The Cleansing Effect of Offshore Outsourcing

In an Analysis of Employment

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Abstract

Despite the public concern regarding the destructive employment effect of offshore outsourcing, empirical studies of U.S. multinationals find that the effect is ambiguous. The source of such ambiguity is very difficult to identify empirically due to data limitations. In this paper, I perform a theoretical analysis of the labor market implications of outsourcing and quantify various employment responses by calibrating parameter values to match the U.S. manufacturing sector. I construct a partial equilibrium model of an industry facing offshore outsourcing with a continuum of firms with heterogeneity in their productivities. Heterogeneity in productivities generates different firm-level responses to outsourcing: the most productive firms outsource, the least productive firms are forced to exit (Cleansing Effect), and the firms with intermediate productivity level continue operating as home-producers.

The theory generates a strong prediction that offshore outsourcing unambiguously reduces aggregate employment at home. However, the numerical analysis finds that the net employment effect within outsourcing firms is indeed ambiguous and that, more strikingly, the strong negativity of the employment effect stems from the cleansing effect. This result suggests that empirical investigation of multinationals understates the true employment effect of offshore outsourcing. By decomposing net employment loss into job destruction and creation, this paper finds that the net employment change can be less than half of the gross employment change, and that the layoffs by outsourcers account for the majority of total job destruction. These findings suggest that the previous empirical studies, of outsourcing firms alone, understate the negative impact of offshore outsourcing on employment.
1 Introduction

In 2004, offshore outsourcing became so common in the public perception that it became a frequent topic of everybody’s dinner-table talk. Especially since it was an election year, it was very much a political matter rather than just an economic phenomenon. Presidential candidates did not hesitate to blame outsourcing for large losses of manufacturing jobs. They went a step further to promise the nation that they would stop the outflow of American jobs. Mankiw and Swagel (2006) show the explosive rise in media references\(^1\) to “outsourcing” in their Figure 1. In 2002 and 2003, the references were around 300 in each year, then it increased to more than 1000 in 2004.

There is yet no consensus definition of offshore outsourcing. Many studies use “offshoring” as carrying out some stages of production at owned affiliates in the foreign country; and “offshore outsourcing” as that using arm’s-length contract (Harrison and McMillan, 2006). However, I use “outsourcing” to refer to both foreign production at owned affiliates and through arm’s-length contract. “Offshore outsourcing” and “outsourcing” are used interchangeably.

Despite the public concern about the link between offshore outsourcing and job loss, empirical studies find that the employment effect of outsourcing is neither unanimously negative nor of significant magnitude. One branch of empirical literature focuses its attention on the activities of foreign affiliate operations of multinational enterprises. They use firm-level data to investigate the within-firm labor substitution between domestic facilities and foreign affiliates. One of the most frequently used datasets is the firm-level surveys on U.S. Direct Investment Abroad collected by the U.S. Bureau of Economic Analysis (BEA). Brainard and Riker (1997) find small substitution between US facilities and foreign affiliates, and stronger substitution among foreign affiliates in low-wage countries. Stronger substitution between US employment and foreign affiliate employment is found by Hanson, Mataloni, and Slaughter (2003). On the other hand, Desai, Foley, and Hines (2005) find complementarity between US locations and foreign affiliates of US multinationals. They find that when foreign employment rises by 10%, US employment within the firm rises by 2.5%. In Contrast, Borga (2005) finds an insignificant effect of offshore outsourcing. Harrison and McMillan (2007) separate horizontal affiliates from vertical affiliates, and also high-cost locations from low-cost locations. They find employment complementarity for vertical affiliates, but substitution for horizontal affiliates. There are also empirical studies on the outsourcing activities of other industrial nations. Muendler and Becker (2006) investigate German multinational enterprises (MNEs) and

\(^1\)Reference by four major newspapers: The New York Times, Washington Post, Los Angeles Times, and USA Today
find strong substitution. Braconier and Ekholm (2000), in their study of Swedish multinationals, find substitution between Swedish facilities and affiliates in high-income countries, but neither substitution nor complementarity between Swedish locations and affiliates in low-income countries.

Although these firm-level data are very rich in various operational information, foreign operation of multinationals should not be the definitive measure of offshore outsourcing activities. In fact, a large portion of offshore outsourcing takes place through arm’s-length contracts (Crino, 2007). If offshore outsourcing through own foreign affiliates and through arm’s-length contracts are driven by distinct incentives (Grossman and Helpman, 2003), their effect on employment at the headquarter location can also be different.

Another branch of the empirical literature takes a sectoral approach. Studies using this approach construct a measure of offshore outsourcing in each industry - at various levels of aggregation - and look for a correlation between this measure and industry employment. The employment effects from these studies are also weak. Amiti and Wei (2006) use the share of imported inputs as a measure of outsourcing, and find that the employment effect is insignificant at the disaggregated level, but positive at a more aggregated level in the U.S. manufacturing sector between 1992 and 2000. In a similar study, Amiti and Wei (2005) find an insignificant employment effect in the U.K. manufacturing industry between 1995 and 2001. For the Canadian manufacturing sector, Morissette and Johnson (2007) find that the industries with intense outsourcing did not show significantly different employment growth rates compared to other industries. Keller and Stehrer (2008) use Austrian data and find that offshore outsourcing has a negative effect during 1995-2000, but a positive effect during 2000-2003.

These ambiguous results suggest that outsourcers may create a number of jobs that is large enough to offset their layoffs. Outsourcing firms might be the source of job destruction, but they are also the ultimate beneficiaries of outsourcing, and the realized benefits will be translated into new jobs. However, these insignificant net effects might reflect a combination of small job destruction and small job creation, or alternatively large destruction and large creation. Although both may result in net effects of the same magnitude, they imply very different adjustment costs for workers. In many cases, offshore outsourcing takes the form of relocation of the most labor-intensive part of the process. This implies that jobs that are destroyed and jobs that are newly created are likely to be different in their tasks and skill levels. In other words, the laid-off workers are not readily employable for the new jobs. In order to reduce the adjustment cost of workers, it is often necessary to provide them with occupational training and, in some cases, remedial education through a
program such as Trade Adjustment Assistance (TAA). In order to properly assist the displaced workers, correct understanding and measurement of the size of outsourcing-related separation is required. None of currently available data on outsourcing activities is appropriate for this purpose. Data on multinationals’ operations fail to capture outsourcing activities that utilize arm’s length contracts. These data also do not report the amount of separation separately from new hires. Data on outsourcing activities measured by usage of imported inputs fail to capture outsourcing in the form of foreign assembly.

For this reason, we need more structural theoretical analysis to capture various labor market dynamics that drive the aggregate impact that we can observe in data. In this paper, I construct a partial equilibrium model of offshore outsourcing with firms that are heterogeneous in their productivity levels (Melitz, 2003). Initially there are two symmetric northern countries that are open for international trade. The manufacturing process consists of two segments, Assembly and Services. As outsourcing becomes feasible, outsourcing firms send their assembly segments to a Southern country that does not consume the final products. Using this structural model, I find that the most productive firms outsource - as found in Kurz (2006) - and that the least productive firms are forced to exit. I call the exit of the least productive firms the Cleansing Effect of Offshore Outsourcing. With this structural model, I can quantify job creation separately from job destruction, and the employment response of different groups of firms - the cleansing effect, non-outsourcers, and outsourcers - separately.

I find that outsourcing unambiguously reduces aggregate employment as outsourcing becomes feasible. Whether this result is contrary to previous empirical findings requires further analysis, since this model includes the entire industry rather than only the outsourcers. For this, I perform numerical analysis by using benchmark parameter values that are calibrated to match the initial and outsourcing equilibrium to the U.S. manufacturing sector of 1992 and 2006, respectively. I find that the net employment loss may reach up to 36% of total initial employment. However, the majority (50-75%, 53% for parameter values for 2006) of such net employment loss is due to the job destruction brought about by the cleansing effect of outsourcing rather than layoffs by outsourcers. As a sensitivity analysis, I show the cleansing effect as a share of net employment loss

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2The TAA program is specially designed for unemployed workers whose layoffs are caused by international trade, including import competition and relocation of production sites to foreign countries, with the purpose of helping them get a new job sooner. The TAA services and benefits include occupational training, remedial education, income support during training, reemployment services, job search allowances, and relocation allowances.

3The term ‘Cleansing Effect’ is first used by Caballero and Hammour (1994). They use the term to refer to firms’ restructuring strategy that clean outdate techniques or less profitable products out of their plants during recession when adjustment cost is low.
for six different sets of parameter values. All six cases confirm the dominance of the cleansing effect in driving the negative net employment effect. Although the cleansing effect is not directly related to outsourcing activities, such job destruction is clearly an outcome of offshore outsourcing. This finding implies that the BEA dataset is only valid for the analysis of within-firm employment effects among outsourcers. In order to discuss the more aggregate employment effects that outsourcing brings about, non-outsourcers, and even the firms that disappear from the market as a result of outsourcing, should be included in the analysis as subjects.

The numerical analysis confirms the previous finding that employment effect of outsourcing on outsourcing firms alone is ambiguous. For the benchmark parameter values, the net effect ranges from 17% net loss to 3% net gain. For six different sets of parameter values, the employment effect in outsourcing firms alone varies from large negative (32% net employment loss) to large positive (12% of net gain). The separate analysis of job destruction and creation shows that the observable net employment change is less than half of the gross job flow. Total job destruction is up to 60% of initial employment and total job creation reaches up to 24%. Despite the striking dominance of the cleansing effect in the net employment effect, the layoffs by outsourcers indeed account for a larger portion of total job destruction, implying that despite the ambiguous net employment effect, the layoffs by outsourcers are an important socio-economic phenomenon that deserves a significant amount of policy attention.

Besides the impact on employment, I show theoretically that outsourcing promotes international trade by eliminating the price disadvantage that exporters face in their foreign market in the absence of outsourcing. Also, I find that outsourcing reduces the total number of varieties available to consumers. This is a surprising result since product variety gain has been discussed as one of the most important benefits of international trade. This result stems from the fact that outsourcing benefits large-scale firms with high productivities, and the cleansing effect drives the small producers out of the market.

The structure of this model can be used for evaluation of various type of anti-outsourcing legislation. For instance, we can analyze the effect of complete prohibition of outsourcing in raising domestic employment by comparing the outsourcing equilibrium presented in the paper to the asymmetric outsourcing equilibrium where firms from one northern country (the home country) is prohibited from outsourcing while outsourcing of the other country’s firms and international trade are allowed. The model can be used to evaluate more specific policy proposal. For instance, in order to evaluate the efficacy of John Kerry’s policy proposal that repeals the tax break for outsourcing
firms\textsuperscript{4}, I can add one parameter for price distortion caused by changes in tax.\textsuperscript{5} Although this is of great policy relevance, it is beyond the scope of this paper.

The rest of the paper is organized as follows. Section 2 introduces the model. Sections 3 and 4 present, respectively, the analytical results and numerical analyses. Section 5 concludes.

2 Model

Initially, there are two symmetric Northern countries that produce and consume the manufacturing products. Two countries trade with each other, so each market is served by its local products and imported products. There is a continuum of firms that are heterogeneous in their productivities. Each firm utilizes only labor as a factor to perform two processes - assembly and services - in order to manufacture the final products. A representative consumer has CES preference over the continuum of goods, so demand for each good is determined by its price relative to the market price index. As outsourcing becomes feasible, I introduce a Southern country with a lower wage as a host of outsourcing activities. The South does not have a market for the final products. A Northern firm has an option to outsource its assembly segment to the South to save its production cost.

2.1 Set-up

2.1.1 Demand

A representative consumer has CES preference over a continuum of goods (indexed by $\omega$). The utility function is as follows:

$$U = \left[ \int_{\omega \in \Omega} q(\omega)^{\rho} d\omega \right]^{\frac{1}{\rho}} \quad (1)$$

$\Omega$ is the set of available varieties. The consumer spends a fixed amount of expenditure, $R$, on these differentiated varieties. For each variety, the quantity demanded, $q(\omega)$, and the revenue, $r(\omega)$, are

\textsuperscript{4}for more detail, see Mankiw and Swagel (2006)
\textsuperscript{5}Or more easily, I can adjust the Southern wage rate which then affects the total price of outsourced products.
as follows.

\[
q(\omega) = R \left[ \frac{p(\omega)}{P} \right]^{-\varepsilon} \\
 r(\omega) = R \left[ \frac{p(\omega)}{P} \right]^{1-\varepsilon}
\]

(2)

(3)

where \( \varepsilon \) is the elasticity of substitution and equal to \( \varepsilon = 1/(1-\rho) \). \( P \) is the price index for the market defined as follows:

\[
P = \left[ \int_{\omega \in \Omega} p(\omega)^{1-\varepsilon} \right]^{1/\varepsilon}
\]

(4)

**2.1.2 Production Technology**

Labor is the only factor of production and the production technology is represented by unit labor requirement. Firms are heterogeneous in their productivity level. Upon entry, a firm draws a productivity \( z \) from a cumulative distribution \( G(z) \). The firm’s unit labor requirement is then determined as \( 1/z \).

Production of the final good is composed of two segments, assembly and services. Each process utilizes a fixed share of workers with \( \gamma \) as the employment share of service segment. Therefore, labor requirement for each segment for one unit of final good is the following:

\[
\text{Assembly} : (1-\gamma)/z \quad \text{Services} : \gamma/z
\]

(5)

If the firm exports, it incurs an additional fixed cost of exporting, \( f_x \). Outsourcing also involves an additional fixed cost, \( f_{os} \). For instance, total labor requirement for a firm that does neither export nor outsource is

\[
l(z) = f + \frac{q(z)}{z}
\]

(6)

where \( q(z) \) is the quantity demanded. The wage rate in both Northern countries is equal to one.

**2.1.3 Decision Making Process**

A new firm enters the market incurring the sunk entry cost, \( f_e \). The entrant gets a productivity draw, \( z \), from the distribution \( G(z) \). After observing \( z \), the firm decides whether to stay and produce at the fixed production cost, \( f \), or to exit. In the absence of outsourcing, successful entrants again decide whether to export to the other Northern country at an additional fixed export cost, \( f_x \).
Where outsourcing is feasible, successful entrants choose one of the following options: first, produce at home without exporting; second, produce at home and export (additional fixed export cost, $f_x$); third, outsource and serve only the domestic market (additional fixed outsourcing cost, $f_{os}$); and lastly, outsource and export (additional cost $f_x + f_{os}$).

After successful entry, every firm faces a probability of death, $\xi$, regardless of their productivity levels, every period. In a steady state equilibrium, as some of existing firms exit, new entrants fill their spots.

2.2 Open Economy without Offshore Outsourcing

The set-up and equilibrium of the economy in the absence of outsourcing is borrowed from the open economy model of Melitz (2003). There are two Northern countries who are identical and trade their final goods with each other.

Every firm produces a different variety and charges a monopoly price. For domestic sales, the price is simply a constant markup over marginal cost; that is

$$p_{d,hp}(z) = \left(\frac{\varepsilon}{\varepsilon - 1}\right)\frac{1}{z} = \frac{1}{\rho z}$$

(7)

The subscript $d$ and $hp$ respectively indicate variables for domestic operation and variables for home-producers - firms that perform both assembly and services in their home countries. The profit from a firm’s domestic sales is

$$\pi_{d,hp}(z) = [p_{d,hp}(z) - mc_{d,hp}(z)]q_{d,hp}(z) - f = \frac{r_{d,hp}(z)}{\varepsilon} - f$$

(8)

where the revenue function, $r_{d,hp}(z)$ is, drawing from equations (3) and (7)

$$r_{d,hp}(z) = R(P\rho z)^{\varepsilon - 1}$$

(9)

If this firm decides to export, it will charge the monopoly price inclusive of transport cost. Transport cost takes the form of the iceberg cost. The price of the same product in foreign market is, therefore,

$$p_{x,hp}(z) = \tau p_{d,hp}(z)$$

(10)
The subscript $x$ indicates the variables for export operation. All exporters also serve their domestic markets. Since the total fixed cost of an exporter is $f + f_x$ whether it serves its domestic market or not, it is always more profitable to serve its domestic market as well as its foreign market. For this reason, I can separately express the export profit from the domestic profit; and, that is

$$
\pi_{x, hp}(z) = \frac{r_{x, hp}(z)}{\varepsilon} - f_x
$$

where

$$
r_{x, hp}(z) = R \left( \frac{P \rho z}{\tau} \right)^{\varepsilon-1} = \tau^{1-\varepsilon} r_{d, hp}(z)
$$

The total profit of an exporter is sum of equations (8) and (11).

### 2.2.1 Initial Open Economy Equilibrium

As seen in Melitz (2003), the equilibrium is characterized by two productivity cut-offs that summarize two decisions of firms - entry and exporting. I let $z_{hp}^0$ and $z_x^0$ denote the entry and export cut-off productivity, respectively. Superscript 0 indicates the variables for the initial open economy equilibrium.

First, I define two productivity cut-offs, $\bar{z}_{d, hp}$ and $\bar{z}_{x, hp}$, whose corresponding profits are zero:

$$
\pi_{d, hp}(\bar{z}_{d, hp}) = \frac{r_{d, hp}(\bar{z}_{d, hp})}{\varepsilon} - f = 0
$$

$$
\pi_{x, hp}(\bar{z}_{x, hp}) = \frac{r_{x, hp}(\bar{z}_{x, hp})}{\varepsilon} - f_x = 0
$$

Since both profit functions, $\pi_{d, hp}(z)$ and $\pi_{x, hp}(z)$, are monotonically increasing in $z$, $\bar{z}_{d, hp}$ and $\bar{z}_{x, hp}$ provide the cut-off productivity for entry and export. That is, every firm with $z > \bar{z}_{d, hp}$ will remain and serve the domestic market and every firm with $z > \bar{z}_{x, hp}$ will export in addition to its domestic operation. The total profit of a firm depends on entry and export status, and can be written as follows:

$$
\pi_{hp}(z) = \begin{cases} 
0 & \text{if } z < \bar{z}_{d, hp} \\
\pi_{d, hp}(z) & \text{if } \bar{z}_{d, hp} \leq z < \bar{z}_{x, hp} \\
\pi_{d, hp}(z) + \pi_{x, hp}(z) & \text{if } z \geq \bar{z}_{x, hp}
\end{cases}
$$

In this equilibrium, the entry and export cut-off productivities, $z_{hp}^0$ and $z_x^0$, are simply the zero profit productivity cut-offs, $\bar{z}_{d, hp}$ and $\bar{z}_{x, hp}$, respectively. The equilibrium profit function and the pattern of operation are depicted in Figure 1.
Using equations (9), (11), and (12), \( z_0^x \) can be written as a function of \( z_{hp}^0 \):

\[
z_0^x = \tau \left( \frac{f_x}{f} \right)^{\frac{1}{\varepsilon - 1}} z_{hp}^0
\]

(14)

In order for both exporters and non-exporters to exist, the fixed export cost must be sufficiently large. More specifically,

\[
f_x > \tau^{1-\varepsilon} f
\]

(15)

I assume that inequality (15) holds throughout this paper.

Let \( M_0^d \) denote the number of domestic varieties in the initial open economy equilibrium, and \( M_0^x \) the number of exporters. Due to symmetry, \( M_0^x \) is also the number of imported varieties. The total number of varieties available to consumers is \( M_0^t = M_0^d + M_0^x \). I define \( \tilde{z}(\hat{z}) \) as an average productivity for all firms with productivity higher than \( \hat{z} \); that is,

\[
\tilde{z}(\hat{z}) = \left[ \frac{1}{1 - G(\hat{z})} \int_{\hat{z}}^{\infty} \hat{z}^{\varepsilon - 1} g(z) dz \right]^{\frac{1}{\varepsilon - 1}}
\]

(16)

Then the average productivity of the available varieties in the open economy equilibrium, \( \tilde{z}_t^0 \), is

\[
\tilde{z}_t^0 = \left\{ \frac{1}{M_t^0} \left[ M_0^d \tilde{z}(z_{hp}^0)^{\varepsilon - 1} + M_0^x \left( \tilde{z}(z_0^x) \frac{\varepsilon - 1}{\varepsilon - 1} \right) \right] \right\}^{\frac{1}{\varepsilon - 1}}
\]

(17)

From equations (4), (7), and (17), I can derive two aggregate variables - price index, \( P_0 \), and the aggregate revenue, \( R \) - as functions of the average productivity, \( \tilde{z}_t^0 \).

\[
P_0 = M_t^0 \frac{1}{\tilde{z}_t^0} p_{d,hp}(\tilde{z}_t^0)
\]

(18)

\[
R = M_t^0 r_{d,hp}(\tilde{z}_t^0)
\]

(19)

### 2.2.2 Equilibrium Conditions

Let \( \tilde{\pi}^0 \) denote the average profit of all operating firms in the initial open economy equilibrium. It can be written as

\[
\tilde{\pi}^0 = \pi_{d,hp}(\tilde{z}(z_{hp}^0)) + P_{x}^0 \pi_{x,hp}(\tilde{z}(z_0^x))
\]

(20)
where \( Pr_x^0 \) is the probability of exporting upon successful entry, and defined as:

\[
Pr_x^0 = \frac{1 - G(z_x^0)}{1 - G(z_{hp}^0)}
\]

(21)

Using two zero cut-off profit conditions - equation (12) - together with equations (9) and (11), we can rewrite the average profit function as the following.

\[
\bar{\pi}^0 = f k(z_{hp}^0) + \left[ \frac{1 - G(z_x^0)}{1 - G(z_{hp}^0)} \right] f_x k(z_x^0)
\]

(22)

where

\[
k(\hat{z}) = \left( \frac{\tilde{z}(\hat{z})}{\hat{z}} \right)^{\varepsilon-1} - 1
\]

(23)

There is free entry in the market. Therefore, the expected value of entry must be zero in the equilibrium. Average expected value upon entry is the stream of expected profit with death hazard, \( \xi \).

\[
\bar{\nu} = \sum_{t=0}^{\infty} (1 - \xi)^t \bar{\pi}^0 = \frac{\bar{\pi}^0}{\xi}
\]

(24)

The probability of successful entry in the initial open economy equilibrium is \( 1 - G(z_{hp}^0) \), and there is an entry cost \( f_e \). Therefore, the free entry condition for this equilibrium is

\[
\bar{\pi}^0 = \frac{\xi f_e}{1 - G(z_{hp}^0)}
\]

(25)

The equilibrium entry cut-off productivity, \( z_{hp}^0 \), must satisfy equations (22) and (25) simultaneously. This constitutes the condition for the initial open economy equilibrium as the following.

\[
\bar{\pi}^0 = f k(z_{hp}^0) + \left[ \frac{1 - G(z_x^0)}{1 - G(z_{hp}^0)} \right] f_x k(z_x^0) = \frac{\xi f_e}{1 - G(z_{hp}^0)}
\]

(26)

where the cut-off productivity for exporting, \( z_x^0 \), is a function of \( z_{hp}^0 \), as in equation (14).
2.3 Open Economy with Outsourcing

Outsourcing takes the form of relocating assembly segment to another country. I introduce a Southern country that can perform assembly and does not demand the final product. The South has a lower wage rate, \( \delta \), which is smaller than one. (\( \delta \) is wage rate per efficiency unit of labor, controlling for any differential in labor productivity.) The production technology is firm-specific, so the productivity, \( z \), is preserved regardless of the location of assembly. The only advantage of outsourcing is the lower wage rate, which is equivalent to a productivity improvement in the sense that it lowers production cost.

If a firm with productivity \( z \) outsources, its marginal production cost becomes

\[
m_{\text{cos}}(z) = \left( (1 - \gamma) \frac{\delta}{z} + \gamma \frac{1}{z} \right) = \left( (1 - \gamma) \delta + \gamma \right) \frac{1}{z}
\]

That is, in comparison with the marginal production cost in the absence of outsourcing,

\[
m_{\text{cos}}(z) = \lambda \cdot m_{\text{d,hp}}(z)
\]

where

\[
\lambda = (1 - \gamma) \delta + \gamma
\]

Since now assembly and services take place in different countries, I need to define the geographical structure of the integration of two production segments and consumption. I assume that the integration of assembly and service segment is virtual and that goods are completed in the South. That is as if the service portion is performed in the firm’s home country and shipped to the South for completion, but there is no iceberg transport cost involved. Service and assembly segments are integrated at the location of assembly. Any extra cost involved in the integration process can be captured by the fixed outsourcing cost, \( f_{\text{os}} \). After completion, final goods are shipped to the market for consumption directly from the South. The iceberg transport cost, \( \tau \), applies to shipment of final goods. One anecdotal example is computer manufacturing industry. More sophisticated tasks - such as research and development, and management services - are performed in the US while a lot of part manufacturing and final assembly is done in low-wage country, such as China, and the world demand is met by direct shipments from those locations.

The transportation structure is summarized in Figure 2. Panel (a) describes traditional international trade where goods are shipped directly from its origin countries. This applies to all firms in the initial open economy equilibrium and non-outsourcers in the outsourcing equilibrium. Panel (b) describes the case for outsourcers. Figure 2 is depicted for two representative goods that
is produced by two firms originated in two Northern countries. These goods are produced with the same productivity. The circles represent the national borders; and two prices in each circle represent the prices of local and imported goods, respectively. One can see that goods face price disadvantage in their foreign markets.

Where goods are outsourced, the markup over the marginal cost of both goods upon completion at the Southern facilities is \( \lambda P \). These goods are shipped to both markets where they are sold for \( \tau \lambda P \). Therefore, outsourcing lowers domestic prices from \( P \) to \( \tau \lambda P \), while it lowers export prices from \( \tau P \) to \( \tau \lambda P \). For this reason, exporters benefit more from outsourcing than non-exporters do. For instance, where \( \tau \lambda \leq 1 \), non-exporters do not have an incentive to outsource while exporters still might depending on the relative size of domestic and foreign sales.\(^6\)

As described in Figure 1, the price of an outsourcer with productivity \( z \), which is the same for domestic and foreign sales, is as follows.

\[
P_{d,os}(z) = P_{x,os}(z) = \frac{\tau \lambda}{\rho z}
\]  

(28)

Since prices in the home and foreign markets are the same, revenues from the two markets are the same as well.\(^7\)

\[
r_{d,os}(z) = r_{x,os}(z) = R \left( \frac{P \rho z}{\tau \lambda} \right)^{\varepsilon-1}
\]  

(29)

There is a fixed cost of outsourcing, \( f_{os} \). Outsourcing firms incur \( f_{os} \) in addition to the fixed production cost \( f \), and fixed export cost \( f_x \) in case they export. As in the initial open economy equilibrium, all exporting outsourcers also serve their domestic markets; so I can write two separate expressions for domestic and export profits of an outsourcer as the following.

\[
\pi_{d,os}(z) = \frac{r_{d,os}(z)}{\varepsilon} - f - f_{os}
\]  

(30)

\[
\pi_{x,os}(z) = \frac{r_{x,os}(z)}{\varepsilon} - f_x
\]  

(31)

\(^6\)I do not allow partial outsourcing - outsource assembly segment for export sales only while perform both assembly and services at home for domestic sales. For the analysis, I excluded (later) the cases where \( \tau \lambda \leq 1 \) and focus on the equilibria with sufficient incentive to outsource. The feasibility of partial outsourcing is not relevant where \( \tau \lambda < 1 \).

\(^7\)Revenues depend on price indices. Due to symmetry, price indices are equal in two markets.
I define two zero-profit productivity levels $\tilde{z}_{d,os}$ and $\tilde{z}_{x,os}$; that is,

\begin{align}
\pi_{d,os}(\tilde{z}_{d,os}) &= 0 & \iff & & r_{d,os}(\tilde{z}_{d,os}) = \varepsilon(f + f_{os}) \\
\pi_{x,os}(\tilde{z}_{x,os}) &= 0 & \iff & & r_{x,os}(\tilde{z}_{x,os}) = \varepsilon f_x
\end{align} 

(32)

Depending on the sizes of fixed costs, we get two different total profit functions. First, if $f_x > f + f_{os}$, $\tilde{z}_{x,os}$ will be above $\tilde{z}_{d,os}$, and the total profit function will look like panel (a) of Figure 3.8 In this case, exporting requires larger revenue, and some outsourcers are not productive enough to meet the required amount of sales. Therefore, there are non-exporting outsourcers as well as exporting ones; and the total profit function of an outsourcer with productivity $z$ is as follows.

\[
\pi_{os}(z) = \begin{cases} 
0 & \text{if } z < \tilde{z}_{d,os} \\
\pi_{d,os}(z) & \text{if } \tilde{z}_{d,os} \leq z < \tilde{z}_{x,os} \\
\pi_{d,os}(z) + \pi_{x,os}(z) & \text{if } z \geq \tilde{z}_{x,os}
\end{cases}
\]

(33)

On the other hand, where $f_x < f + f_{os}$, exporting is very attractive, so all outsourcers export. This case is depicted in panel (b) of Figure 3. In this case, the break-even point is neither at $\tilde{z}_{d,os}$ nor at $\tilde{z}_{x,os}$. It is where the total profit - sum of domestic and export profits - is zero. I call this productivity level, $\tilde{z}_{os}$, and define it as the following.

\[
\pi_{d,os}(\tilde{z}_{os}) + \pi_{x,os}(\tilde{z}_{os}) = 0
\]

(34)

The total profit function for an outsourcer in this case is

\[
\pi_{os}(z) = \begin{cases} 
0 & \text{if } z < \tilde{z}_{os} \\
\pi_{d,os}(z) + \pi_{x,os}(z) & \text{if } z \geq \tilde{z}_{os}
\end{cases}
\]

(35)

Not to participate in outsourcing is still an option for firms. I call the firms that choose not to outsource home-producers. In this equilibrium, variables for home-producers are indicated by subscript $hp$. Their total profit function is introduced by equations (8), (9), (11)-(14) and is depicted in Figure 1.

8This is because domestic and export revenue are equal and monotonically increasing in $z$. 

14
2.3.1 Equilibria

Firms make three decisions in the outsourcing equilibrium: first, whether to stay in the market or exit (exit/stay); second, whether to produce at home or outsource (assembly location); finally, whether to export (export status). Such decisions are based on two profit functions, $\pi_{hp}(z)$ - equation (13) - and $\pi_{os}(z)$ - equation (33) and (35). More specifically, a firm will choose to stay in the market if its profit with either strategy - outsourcing or home-production - is positive. This firm will outsource if outsourcing profit is larger than home-production profit, and will not outsource otherwise. Finally, this firm exports if its productivity is higher than the relevant zero-profit productivity for exporting - $\tilde{z}_{x,hp}$ or $\tilde{z}_{x,os}$ - depending on the choice of assembly location. These decisions depend crucially on where $\pi_{hp}(z)$ and $\pi_{os}(z)$ intersect, and where these curves kink. These features of two profit functions, then, depend on parameter values - size of cost reduction ($\lambda$), transport cost ($\tau$), elasticity of substitution ($\varepsilon$), and the sizes of fixed costs ($f, f_x, f_{os}$). According to these parameter values, we have twelve different equilibria where outsourcing is feasible. Table 1 summarizes the conditions for each equilibrium and Figure 4 shows various cut-off productivities and the pattern of operation for each equilibrium. The derivation process is explained in detail in Technical Appendix.\(^9\)

Although each equilibrium is fundamentally different - they correspond to different parameter values - some share the same operational pattern. In practice, different industries have distinctive characteristics; therefore, they respond to the feasibility of offshore outsourcing differently. For this reason, every equilibrium of Figure 4 has its own practical significance and is worth investigating. However, the goal of this paper is to study the response of labor market to offshore outsourcing; so, I devote the attention to the case where outsourcing brings out employment response of significant size. Recall that where $\tau\lambda \leq 1$, non-exporters do not have an incentive to outsource because outsourcing raises the prices for domestic sales. Therefore, I focus on the equilibria under the condition $\tau\lambda < 1$ where outsourcing lowers domestic prices as well as export prices. According to table 1, equilibria $a, b, c, d, h, i, \text{ and } j$ satisfy the condition.

The operational patterns of these seven equilibria, then, can be summarized as in Figure 5. Equilibrium $b$ shows pattern A; $c$ and $i$ shows pattern B; and, $d$ and $j$ show pattern C. Equilibrium $h$ corresponds to pattern I, and equilibrium $a$ to II. I combine the information provided by table 1 and Figure 5 and show the sizes of fixed costs that correspond to each pattern given other parameter values in Figure 6. $\alpha$ is the size of fixed export cost relative to that of fixed production.

\(^9\)available on www.umich.edu/~ejpark/jypark_cleansing_tech.pdf
cost (\(\alpha = f_x/f\)), and \(\beta\) denotes the size of fixed outsourcing cost relative to \(f\) (\(\beta = f_{os}/f\)).

According to Figure 6, we achieve patterns I and II where fixed outsourcing cost is very small. Under these two patterns, all firms take advantage of outsourcing; therefore, there is no home-producer in the market. In addition to small fixed outsourcing cost, pattern I also has a very small fixed export cost; therefore, every firm exports. Under pattern II, there exist non-exporting outsourcers as well as exporting ones.

Pattern A, B, and C are where the fixed outsourcing cost is large enough for some firms to choose not to outsource. For a given value of fixed export cost, pattern A has the smallest fixed outsourcing cost, and C has the largest. This determines the number of outsourcers in these three patterns. Under the pattern A (smallest \(\beta\)), outsourcing is more attractive than exporting, so outsourcing cut-off productivity is lower than that of exporting. Under the pattern C, the opposite is true, so the productivity cut-off for exporting is lower than that of outsourcing. Pattern B is the intermediate case, and export cut-off productivity coincides with the outsourcing cut-off productivity. Accordingly, pattern A have the largest number of outsourcers, and the impact of outsourcing on the industry - such as the effect on employment - is the largest.

In order to analyze the impact of outsourcing on the various aspects of the industry, comparison between the initial open economy equilibrium and the outsourcing equilibrium is required. However, this comparison should be carried out separately for each outsourcing equilibrium pattern - I, II, A, B, and C - because the firms’ operational responses differ across patterns. In the next section, I present the detailed model under the pattern A where outsourcing affects the economy to a greatest extent. The detailed model for other patterns is not presented in this paper, but other patterns will be included in the analysis.

2.3.2 Equilibrium Pattern A.

The operational pattern A can be observed in the outsourcing equilibrium \(b\). Under this pattern, there are three groups of firms - home producers that only serve their domestic market, outsourcers that only serve their domestic market, and outsourcers that serve both domestic and foreign markets. As can be seen in panel (b) of Figure 4 and panel (c) of Figure 5, the firms with the lowest productivities are home-producers. Therefore, the entry cut-off productivity, \(z_{hp}^A\), is at the zero-profit productivity, \(\tilde{z}_{d,hp}\) - equation (12). The outsourcing cut-off productivity, \(z_{os}^A\), is where a firm is indifferent between outsourcing and home-production; that is
\[
\pi_{d, hp}(z_{os}^A) = \pi_{d, os}(z_{os}^A)
\]

All exporters are outsourcers, so the export cut-off productivity, \(z_x^A\) is the productivity level with which an outsourcer’s export profit is zero - \(\tilde{z}_{x, os}\), equation (32). The superscript A indicates the variables under the pattern A of the outsourcing equilibrium. Using equations (8), (9), and (29)-(32), \(z_{os}^A\) and \(z_x^A\) can be written as functions of \(z_{hp}^A\) as the following:

\[
\begin{align*}
\tilde{z}_{os}^A &= \left[ \frac{1}{(\tau \lambda)^{1-\varepsilon}} - 1 \left( \frac{f_{os}}{f} \right) \right]^\frac{1}{\varepsilon - 1} z_{hp}^A \\
\tilde{z}_x^A &= \tau \lambda \left( \frac{f_x}{f} \right)^\frac{1}{\varepsilon - 1} z_{hp}^A
\end{align*}
\]

The average productivity of all varieties that are available in one market is as follows.

\[
\begin{align*}
\tilde{z}_t^A &= \left\{ \frac{1}{M_t^A} \left[ M_{hp}^A \tilde{z}_{hp}^A \varepsilon^{-1} + M_{os}^A \left( \frac{\tilde{z}(z_{os}^A)}{\tau \lambda} \right) \varepsilon^{-1} + M_x^A \left( \frac{\tilde{z}(z_x^A)}{\tau \lambda} \right) \varepsilon^{-1} \right] \right\}^\frac{1}{\varepsilon - 1}
\end{align*}
\]

\(M_{hp}^A, M_{os}^A,\) and \(M_x^A\), respectively, denote the numbers of home producers’ varieties, outsourcers’ varieties, and imported varieties. \(M_t^A\) is the total number of varieties that are available in the market; that is \(M_t^A = M_{hp}^A + M_{os}^A + M_x^A\). \(\tilde{z}_{hp}^A\) is the average productivity of home-producers whose productivities lie between \(z_{hp}^A\) and \(z_{os}^A\). \(\tilde{z}_{hp}^A\) can be written as the following.

\[
\tilde{z}_{hp}^A = \left[ \frac{M_d^A}{M_{hp}^A} \tilde{z}(z_{hp}^A) \varepsilon^{-1} - \frac{M_{os}^A}{M_{hp}^A} \tilde{z}(z_{os}^A) \varepsilon^{-1} \right]^\frac{1}{\varepsilon - 1}
\]

\(M_d^A\) is the number of domestic varieties, hence, sum of \(M_{hp}^A\) and \(M_{os}^A\). The aggregate revenue and the price index are, from equations (7), (18), and (19),

\[
\begin{align*}
R &= M_t^A r_{d, hp}(\tilde{z}_t^A) \\
P_A &= M_t^A \frac{1}{\rho_{t}^A} \left( \frac{1}{\rho_{t}^A} \right)
\end{align*}
\]

As in the initial open economy equilibrium, an equilibrium condition is made up of two equations that characterize the average profit of active firms in equilibrium. First, the average profit is sum of average profits of firms with different operational strategies - non-exporting home-producers, non-exporting outsourcers, and exporting outsourcers - weighted by the probability of each strategy.
upon successful entry. That is,

\[ \bar{\pi}^A = Pr_{hp}^A \pi_{d, hp}(z^A_{hp}) + Pr_{os}^A \pi_{d, os}(z^A_{os}) + Pr_x^A \pi_{x, os}(z^A_x) \]  

(41)

where the probability of each strategy is as follows.

\[ Pr_{hp}^A = \frac{G(z^A_{os}) - G(z^A_{hp})}{1 - G(z^A_{hp})}; \quad Pr_{os}^A = \frac{1 - G(z^A_{os})}{1 - G(z^A_{hp})}; \quad Pr_x^A = \frac{1 - G(z^A_x)}{1 - G(z^A_{hp})} \]  

(42)

Using equations (8)-(11), (16), (23), (29)-(31), and (36), equation (41) can be rewritten as the following:

\[ \bar{\pi}^A = k(z^A_{hp})f + \left[ \frac{1 - G(z^A_{os})}{1 - G(z^A_{hp})} \right] k(z^A_{os})f_{os} + \left[ \frac{1 - G(z^A_{x})}{1 - G(z^A_{hp})} \right] k(z^A_x)f_x \]  

(43)

Free entry condition requires that the expected value of entry is equal to the sunk entry cost in the equilibrium; that is,

\[ \bar{\pi}^A = \frac{\xi f_e}{1 - G(z^A_{hp})} \]  

(44)

The derivation of equation (44) is identical to that of equation (25). Finally, the equilibrium is represented by the cut-off productivities that satisfy equations (43) and (44) simultaneously.

\[ \bar{\pi}^A = k(z^A_{hp})f + \left[ \frac{1 - G(z^A_{os})}{1 - G(z^A_{hp})} \right] k(z^A_{os})f_{os} + \left[ \frac{1 - G(z^A_{x})}{1 - G(z^A_{hp})} \right] k(z^A_x)f_x = \frac{\xi f_e}{1 - G(z^A_{hp})} \]  

(45)

3 Theoretical Results

The impact of offshore outsourcing on the economy can be analyzed by comparing features of the outsourcing equilibrium to those of the initial open economy equilibrium. Although the ultimate goal of this paper is to investigate the labor market response to outsourcing, the rich structure of the model allows us to derive many valuable economic implications. In this section, I do not restrict the analysis to the equilibrium pattern A and rather expand the scope to patterns B and C as well. More specifically, I analyze the subset of the equilibrium space introduced by Figure 6; that is

\[ \alpha > (\tau \lambda)^{1-\varepsilon} \quad \text{and} \quad \beta > (\tau \lambda)^{1-\varepsilon} - 1 \]  

(46)
Patterns I and II - where every active firm outsources - are also interesting and are practically plausible, I do not discuss them for the rest of the paper.

First, I look at the changes in entry and export cut-off productivities, and where outsourcing cut-off productivity is located. The location of cut-off productivities is of great importance because it determines the operational responses of firms. For instance, a change in the entry cut-off productivities either forces some firms to exit, or invites more firms to stay active in the market. A change in export cut-off productivities either generates or eliminates export opportunities for some firms. The location of outsourcing cut-off productivities determines how many firms lay off workers to relocate their assembly segments (and improve their profits by doing so). These different responses by different firms, then, determines impact of offshore outsourcing on various aspect of economy such as aggregate productivity, trade flow, number of varieties, and most importantly employment. Proposition 1 and 2 summarize the relative size of cut-off productivities.

**Proposition 1 Cleansing Effect of Outsourcing** The entry cut-off productivity is higher in outsourcing equilibrium than in the initial open economy equilibrium. Also, the rise of the entry cut-off productivity is the largest where fixed outsourcing cost \( f_{os} \) is the smallest (pattern A), and the smallest where \( f_{os} \) is the largest (pattern C). That is,

\[
\begin{align*}
  z^0_{hp} &< z^C_{hp} < z^B_{hp} < z^A_{hp}
\end{align*}
\]

**Lemma 1** The outsourcing cut-off productivity relative to the entry cut-off productivity is the lowest under the pattern A and the highest under the pattern C of the outsourcing equilibrium. That is,

\[
\begin{align*}
  \frac{z^A_{os}}{z^A_{hp}} &< \frac{z^B_{os}}{z^B_{hp}} < \frac{z^C_{os}}{z^C_{hp}}
\end{align*}
\]

**Lemma 2** The export cut-off productivity relative to the entry cut-off productivity is the lowest under the pattern A and the highest under the pattern C. The value for the pattern C is equal to that for the initial open economy equilibrium. That is,

\[
\begin{align*}
  \frac{z^A_x}{z^A_{hp}} &< \frac{z^B_x}{z^B_{hp}} < \frac{z^C_x}{z^C_{hp}} = \frac{z^0_x}{z^0_{hp}}
\end{align*}
\]

**Proof:** See Appendix A.1
The first implication of Proposition 1 is that the entry cut-off productivity rises with outsourcing regardless of the pattern of operation in the outsourcing equilibrium. This implies that the least productive firms in the initial open economy equilibrium exit as outsourcing becomes feasible. As prices of outsourcers decrease, non-outsourcers face a rise in their relative prices and a fall in the demand for their products. To the firms who made small profits in the initial open economy equilibrium, such a sales loss is enough to turn their positive profits into negative ones, driving them out of the market. I call this the Cleaning Effect of Offshore Outsourcing.\textsuperscript{10} The cleansing effect is directly related to the employment level of the industry. As firms exit, all workers hired by the exiting firms lose jobs. This implies that non-outsourcers can be a source of significant amount of outsourcing-related job losses. In section 4, I quantify the size of the job losses due to the cleansing effect by calibrating parameter values.

Proposition 1 also shows that the cleansing effect is larger where outsourcing is relatively easy (pattern A). In this case, more firms take advantage of outsourcing; therefore, the price index goes further down. This enlarges the cleansing effect. As more firms exit under the pattern A than under the pattern C, job destruction due to the cleansing effect is also larger under the pattern A. Therefore, in an industry where outsourcing is relative easy to carry out - industries with easily transferrable technology, less issue of intellectual property right, and smaller potential variation in quantity, such as textile, apparel, and footwear - the job destruction due to the cleansing effect is expected to be more significant. It is also worth noting that there is a rise in the availability of outsourcing advisory services\textsuperscript{11} which potentially reduces the fixed cost of outsourcing. This trend might expand the influence of the cleansing effect on employment.

**Proposition 2** The cut-off productivity for outsourcing is the lowest under the outsourcing equilibrium pattern A and the highest under the pattern C; that is,

\[
z_{A}^{os} < z_{B}^{os} < z_{C}^{os}
\]

\textsuperscript{10}This paper is not the first to find such an effect. Melitz (2003) and Helpman et al (2004) theoretically show that the least productive firms exit as a country opens up for free trade or FDI. Bernard et al (2006) closely investigates the response of U.S. manufacturing plants to the imports from low-wage countries and find that this specific import competition raises probability of plant death significantly. They also find that the rise of the death probability is larger for more labor-intensive plants. More labor-intensive firms in their study are equivalent to the least productive firms in this paper since labor is the only factor of production.

\textsuperscript{11}These services are provided by consulting firms such as Deloitte, EquaTerra, neoIT, PA consulting group, Pace Harmon, PricewaterhouseCoopers, RampRate, and TPI. (source: Forrester Research, Inc. \url{http://www.forrester.com/Research/Document/Excerpt/0,7211,40655,00.html} )
**Proof**: See Appendix A.2

Proposition 2 implies that outsourcing is profitable for firms with lower productivities under the pattern A than under the pattern B or C. In other words, more firms will take advantage of outsourcing opportunities. This is not surprising since pattern A is where the fixed outsourcing cost is the lowest among the outsourcing equilibrium pattern A, B, and C.

Unlike the entry cut-off productivity, export cut-off productivity does not uniformly rise or decrease with outsourcing. Whether it increases or decreases depends on the parameter values and the sizes of various fixed costs. Generally, though, export cut-off productivity is low where fixed outsourcing cost is small (pattern A). This is because outsourcing benefits exporters more than non-exporters by bringing about a large reduction in exporters’ prices in their foreign markets. This generates a significant rise in their revenues. Such an increase in revenue allows firms with lower productivities to export. In other words, outsourcing expands export opportunities; so, the export cut-off productivity is lower where outsourcing is fairly easy. Under pattern A, all exporters are outsourcers; and even the exporter with the lowest productivity \( z_A \), whose export profit is zero, experiences a rise its revenue. In the absence of outsourcing, this firm’s revenue falls short of the fixed export cost; thus, it would not export. For this reason, the export cut-off productivity falls under the pattern A. Under the pattern C, the exporters with the lowest productivity \( z_C \) is a home-producer, and its relative price is higher in the outsourcing equilibrium. In the absence of outsourcing, this firm makes positive profit rather than zero profit, so the export cut-off productivity (the zero-profit productivity for exporting) must be lower \( (z^0_x < z^C_x) \). Pattern B is the intermediate case, and the sign of the change in the export cut-off productivity is ambiguous.

### 3.1 Firm-level Operational Responses to Outsourcing under the Pattern A

In this section, I briefly discuss how different firms respond to outsourcing in more detail by presenting the case under the outsourcing equilibrium pattern A. Figure 7 depicts the cut-off productivities of both the initial open economy equilibrium and the outsourcing equilibrium. These cut-off productivities divide firms into five groups - (A.b) through (A.f). The firms that fall in the range of (A.a) exit in both equilibria; therefore, they are not relevant for the analysis. As feasibility of outsourcing results in different operational responses for different groups of firms, the employment implications also differ across groups.

The firms in the group (A.b) are forced to exit due to the *Cleansing Effect*. As these firms
shut down, the workers previously employed by these firms will be laid off generating pure job
destruction. The firms in the group (A.c) survive as home-producers. I call these firms *Home-
Producers*. Although they do not change their operational behavior, their relative prices rise; thus,
they suffer from a decrease in sales which, in turn, results in layoffs.

The firms in the group (A.d) are the firms that switch from being non-exporting home-producers
to non-exporting outsourcers. I call these firms *New Outsourcers*. The change in the assembly
location involves job destruction; however, the price reduction generates a rise in demand. In order
to meet the higher demand, these firms have to hire more workers in their service segments creating
new jobs. Thus, in this group, there will be both job destruction and job creation. Depending on
the relative size of these two effects, the net employment effect may be either positive or negative.

The firms in the group (A.e) are *New Exporters* switching from being non-exporting home-
producers to exporting outsourcers. The initiation of export operation brings these firms a whole
new market, and the increase in sales due to market expansion generates a large number of new
jobs. Especially, the employment in the export operation is pure job creation. In their domestic
operations, there is job destruction as well as job creation, as for new outsourcers.

The firms in the group (A.f) are *Existing Exporters*, but they move their assembly operation
to the South. In the initial equilibrium, the domestic operation accounts for majority of their
sales due to the price disadvantage that they face in their foreign markets. As they outsource,
elimination of such price disadvantage raises their foreign sales more than their domestic sales.
Thus, larger portion of job destruction occurs in their domestic portion of job destruction occurs
in their domestic sales while more jobs are created in the export operations.

When one looks empirically at the aggregate employment Figures over time from the period
with little outsourcing to the period with a significant portion of market composed of outsourcers,
one only observes the net change in employment, which is a mixture of job destruction and creation
in different types of firms. The structural model introduced in sections 2 enables us to separate
job destruction and job creation, and the relative size of employment changes in different groups
of firms.

### 3.2 Distributional Assumption

Under a certain functional assumption for the productivity distribution, $G(z)$, we can derive
more practical implications. For the rest of the theoretical analysis and the numerical analysis, I
assume that the productivity draws follow a Pareto Distribution. The Cumulative Distribution Function \( G(z) \) is

\[
G(z) = 1 - \left( \frac{z_{\min}}{z} \right)^\eta \quad \text{where} \quad \eta > \varepsilon - 1 \quad \text{and} \quad z \geq a
\]  

(47)

\( z_{\min} \) is the minimum value of \( z \), and \( \eta \) is the shape parameter that determines the dispersion of the productivity draws. Large \( \eta \) implies low dispersion; that is, large mass is concentrated at the low productivity. With small \( \eta \), productivity draws are more evenly distributed, so the chance of drawing higher productivity is larger. For this reason, the shape parameter is crucial in determining the overall productivity level of an industry and the cut-off productivities in equilibria. The inequality, \( \eta > \varepsilon - 1 \) is required for the average productivity to be finite.

Under the Pareto distribution, the probabilities of outsourcing and exporting can be written in a very simple form. For example, the probability of exporting in the initial open economy equilibrium - equation (21) - can be written as the following.

\[
P_{e}^0 = \left( \frac{z_{hp}^0}{z_{x}^0} \right)^\eta
\]

Then, lemma 1 and 2 have direct implications on the composition of the market. They show that both the fraction of outsourcers and exporters among domestic firms are the largest under the pattern A and the smallest under the pattern C in the outsourcing equilibrium. This confirms that outsourcing promotes exporting, hence, international trade.

Under this distributional assumption, \( k(\hat{z}) \) is a constant that is independent of \( \hat{z} \). I define \( k \) as the constant value of \( k(\hat{z}) \) as follows.

\[
k = k(\hat{z}) = \frac{\varepsilon - 1}{\eta - \varepsilon + 1}
\]  

(48)

Since \( \eta > \varepsilon - 1 \), \( k \) is positive. Using equations (47) and (48), I can rewrite equilibrium conditions for the initial open economy equilibrium and the outsourcing equilibrium A.

\[
\bar{\pi}^0 = kf + \left( \frac{z_{hp}^0}{z_{x}^0} \right)^\eta \quad \text{where} \quad \eta > \varepsilon - 1 \quad \text{and} \quad \eta > \varepsilon - 1
\]

(49)

\[
\bar{\pi}^A = kf + \left( \frac{z_{hp}^A}{z_{x}^A} \right)^\eta \quad \text{where} \quad \eta > \varepsilon - 1
\]

(50)

\[\text{used by Helpman, Melitz, and Yeaple (2004), Ghironi and Melitz (2005), Bernard, Redding, and Schott (2007), and many others.}\]
Using the same derivation method that is used in deriving equation (50), we can obtain the equivalent expression that constitute equilibrium conditions for patterns B and C as follows.

\[
\hat{\pi}^B = kf + \left( \frac{z_{hp}}{z_{os}} \right)^{\eta} k(f_{os} + f_x) = \frac{\xi f_e}{1 - G(z_{hp})} \tag{51}
\]

\[
\hat{\pi}^C = kf + \left( \frac{z_{hp}}{z_{os}} \right)^{\eta} k f_{os} + \left( \frac{z_{hp}}{z_x} \right)^{\eta} k f_x = \frac{\xi f_e}{1 - G(z_{hp})} \tag{52}
\]

The rank of the entry cut-off productivities shown by Proposition 1 together with the change in the export cut-off productivities discussed in the previous section has a direct implication on the number of varieties in each equilibrium. The following Propositions summarize the impact of outsourcing on product varieties.

**Proposition 3** The number of domestic varieties decreases as outsourcing becomes feasible. Also, the decrease in variety is the largest where fixed outsourcing cost \( f_{os} \) is the smallest (pattern A), and the smallest where \( f_{os} \) is the largest (pattern C). That is,

\[ M_d^A < M_d^B < M_d^C < M_d^0 \]

**Proposition 4** Outsourcing Reduces Variety: The total number number of varieties available to consumers decreases as outsourcing becomes feasible.

\[ \max\{ M_t^A, M_t^B, M_t^C \} < M_t^0 \]

*Proof:* See Appendix A.3 and A.4

Proposition 3 implies, first, that the number of domestic varieties decrease with outsourcing, and second, that the decrease in domestic varieties gets larger as outsourcing intensifies. Under the outsourcing equilibrium pattern A - the equilibrium with the greatest extent of outsourcing activities - there are fewer domestic varieties than any other equilibrium. This is due to the cleansing effect. As shown in Proposition 1, the magnitude of the cleansing effect is large where outsourcing is relatively easy to undertake. Therefore, more domestic firms are driven out of the market under pattern A.

Unlike domestic varieties, the number of imported varieties (same as the number of exporters) does not uniformly increase or decrease. The pattern of increase and decrease resembles that of the
export cut-off productivities. The number of imported varieties under the outsourcing equilibrium pattern A is larger than that of the initial open economy equilibrium \((M^A_x > M^0_x)\). Since outsourcing benefits exporters more than non-exporters, the relative easiness of outsourcing promotes exporting very much. Under the pattern C, low-productivity exporters are not outsourcers, and outsourcing generates the cleansing-like effect on home-producing exporters as well. As price index falls in both markets due to outsourcing, home-producing exporters face a rise in their relative prices in their foreign markets. Some firms’ profits turn negative and they have to exit. In the process, the number of imported varieties decreases \((M^C_x < M^0_x)\). The pattern B is the intermediate case, and the sign of the change in the number of imported varieties is ambiguous.

Proposition 4 summarizes the changes in the numbers of domestic and imported varieties. It states that the total number of varieties that are available to consumers unambiguously falls as outsourcing becomes feasible. This is rather surprising since the increase in product variety is often discussed as one of the most important gains from international trade. This negative effect of outsourcing on product variety is a result of the cleansing effect. Especially under the outsourcing equilibrium pattern A, the number of imported varieties rises; but the decrease in domestic product variety due to the cleansing effect dominates the rise in imported product variety, resulting a net decrease in total product variety.

Since death of firms causes massive job destruction, the changes in product varieties summarized by Propositions 3 and 4 have important implications on the employment effect of outsourcing. However, the total impact should include changes within firms - sales loss of surviving home-producers, layoffs by outsourcers, and sales expansion of outsourcers. The next section presents the employment effect of outsourcing.

### 3.3 Employment

Total employment of an industry consists of production employment by active firms and the investment made by new entrants. The production employment, then, consists of assembly, services and fixed cost employment of home-producers, outsourcers, exporters and non-exporters. Since each equilibrium - the initial open economy equilibrium and three outsourcing equilibrium patterns - is composed of different groups of firms, the total employment should be calculated separately. In this section, I presents the initial open economy equilibrium, and the outsourcing equilibrium pattern A. Employment under the patterns B and C resemble that of the pattern A.
3.3.1 Initial Open Economy Equilibrium

There are two types of firms in this equilibrium - non-exporting home-producers and exporting home-producers. We can separate these firms’ operations into two categories: first, domestic operation by home-producers and, second, export operation by home-producers. \( M_d^0 \) firms - firms with \( z \geq z_{hp}^0 \) - serve domestic markets and each firm’s labor requirement for domestic operation is the same as equation (6). Total employment for domestic operations can be obtained by multiplying the number of firms, \( M_d^0 \), to the average labor requirement by these firms, which is as follows.

\[
l_{d, hp}(\tilde{z}(z_{hp}^0)) = f + \frac{q_{d, hp}(\tilde{z}(z_{hp}^0))}{\tilde{z}(z_{hp}^0)} \tag{53}
\]

\( q_{d, hp}(\cdot) \) is the quantity of domestic sales and is defined by equation (2). \( M_x^0 \) firms - firms with \( z \geq z_x^0 \) - export, and the average labor requirement of these firms’ export operation is as follows.

\[
l_{x, hp}(\tilde{z}(z_x^0)) = f_x + \frac{\tau q_{x, hp}(\tilde{z}(z_x^0))}{\tilde{z}(z_x^0)} \tag{54}
\]

Using equations (2), (7), (10), (53), and (54), we obtain the number of production workers as the following.\(^\text{13}\)

\[\rho R + M_d^0 f \left[ 1 + \left( \frac{z_{hp}^0}{z_x^0} \right)^\eta \frac{f_x}{f} \right] \tag{55}\]

The entry investment employment is \( M_e^0 f_e \) where \( M_e^0 \) is the number of new entrants each period in the equilibrium. In the steady state, number of successful entry each period must be equal to the number of firms death; that is \( \left[ 1 - G(z_{hp}^0) \right] M_e^0 = \xi M_d^0 \). Therefore, the entry investment employment is, using equation (49),

\[M_e^0 f_e = M_d^0 \pi^0 = M_d^0 k f \left[ 1 + \left( \frac{z_{hp}^0}{z_x^0} \right)^\eta \frac{f_x}{f} \right] \tag{56}\]

Equation (56) implies that the total amount of resources used as entry investment is equal to the total profit of active firms. This ensures that the industry as a whole yields zero profit in

\[^{13}\text{also used are i) } \tilde{z}(z_{hp}^0) = \tilde{z}(z_{hp}^0) \left( \frac{z_{hp}^0}{z_{hp}^0} \right) \quad \text{ii) } M_x^0 = \left( \frac{z_{hp}^0}{z_x^0} \right)^\eta M_d^0 \quad \text{iii) } P_e^{\alpha-1} = \left[ M_e^0 \rho^{\alpha-1} - z_e^{\alpha-1} \right]^{-1} \text{ equation (18) } \quad \text{iv) } \tilde{z}_{e-1} = M_{e-1} \tilde{z}(z_{hp}^0)^{\alpha-1} \left[ 1 + \tau^{-1} \left( \frac{z_{hp}^0}{z_{hp}^0} \right)^{\varepsilon-1-\eta} \right] : \text{ equation (17) }\]
the equilibrium. Now, the total employment in the initial open economy equilibrium is sum of equations (55) and (56).

\[ Emp^0 = \rho R + M^0_d (k + 1) f \left[ 1 + \left( \frac{z^0_{hp}}{z^0_x} \right) \frac{f_x}{f} \right] \]  

(57)

\( Emp^0 \) denotes total employment in this industry in the initial open economy equilibrium. In order to simplify further, I assume that the total labor compensation is equal to the total expenditure in this industry in the initial employment. Since the wage rate is 1, \( Emp^0 \) must be \( R \). Then, the total initial employment in this industry, equation (57), can be re-written as the following:

\[ Emp^0 = R = \varepsilon M^0_d (k + 1) f \left[ 1 + \left( \frac{z^0_{hp}}{z^0_x} \right) \frac{f_x}{f} \right] \]  

(58)

### 3.3.2 Outsourcing Equilibrium Pattern A

There are three types of firms in this equilibrium: nont-exporting home-producers, non-exporting outsourcers, and exporting outsourcers. Their operations can be divided into three categories; first, home-producers’ domestic operation; second, outsourcers’ domestic operation; and finally, outsourcers’ export operation. There are \( M^A_{hp} \) home-producers and their productivities lie between \( z^A_{hp} \) and \( z^A_{os} \). Their average productivity, \( \tilde{z}^A_{hp} \), is described by equation (38). The average number of workers hired by their domestic operation is as follows.

\[ l_{d,hp}(\tilde{z}^A_{hp}) = f + \frac{qd_{hp}(\tilde{z}^A_{hp})}{\tilde{z}^A_{hp}} \]  

(59)

\( M^A_{os} \) firms, whose productivities are such that \( z \geq z^A_{os} \), outsource and serve their domestic markets. Their assembly segments are sent to the South, and the final product need to be shipped from the South; therefore, the average labor requirement for these firms’ domestic operation is

\[ l_{d,os}(\tilde{z}(z^A_{os})) = f + f_{os} + \frac{\tau \gamma q_{d,os}(\tilde{z}(z^A_{os}))}{\tilde{z}(z^A_{os})} \]  

(60)

Similary, each outsourcer’ export operation - carried out by \( M^A_x \) firms - requires the following
number of workers on average.

\[ l_{x,os}(\tilde{z}^{A}_{x}) = f_{x} + \frac{\tau \gamma q_{d,os}(\tilde{z}^{A}_{x})}{\tilde{z}^{A}_{x}} \]  

(61)

The total number of production workers in this industry is \( M^{A}_{hp} l_{d,hp}(\tilde{z}^{A}_{hp}) + M^{A}_{os} l_{d,os}(\tilde{z}^{A}_{os}) + M^{A}_{x} l_{x,os}(\tilde{z}^{A}_{x}) \). The entry investment employment is again \( M^{A}_{e} f_{e} \); and, in the steady state equilibrium, it must be that 

\[ \left[ 1 - G(\hat{z}^{A}_{hp}) \right] M^{A}_{e} = \xi M^{A}_{d}. \]  

From equation (50), the entry investment employment in the outsourcing equilibrium pattern A is as follows.

\[ M^{A}_{e} f_{e} = \bar{\pi}^{A} M^{A}_{d} = k f \left[ 1 + \left( \frac{z^{A}_{hp}}{z^{A}_{os}} \right)^{\eta} \frac{f_{os}}{f} + \left( \frac{z^{A}_{hp}}{z^{A}_{x}} \right)^{\eta} \frac{f_{x}}{f} \right] \]  

(62)

Then, the total employment in this industry is, using equations (2), (28), (38), (59) - (62), the following:

\[ Emp^{A} = R \left( \frac{\varepsilon - 1}{\varepsilon} \right) \frac{M^{A}_{d}}{M^{A}_{d}^{0}} \left\{ 1 + \left[ \chi \left( \tau \lambda \right)^{1-\varepsilon} - 1 \right] \left( \frac{z^{A}_{hp}}{z^{A}_{hp}} \right)^{\varepsilon - 1 - \eta} + \frac{\chi \left( \tau \lambda \right)^{1-\varepsilon} \left( \frac{z^{A}_{hp}}{z^{A}_{hp}} \right)^{\varepsilon - 1 - \eta}}{1 + \tau^{1-\varepsilon} \left( \frac{z^{A}_{hp}}{z^{A}_{hp}} \right)^{\varepsilon - 1 - \eta}} \right\} \]  

\[ + (k + 1) M^{A}_{d} f \left[ 1 + \left( \frac{z^{A}_{hp}}{z^{A}_{os}} \right)^{\eta} \frac{f_{os}}{f} + \left( \frac{z^{A}_{hp}}{z^{A}_{x}} \right)^{\eta} \frac{f_{x}}{f} \right] \]  

(63)

In a similar manner, we can obtain total employment in the outsourcing equilibrium patterns B and C.

3.3.3 Employment Effect of Outsourcing

The analysis of the impact of outsourcing on employment requires comparison between total initial employment and total employment in the outsourcing equilibrium employment. The ratio between two total employment can be obtained using equations (58), (63), (A.3.2), and (A.3.3)\(^{14}\),

\[ P_{A} = P_{0} \left( \frac{z^{A}_{hp}}{z^{A}_{hp}} \right) \]

\[ P_{0}^{-1} = \left\{ \rho^{1-\varepsilon} M^{A}_{d} \tilde{z}(z^{A}_{hp})^{\varepsilon - 1 - \eta} \left[ 1 + \tau^{1-\varepsilon} \left( \frac{z^{A}_{hp}}{z^{A}_{hp}} \right)^{\varepsilon - 1 - \eta} \right] \right\}^{1} \]  

: equations (17) & (18)

\(^{14}\) Also used are: i) \( M^{A}_{d} = \left( \frac{z^{A}_{hp}}{z^{A}_{os}} \right)^{\eta} M^{A}_{d} \); \( M^{A}_{e} = \left( \frac{z^{A}_{hp}}{z^{A}_{x}} \right)^{\eta} M^{A}_{d} \); \( M^{A}_{hp} = \left[ 1 - \left( \frac{z^{A}_{hp}}{z^{A}_{os}} \right)^{\eta} \right] M^{A}_{d} \)

ii) \( \tilde{z}(z^{A}_{hp}) = \tilde{z}(z^{A}_{hp}) \left( \frac{z^{A}_{hp}}{z^{A}_{hp}} \right) \); \( \tilde{z}(z^{A}_{hp}) = \tilde{z}(z^{A}_{hp}) \left( \frac{z^{A}_{hp}}{z^{A}_{hp}} \right) \)

iii) \( \tilde{z}(z^{A}_{hp}) = \tilde{z}(z^{A}_{hp}) \left( \frac{z^{A}_{hp}}{z^{A}_{hp}} \right) \)

iv) \( \tilde{z}(z^{A}_{hp}) = \tilde{z}(z^{A}_{hp}) \left( \frac{z^{A}_{hp}}{z^{A}_{hp}} \right) \)

\(^{15}\) from Appendix 3
as the following\(^\text{16}\):

\[
\frac{\text{Emp}^A}{\text{Emp}^B} = \left(\frac{\varepsilon - 1}{\varepsilon}\right)\left(\frac{z_0}{z_{hp}^A}\right)\eta \left\{\frac{1 + \left[\frac{\varepsilon - 1}{\lambda} + \frac{\varepsilon - 1}{\eta}\right]}{1 + \varepsilon - 1} - \frac{\varepsilon - 1}{\eta}\right\} + \frac{1}{\varepsilon} \tag{64}
\]

The last term, \(\frac{1}{\varepsilon}\), represents the employment for fixed costs and the entry investment. This implies that the number of workers hired for fixed costs and entry investment is, from equation (58), constant at \(\frac{R}{\varepsilon}\) which is the markup portion of the total revenue in this industry. This means that the total expenditure in this industry goes entirely to workers - both Northern and Southern workers - as a compensation.

The first part of the first term \((\varepsilon - 1)\varepsilon\) indicates the variable cost portion of employment. If the first term excluding \((\varepsilon - 1)\varepsilon\) is equal to one, outsourcing has no impact on total employment. The second part of the first term - the ratio between two entry cut-off productivities - represents the cleansing effect. As \(z_{hp}^A\) is larger than \(z_{hp}^0\), employment in the outsourcing equilibrium decrease. The terms in the curly bracket is the comparison of average firm-level employment.

Using equation (64) and the equivalent expressions for the outsourcing equilibrium patterns B and C, I can summarize the effect of outsourcing on total employment of the subject industry in Proposition 5.

**Proposition 5 Outsourcing Results in Net Job Loss:** *Outsourcing unambiguously reduces the aggregate employment.*

\[
\text{Emp}^A < \text{Emp}^B < \text{Emp}^C < \text{Emp}^0
\]

**Proof:** See Appendix A.5

\(\text{Emp}^B\) and \(\text{Emp}^C\) denote total employment levels under the outsourcing equilibrium patterns B and C. Proposition 5 strongly suggest that outsourcing does hurt employment at the aggregate level

\(^{16}\)Also uses the fact that \(\frac{M^A}{M^B} = \left(\frac{z_{hp}^0}{z_{hp}^A}\right)\eta\) which is obtained from equations (A.3.2), (A.3.3), (49), and (50) in the following way: \(\frac{\bar{\pi}_0}{\bar{\pi}_A} = \frac{1 - G(z_{hp}^A)}{1 - G(z_{hp}^B)} = \left(\frac{z_{hp}^0}{z_{hp}^A}\right)^\eta \frac{1 + \frac{z_{hp}^0}{z_{hp}^A}}{1 + \frac{z_{hp}^B}{z_{hp}^A}} \frac{\lambda}{\ell} = \frac{M^A}{M^B}\)
regardless of the difficulty of outsourcing. Different groups of firms (as seen in Figure 7) destroy and create different amount of jobs under different patterns; but the sum of various employment responses is always negative.

4 Numerical Analyses

Proposition 5 may serve as a supporting argument for the public concern that outsourcing destroys U.S. manufacturing jobs. However, the blame by the public is very concentrated on the outsourcing firms rather than the whole economy. As shown by Proposition 1 and Figure 7, there are firms that exit due to lack of competitiveness and, they generate pure job destruction which could possibly explain the negative employment effect. Whether outsourcing firms alone bring out net employment loss requires further investigation. For this purpose, I perform various numerical analyses to quantify the employment implications of different groups of firms, and their job destruction and creation separately. This provides valuable information on the employment dynamics that is not observable without very detailed operational data on every firm in the economy.

4.1 Calibration

There are six parameters in this model, transport cost ($\tau$), relative Southern efficiency wage ($\delta$), employment share of the service segment ($\gamma$), marginal production cost of outsourcers relative to home producers ($\lambda$), elasticity of substitution ($\varepsilon$), and the shape parameter of Pareto distribution ($\eta$).

First, $\tau=1.3$ is chosen from Anderson and van Wincoop (2004). Their estimate of international transport cost is equivalent of a 70% ad valorem tariff rate ($\tau=1.7$). Out of this 70%, 30% is variable cost (physical transit cost, time cost of transit, and tariffs) and the remaining 40% is border-related cost (language, currency, information, and security). Since I have a fixed cost of exporting in addition to transport cost, I take 30% of the tariff-equivalent transport cost for the analyses. Second, $\delta=0.5$ is chosen from the data on manufacturing wage and productivity of the US (from Bureau of Economic Analysis, BEA) and Mexico (Instituto Nacional de Estadística y Geografía, INEGI) for 2000. Third, the 2002 Census of Manufactures reports that the share of non-production workers in US manufacturing employment is 29.6%. I use $\gamma=0.3$. Fourth, $\lambda$ is

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$^{17}$Chinese efficiency wage was 40% of the US in 2000. Data source: National Bureau of Statistics of China
simply a combination of $\delta$ and $\gamma$, equation (27), with $\delta=0.5$ and $\gamma=0.3$ implying that $\lambda=0.65$.

Fifth, Broda and Weinstein (2006) estimate various elasticities for different aggregation levels (3-, 4-, 5-digit) of SITC manufacturing industry classifications (Rev.2 for 1972-1988, Rev.3 for 1990-2001). I use the estimates of 4-digit SITC for the period 1990-2001 whose median is 2.53 and mean is 5.88. The high value of the mean is due to a few outliers. For the analyses, I choose $\varepsilon=3$. Lastly, $\eta=4$ is chosen for the shape parameter of Pareto distribution. For this, I match the model’s prediction on the market share of imports of the initial open economy equilibrium to the 1992 US manufacturing industry. According to BEA’s report, imports accounted for 18.08% of the US manufacturing market in 1992. The model’s prediction gives us a range of market share of imports for different size of fixed export cost rather than a single value. The range that includes 18.08% is generated by $\eta=4$.

### 4.2 Net Employment Effect

The total employment includes the production workers - assembly and service workers, workers hired as fixed production cost, fixed export cost, and fixed outsourcing cost - and the entry investment employment - the sunk entry cost portion of employment. In the equilibrium, the entry investment employment accounts for 17% of the total initial employment under the benchmark set of parameters.

Figure 8 shows the net employment change as a share of total initial employment. Panel (a) presents the entire $\alpha - \beta$ space.\(^{18}\) It tells us that for very small $\beta$, the economy loses up to 36% of its initial employment. As can be seen by equation (64), (A.5.1), and (A.5.2)\(^{19}\), the fixed and sunk costs portion of employment is a fixed share of total initial employment regardless of equilibrium; so the employment response shown in Figure 8 comes solely from the changes in the numbers of assembly and service workers.

Panel (a) also tells us that the net employment loss depends greatly on the size of $\beta$ and relatively little on the size of $\alpha$. As $\beta$ increases - as outsourcing becomes more difficult - the net employment loss decreases dramatically. In this model, the feasibility of outsourcing is the only shock to the economy. Where outsourcing is very difficult (large $\beta$), the feasibility alone is not enough to induce many firms to outsource. As smaller number of firms outsource, the overall effect of outsourcing on the economy is also small, resulting in a smaller net job loss. Panel (b) presents

\(^{18}\)Recall $\alpha = \frac{4}{F}$ and $\beta = \frac{\text{os}}{F}$

\(^{19}\)from Appendix A.5
net employment effect for selected values of alpha. This shows the dependency of employment response on the size of $\beta$ more clearly. Net employment effect approaches to zero where $\beta$ is very large, but never becomes positive. Overall, the net job loss is quite sizeable for reasonable value of $\beta$.

In order to understand the net employment effect of outsourcing better, we need to look at it at more disaggregate level. Figure 9 presents the net employment effect of five different groups of firms under the Pattern A discussed in Figure 7. The vertical axes show the size of employment change as a share of total initial employment. Overall, the employment effects of different groups of firms differ dramatically in signs, sizes, and shapes. These diagrams show that analysis of only the aggregate employment change unintentionally discards a lot of valuable information. Panel (a) is the net employment effect for all firms and is identical to Figure 8. Also, summing panels (b) to (f) of Figure 9 yields panel (a).

The most noticeable features are the negative employment effect of the cleansing effect. As can be seen by comparing the units of measurement along the vertical axes, the magnitude is overwhelmingly large compared to other groups’ employment effects. Other firm groups show different responses to offshore outsourcing, but their magnitudes are all small relative to that of the cleansing effect. For the benchmark parameters, non-exporting outsourcers - New Outsourcers, panel (d) - and exporting outsourcers who previously exported - Existing Exporters, panel (f) - fail to create net job gain. The increase in sales is not large enough to offset the layoffs of assembly workers. New exporters, on the other hand, create more jobs than they destroy. Although the magnitude is small, it shows that one of the major benefits of offshore outsourcing is that it gives some of outsourcers the opportunity to expand their business to foreign market. Overall, the net job loss that outsourcing brings about is driven by job destruction due to the cleansing effect; and, its negative effect is somewhat offset by the net job creation of new exporters who are give then opportunities to export due to the price reduction from outsourcing.

Patterns B and C do not share the same categorization of firms as presented in Figure 7. However, in all equilibria, firms can be categorized into three major groups. First, Cleansing Effect - the firms that initially were non-exporting home-producers who then are forced to exit in the outsourcing equilibrium; second, Home-Producers - home-producers that survive and choose not to outsource regardless of their export orientation; and finally, Outsourcers - outsourcing firms regardless of their export orientation. For pattern A, the group (A.b) Cleansing Effect belongs to the firm group Cleansing Effect for obvious reason. The group (A.c) Home-Producers belongs to the
firm group Home-Producers, the rest of firms, group (A.d) New Outsourcers, (A.e) New Exporters, and (A.f) Existing Exporters, belong to the firm group Outsourcers. The export orientation of Home-Producers changes across patterns. For instance, no home-producers in pattern A export, but some in pattern C do. There are non-exporting as well as exporting outsourcers in pattern A, but all outsourcers export in pattern C.

Figure 10 presents the net employment effect of the cleansing effect, home-producers, and outsourcers for the entire $\alpha - \beta$ space. The cleansing effect again shows dominance in magnitude. One can also notice the resemblance of the net employment of the cleansing effect alone - panel (a) - to panel (a) of Figure 8. This confirms the dominance of the cleansing effect in driving the overall effect of outsourcing on total employment. The effect of home-producers is generally small. The net employment effect of outsourcers is very negative for very small $\beta$, but the magnitude decreases rapidly as $\beta$ rises, and in fact becomes positive for a certain range of $\alpha$ and $\beta$. This implies that job creation of outsourcers exceeds their job destruction in that range. Overall, the net employment loss by outsourcers is less than 10% of total initial employment, and is smaller for relatively large values of $\beta$.

Figure 9, and 10, strongly suggest the dominance of the cleansing effect in employment responses to offshore outsourcing. In an attempt to summarize, Figure 11 shows the net employment loss due to the cleansing effect as a share of total net employment effect for selected values of $\alpha$. Job destruction due to cleansing effect takes up to 70-75% of total net employment loss for small value of $\beta$, and more than 50% for the most range of $\alpha$ and $\beta$. As $\beta$ rises, the cleansing effect gets quite small (panel (a), Figure 10); however, total net job loss also decreases, keeping the fraction of it due to the cleansing effect approximately constant after $\beta = 20$. The lower bound for the value of beta for the values of alpha shown is around 45%.

One might wonder whether the dominance of the cleansing effect in outsourcing-related employment response is specific to the parameter values chosen for the benchmark case. Figure 12 presents the net employment effect for various deviations from the benchmark parameter values. The first column shows the total net employment effect, the second column is that due to the cleansing effect, and the last column is that of survivors. All figures are relative to the total initial employment, so that the sum of the second and third columns yields the first column. These figures show how total net employment effect change and how significant the cleansing effect is in driving the aggregate net employment change for different sets of parameter values. Figure 13 shows the cleansing effect as a share of total net employment effect for the six sets of parameter values that
are analyzed in Figure 12.

There are three main messages that we can learn from Figures 12 and 13. First, the dominance of the cleansing effect in employment response to offshore outsourcing is preserved for various sets of parameter values. This is easier to see in Figure 13. The cleansing effect takes up significant portion of total employment loss in all six cases although the size varies across different parameter values used. In panel (b) and (d), job destruction from cleansing effect exceeds the total net employment loss. In these two cases, survivors together generate net gain of jobs for a certain values of $\alpha$ and $\beta$. In panel (a) and (e), the cleansing effect is smaller, but still is more than 18% of total net employment loss.

Second, as mentioned briefly above, survivors generate net employment gain for some parameter values. Panel (d) shows the most significant job gain. This is where the Southern wage rate is very low relative to Northern wage rate. Lower Southern wage rate is directly related to the size of benefits that one firm can realize from relocating its assembly segment. Outsourcing lowers outsourcers price very much, in turn raises their sales volume very much. Outsourcers have to newly hire large number of service workers in order to meet the massive increase in sales.

Third, total net employment effect is always very negative. This is the case even when there is significant amount of job creation by outsourcers - as in panel (d). The cleansing effect is always significantly large to more than offset the job creation. This can be easily explained why. Where the benefit from outsourcing is very large, so outsourcers generate large amount of new jobs, more firms will want to outsource. As a result, the overall price level falls greatly, more of home-producers with low productivity will eventually be driven out of market; thus, larger cleansing effect. Whenever outsourcing affect the market in a larger scale, the cleansing effect gets larger as well, generating net loss of employment in any case.

Besides the three major points, Figures 12 and 13 convey a lot of valuable information about outsourcing. The labor market responses to offshore outsourcing in their magnitude and the sensitivity to the size of fixed export and outsourcing costs differ across different sets of parameter values. In comparison between panels (a) and (b), the job destruction due to the cleansing effect of small shape parameter of Pareto distribution is much less sensitive to the value of $\beta$. From panel (a) and (b) of Figure 13, we can also see that in the case of small shape parameter, the cleansing effect accounts for much smaller portion of total net employment effect. Under a small shape parameter ($\eta$), productivity draws are more evenly distributed. Therefore, more firms belong to the groups of outsourcers and home-producers, and less firms belong to the group of the cleansing
effect compared to the case with high $\eta$. A smaller number of firms in the cleansing effect group directly implies smaller job destruction due to the cleansing effect. Where $\eta$ is high, large mass is concentrated at the bottom of productivity spectrum, so there are more firms in the cleansing effect group, and less firms in the groups home-producers and outsourcers.

The high sensitivity of the net employment effect under high $\eta$ also stems from the high concentration of firms at low productivity. Where outsourcing is very easy (very low $\beta$), the cut-off productivity for outsourcing is low enough to reach the range of productivity with significant mass of firms. In this case, outsourcing affects substantial portion of the market; and, the large fall in price index will generate large cleansing effect, and hence, large change in employment. However, since the mass is so concentrated at the bottom of productivity spectrum, it requires a very small value of $\beta$ to generate this result. For a reasonably high value of $\beta$, the cut-off productivity for outsourcing would not be low enough to induce a lot of outsourcing activity. The market is simply not affected by outsourcing much in this case, generating very small employment response as can be seen in panel (b) in Figure 12.

Panels (c) and (d) present the sensitivity of employment responses to the size of Southern wage rate, $\delta$. Southern wage rate determines the attractiveness of outsourcing. Under the benchmark parameter value ($\delta = 0.5 \leftrightarrow \lambda = 0.65$), the price reduction from outsourcing is 15% for domestic sales ($\tau \lambda = 0.845$) and 35% for foreign sales ($\lambda = 0.65$). Given $\tau = 1.3$, $\delta = 0.6$ - panel (c) - implies that the price reduction for domestic sales is only 6% ($\tau \lambda = 0.936$) and that for foreign sales is 28% ($\lambda = 0.72$). There is very small incentive to outsource if a firm does not export. Outsourcing is still attractive to exporters because of the elimination of price disadvantage in their foreign market. Therefore, there are outsourcing firms, but less than in the case with small $\delta$. Also, the effect of outsourcing on the price index is small since the price reduction from it is small. For this reason, the overall employment response is also small - small cleansing effect, small net employment loss by survivors, and hence, small total net employment loss. On the other hand, $\delta = 0.3$ - panel (d) - implies 34% price reduction for domestic sales and 49% price reduction for foreign sales. Small $\delta$ enlarges the benefit of outsourcing, outsourcers generate net employment gain. The job creation is so big, the net employment effect of survivors is still positive even after combining job destruction from home-producers. However, as discussed above, the attractiveness induces large number of firms to outsource, lowering the price index by much, thus raising the magnitude of the cleansing effect. Despite the large net employment gain by survivors, the total net employment effect is still negative due to the large cleansing effect.
Panel (e) shows the net employment effect under high elasticity of substitution ($\varepsilon$). The cleansing effect is the smallest among the six cases studied in Figures 12 and 13 in terms of its share of total net employment loss. High $\varepsilon$ means that consumers are more price-sensitive. In the initial open economy equilibrium, low price (high productivity) firms serve larger share of the market with high $\eta$, hence, employ larger portion of the total employment. This implies less workers are hired by firms in the cleansing effect group. Thus, the cleansing effect from outsourcing results in smaller number of job destruction. Despite the smaller cleansing effect, the net employment loss under high $\varepsilon$ is very large. This is driven by large job losses of survivors. This is somewhat counter-intuitive since high elasticity is often translated into larger consumption switch in response to price reduction. The price reduction from outsourcing is expected to generates large sales gain, thus, large job creation. However, there is another dimension to consider. Outsourcers employ large numbers of assembly workers as well as service workers in the initial equilibrium. As they outsource, the number of workers they outsource is also very large; and in this case the larger job destruction dominates the large job creation that high $\varepsilon$ brings about. Also, the sensitivity of consumer response to outsourcers’ price reduction reduces the sales of home-producers whose relative prices rise. Home-producers are significant source of job destruction in this case.

Panel (f) shows the effect of size of transport cost ($\tau$) in employment response. The size of $\tau$ also affects the incentive to outsource. Given $\delta = 0.5$ ($\lambda = 0.65$), $\tau \lambda = 0.715$, meaning 28% price reduction for domestic sales, and 35% price reduction for foreign sales. The interesting thing to notice in this case is the disparity between panel (f) and (d). Both small $\delta$ and small $\tau$ increases the price reduction, but the net employment effects of survivors in two cases are vastly different. This is because how $\tau$ and $\delta$ raise the attractiveness of outsourcing are fundamentally different. Small value of $\tau$ is relevant for both the initial equilibrium and the outsourcing equilibrium, while $\delta$ is only relevant to the outsourcing equilibrium. Small $\tau$ means that the price disadvantage that an exporter faces in the initial equilibrium is small; hence, exporting is more profitable. Therefore, there would be more exporters in the initial equilibrium; and, those exporters employ more workers to serve larger quantities in their foreign market than in the case with high $\tau$. As exporters are the high productivity firms, they are more likely to belong to the group of outsourcers than non-exporters. As outsourcing becomes feasible and these firms relocate their assembly segment to the South, their job destruction is larger since they initially employed more workers - in assembly as well as service segment. Therefore, low $\tau$ brings more job destruction by outsourcers than low $\delta$. Also, low $\delta$ has larger price reduction for foreign sales than low $\tau$ although the price reduction
for domestic sales is similar. So, outsourcing with low $\delta$ creates more jobs than with low $\tau$. As a result, the net employment effect of survivors in panel (d) is positive while that in panel (f) is very negative.

To sum up, the cleansing effect plays a dominant role in generating net employment loss from outsourcing. This should not be interpreted as that outsourcers are not responsible for the unemployments that workers experience in the wake of offshore outsourcing. It should rather be interpreted as that when we measure the employment responses to outsourcing, we should not only focus on the employment changes within outsourcing firms and that the workers employed by non-outsourcers and, more importantly, the firms who disappear due to lack of competitiveness in the outsourcing equilibrium are very much affected and should be the subject of analyses.

4.3 Job Destruction and Creation

If the purpose of all the attempts that we make to measure the labor market implications of offshore outsourcing is to prepare proper policy tools to reduce the adjustment costs of laid-off workers, it is particularly important to measure the size of job destruction. It is often the case, in the manufacturing sector, that employment is not only decreasing, the composition of employment is moving toward a higher ratio of high-skilled jobs. This is especially true for outsourcing-related layoffs. Since labor cost reduction is the major benefit of outsourcing, firms tend to send the most low-skilled and labor-intensive parts of their businesses abroad. For this reason, the displaced workers are not readily employable in the newly created jobs that tend to be high-skilled managerial tasks.

Even if labor is quite mobile across occupations, correctly measuring the amount of job destruction is still of great importance in regard to the length of unemployment. Every job loss involves a period of unemployment, and the length of unemployment depends greatly on the availability of vacancies in the economy. As jobs are destroyed due to offshore outsourcing - from various sources; the cleansing effect, sales loss of home-producers, and relocation of assembly segment by outsourcers -, new jobs are also created by outsourcers. These jobs will absorb fraction of unemployment generated by outsourcing. Under the assumption that workers are perfectly mobile between assembly and services, the size of job destruction is the total number of unemployment. The size of job creation indicates the number of temporary unemployment, and the difference between total number of job destruction and creation, which is total net employment loss that is presented in Figure 8, measures the number of permanent employment. Again, if establishment of proper labor policy is
the concern, the policy tool for permanent displacement should be different from that for temporary unemployment. For that, separate measurement of permanent and temporary unemployment is crucial.

Figure 14 compares the total net employment, total job destruction, and total job creation. While the net job loss is up to 36% of initial employment, job destruction and creation separately reach up to 59% and 23% of initial employment. This shows that looking only at net employment effect discard a lot of valuable information on changes in the labor market. According to Figure 14, 59% of workers lose their jobs. 39% of these job losses (23% of all workers) are temporary, and the rest, 61%, are of permanent nature.

Figure 15 presents decomposition of the job destruction caused by outsourcing. Panel (a) shows the total job destruction which is identical to panel (b) of Figure 14. Panel (b) is job destruction due to the cleansing effect and identical to panel (a) of Figure 10 in magnitude. Figure 16 presents job destruction due to the cleansing effect as a share of total job destruction. Where \( \beta \) is small, the cleansing effect accounts for 30-40% of total job destruction, then decreases as \( \beta \) increases. However, even for larger \( \beta \), the cleansing effect is around 30% of total job destruction. Panel (c) of Figure 15 shows the job destruction by surviving home-producers. For a very small value of \( \beta \), nearly every surviving firm outsources, leaving a small number of firms to stay as home-producers. The size of job destruction by home-producers is also small for that reason. Except when \( \beta \) is very small, the magnitude of this type of job destruction is rather constant at around 2-4% of initial employment. As \( \beta \) increases, the number of home-producers rises, but the impact of outsourcing on the price level gets smaller; therefore, each firm loses smaller number of workers. This together with rising number of home-producers maintains the relatively constant size of job destruction.

Panel (d) shows job destruction caused by outsourcers’ relocation of assembly segment. It depends largely on the value of \( \beta \) because it determines how many firms outsource. The more firms outsource, the more assembly workers are let go. One should notice that outsourcers’ job destruction is larger than the cleansing effect. Although the analysis of net employment effect in the previous section finds the dominance of the cleansing effect, layoffs by outsourcers account for larger portion of the total unemployment caused by offshore outsourcing. In terms of net employment effect, new jobs that they create offset a fraction of their large number of layoffs (sometimes more than offset as seen in panel (d) of Figure 12), making their net employment loss smaller than the cleansing effect (again, they may bring net job gain). The smaller net job loss of outsourcers does not means that the new jobs created by outsourcers are filled by the workers displaced by
outsourcers; therefore the job destruction by outsourcers is not less important than the cleansing effect. Rather, the cleansing effect includes both assembly and service workers while outsourcers' layoffs only include assembly workers. If labor is not perfectly mobile between segments, the service workers who are laid off due to the cleansing effect will be more easily reemployed to fill up the new service jobs created by outsourcers. However, the unemployment of the assembly workers who are laid off by outsourcers is more permanent.

Figure 16 shows the size of job destruction due to the cleansing effect and that due to the relocation of assembly segments by outsourcers as a share of total job destruction. Two panels confirm that outsourcers' job destruction is larger than what the cleansing effect brings about. According to panel (b), outsourcers' layoffs account for more than half of total job destruction cause by outsourcing where outsourcing is relatively easy to undertake (small $\beta$). For larger value of $\beta$, outsourcers' job destruction accounts for 40 - 50% of total job destruction. Panel (a) of figure 16 can be compared to figure 12. We can clearly see that the significance of the cleansing effect is substantially reduced in the context of job destruction alone, compared to that of total net employment effect.

It is also interesting to see how jobs are created by outsourcers. Figure 17 presents job creation by different type of outsourcers under Pattern A. Recall that, under the pattern A, there are New Outsourcers - non-exporting outsourcers that used to be non-exporting home-producers, New Exporters - exporting outsourcers that used to be non-exporting home-producers, and Existing Exporters - exporting outsourcers that used to be exporting home-producers. Since pattern A requires the smallest value of $\beta$, it includes largest number of outsourcers and more types outsourcers (three, more precisely) than other patterns. The total job creation is between 9-23% of initial employment, and new exporters' job creation - panel (c) - accounts for more than 60% of it (7-14% of initial employment). Where $\beta$ is very small, and $\alpha$ is relatively large, new outsourcers - panel (b) - generate sizeable job creation because more firms belong to this category. This Figure shows that the expansion of export opportunity due to outsourcing is very important benefit of offshore outsourcing.

5 Conclusion

As outsourcing becomes feasible, some - not all - firms start outsourcing their assembly segment to the South where the wage rate is only a fraction of the Northern one. The overall price level
decreases, and competition gets fiercer. As a result, the minimum productivity required to survive in the market rises, forcing large number of firms who operated at the bottom of the productivity spectrum out of the market. This is called the cleansing effect of offshore outsourcing. The surviving firms choose either to stay as home-producers or to start outsourcing. Home-producers destroy jobs as their relative prices rise and demand decreases. Outsourcers lay off assembly workers, but they create new service jobs as their demand rises due to price reduction. Outsourcing allows some firms to expand their operations from only their home market to their foreign market. These firms realize the largest benefits from outsourcing. At the aggregate level, various employment responses to outsourcing together generate a net loss of employment in all cases. Outsourcing also reduces the number of product varieties available for consumption.

The numerical analysis confirms the theoretical finding that outsourcing unambiguously reduces the aggregate employment. The net employment loss under the benchmark parameter values, which is calibrated to match various moments of the data, reaches up to 36% of total initial employment. This negativity of employment effect stems mostly from the cleansing effect. As a large number of small firms exit, they let go of all of their workers. Such job destruction accounts for 50-75% of the aggregate net employment loss. The sensitivity analysis shows that the dominance of the cleansing effect in driving the negative net employment effect is not specific to the benchmark parameter values and is rather a general result.

The numerical analysis also supports the previous empirical finding that the net employment effect of outsourcing firms is ambiguous. Under the benchmark parameter values, the net effect could be negative or positive depending on the difficulty of outsourcing. It ranges from 17% net loss to a net gain that is equivalent to 3% of the initial employment. Sensitivity analysis confirms the ambiguity of the employment effect of outsourcers. For different parameter values that are studied, the employment effect could be very negative (32% net employment loss) or significantly positive (12% of net gain).

The separate analysis of job destruction and creation shows that analysis of the net employment effect alone throws away a lot of valuable information. The net employment change of up to 36% of total initial employment is sum of total job destruction up to 60% and total job creation up to 24%. Investigation of job destruction alone shows the significance of outsourcers’ layoffs. The layoffs by outsourcers account for 45-55% of total job destruction under the benchmark parameters while the cleansing effect accounts for 29-42%.

Economists always acknowledge the fact that there are winners and losers of international trade,
and it is also the case for offshore outsourcing. The winners in this context are the outsourcing firms, who enjoy a rise in their profits, and the service workers, who enjoy more employment opportunity. In this partial equilibrium model, the Northern wage is fixed at one; however, in reality, the rise in demand for service (skilled) workers will raise their wage rate while it lowers the wage rate of assembly (low-skilled) workers. In this model, it is also assumed that labor is perfectly mobile between assembly and service segments. However, this is generally not the case. In order to reduce the adjustment costs of the displaced assembly workers, proper unemployment policy tools should be prepared. As discussed above, outsourcing causes permanent as well as temporary unemployment. In order to establish an unemployment policy that serves both types of unemployment, the correct measure of the size of each type of unemployment is a prerequisite.

The results of the numerical analysis emphasize the inadequacy of currently available datasets in evaluating the aggregate labor market dynamics - gross rather than net - that outsourcing brings out. It also calls for a more detailed and thorough dataset on the outsourcing activities of U.S. manufacturing firms. The dataset should include the entire manufacturing sector rather than multinational firms alone. It should also convey the number of layoffs and new hires of production and non-production workers separately. Detailed operational information of outsourcers will help us establish a meaningful measure of industry-level outsourcing activities which then can be used to measure the levels of competitive pressure that non-outsourcers face.
References


A Appendix. Proofs of Propositions and Lemmas

A.1 Proof of Proposition 1

A.1.1 Proof of Lemma 1

Equation (36) shows the outsourcing cut-off productivity as a function of the entry cut-off productivity for outsourcing equilibrium pattern A. The outsourcing cut-off productivities of patterns B and C are as follows.

\[
\begin{align*}
z^B_{os} &= \left[ \frac{1}{2(\tau \lambda)^{1-\varepsilon} - 1} \left( \frac{f_{os}}{f} + \frac{f_x}{f} \right) \right]^{\frac{1}{\varepsilon-1}} z^B_{hp} \\
z^C_{os} &= \left[ \frac{1}{2(\tau \lambda)^{1-\varepsilon} - 1 - \tau^{1-\varepsilon}} \left( \frac{f_{os}}{f} \right) \right]^{\frac{1}{\varepsilon-1}} z^C_{hp}
\end{align*}
\]

(L.1.1)

The sizes of fixed costs differ across patterns. Figure 6 shows the range of \(\alpha (= f_x/f)\) And \(\beta (= f_{os}/f)\) that correspond to each pattern. That is,

- pattern A: \((\tau \lambda)^{1-\varepsilon} \leq \beta < [1 - (\tau \lambda)^{\varepsilon-1}] \alpha\)
- pattern B: \([1 - (\tau \lambda)^{\varepsilon-1}] \alpha \leq \beta < \{\tau^{\varepsilon-1} [2(\tau \lambda)^{1-\varepsilon} - 1] - 1\} \alpha\) (L.1.2)
- pattern C: \(\{\tau^{\varepsilon-1} [2(\tau \lambda)^{1-\varepsilon} - 1] - 1\} \alpha \leq \beta\)

Equations (36), (L.1.1), and (L.1.2) together yield the following inequalities.

\[
\begin{align*}
1 &\leq \left( \frac{z^A_{os}}{z^A_{hp}} \right)^{\varepsilon-1} < (\tau \lambda)^{\varepsilon-1} \alpha \\
(\tau \lambda)^{\varepsilon-1} \alpha &\leq \left( \frac{z^B_{os}}{z^B_{hp}} \right)^{\varepsilon-1} < \tau^{\varepsilon-1} \alpha \\
tau^{\varepsilon-1} \alpha &\leq \left( \frac{z^C_{os}}{z^C_{hp}} \right)^{\varepsilon-1}
\end{align*}
\]

(L.1.3)

Equation (46) ensures that the first inequality is valid, and equation (L.1.3) proves Lemma 3. q.e.d.
A.1.2 Proof of Lemma 2

Equations (14) and (36) show the export cut-off productivities as functions of the corresponding entry cut-off productivities for the initial equilibrium and outsourcing equilibrium pattern A. For patterns B and C,

\[ z^B_x = \left[ \frac{1}{2(\tau \lambda)^{1-\varepsilon} - 1} \left( \frac{f_{os}}{f} + \frac{f_x}{f} \right) \right]^{\frac{1}{1-\varepsilon}} z^B_{hp} \]  
\[ z^C_x = \tau \left( \frac{f_x}{f} \right)^{\frac{1}{1-\varepsilon}} z^C_{hp} \]  

Equations (L.1.1) and (L.2.1) show that \( z^B_x = z^B_{os} \); therefore, the size of \( z^B_x/z^B_{hp} \) from equation (L.1.3), has the following range.

\[ \tau \lambda \left( \frac{f_x}{f} \right)^{\frac{1}{1-\varepsilon}} \leq \frac{z^B_{os}}{z^B_{hp}} < \tau \left( \frac{f_x}{f} \right)^{\frac{1}{1-\varepsilon}} \]  

Then, equations (14), (36), (L.2.2), and (L.2.3) prove Lemma 4. q.e.d.

A.1.3 Proof of Proposition 1

The proof of this Proposition utilizes the method that is used in Melitz (2003), Appendix B. The equilibrium conditions for the initial open economy - equations (26) - and the outsourcing equilibrium pattern A - (45) - can be rewritten as the following:

\[ f \left[ 1 - G(z^0_{hp}) \right] k(z^0_{hp}) + f_x \left[ 1 - G(z^0_x) \right] k(z^0_x) = \xi f_e \]  
\[ f \left[ 1 - G(z^A_{hp}) \right] k(z^A_{hp}) + f_{os} \left[ 1 - G(z^A_{os}) \right] k(z^A_{os}) + f_x \left[ 1 - G(z^A_x) \right] k(z^A_x) = \xi f_e \]  

The equivalent expressions for outsourcing equilibrium pattern B and C are as follows.

\[ f \left[ 1 - G(z^B_{hp}) \right] k(z^B_{hp}) + f_{os} \left[ 1 - G(z^B_{os}) \right] k(z^B_{os}) + f_x \left[ 1 - G(z^B_x) \right] k(z^B_x) = \xi f_e \]  
\[ f \left[ 1 - G(z^C_{hp}) \right] k(z^C_{hp}) + f_{os} \left[ 1 - G(z^C_{os}) \right] k(z^C_{os}) + f_x \left[ 1 - G(z^C_x) \right] k(z^C_x) = \xi f_e \]  

I define the following function.

\[ j(x) = [1 - G(x)] k(x) \]
Using equations (16) and (23), we know that \( j(x) \) is nonnegative, and is decreasing in \( x \). That is,

\[
j'(x) = \frac{1 - \varepsilon}{x^\varepsilon} \int_x^\infty z^{\varepsilon-1} g(z) dz < 0
\]

Using equation (A.1.5), I rewrite equations (A.3.1) - (A.3.4) as follows.

\[
j(z_0) f + j(z_0) f_x = \xi f_e \tag{A.1.6}
\]
\[
j(z_A) f + j(z_A) f_{os} + j(z_A) f_x = \xi f_e \tag{A.1.7}
\]
\[
j(z_B) f + j(z_B) f_{os} + j(z_B) f_x = \xi f_e \tag{A.1.8}
\]
\[
j(z_C) f + j(z_C) f_{os} + j(z_C) f_x = \xi f_e \tag{A.1.9}
\]

Equations (14), (36), (L.1.1), (L.2.1), and (L.2.2) show that all cut-off productivities are linear functions of their corresponding entry cut-off productivities. Therefore, the left-hand sides of equations (A.1.6)-(A.1.9) are decreasing in their entry cut-off productivities, \( z_{hp}, z_{hp}, z_{hp}, z_{hp} \), respectively.

Suppose that four entry-cutoffs, \( z_0, z_A, z_B, \) and \( z_C \), are all equal. Then, from lemma 3 and 4, the following is true.

\[
z_A < z_B < z_C \quad \text{and} \quad z^{A}_x < z^{B}_x < z^{C}_x = z_0
\]

Then, since \( j(x) \) is decreasing in \( x \), the left-hand side equation (A.1.7) is the largest, followed by (A.1.8) and (A.1.9). The left-hand side of equation (A.1.6) is the smallest. This is contradiction since the right-hand side of four equations are equal. In order to achieve the equality of left-hand and right-hand side for all equations, the size of entry cut-off productivities should be as follows.

\[
z^0_{hp} < z^C_{hp} < z^B_{hp} < z^A_{hp}
\]

This proves Proposition 1. \( \textbf{q.e.d.} \)
A.2 Proof of Proposition 2

Suppose the outsourcing productivity cut-offs are the same under the outsourcing equilibrium patterns A, B, and C. This implies, from figure 5, the following:

\[ z_A^x < z_B^x < z_C^x \] (A.2.1)

This, together with Proposition 1 yields the following three rankings.

\[ j(z_{hp}^A) < j(z_{hp}^B) < j(z_{hp}^C) \]
\[ j(z_{os}^A) = j(z_{os}^B) = j(z_{os}^C) \]
\[ j(z_A^x) < j(z_B^x) < j(z_C^x) \]

These rankings imply that the left-hand side of equation (A.1.7) is smaller than that of equation (A.1.8), which in turn is smaller than that of equation (A.1.9). This is a contradiction since the right-hand sides of equations (A.1.7) - (A.1.9) are the same. In order to equalize the left-hand sides of equations (A.1.7) - (A.1.9), it must be that

\[ z_{os}^A < z_{os}^B < z_{os}^C \]

q.e.d.

A.3 Proof of Proposition 3.

In initial equilibrium, average revenue for an active firm is

\[ r^0 = \bar{r}^0 + f + \left( \frac{z_0^0}{z_0^0} \right)^{\eta} f_x \] (A.3.1)

Since total revenue is fixed at \( R \), equations (A.3.1) and (49) provide the number of domestic firms in the initial equilibrium as follows.

\[ M_d^0 = \frac{R}{r^0} = \frac{R}{\varepsilon (k + 1)f \left[ 1 + \left( \frac{z_{hp}^0}{z_x^0} \right)^{\eta} \frac{f_x}{f} \right]} \] (A.3.2)
We can obtain equivalent expressions for outsourcing equilibrium patterns A, B, and C. For instance, the number of domestic firms in pattern A is,

\[ M^A_d = \frac{R}{\varepsilon(k+1)f} \left[ 1 + \left( \frac{z^A_{hp}}{z^A_{os}} \right)^\eta \frac{f_{os}}{f} + \left( \frac{z^A_{hp}}{z^A_x} \right)^\eta \frac{f_x}{f} \right] \]  

(A.3.3)

Using equations (A.3.2), (A.3.3), and the equivalent expressions for patterns B and C, I obtain various relative numbers of domestic firms as follows.

\[ \frac{M^A_d}{M^B_d} = \frac{1 + \left( \frac{z^B_{hp}}{z^B_{os}} \right)^\eta \frac{f_{os}}{f} + \left( \frac{z^B_{hp}}{z^B_x} \right)^\eta \frac{f_x}{f}}{1 + \left( \frac{z^A_{hp}}{z^A_{os}} \right)^\eta \frac{f_{os}}{f} + \left( \frac{z^A_{hp}}{z^A_x} \right)^\eta \frac{f_x}{f}} \]  

(A.3.4)

\[ \frac{M^B_d}{M^C_d} = \frac{1 + \left( \frac{z^C_{hp}}{z^C_{os}} \right)^\eta \frac{f_{os}}{f} + \left( \frac{z^C_{hp}}{z^C_x} \right)^\eta \frac{f_x}{f}}{1 + \left( \frac{z^A_{hp}}{z^A_{os}} \right)^\eta \frac{f_{os}}{f} + \left( \frac{z^A_{hp}}{z^A_x} \right)^\eta \frac{f_x}{f}} \]  

(A.3.5)

\[ \frac{M^C_d}{M^0_d} = \frac{1 + \left( \frac{z^0_{hp}}{z^0_x} \right)^\eta \frac{f_x}{f}}{1 + \left( \frac{z^C_{hp}}{z^C_{os}} \right)^\eta \frac{f_{os}}{f} + \left( \frac{z^C_{hp}}{z^C_x} \right)^\eta \frac{f_x}{f}} \]  

(A.3.6)

Using lemmas 3 and 4, I can show that equations (A.3.4) - (A.3.6) are less than 1, which then proves Proposition 3.

q.e.d.

A.4 Proof of Proposition 4.

For the proof, I compare total number of available varieties of each outsourcing equilibrium pattern to that of the initial equilibrium. First, let us look at the outsourcing equilibrium pattern A.

(a) Proof of \( M^A_t < M^0_t \)

The entry cut-off productivity under the pattern A, \( z^A_{hp} \), is home-producers’ zero profit productivity of entry as described by equation (12). Then, combining equations (9), (12), and (14) yields the following expression.

\[ \left( \frac{z^A_t}{z^A_{hp}} \right)^{\varepsilon^{-1}} = \frac{R}{\varepsilon f M^A_t} \]  

(A.4.1)
\( z_t^A \) is defined by equation (37). Substituting equation (38) into equation (37), then dividing the expression by \( z_{hp} \) gives us an alternative expression of equation (A.4.1) as the following.

\[
\left( \frac{z_t^A}{z_{hp}} \right)^{\varepsilon-1} = \frac{M_d^A}{M_t^A} \left( \frac{\hat{z}(z_{hp})}{z_{hp}} \right)^{\varepsilon-1} + \frac{M_A^A}{M_t^A} \left[ (\tau\lambda)^{1-\varepsilon} - 1 \right] \left( \frac{\hat{z}(z_{os})}{z_{os}} \right)^{\varepsilon-1} \left( \frac{z_t^A}{z_{hp}} \right)^{\varepsilon-1} + \frac{M_A^x}{M_t^A} \left( \frac{\hat{z}(z_x)}{z_x} \right)^{\varepsilon-1} \left( \frac{z_t^A}{z_{hp}} \right)^{\varepsilon-1} \tag{A.4.2}
\]

Using equations (23), (36) and (48), I can re-write equation (A.4.2) as follows.

\[
\left( \frac{z_t^A}{z_{hp}} \right)^{\varepsilon-1} = (k + 1) \left[ \frac{M_d^A}{M_t^A} + \frac{M_A^A}{M_t^A} \left( \frac{f_x}{f} \right) + \frac{M_A^x}{M_t^A} \left( \frac{f_{os}}{f} \right) \right] \tag{A.4.3}
\]

By the same methodology, we can obtain the equivalent expression for the initial open economy equilibrium.

\[
\left( \frac{z_0^A}{z_{hp}} \right)^{-1} = (k + 1) \left[ \frac{M_0^d}{M_t^0} + \frac{M_A^A}{M_t^0} \left( \frac{f_x}{f} \right) \right] \tag{A.4.4}
\]

Recall \( M_t^0 = M_d^0 + M_x^0 \) and \( M_t^A = M_d^A + M_x^A \). Then, the term in the square bracket of equation (A.4.4) is a weighted average of 1 and \( \frac{f_x}{f} \). Equivalently, the first two terms in the square bracket of equation (A.4.3) is also a weighted average of 1 and \( \frac{f_x}{f} \). Again, recall that the outsourcing equilibrium pattern A corresponds to equilibrium b in figure 6. According to table 1, equilibrium b is obtained where \( f_x > f + f_{os} \). That is, \( \frac{f_x}{f} > 1 \).

According to lemma 2, the fraction of exporters among domestic firms is larger in the outsourcing equilibrium pattern A than in the initial open economy equilibrium. This implies the following.

\[
\frac{M_t^A}{M_t^0} > \frac{M_0^d}{M_t^0} \tag{A.4.5}
\]

Equation (A.4.5) and the fact that \( \frac{f_x}{f} > 1 \) proves that the first two terms in the square bracket of equation (A.4.3) is larger than the terms in the square bracket of equation (A.4.4). Therefore,

\[
\left( \frac{z_t^A}{z_{hp}} \right)^{\varepsilon-1} > \left( \frac{z_0^A}{z_{hp}} \right)^{\varepsilon-1} \].

Then, we know from equation (A.4.1) the following:

\[
\frac{R}{\varepsilon f M_t^A} > \frac{R}{\varepsilon f M_t^0}
\]
Therefore, $M_t^A < M_t^0$. \textbf{q.e.d.}

(b) \textbf{Proof of} $M_t^B < M_t^0$ \textbf{and} $M_t^C < M_t^0$

The equivalent expressions for equation (A.4.3) for the outsourcing equilibrium patterns B and C are as follow.

\[
\left( \frac{z_B}{z_{hp}} \right)^{\varepsilon-1} = (k + 1) \left[ \frac{M_t^B}{M_t^B} + \frac{M_t^B}{M_t^B} \left( \frac{f_x}{f} \right) + \frac{M_t^B}{M_t^B} \left( \frac{f_{os}}{f} \right) \right]
\]  
(A.4.6)

\[
\left( \frac{z_C}{z_{hp}} \right)^{\varepsilon-1} = (k + 1) \left[ \frac{M_t^C}{M_t^C} + \frac{M_t^C}{M_t^C} \left( \frac{f_x}{f} \right) + \frac{M_t^C}{M_t^C} \left( \frac{f_{os}}{f} \right) \right]
\]  
(A.4.7)

The first two terms in the square brackets of both equations are also weighed average of 1 and \( \frac{f_x}{f} \). According to equation (46), \( \frac{f_x}{f} \) is always larger than 1 in the relevant parameter space. Also, lemma 2 implies that $\frac{M_t^B}{M_t^0} > 1$ and $\frac{M_t^C}{M_t^0} > 1$. So, the following must be true.

\[
\left( \frac{z_B}{z_{hp}} \right)^{\varepsilon-1} > \left( \frac{z_0}{z_{hp}} \right)^{\varepsilon-1} \quad \text{and} \quad \left( \frac{z_C}{z_{hp}} \right)^{\varepsilon-1} > \left( \frac{z_0}{z_{hp}} \right)^{\varepsilon-1}
\]  
(A.4.8)

Using the equivalent expressions of equation (A.4.1) for the patterns B and C, equation (A.4.8) implies the following inequalities.

\[
\frac{R}{\varepsilon f M_t^B} > \frac{R}{\varepsilon f M_t^0} \quad \text{and} \quad \frac{R}{\varepsilon f M_t^C} > \frac{R}{\varepsilon f M_t^0}
\]

Therefore, it must be that $M_t^B < M_t^0$ \textbf{and} $M_t^C < M_t^0$. \textbf{q.e.d.}

\section*{A.5 Proof of Proposition 5.}

We can obtain total employment as a share of total initial employment in the outsourcing equilibrium patterns B and C using the same methodology used to drive equation (64); and they are as
follows.

\[
\text{Emp}_B^{\lambda} = \left( \varepsilon - 1 \right) \left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right) \eta \left\{ \frac{1 + \left[ \frac{2}{\lambda} \tau_{\lambda} - 1 \right] \left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right)^{\varepsilon - 1 - \eta}}{1 + \tau^{\varepsilon - 1}} \right\}^{\varepsilon - 1 - \eta} + \frac{1}{\varepsilon} \tag{A.5.1}
\]

\[
\text{Emp}_B^{\mu} = \left( \varepsilon - 1 \right) \left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right) \eta \left\{ \frac{1 + \left[ \frac{2}{\lambda} \tau_{\lambda} - 1 - \tau^{\varepsilon - 1} \right] \left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right)^{\varepsilon - 1 - \eta} + \tau^{\varepsilon - 1} \left( \frac{z_{C,0}^{A}}{z_{C,0}^{A}} \right)^{\varepsilon - 1 - \eta}}{1 + \tau^{\varepsilon - 1}} \right\}^{\varepsilon - 1 - \eta} + \frac{1}{\varepsilon} \tag{A.5.2}
\]

In order to prove Proposition 5, I first prove \( \text{Emp}^A < \text{Emp}^B \), then \( \text{Emp}^B < \text{Emp}^C \), and finally \( \text{Emp}^C < \text{Emp}^0 \).

**(a) Proof of \( \text{Emp}^A < \text{Emp}^B \)**

Let us suppose that \( \text{Emp}^B < \text{Emp}^A \), then the following must be true.\[
\frac{\text{Emp}^B}{\text{Emp}^0} < \frac{\text{Emp}^A}{\text{Emp}^0} \tag{A.5.3}
\]

Using equations (64) and (A.5.1), we know that inequality (A.5.3) is satisfied if and only if the following inequality is satisfied.

\[
\left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right)^{\eta} < 1 + \left[ \frac{2}{\lambda} \tau_{\lambda} - 1 \right] \left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right)^{\varepsilon - 1 - \eta} \frac{1 + \left[ \frac{2}{\lambda} \tau_{\lambda} - 1 \right] \left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right)^{\varepsilon - 1 - \eta}}{1 + \tau^{\varepsilon - 1}} \left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right)^{\varepsilon - 1 - \eta} \right\} + \frac{1}{\varepsilon} \tag{A.5.4}
\]

Using equations (36) and (L.1.1), the right-hand side of inequality (A.5.4) can be re-written as the following.

\[
1 + \frac{\frac{2}{\lambda} \tau_{\lambda} - 1}{\left( \frac{f_{\infty}}{f_{\infty}} \right) - 1} \left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right)^{\eta} + \frac{\tau_{\lambda} - 1}{\left( \frac{f_{\infty}}{f_{\infty}} \right) - 1} \left( \frac{z_{B,0}^{A}}{z_{B,0}^{A}} \right)^{\eta} \tag{A.5.5}
\]

The left-hand side of inequality (A.5.4) can also be re-written, using equations (47), (50), and (51),
as the following.

\[
1 + \left( \frac{\ell^{A}}{\ell} \right) \left( \frac{z_{hp}^{A}}{z_{os}} \right)^{\eta} + \left( \frac{\ell}{\ell^{A}} \right) \left( \frac{z_{hp}^{A}}{z_{os}} \right)^{\eta} \frac{1}{1 + \left( \frac{\ell^{A}}{\ell} \right) \left( \frac{z_{hp}^{A}}{z_{os}} \right)^{\eta}} \tag{A.5.6}
\]

From equations (A.5.5) and (A.5.6), we know that inequality (A.5.4) holds as long as \( \gamma \) is larger than \( \lambda \). However, equation (27) shows that \( \gamma < \lambda \) by definition. This is contradiction. Therefore, \( \text{Emp}^{A} \) must be smaller than \( \text{Emp}^{B} \).

q.e.d.

(b) Proof of \( \text{Emp}^{B} < \text{Emp}^{C} \)

I follow the same procedure as in the proof of \( \text{Emp}^{A} < \text{Emp}^{B} \). First, let us suppose that \( \text{Emp}^{B} > \text{Emp}^{C} \); that is,

\[
\frac{\text{Emp}^{C}}{\text{Emp}^{0}} < \frac{\text{Emp}^{B}}{\text{Emp}^{0}} \tag{A.5.7}
\]

From equations (A.5.1) and (A.5.2), we know that inequality (A.5.7) holds if the following inequality is satisfied.

\[
\left( \frac{z_{hp}^{B}}{z_{hp}^{C}} \right)^{\eta} < \frac{1 + \left[ \frac{2z_{hp}^{A}(\tau\lambda)^{1-\varepsilon} - 1}{z_{hp}^{B}} \right]^{\varepsilon-1-\eta}}{1 + \left[ \frac{2z_{hp}^{A}(\tau\lambda)^{1-\varepsilon} - 1 - \tau^{1-\varepsilon}}{2z_{hp}^{C}} + \tau^{1-\varepsilon} \right]^{\varepsilon-1-\eta}} \tag{A.5.8}
\]

We can rewrite both left-hand side - using equations (47), (51), and (52) - and right-hand side - using equations (L.1.1) and (L.2.2), so that we obtain alternative expression for inequality (A.5.8) as the following.

\[
1 + \left( \frac{\ell^{A}}{\ell} \right) \left( \frac{z_{hp}^{B}}{z_{os}} \right)^{\eta} + \left( \frac{\ell}{\ell^{A}} \right) \left( \frac{z_{hp}^{B}}{z_{os}} \right)^{\eta} \frac{1}{1 + \left( \frac{\ell^{A}}{\ell} \right) \left( \frac{z_{hp}^{B}}{z_{os}} \right)^{\eta}} \tag{A.5.9}
\]

Again, from equation (27), \( \gamma \) is always smaller than \( \lambda \). Therefore, inequality (A.5.9) can not hold; rather, the opposite is true. Therefore, \( \text{Emp}^{B} \) must be smaller than \( \text{Emp}^{C} \).

q.e.d.

(c) Proof of \( \text{Emp}^{C} < \text{Emp}^{0} \)

Suppose \( \text{Emp}^{C} > \text{Emp}^{0} \); then, equation (A.5.2) must be larger than 1. Notice that equation
(A.5.2) is a weighted average of 1 and the following.

\[
\left( \frac{z_0^{hp}}{z_{hp}^C} \right)^\eta \left\{ 1 + \left[ \frac{2\gamma}{\lambda} (\tau \lambda)^{1-\varepsilon} - 1 - \tau^{1-\varepsilon} \right] \left( \frac{z_C^{hp}}{z_{hp}^C} \right)^{\varepsilon-1-\eta} + \tau^{1-\varepsilon} \left( \frac{z_C^{hp}}{z_{hp}^C} \right)^{\varepsilon-1-\eta} \right\}
\]

(A.5.10)

Therefore, \( Emp^C > Emp^0 \) requires that equation (A.5.10) is larger than 1. Using equations (14), (47), (49), (50), (L.1.1), and (L.2.2), I can rewrite equation (A.5.10) so that \( Emp^C > Emp^0 \) requires the following inequality to hold.

\[
1 + \frac{\left[ \frac{2\gamma}{\lambda} (\tau \lambda)^{1-\varepsilon} - 1 - \tau^{1-\varepsilon} \right] \frac{f_{\lambda\psi}}{f} \left( \frac{z_C^{hp}}{z_{hp}^C} \right)^\eta + \frac{f_{\lambda\psi}}{f} \left( \frac{z_C^{hp}}{z_{hp}^C} \right)^\eta}{1 + \frac{f_{\lambda\psi}}{f} \left( \frac{z_0^{hp}}{z_0^{C hp}} \right)^\eta} > \frac{1 + \frac{f_{\lambda\psi}}{f} \left( \frac{z_C^{hp}}{z_{hp}^C} \right)^\eta + \frac{f_{\lambda\psi}}{f} \left( \frac{z_C^{hp}}{z_{hp}^C} \right)^\eta}{1 + \frac{f_{\lambda\psi}}{f} \left( \frac{z_0^{hp}}{z_0^{C hp}} \right)^\eta}
\]

(A.5.11)

This can be simplified to \( \gamma > \lambda \), which is a contradiction. Therefore, \( Emp^C \) must be smaller than \( Emp^0 \).

q.e.d
\[ f_x > f + f_{os} \]

<table>
<thead>
<tr>
<th>( \tau \lambda &lt; 1 )</th>
<th>( \tau \lambda &gt; 1 )</th>
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<tbody>
<tr>
<td>if ( \frac{f_{os}}{f} &lt; (\tau \lambda)^{-\tau} - 1 )</td>
<td>eqm.a</td>
</tr>
<tr>
<td>if ( \frac{f_{os}}{f} \geq (\tau \lambda)^{-\tau} - 1 )</td>
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<tr>
<td>i) ( \frac{f_{os}}{f} \geq 1 - (\tau \lambda)^{-1} )</td>
<td>eqm.b</td>
</tr>
<tr>
<td>ii) ( 1 - (\tau \lambda)^{-\tau} \leq \frac{f_{os}}{f} &lt; \frac{2(\tau \lambda)^{-\tau}}{\tau^{-1}} - 1 )</td>
<td>eqm.c</td>
</tr>
<tr>
<td>iii) ( \frac{2(\tau \lambda)^{-\tau}}{\tau^{-1}} - 1 \leq \frac{f_{os}}{f} )</td>
<td>eqm.d</td>
</tr>
<tr>
<td>if ( \tau^{-\tau} + 1 &lt; 2 \lambda^{-\tau} )</td>
<td></td>
</tr>
<tr>
<td>i) ( \frac{f_{os}}{f} &lt; \frac{2(\tau \lambda)^{-\tau}}{\tau^{-1}} - 1 )</td>
<td>eqm.e</td>
</tr>
<tr>
<td>ii) ( \frac{f_{os}}{f} \geq \frac{2(\tau \lambda)^{-\tau}}{\tau^{-1}} - 1 )</td>
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<td>if ( \tau^{-\tau} + 1 &lt; 2 \lambda^{-\tau} )</td>
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<td>if ( \tau^{-\tau} + 1 &lt; 2 \lambda^{-\tau} )</td>
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\[ f_x < f + f_{os} \]

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<td>if ( 2(\tau \lambda)^{-\tau} - 1 \leq \frac{f_{os}}{f} + \frac{f_x}{f} &lt; \tau^{-1}[2(\tau \lambda)^{-\tau} - 1] \frac{f_x}{f} )</td>
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<td>i) ( \frac{f_{os}}{f} + \frac{f_x}{f} \leq \frac{f_{os}}{f} + \frac{f_x}{f} )</td>
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<td>eqm.k</td>
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<tr>
<td>if ( 2 \lambda^{-\tau} \leq \tau^{-\tau} )</td>
<td>eqm.l</td>
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</tbody>
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Table 1. Relevant Parameter Values for each equilibrium
Figure 1: Open Economy Equilibrium

Figure 2: Transportation Structure
Figure 3: Total Profit Functions of Outsourcers

(a) $f_x > f + f_{o,x}$

(b) $f_x \leq f + f_{o,x}$
Figure 4: Twelve Equilibria under Outsourcing (1)
Figure 4: Twelve Equilibria under Outsourcing (2)
Figure 5: Various Patterns of Outsourcing in Outsourcing Equilibria
Figure 6: Equilibrium Space

Figure 7: Different Operational Responses by Different Group of Firms under Pattern A
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(a) Entire $\alpha - \beta$ space

(b) for selected values of $\alpha$
Figure 9: Net Employment Effect by various firm groups under the Pattern A

(a) Total Net Employment Effect
(b) Cleansing Effect (A.b)
(c) Home Producers (A.c)
(d) New Outsourcers (A.d)
(e) New Exporters (A.e)
(f) Existing Exporters (A.f)
Figure 10: Net Employment Effect: Cleansing Effect, Home-Producers, and Outsourcers

(a) Cleansing Effect  (b) Home Producers  (c) Outsourcers

Figure 11: Cleansing Effect as a Share of Total Net Employment Effect
Figure 12: Various Deviations from Benchmark Parameters (1)

(a) High Dispersion of Productivity Draws : $\eta = 2.6$

(b) Low Dispersion of Productivity Draws : $\eta = 6$

(c) High Southern Wage : $\delta = 0.6$
Figure 12: Various Deviations from Benchmark Parameters (2)
Figure 13: Cleansing Effect as a Share of Total Net Employment Loss
Various Deviations from Benchmark Parameters
Figure 14: Net Employment Effect, Job Destruction, and Job Creation

Figure 15: Decomposition of Total Job Destruction
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