry costs, or $[1 - G(\varphi_k)]\pi_k = w_k$. That is, expected certainty equivalent profits must exactly equal the entrepreneur’s outside option, which is to work as production labour earning a certainty equivalent payment equal to the wage rate. Rearranging, this gives the Free Entry condition (FE) as

$$\pi_k = \frac{w_k}{[1 - G(\varphi_k)]}.$$ \hfill (31)

Second, from (25), we may write $r(\varphi_k) = f w_k$, where $r(.)$ denotes firm revenue for an in-house firm defined by $r(\varphi) \equiv \theta_k \hat{\varphi}_k w_k \varphi^{-1} \varphi'^{-1}$. We then make use of the fact that $r(\varphi) / r(\varphi') = (\varphi / \varphi')^{\sigma-1}$ in writing $r(\hat{\varphi}_k) = (\hat{\varphi}_k / \varphi')^{\sigma-1} f w_k$. Further, we must adjust average profits to account for the riskiness involved with outsourcing in order to arrive at certainty equivalent average profits. Each firm that outsources requires this adjustment to give its certainty equivalent profits, so the adjustment required for average certainty equivalent profits involves subtracting the expected entrepreneur risk premium, given by the integral of $S(v)$ over the range of firms that outsource. Hence the adjustment is $\int_{\Lambda^o_k \varphi_k}^{\varphi_k} w_k S(v_o) \mu_k(\varphi) d\varphi$. Then since certainty equivalent average profits $\pi_k$ must equal average revenue, less fixed costs, and adjusted for outsourcing risk, we may write the Zero-Profit Cut-off condition (ZPC) as

$$\pi_k = \left[ \left( \frac{\hat{\varphi}_k(\varphi_k)}{\varphi_k} \right)^{\sigma-1} - 1 \right] f w_k - w_k \int_{\Lambda^o_k \varphi_k}^{\varphi_k} S(v_o) \mu_k(\varphi) d\varphi$$

Note that in comparison to Melitz (2003), the FE condition is qualitatively identical, but ZPC differs.\footnote{The only difference being constants.}
We may explore this further, defining $t_k(\varphi) \equiv [(\tilde{\varphi}_k/\varphi_k)^{\sigma-1} - 1]$ just as in Melitz (2003), allowing us to write ZPC as

$$
\tilde{\pi}_k = t_k(\varphi)f w_k + f w_k \int_{\tilde{\varphi}_k}^{\varphi} \left[ \lambda_o \left( \frac{\varphi}{\tilde{\varphi}_k} \right)^{\sigma-1} - \frac{S(v_o)}{f} \right] \mu_k(\varphi) d\varphi
$$

(33)

Clearly then, the ZPC under outsourcing may lie to the left or the right of that under homogeneous organisational forms, depending on the sign of the term in square brackets. What is the intuition for this ambiguity? First, outsourcing raises average productivity wherever $\lambda_o > 0$, which ceteris paribus works to shift the ZPC to the right. However, outsourcing is also risky, and since we are concerned here with certainty equivalent profits, these may fall on average on account of the higher average level of risk associated with production. For the productivity effect to dominate, we require a restriction on the size of entrepreneurs’ risk premia, $S(\cdot)$. Thus, when $S(v_o) < \lambda_o f(\varphi/\tilde{\varphi}_k)^{\sigma-1}$, outsourcing raises average certainty equivalent profits, as the productivity gain exceeds the rise in risk, shifting ZPC to the right relative to the case with homogeneous organisational forms.

The equilibrium exit cut-off is determined by solving (31) and (32) simultaneously. Note that in equating the two conditions, the relevant wage rate cancels out. Just as in Melitz (2003), a sufficient condition for a unique equilibrium is that FE be increasing and ZPC be decreasing in $\tilde{\varphi}_k$. Analogously, a sufficient condition for this is that $[1 - G(\varphi)]t_k(\varphi) + \int_{\tilde{\varphi}_k}^{\varphi} \left[ \lambda_o \left( \frac{\varphi}{\tilde{\varphi}_k} \right)^{\sigma-1} - \frac{S(v_o)}{f} \right] g(\varphi) d\varphi$ is decreasing in $\tilde{\varphi}_k$. From Melitz, this is the case for the term $[1 - G(\cdot)]t(\cdot)$, and it is also the case for the second term (due to outsourcing) by inspection. Thus we conclude that we obtain a unique equilibrium, which under outsourcing entails a higher exit cut-off, and higher average productivity, than the case with in-house production only. This is illustrated in Figure 3. The curve $ZPC_{in-house}$ corresponds to Melitz (2003)’s model. The relevant ZPC curve with outsourcing too is given by $ZPC_{out-s}$. When outsourcing confers a productivity gain, it lies to the right of $ZPC_{in-house}$.

**Proposition 3** When the productivity gain from outsourcing exceeds the rise in riskiness from outsourcing, certainty equivalent average profits rise. This entails a higher exit productivity cut-off, and higher average productivity in equilibrium.

Intuition for this result may be provided by considering the impact of increased outsourcing on the price index. Since firms which outsource, if not too risky, gain a reduction in variable costs, they charge lower prices in equilibrium. This works to lower the sector price index, and since other firms’ profits are increasing in this index, other firms’ profits must fall. This harms in particular those firms operating at the margin, with the lower productivity draws, forcing them to exit.

The characterisation of the sectoral equilibrium is not yet complete: we need also to determine the equilibrium number of firms. Straightforwardly, the number of firms $n_k$ is equal to the number of

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14 Raising $\tilde{\varphi}_k$ both raises the lower limit on the integral, and lowers the size of the term under the integral.
entrepreneurs who undertake successful entry. So the number of active firms must equal the total number of entrants $n_k^e$ times the probability of successful entry, or $n_k = [1 - G(\tilde{\phi}_k)]n_k^e$.

Substituting these equilibrium conditions into the expression for the sector price index then gives $P_k = n_k^{\bar{\pi}} p(\tilde{\phi}_k)$.

### 2.4 Equilibrium with offshoring

Consider now the case in which offshoring is possible. Entrepreneurs’ free entry conditions remain exactly as before. But their zero profit cut-off conditions must be modified to account for locating production abroad. The ZPC will in general depend on the relative home/foreign wage, as this in part determines the attractiveness of producing overseas. This influence is clear when we write the cut-offs for offshore production in terms of the domestic exit cutoff, from (26) and (27), as

$$\varphi_{k}^{\text{in}^*} = \Lambda_{k}^{\text{in}^*}(w_l/w_k)\tilde{\phi}_k \quad (34)$$

$$\varphi_{k}^{\text{o}^*} = \Lambda_{k}^{\text{o}^*}(w_l/w_k)\tilde{\phi}_k \quad (35)$$

(see appendix). Both $\Lambda^{\text{in}^*}$ and $\Lambda^{\text{o}^*}$ are increasing in $w_l/w_k$, indicating a reduction in both types of offshore production as the foreign wage increases, all else equal.

The ZPC condition is modified to account for (i) the change in variable costs that firms enjoy as a
result of offshoring and (ii) the change in riskiness. In all, we may write

\[ \bar{\pi}_k = \left( \frac{\bar{\varphi}_k}{\varphi_k} \right)^{-1} \int w_k - w_k \int_{\varphi_k}^{\varphi_{in}^*} S(v_o) \mu_k d\varphi \]

\[ -w_k \int_{\varphi_{in}^*}^{\varphi_{in}^*} S(v_{in}^*) \mu_k d\varphi - w_k \int_{\varphi_{in}^*}^{\varphi_{in}^*} S(v_{in}^*) \mu_k d\varphi \]

(36)

where now, relative to the case of homogeneous organisational forms, sectoral average productivity is

\[ \varphi_k^{\sigma-1} = \varphi_k^{\sigma-1} + \lambda_{in} \int_{\varphi_k^{\varphi_k^{\sigma-1}}}^{\varphi_{in}^*} \varphi_k^{\sigma-1} \mu_k d\varphi + \lambda_{in} \int_{\varphi_{in}^*}^{\varphi_{in}^*} \varphi_k^{\sigma-1} \mu_k d\varphi + \lambda_{in} \int_{\varphi_{in}^*}^{\varphi_{in}^*} \varphi_k^{\sigma-1} \mu_k d\varphi \]

(37)

\[ \lambda_{in} \equiv \left( \frac{w_l}{w_k} \right)^{1-\sigma} - 1 \]

(38)

\[ \lambda_{os} \equiv \left( \frac{\alpha s w_l}{w_k} \right)^{1-\sigma} - 1 \]

(39)

Consider a case where we move from allowing domestic in-house and outsourcing only, to allowing in-house production abroad as well. Then a new threshold arises at \( \varphi_{in}^* \), beyond which firms engage in in-house production abroad, enjoying a factor cost saving where \( w_l < w_k \), boosting effective productivity, but also operating with worse monitoring. For the first effect to dominate the second, we require that \( S(v_{in}^*) - S(v_{in}^*) < f \varphi_k^{\sigma-1} (\lambda_{in} - \lambda_{os}) \), or that the additional risk premium is not too big relative to the variable cost saving. In this case, the ZPC under both home production plus foreign in-house production lies to the right of that for just home production alone, exactly analogously to the case discussed above in which domestic outsourcing was added to in-house production as an organisational possibility. Analogously, allowing foreign outsourcing in addition to foreign in-house production shifts the ZPC further to the right as long as \( S_{in} - S_{in}^* < f \varphi_k^{\sigma-1} (\lambda_{os} - \lambda_{in}) \). We then may predict that when factor cost savings are sufficient to enable offshoring, the domestic exit cut-off will be higher, all else equal. This, together with the variable cost savings that offshoring brings, raising effective productivity, implies that offshoring will raise average productivity relative to the case in which no offshoring takes place.

As well as these new organisational forms affecting the ZPC via average productivity, we also noted that the attractiveness of offshoring will depend, inter alia, on the relative home/foreign wage rate. Since this relative wage rate helps to determine the new organisational form cut-offs, and these cut-offs in turn determine average productivity and the risk adjustment, the ZPC will now also depend on the North/South relative wage. This in turn implies the combination of FE and ZPC conditions now determines the exit cut-off \( \varphi \) conditional on the North/South relative wage, \( \varphi(w_S/w_N) \).

2.5 Goods and Labour market equilibrium

To close the model, we need to determine equilibrium in the world goods market together with equilibrium in each country’s factor market. We work in certainty equivalent terms, meaning that for a given country’s
market, we equate certainty equivalent labour payments and certainty equivalent profits to certainty equivalent revenues.

2.5.1 Equilibrium with no offshoring

When production is constrained to take place domestically only, the total certainty equivalent revenue of all firms in country $k$, $R_k$, must equal total certainty equivalent payments made to labour used in production, $w_k L_k^p$, plus total firm certainty equivalent profits which received by entrepreneurs $\Pi_k$. That is, $w_k L_k^p + \Pi_k = R_k$. We may use entrepreneurs’ free entry condition, together with the equation for equilibrium firm numbers to re-write $\Pi_k = \bar{\pi}_k n_k = w_k n_k^e$. In words, total certainty equivalent profits must equal the certainty equivalent value of all entrants’ outside options. Then we have that $w_k (L_k^p + n_k^e) = R_k$.

But labour market clearing requires that $L_k^p + n_k^e = L_k$, so in each country it is the case that

$$w_k L_k = R_k \tag{40}$$

Consumer preferences are such that firms in country $k$ enjoy share $\eta_k$ of total world spending $R = R_N + R_S$, or that spending in country $k$ is $R_k = \eta_k R$. Using this, and choosing the Southern wage as the numeraire ($w_S = 1$), the equilibrium relative North-South wage $\omega \equiv w_N / w_S$ under free trade (FT) may be written

$$\omega_{FT} = \frac{L_S \eta_N}{L_N \eta_S} \tag{41}$$

Then the South has a relatively low wage in equilibrium if $L_S$ is large relative to $L_N$, and/or if the North enjoys a larger share of world spending than does the South.

2.5.2 Equilibrium with offshoring

When offshoring occurs, we need to account for payments made to foreign factors of production by domestic firms. Suppose offshoring is liberalised from a starting point of free trade but domestic production only. The lower wage rate in the South provides an incentive for Northern firms to shift production there. We denote the proportion of Northern firms that do this by $\chi_N \equiv 1 - G[\omega_{FT}^N(\omega)]$, which varies with the relative North-South wage rate $\omega$. In particular, we have that $\chi_N' > 0$, indicating that an increase in the wage in the North increases the proportion of firms that choose to offshore. These firms employ Southern labour, leaving share $(1 - \chi_N)$ employing Northern labour. We then re-write the market clearing conditions for North and South as

$$\omega L_N = (1 - \chi_N) \eta_N R \tag{42}$$

$$L_S = \eta_S R + \chi_N \eta_N R \tag{43}$$

\textsuperscript{15}‘Actual’ magnitudes may then be straightforwardly obtained from these magnitudes by correcting for the exogenously given risk premia entrepreneurs and workers in outsourced relationships demand. In particular, both sides of (Revenue) = (Spending) will be higher by some fixed amount in ‘actual’ terms. This fixed amount reflects risk premia paid to workers under outsourcing. Dividing both sides of (Revenue) = (Spending) by this amount gives certainty equivalent revenue equal to certainty equivalent spending, used in the text.
which gives the relative North-South wage under offshoring as

$$\omega = \frac{L_S (1 - \chi_N) \eta_N}{L_N \eta_S + \chi_N \eta_N}$$  \hspace{1cm} (44)

Recall that $\chi_N$ is endogenous, so we are required to solve for $\chi_N$ and $\omega$ simultaneously. Plotting $\chi_N(\omega)$ and $\omega(\chi_N)$ from (44) in Figure 4 we arrive at the unique wage rate $\omega_{off}$ in equilibrium. The Northern relative wage unambiguously declines under offshoring, reflecting the fall in labour demand it brings about.

2.6 Offshoring and productivity, welfare and inequality

2.6.1 Productivity effects of offshoring

First, we examine the effects of offshoring on aggregate productivity. In the South firms’ FE and ZPC conditions are unaffected by the presence of Northern firms, so the Southern cut-off remains unchanged. Average productivity in the South is therefore left unaffected by Northern firms employing labour there. In the North, firms that offshore access cheaper labour, and those that outsource in the South also enjoy reductions in per unit input requirements, raising efficiency. Northern firms’ ZPC shifts to the right and the exit cut-off in the North rises. The average productivity of Northern firms therefore rises. Given this, and that Southern firms’ average productivity is unaffected, average productivity in the world must rise due to offshoring.
2.6.2 Welfare effects of offshoring

We may examine welfare by rewriting agent $j$’s utility function $U_j$ in log form (see appendix) as

$$\ln U_j = \tilde{\eta} + \ln \left( \frac{e_j}{P_N} \right)^{\eta N} + \ln \left( \frac{e_j}{P_S} \right)^{\eta S} \quad (45)$$

where $\tilde{\eta}$ is a constant, $e_j$ is agent $j$’s certainty equivalent income and $P_k$ is the price index for goods from country $k = N, S$. In words, utility is a weighted average of real expenditure on each country’s goods, where the weights are expenditure shares. Therefore changes to utility as a result of offshoring work through changes to an agent’s certainty equivalent income and the country price indices. The latter are affected by product variety and average price, since $P_k = n_k^{1-\sigma} p(\tilde{\varphi}_k)$. Utility is therefore increasing in product variety and increasing in average productivity, as the latter gives lower average prices. This price index effect is common to all agents, whereas $e_j$ depends on the type of agent in question, viz. whether they are an entrepreneur or a worker, and their location, viz. whether they live in the North or South.

We have argued that average productivity must rise as a result of offshoring. This tends to increase welfare as a result of lower prices. However, the expansion of firm size as a result of the efficiency gains due to offshoring leads to a loss of variety. Firm numbers in the North and the South may be deduced from

$$\omega L_N = (1 - \chi_N) R_N \quad (46)$$

and

$$L_S = R_S + \chi_N R_N \quad (47)$$

Combining these equations, we have

$$\omega L_N + L_S = R_S + R_N \quad (48)$$

The RHS may be written $R_S + R_N = R$, where $R$ is world revenue. This must equal the number of firms in the world times the average revenue of a firm in the world, or $nr(\bar{\tilde{\varphi}})$, where $\bar{\tilde{\varphi}}$ is average world productivity. Using this in (48) and rearranging for $n$ gives

$$n = \frac{\omega L_N + L_S}{r(\bar{\tilde{\varphi}})} \quad (49)$$

We argued that as offshoring increases, the relative Northern wage $\omega$ falls. Likewise, northern average productivity rises, while than in the South remains unchanged, so average world productivity must also rise, raising average world revenue, or the denominator of (49). Thus, as offshoring increases, firm numbers must fall, indicating an overall loss of variety.

**Proposition 4** As offshoring increases, average world productivity rises, tending to lower average world prices, reducing the world price index. The efficiency gains from offshoring lead however to firm exit, tending to reduce the number of firms active in equilibrium. This reduces product variety on offer, tending to raise the world price index.
Can we say more about firm numbers in each country? First, for Southern firms, from (47) we have

\[ n_S = \frac{L_S - \chi_N R_N}{r(\hat{\phi}_S)} \]  
(50)

As offshoring increases, \( \hat{\phi}_S \) is unaffected, but \( \chi_N R_N \) becomes positive, such that \( n_S \) must fall. That is, offshoring by Northern firms forces exit by Southern firms. The mechanism straightforwardly acts via the labour market, through increased competition for scarce factors. Knowing that Southern firms exit and that there are fewer varieties produced in total after offshoring is however not enough to pin down what happens to Northern firm numbers. Using \( R_k = n_k r(\hat{\phi}_k) \) and rearranging (49) gives

\[ n_N = \frac{\omega L_N + L_S - n_S r(\hat{\phi}_S) \cdot r(\hat{\phi}_N)}{r(\hat{\phi}_N)} \]  
(51)

We know that offshoring causes \( \omega \) to fall and \( r(\hat{\phi}_N) \) to rise, tending to reduce \( n_N \). But the exit of Southern firms giving a lower \( n_S \) works against this. That is, the reduction in the Northern wage reduces spending on Northern varieties, which together with more efficient competitors resulting from offshoring puts downward pressure on Northern firm numbers. But offset against this is a slackening of competition from Southern firms, via Southern firm exit. The overall effect on Northern firm numbers is therefore ambiguous.

**Proposition 5** Offshoring reduces the total number of firms operating in equilibrium. This is achieved via an exit of Southern firms sufficient to offset any change in the number of Northern firms that might raise firm numbers.

The impact on welfare via the price indices is therefore ambiguous. Lower prices achieved through increased average productivity serve to raise utility. This is offset against a loss of variety brought about by firm exit. This loss of variety effect is stronger the more skewed is consumption towards Southern goods, owing to the unambiguous loss of Southern varieties.

The total impact on welfare depends also on agents’ incomes. For workers, we know that the relative wage in the North must fall with offshoring, lowering Northern workers’ welfare ceteris paribus. If price falls are sufficient, this negative effect may be offset as real income can still rise. They do however suffer an unambiguous utility loss on the part of consumption concentrated on Southern goods, as the Southern price index rises. We may say however that if Northern workers are made better off as a result of offshoring, then Southern workers must unambiguously be made better off, since the nominal incomes of the former must fall while those in the South do not.

In ex post terms, the Southern entrepreneurs who continue to produce (i.e. who are not forced to exit) have no change in their nominal income. Therefore, like Southern workers, we may say that if Northern workers are better off as a result of offshoring, then Southern entrepreneurs who continue to produce ex post must unambiguously also be made better off, since the former implies an overall reduction in price indices.
Finally, the ex post nominal incomes of Northern entrepreneurs must rise after offshoring, as their nominal profits rise. They are the only class of agent whose nominal income must rise. It is possible therefore that Northern entrepreneurs are the only group who are made better off as a result of offshoring.

**Proposition 6** A sufficient condition for all agents to be made better off as a result of offshoring is that Northern workers, who suffer a reduction in nominal income, be made better off as a result of price reductions following offshoring.

### 2.6.3 Inequality effects of offshoring

We may compare inequality between entrepreneurs and workers both within and between the North and the South. The effects on inequality follow from the impact of offshoring on nominal incomes. In particular, the nominal incomes of Northern entrepreneurs must rise, while those of Northern workers must fall. Those of all Southern agents remain the same. Hence offshoring entails a widening of inequality in the North, but none in the South. Inequality between workers in the North and those in the South must fall, but inequality between entrepreneurs in the North and those in the South must rise. In other words, in this model, offshoring entails an increase in inequality between Northern entrepreneurs and all other agents in the two-country economy.

**Proposition 7** Offshoring implies

1. An increase in inequality between Northern entrepreneurs and Northern workers;
2. A decrease in inequality between Northern workers and Southern workers;
3. An increase in inequality between Northern entrepreneurs and all other agents.

### 3 Conclusions

We have presented a model in which firms’ ability to monitor output is a key driver of outsourcing and offshoring decisions. Only when monitoring is sufficiently effective can firms take advantage of the variable cost savings due to fragmentation. In-house production is characterised by better monitoring than outsourced production, and production abroad is characterised by worse monitoring than at home. But entrepreneurs make variable cost savings from outsourcing production, be it at home or abroad, owing to their inferior ability to organise production. In equilibrium, the most productive Northern firms outsource in the South, and the least productive produce in-house in the North. In intermediate ranges, the least productive outsource in the North and the most productive produce in-house in the South. Where the South is sufficiently labour abundant, it has a lower wage in equilibrium. This provides a
factor cost motive for offshoring by Northern firms, but together with worse monitoring abroad rules out
offshoring by Southern firms.

We view this theory of offshoring based on monitoring as complementary to the theory of Antras
and Helpman (2004) based on hold up and investment incentives. Both explore the effects of imperfect
information on firms’ choices regarding the international location and fragmentation of production, but
differ in the ‘microfoundations’ they posit. In reality firms are likely to be active in tackling both problems
of hold up and monitoring, plus more. As firms invest across national boundaries they confront these
informational issues, and it may be that the problem of monitoring and production incentives is more
important in pure assembly operations (e.g. taking place ‘North–South’), where the problem of hold-up
is more prevalent in situations where greater activism on the part of sub-contractors is required (e.g.
taking place ‘North–North’). Ultimately more empirical work is required to investigate.

We use our model to examine the impact of offshoring on productivity, welfare and inequality. As
offshoring increases, average world productivity rises as a result of Northern firms making cost savings
associated with foreign outsourcing and cheaper Southern labour. This leads to lower average prices. The
efficiency gains however also lead to firm exit via greater competition, giving an overall loss of variety.
These two effects oppose each other in their impact on welfare. The model suggests that the net exit of
firms is achieved in particular by the exit of Southern firms, which offsets any change in the number of
Northern firms that might raise firm numbers in total.

Welfare effects depend overall on the combined impact of offshoring on prices and nominal incomes.
We find a sufficient condition for all agents to be made better off as a result of offshoring is for Northern
workers to be made better off following offshoring. These workers face a fall in their nominal incomes as
a result of Northern firms moving production offshore; if prices fall by enough to offset this, they also fall
enough to make all Southern agents (whose nominal incomes do not change) and Northern entrepreneurs
(whose nominal incomes rise) better off as well. Northern entrepreneurs are the only group whose nominal
incomes rise after the adjustment to offshoring.

A further result of this is that inequality between Northern entrepreneurs and Northern workers must
rise following an increase in offshoring. Inequality between Northern and Southern workers must fall.
Finally, there is a rise in inequality between Northern entrepreneurs and all other agents.

References


A Organisational form cut-offs

First we find an expression for the outsourcing and exit cut-offs, defined respectively by \( \pi^{in} = \pi^{o} \) and \( \pi^{ex} = \pi^{e} \). From the profit functions these may be written

\[
\varphi_k = \frac{fw_k}{\theta_k \rho w_k^{1-\sigma}} \tag{52}
\]

\[
\varphi^o_k = \frac{S(v_o)w_k}{\theta_k \rho w_k^{1-\sigma}[(\alpha v_o s)^{1-\sigma} - 1]} \tag{53}
\]

Dividing the first by the second, we may then write

\[
\varphi^o_k = \Lambda^o_k \varphi_k \tag{54}
\]

where \( \Lambda_o = \left( \frac{S(v_o)}{f[(\alpha v_o s)^{1-\sigma} - 1]} \right)^{\frac{1}{\sigma-1}} \) (55)

For in–house and outsourcing abroad, by equating the relevant profit functions, cut-offs may be fully written as

\[
\varphi^{in}_k = \Lambda^{in}_k \varphi_k \tag{56}
\]

where \( \Lambda^{in}_k = \left( \frac{S(v_{in}) - S(v_o) + f \left( \frac{w_l}{w_k} - 1 \right)}{f[(v_{in} s \frac{w_l}{w_k})^{1-\sigma} - (\alpha v_o s)^{1-\sigma}]} \right)^{\frac{1}{\sigma-1}} \) (57)

\[
\varphi^{o*}_k = \Lambda^{o*}_k \varphi_k \tag{58}
\]

where \( \Lambda^{o*}_k = \frac{w_l}{w_k} \left( \frac{S(v_{o*}) - S(v_{in})}{f[(\alpha v_o s)^{1-\sigma} - (v_{in} s)^{1-\sigma}]} \right)^{\frac{1}{\sigma-1}} \) (59)

in which \( \Lambda^{in}_k \) and \( \Lambda^{o*}_k \) are increasing in the relative foreign wage \( w_l/w_k \). Then clearly increases in the relative foreign wage rate, which raise \( \varphi^{in}_k \) and \( \varphi^{o*}_k \), reduce the amount of offshoring that firms choose in equilibrium, ceteris paribus.

B Welfare

Utility is given by \( U = Q_{N}^{\rho} Q_{S}^{\rho} \), where \( Q_k = \left[ \int_{\gamma \in \Gamma_k} q(\gamma)^{\rho} d\gamma \right]^\frac{1}{\rho} \), for \( 0 < \rho < 1 \). Since we identify varieties \( \gamma \in \Gamma_k \) with entrepreneurs’ technologies \( \varphi \), using the demand function \( q(\varphi) = \theta_k p(\varphi)^{-\sigma} \) and
\[ \rho = \frac{\sigma}{\sigma - 1}, \text{ we write} \]

\[ Q_k = \left[ \int_{0}^{\bar{\varphi}} q(\varphi)^{\rho} n_k \mu_k(\varphi) d\varphi \right]^{\frac{1}{\rho}} \]  
\[ = \left[ \int_{0}^{\bar{\varphi}} \theta_k^p p(\varphi)^{-\rho} n_k \mu_k(\varphi) d\varphi \right]^{\frac{1}{\rho}} \]  
\[ = \theta_k \left[ \int_{0}^{\bar{\varphi}} p(\varphi)^{1-\rho} n_k \mu_k(\varphi) d\varphi \right]^{\frac{1}{\rho}} \]  
\[ = \theta_k [P_k^{1-\rho}]^{\frac{1}{\rho}} \]  
\[ = \frac{\eta_k e_j}{P_k^{1-\rho}} P_k^{-\rho} \]  
\[ = \frac{\eta_k e_j}{P_k} \]  
(60)

(61)

(62)

(63)

(64)

(65)

Thus, taking logs of the utility function, we may write

\[ \ln U_j = \eta_N \ln \eta_N + \eta_S \ln \eta_S + \eta_N \ln \left( \frac{e_j}{P_N} \right) + \eta_S \ln \left( \frac{e_j}{P_S} \right) \]  
\[ = \tilde{\eta} + \eta_N \ln \left( \frac{e_j}{P_N} \right) + \eta_S \ln \left( \frac{e_j}{P_S} \right) \]  
(66)

(67)

in the text, where \( \tilde{\eta} = \eta_N \ln \eta_N + \eta_S \ln \eta_S \) is a constant and \( e_j \) is the nominal income of agent \( j \).