Multinational Entry and Organizational Change*

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Abstract

This study explores domestic firms' vertical organizational changes with increased openness to new foreign multinational firms' entry into a host country. We focus on the two-sided hold-up problem between input suppliers and heterogeneous firms. When the severity of hold-up problems is endogenously determined by the total number of firms in the sector, the new foreign multinational firms' entry induces some domestic firms to change the organizational choice between vertical integration and outsourcing. We show that the cross-sectoral differences in the input intensity of production explain the different shifts in the prevalence of vertical integration and outsourcing across the countries and sectors.

JEL classifications code: F23, L12, L41, L42, C72.
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1 Introduction

Multinational firms have increased their share of global production in recent decades. According to UNCTAD (2015), multinational firms contributed 34.4 percent of the global GDP in 2013. Sales by foreign affiliates to foreign customers are essential methods of serving foreign markets. For example, the Direct Investment and MNE data from the Bureau of Economic Analysis of the United States for 2013 indicate the sales of the foreign affiliates of U.S. multinational firms to be slightly more than $7 trillion, whereas U.S. exports are about $2.3 trillion.[1]

As more foreign multinational firms enter and serve foreign markets in host countries, the impact of multinational entry becomes one of the vital economic topics. Among the impacts of multinational entry, local firms' organizational change is an important concern. In business literature, several studies report cases of vertical integration in the face of increased competition (Dyer, 1996; Bhattacharya and Michael, 2008).[2] Moreover, the upward trend in the vertical integration in the manufacturing and service sectors has sometimes been discussed (McGrath, 2009).[3] Conversely, during the past couple of decades, the aggregate statistics demonstrate the general trend of the increasing international disintegration of production under globalization (Feenstra and Hanson, 1996; Campa and Goldberg, 1997).[4] In summary, we observe both the integration and disintegra-

[1] The data is available at the website of the U.S. Bureau of Economic Analysis (`https://apps.bea.gov/iTable/iTable.cfm?isuri=1&reqid=2&step=1#isuri=1&reqid=2&step=1`).

[2] Bhattacharya and Michael (2008) refer to mergers and acquisitions of Focus Media, a Chinese outdoor advertising firm, when facing competition with America's Clear Channel Communications and France's JCDecaux. By scaling up rapidly through mergers and acquisitions, Focus Media obtains the leading market position in China. Dyer (1996) documents the restructuring of Chrysler, a U.S. automaker, in the face of the increased competition with Japanese automobiles. Chrysler creates "American Keiretsu," which is based on the strong vertical ties of firms, by modifying Japanese business practices.

[3] See also the news article "Companies More Prone to Go 'Vertical'" *The Wall Street Journal*, November 30, 2009 (`https://www.wsj.com/articles/SB125954262100968855`), and "What's Behind the Current Wave of Vertical Integration?" *Kellogg Insight* January 5, 2018 (`https://insight.kellogg.northwestern.edu/article/whats-behind-the-current-wave-of-vertical-integration`) for example.

[4] Feenstra and Hanson (1996) and Campa and Goldberg (1997) calculate the imported intermediate-input shares and provide empirical evidence on the increase in the share for several countries. See also Feenstra (1998) for the survey on the global disintegration trend.

tion evidence.

This study aims to provide an economics analysis for local firms' organizational changes when facing increased openness to multinational entry. Among organizational forms' decisions, this study focuses on the vertical relation of production to capture the domestic firm's choice between the insourcing and outsourcing of intermediate inputs. More importantly, we consider how the sector's features affect the domestic firms' organizational choices.

We construct a model of domestic firms' organizational choices based on a framework established by Antràs and Helpman (2004). In each sector, there are suppliers and heterogenous firms (final-good producers). Every variety of final goods is produced by a pair of a supplier and a firm. The production of the final goods requires two relationship-specific inputs, supplied by both the supplier and the firm. Among the sector-specific features, we primarily focus on the input intensity, the degree of the contribution of each relationship-specific input to the production of the final goods.

Before starting the production, the firms determine whether to outsource the intermediate inputs to suppliers or insource them. When the firms choose outsourcing, they are required to incur low organizational costs, whereas there exists a two-sided hold-up problem because they sign an incomplete contract, which is not ex-ante enforceable. We assume that the firm's and the supplier's revenue under outsourcing is determined by the ex-post bargaining, which takes the form of generalized Nash bargaining. Alternatively, when firms choose vertical integration, they must incur higher organizational costs, although they can achieve joint profit maximization because vertical integration solves the two-sided hold-up problem. This study's notable feature is that the ex-post bargaining outcome under outsourcing depends on the total number of firms in each sector. This is one of the formulations to capture the market thickness.

In this setting, we theoretically explore how the fraction of domestic vertical integration or outsourcing changes in a market through multinational entry. Subsequently, we investigate the impact of multinational entry on the number of each organizational form of domestic firms by using numerical analysis. In both analyses, when multinational entry occurs, both the fraction and the number of vertical integrations (outsourcings) change, depending on the sector's input intensity. More precisely, multinational entry is more likely to facilitate domestic vertical integrations (outsourcings) if the sector is relatively intensive in the firms' (suppliers') inputs, and the firms have weak (strong) bargaining power.

To comprehend this result, consider the impact of multinational entry on a two-sided hold-up problem between a supplier and a domestic firm under outsourcing. When the industry experiences increased openness to new foreign multinational entry, an increase in the sector's firms induces richer outside options for the suppliers under the ex-post bargaining. Such a change of outside options allows the suppliers to possess a higher revenue share, enhancing the suppliers' ex-ante incentive for the input supply. Conversely, the domestic firms have a lower revenue share, eliminating the domestic firms' ex-ante incentive to supply their input. When the sector is relatively intensive in the firms' inputs, and the firms have weak bargaining power, the firms' under-supply becomes a more severe problem. Therefore, the contracting party's joint profit under outsourcing decreases. Thus, the domestic firms are more likely to choose vertical integration.

This study is related to the literature on the analysis of how multinational activities influence different aspects of domestic economies, given the increasing presence of multinational firms in a host country. An growing number of empirical studies demonstrate that increased openness to foreign multinational entry leads to productivity gains (Keller and Yeaple, 2009; Alfaro and Chen, 2018), factor market reallocation, and an increase in wages (Aitken, Harrison, and Lipsey, 1996; Feenstra and Hanson, 1997; Alfaro and Chen, 2018).

A few theoretical studies explore the local firms' organizational changes facing trade liberalization and the firms' relocations. Conconi, Legros, and Newman (2012) find that free trade and the suppliers' mobility between two countries change vertical organizational structures. Their core determinants of a vertical organizational structures are the price of output and the terms of trade. McLaren (2000) provides an analysis on the impact of the market thickness on an organizational choice through input trade liberalization. Our study's significant distinction is that we provide a model framework to explain that a cross-sectoral distinction in the input intensity explains the difference in the prevalence of vertical integration and outsourcing across countries and sectors through two-sided hold-up problems between the suppliers and firms.

There are studies on vertical organizational form choices of homogeneous firms in a market, in which firms endogenously determine whether to produce inputs independently or purchase from the suppliers (Grossman and Helpman, 2002, 2003). They do not consider multinational entry or heterogeneous firms, whereas this study follows their essential concept of a trade-off between the low fixed cost of outsourcing and the efficient production of vertical integration by assuming firms' heterogenity.

The remainder of this study is organized as follows. Section 2 introduces the model. Section 3 characterizes the equilibrium, and Section 4 provides a comparative statics analysis to perceive the change in the relative prevalence of domestic outsourcing and domestic vertical integration after foreign multinational entry. In Section 5, we provide a numerical analysis. Some concluding remarks are provided in Section 6. Finally, Appendix A introduces a numerical analysis under another parameter set, and Appendix B provides the proofs of all the results.

2 Model

We construct a model of the organizational choices in the presence of multinational entry, based on the concept of a firms' organizational decisions in Antràs and Helpman (2004). The two major differences between this study and Antràs and Helpman (2004) are that (i) vertical integration enables firms to write a complete contract with the suppliers, and (ii) the bargaining outcome under outsourcing depends on the total number of firms (final-good producers) in the sector.

The rest of this section is organized as follows. While Subsection 2.1 characterizes consumers, and Subsection 2.2 characterizes producers, Subsection 2.3 introduces the game timing. The variables and parameters used in this study are provided in Table 1.

[Table 1 about here]

2.1 Consumers

Consider a single-country's economy with $J \in \mathbb{N}_+$ sectors and populated by a unit measure of consumers.[5] We assume that consumers have identical preferences represented by

$$U = x_0 + \frac{1}{\mu}\sum_{j=1}^{J} X_j^{\mu},\ 0 < \mu < 1,$$

where x_0 is the consumption of a homogeneous good, X_j is an index of the aggregate consumption in sector $j \in \{1, 2, .., J\}$, and μ is the share that a consumer spends on the products of sector j. The aggregate consumption in sector j is a constant elasticity of substitution (CES) function,

$$X_j = \left[\int x_j\left(i\right)^{\alpha} di\right]^{\frac{1}{\alpha}}, 0 < \alpha < 1,$$

of the consumption of different varieties $x_j(i)$. A parameter α measures the degree of the product differentiation. In other words, as α becomes larger, the product is less differentiated. We assume that $\alpha > \mu$, meaning that the varieties within a sector can be substituted more for one another than for x_0 or for the varieties from a different sector. The elasticity of substitution between any two varieties in sector j is given by $1/(1-\alpha)$. We assume that the parameters μ and α are the same for every sector. Given the above preferences, the inverse demand function of good i in sector j can be provided as

$$p_j\left(i\right) = X_j^{\mu-\alpha} x_j\left(i\right)^{\alpha-1}. \tag{1}$$

[5] To clearly understand the logic of a foreign multinational entry's impact, we construct a simple single-country model to focus on domestic firms' decisions. The single-country model used here can be justified as follows. A domestic firm's decision to become a multinational and serve a foreign country does not affect other domestic firms' decisions in the home country. This is because multinationals obtain the profits in each country independently, and the consumers' preferences introduced in this study are quasi-linear. Thus, we can disregard the economic activity by foreign subsidiaries of domestic multinational firms. This model setting focuses on understanding the domestic firms' decisions in an organizational form when a domestic market experiences new foreign multinational entry.

2.2 Producers

A continuum of suppliers (intermediate-input suppliers) and one unit of a continuum of firms (final-good producers) are located in every sector j. Only the firms are aware of how to produce the final-good varieties. Every sector has two types of firms: domestic (denoted by H) and multinational (denoted by M).[6] For each type $l \in \{H, M\}$, firms are heterogeneous in terms of the productivity of the final goods, $\theta > 0$. For each type l, the productivity level of the firms in sector j is drawn from a common distribution, $G(\theta)$, whose probability density function is denoted by $g(\theta)$. In Section 5, we introduce the case in which $G(\theta)$ is defined as a Pareto distribution.

The production of the final goods' varieties requires a combination of two relationship-specific inputs, $y_j(i)$ and $z_j(i)$. While $y_j(i)$ is the firm's investments (firm's inputs), in which only the firms invest,[7] $z_j(i)$ represents the intermediate inputs (the supplier's inputs) produced only by the suppliers. The output of each final good is a sector-specific Cobb–Douglas function of inputs,

$$x_j\left(y_j(i), z_j(i)\right) = \theta \left[\frac{y_j(i)}{\eta_j}\right]^{\eta_j} \left[\frac{z_j(i)}{1-\eta_j}\right]^{1-\eta_j}, \tag{2}$$

where the productivity parameter θ is firm-specific, and the parameter η_j is sector-specific. One can easily see that as the productivity θ increases, the level of the final-good production increases as well. More importantly, as the value of η_j becomes larger (smaller), sector j becomes the firm's investment intensive (intermediate-input intensive). The revenue from the final-good sales is $R_j(i) = p_j(i)\, x_j\left(y_j(i), z_j(i)\right)$. From equations (1) and (2), we have

$$R_j\left(y_j(i), z_j(i)\right) = X_j^{\mu-\alpha} \theta^{\alpha} \left[\frac{y_j(i)}{\eta_j}\right]^{\alpha\eta_j} \left[\frac{z_j(i)}{1-\eta_j}\right]^{\alpha\left(1-\eta_j\right)}. \tag{3}$$

Both firms and suppliers face a perfectly elastic labor supply, and the wage rate c is fixed for

[6] For simplicity, the domestic country does not have multinational firms that have subsidiaries in foreign countries. Because the utility function in this study is quasi-linear, the higher gains from the multinational activities increase the firms' income levels in foreign countries. However, it does not affect the domestic firms' decision to be a multinational, even after new entry.

[7] The firm's investment can be interpreted as the investments in advertisement, managerial skills, and R&D.

simplicity.[8] We assume that both the firms and the suppliers use one unit of labor to supply one unit of relationship-specific input. In other words, the cost to supply one unit of relationship-specific input is c.

2.3 Timing of game

The game's timing is as follows (See also Figure 1). The game consists of four stages. In Stage 1, all the firms observe their productivity level θ and decide whether to be active. If the firms decide to be inactive, they earn zero profits.

[Figure 1 about here]

In Stage 2, the active firms decide on their organizational form. In other words, they choose outsourcing (denoted by O) or vertical integration (denoted by V). Subsequently, the firms incur fixed organizational costs. Following Antràs and Helpman (2004), we assume that the organizational costs in the host country are denominated in terms of labor. We denote the organizational cost in sector j, when a type $l \in \{H, M\}$ firm chooses an organizational form $k \in \{O, V\}$ as $cf_{l|kj}$. For the sake of a simple discussion in Section 4, we assign $f_{l|kj}$ as the organizational costs. Furthermore, in every sector j, we assume higher organizational costs in vertical integration than in outsourcing because firms must invest in subsidiaries. Thus, the organizational costs in sector j can be ranked as follows. For each $l \in \{H, M\}$,

$$f^j_{l|O} < f^j_{l|V}. \tag{4}$$

In addition, in every sector j, we assume higher organizational costs in multinational firms than in domestic firms; that is, for each $k \in \{O, V\}$, we obtain

$$f^j_{H|k} < f^j_{M|k}. \tag{5}$$

[8] This may be justified in a general equilibrium by considering c the productivity of the labor required to produce x_0 and the labor supply which is adequately large for the country to produce x_0.

This assumption can be justified because the fixed costs of searching, monitoring, and communication are significantly high in a foreign country.[9]

To commence the final-good production, every firm is required to contract with a supplier for the intermediate inputs. The firm offers a contract stipulating some fixed fees for the supplier to pay when the supplier participates in a relationship with the firm, $T_{l|k}(i) \geq 0$. We assume that the supplier's size is adequately large to allow the firm to choose $T_{l|k}(i)$ so that the supplier's net profits are equal to its ex-ante outside of the option earnings. For simplicity, we further assume that the ex-ante outside option earning of the supplier is zero; therefore, each supplier earns nothing in equilibrium. The amount of type $l \in \{H, M\}$ firms engaged in an organizational form $k \in \{O, V\}$ in sector j is denoted by $N^j_{l|k} \in [0, 1]$. Thus, the total amount of firms engaged in an organizational form k in sector j can be denoted by N^j_k. By definition, we have $N^j_k = N^j_{H|k} + N^j_{M|k}$. In addition, the amount of active firms in sector j can be denoted by N_j, where $N_j \equiv N^j_O + N^j_V$.

In Stage 3, firms and suppliers choose the supply level of relationship-specific inputs. The supply level of the inputs highly depends on the organizational form determined in Stage 2. When a firm chooses vertical integration in Stage 2, the firm and the supplier can sign a complete contract. They can choose the supply levels to maximize their joint profit in Stage 3.[10]

Conversely, when the firm chooses outsourcing in Stage 2, the firm and the supplier sign an incomplete contract as in Antràs and Helpman (2004). In other words, they cannot sign an ex-ante enforceable contract specifying the purchase of relationship-specific intermediate inputs for a certain price, the amount of labor hired, and the sales revenue when the final goods are sold. Thus, every firm–supplier pair bargains over their joint profit after their relationship-specific inputs have been supplied. We assume that the ex-post bargaining takes the form of a generalized Nash bargaining game, wherein the firm obtains a fraction $\beta \in (0, 1)$ of the ex-post gain from the contracting

[9] This organizational cost for becoming a multinational firm is paid for by the headquarter in the home country. Subsequently, it enters the host country.

[10] This setting is different from Antràs and Helpman (2004), and the modeling strategy helps us focus on the determination of the outside options under outsourcing.

parties' joint revenue $R_j\left(y_j(i), z_j(i)\right)$.

Unlike Antràs and Helpman (2004), our fundamental assumption is that the ex-post outside option earnings of each contracting party are endogenously determined by the amount of active firms N_j. In the case of failure to reach an agreement on the distribution of surplus, the supplier may sell the intermediate inputs to one of the firms in the downstream market (for example, at an auction).[11] Because the intermediate inputs are relationship specific, the matched firms purchase them at a fraction $\sigma_j\left(N_j\right) \in (0,1)$ of the revenue from the final-good production. This occurs although these processes are costly and generate a loss of a fraction $1-\gamma_j \in (0,1)$ of the final-good production. Therefore, the outside option earnings of outsourcing firms become $\gamma_j^{\alpha}\left(1-\sigma_j\left(N_j\right)\right) R_j\left(y_j(i), z_j(i)\right)$, and those of the suppliers become $\gamma_j^{\alpha}\sigma_j\left(N_j\right) R_j\left(y_j(i), z_j(i)\right)$. We assume that $\sigma_j\left(N_j\right)$ has the following property.[12] [13]

Assumption 1. *The possibility that the intermediate inputs are highly evaluated by other firms becomes higher as the amount of active firms increases. In other words,* $\sigma'_j\left(N_j\right) > 0$.

Under Assumption 1, a firm's (the supplier's) share of the outside option earnings under outsourcing decreases (increases) as the amount of active firms increases.[14]

In Stage 4, the production of the final goods commences with two inputs, and the final goods are sold to the final consumers. In the equilibrium, firms earn all the joint profit, whereas the

[11] This can be justified if the suppliers have a low level of internal reserves and assets. In such a case, the supplier deems it difficult to raise money for all the transfers $T_{l|k}(i)$ and wages $cz_j(i)$, when no agreement is reached on the distribution of a surplus. Thus, the supplier has to naturally go bankrupt and sell all the intermediate inputs at an auction.

[12] We obtain a similar property under the successive Cournot model. The change in the revenue share is analogous to that in the price of intermediate inputs in successive Cournot competition with a fixed number of suppliers, a linear-demand, and a quadratic-cost function. In this setup, the intermediate-input price in outsourcing can increase from the higher demand due to additional entry, thus raising the upstream revenue share.

[13] The results demonstrate no qualitative changes even when we assume that the functional form of $\sigma(\cdot)$ is $\sigma(N_O)$. This could capture the successive Cournot competition in the outsourcing market. More precisely, the results do not qualitatively change if $\sigma(\cdot)$ is a function of a variable that increases by multinational entry.

[14] When considering the suppliers selling their products at an auction, this assumption can be interpreted as an increase in the bid price as the number of bidders rises.

suppliers earn nothing. A firm's net profit, including its organizational cost, can be denoted by $\pi_k^j(\theta, f_{l|k}^j)$, where $l \in \{H, M\}$ and $k \in \{O, V\}$.[15]

3 Equilibrium

This section explores the decision on the organizational form. Because we focus on a particular sector, we omit index j from all variables. Let $\theta_{l|k}$ be the cutoff productivity of type $l \in \{H, M\}$ firms, the lowest value of θ that would induce a firm to choose the organizational form $k \in \{O, V\}$. Although many equilibrium patterns exist, this study focuses on the following equilibrium, which is most reasonable under condition (4): for each $l \in \{H, M\}$,

$$\theta_{l|O} < \theta_{l|V}. \tag{6}$$

Assuming the order of cutoff productivities (6), we first characterize the profit of the firms under their organizational form k in Subsection 3.1. Subsequently, we examine the existence of an equilibrium and derive each cutoff productivity in Subsection 3.2.

3.1 Two-organizational forms

In this subsection, we derive the equilibrium's profit of the firms. We first characterize the case of vertical integration and then the case of outsourcing.

Vertical integration

When a firm and supplier integrate in Stage 2, they sign a complete contract and choose the supply levels for the relationship-specific inputs that maximize their joint profits in Stage 3. The equilibrium production levels of the relationship-specific inputs under vertical integration is denoted by $y_{l|V}(i)$ and $z_{l|V}(i)$ and can be obtained by solving the following joint profit maximization problem:

$$\left(y_{l|V}(i), z_{l|V}(i)\right) \equiv \underset{y(i),z(i)}{\operatorname{argmax}} R\left(y(i), z(i)\right) - c\left(y(i) + z(i)\right),$$

[15] The profits of intermediate-input suppliers are not depicted because they earn zero profits in an equilibrium.

subject to equation (3). By using a fixed transfer $T_{l|V}$, the firm extracts all the joint profit, and hence, the supplier earns nothing. Because the firm incurs $cf_{l|V}$ after choosing the organizational form, the net profit of the type $l \in \{H, M\}$ firm under vertical integration becomes

$$\pi_V(\theta, f_{l|V}) = X^{\frac{\mu-\alpha}{1-\alpha}} \psi_V \theta^{\frac{\alpha}{1-\alpha}} - cf_{l|V}, \tag{7}$$

where

$$\psi_V = (1-\alpha)\left[\frac{\alpha}{c}\right]^{\frac{\alpha}{1-\alpha}}.$$

Outsourcing

When a firm chooses outsourcing in Stage 2, the firm and the supplier bargain over their joint profit after the relationship-specific inputs have been supplied in Stage 3. Under the generalized Nash bargaining game, the firm obtains its ex-post outside option earnings $\gamma^\alpha(1-\sigma(N))R(y(i), z(i))$, and a fraction β of the ex-post net gains from the contracting party $(1-\gamma^\alpha)R(y(i), z(i))$. For the bargaining outcome in this stage, see also Figure 2. Thus, the firm's revenue becomes $\beta_O R(y(i), z(i))$, where

$$\beta_O = \beta(1-\gamma^\alpha) + \gamma^\alpha(1-\sigma(N)). \tag{8}$$

Similarly, the supplier earns revenue $(1-\beta_O)R(y(i), z(i))$. Contrary to vertical integration, each firm under outsourcing chooses an input supply level that maximizes its operating profits, given the trading partner's input supply level. The firm's maximization problem in Stage 3 is given by

$$\max_{y(i)} \beta_O R(y(i), z(i)) - cy(i), \tag{9}$$

subject to (3). Conversely, the supplier's maximization problem under outsourcing in Stage 3 is given by

$$\max_{z(i)} (1-\beta_O) R(y(i), z(i)) - cz(i), \tag{10}$$

subject to (3). By solving first-order conditions (9) and (10) with respect to $y(i)$ and $z(i)$, we obtain the equilibrium supply levels of relationship-specific inputs under outsourcing, denoted by $y_{l|O}(i)$

and $z_{l|O}(i)$. At the beginning of Stage 2, the firm anticipates this equilibrium outcome and chooses a fixed transfer $T_{l|O}$, which is equal to the supplier's operating profit. The firm, therefore, extracts the entire joint profit, while the supplier earns nothing. The type $l \in \{H, M\}$ firm's net profit, including the organizational cost under outsourcing becomes

$$\pi_O(\theta, f_{l|O}) = X^{\frac{\mu-\alpha}{1-\alpha}} \psi_O \theta^{\frac{\alpha}{1-\alpha}} - c f_{l|O}, \tag{11}$$

where

$$\psi_O = \frac{1 - \alpha(\beta_O \eta + (1 - \beta_O)(1 - \eta))}{\left[\frac{c}{\alpha}\left(\frac{1}{\beta_O}\right)^{\eta}\left(\frac{1}{1-\beta_O}\right)^{1-\eta}\right]^{\frac{\alpha}{1-\alpha}}}.$$

[Figure 2 about here]

Note that ψ_O is interpreted as the severity of a two-sided hold-up problem, which plays a crucial role in this analysis. In the following sections, we explore the properties of ψ_O and how they affect firms' organizational decisions.

3.2 Decision of organizational forms

In this subsection, we compare the profits' sizes obtained in the previous subsection and derive the order of the cutoff productivities that satisfy condition (6). A simple comparison of equations (7) and (11) indicates that the firms' profits $\pi_k(\theta, f_{l|k})$ linearly increase in $\theta^{\frac{\alpha}{1-\alpha}}$ but depend on the degrees of ψ_k and $f_{l|k}$ for all organizational forms. From condition (4), we have $f_{l|O} < f_{l|V}$. Conversely, the following lemma characterizes the relationship between ψ_V and ψ_O.

Lemma 1. *$\psi_V > \psi_O$ always holds.*

The result in Lemma 1 implies that if organizational costs coincide ($f_{l|O} = f_{l|V} = f$), then all the active firms choose vertical integration; that is, $\pi_V(\theta, f) > \pi_O(\theta, f)$ for all θ. This is because under outsourcing, the two-sided hold-up problem occurs, where firms under outsourcing have a smaller incentive to supply the relationship-specific inputs. To clarify this, we rewrite the first-order condition with respect to $y(i)$ under vertical integration $R_y(y_{l|V}(i), z) = c$, as follows:

$$\beta_O R_y(y_{l|V}(i), z) + (1-\beta_O) R_y(y_{l|V}(i), z) = c.$$

Conversely, the first-order condition under outsourcing is $\beta_O R_y(y_{l|O}(i), z) = c$. Because $R_y(y, z) > 0$ for all $y > 0$ and $z > 0$, $y_{l|O}(i) < y_{l|V}(i)$ holds if $z_{l|O}(i) \leq z_{l|V}(i)$. Similarly, $z_{l|O}(i) < z_{l|V}(i)$ if $y_{l|O}(i) \leq y_{l|V}(i)$. Thus, outsourcing induces the suppliers and the firms to choose a smaller input supply level, and this prevents them from maximizing their joint profit. This is because each firm and supplier cannot internalize a positive input-production externality. Therefore, an increase in the input production of a supplier (a firm) increases the profit of the firm (the supplier).

The result in Lemma 1 also implies that a firm with a sufficiently high productivity level chooses vertical integration regardless of the organizational cost. However, for a small or intermediate productivity level, the organizational decision depends on the organizational cost level. Assuming the order of the cutoff productivities (6), we can derive the following cutoff productivities by using equations (7) and (11), should they exist.

Definition 1. *For each $l \in \{H, M\}$, the two types of cutoff productivity are defined as follows:*

1. *Cutoff productivity for lO; $\pi_O(\theta_{l|O}, f_{l|O}) = 0$.*
$$\theta_{l|O} = X^{\frac{\alpha-\mu}{\alpha}} \left[\frac{c f_{l|O}}{\psi_O}\right]^{\frac{1-\alpha}{\alpha}}. \tag{12}$$

2. *Cutoff productivity for lV; $\pi_O(\theta_{l|V}, f_{l|O}) = \pi_V(\theta_{l|V}, f_{l|V})$.*
$$\theta_{l|V} = X^{\frac{\alpha-\mu}{\alpha}} \left[\frac{c\left(f_{l|V} - f_{l|O}\right)}{\psi_V - \psi_O}\right]^{\frac{1-\alpha}{\alpha}}, \tag{13}$$

where

$$N = \int_{\theta_{H|O}}^{\infty} g(\theta) d\theta + \int_{\theta_{F|O}}^{\infty} g(\theta) d\theta, \tag{14}$$

$$X = \left(\frac{\alpha}{c}\right)^{\frac{1}{1-\mu}} \left\{\beta_O^{\frac{\alpha\eta}{1-\alpha}} (1-\beta_O)^{\frac{\alpha(1-\eta)}{1-\alpha}} \sum_{l\in\{H,M\}} \int_{\theta_{l|O}}^{\theta_{l|V}} g(\theta) d\theta + \sum_{l\in\{H,M\}} \int_{\theta_{l|V}}^{\infty} g(\theta) d\theta\right\}^{\frac{1-\alpha}{\alpha(1-\mu)}}. \tag{15}$$

The following proposition identifies the existence of an equilibrium:

Proposition 1. *For each $l \in \{H, M\}$, there exists the order of the cutoff productivities (6) characterized by conditions (12) and (13) if f_{lV} is sufficiently high.*

The results in Proposition 5.1 are summarized in Figure 3. A few comments are necessary regarding the results. First, Proposition 5.1 does not provide the exact condition of $(f_{l|O}, f_{l|V}) \in \mathbb{R}^2_{++}$ that satisfies the order of cutoff productivities (6). Thus, an equilibrium can be determined more easily to exogenously set a pair $(\theta_{l|O}, \theta_{l|V})$ such that $\theta_{l|V} > \theta_{l|O} > 0$ in numerical analysis. Second, multinational firms' cutoff productivity is always higher than that of firms in the host country because the fixed organizational costs of multinational firms are higher than that of domestic firms.

[Figure 3 about here]

4 Comparative statics: fraction of domestic firms

This section investigates how the multinational entry in outsourcing impacts domestic firms' organizational form in terms of the fraction. More precisely, this study examines how a decrease in the multinational firms' organizational costs for outsourcing $f_{M|O}$ affects the domestic firms' incentive to vertically integrate or outsource in terms of the fraction of the firms. For the analysis of this section, we choose $G(\theta)$ as a Pareto distribution with shape δ and scale b. In other words, the probability density function is $g(\theta) = \delta b^{\delta} \theta^{-\delta-1}$ and

$$G(\theta) = 1 - \left[\frac{b}{\theta}\right]^{\delta} \text{ for } \theta \geq b > 0, \tag{16}$$

where $\delta > \alpha / (1 - \alpha)$. [16]Under the Pareto distribution, N and X can be rewritten as follows:

$$N = \left[\frac{b}{\theta_{H|O}}\right]^{\delta} + \left[\frac{b}{\theta_{M|O}}\right]^{\delta}, \tag{17}$$

[16] In this case, the sales distribution also becomes Pareto. It is consistent with the several empirical evidences such as Helpman, Melitz, and Yeaple (2004).

$$X = \left(\frac{\alpha}{c}\right)^{\frac{1}{1-\mu}} \left(\frac{\delta b^{\delta}}{\delta - \frac{\alpha}{1-\alpha}}\right)^{\frac{1-\alpha}{\alpha(1-\mu)}} \left\{\beta_O^{\frac{\alpha\eta}{1-\alpha}} (1-\beta_O)^{\frac{\alpha(1-\eta)}{1-\alpha}} \left(\theta_{HO}^{\frac{\alpha}{1-\alpha}-\delta} + \theta_{MO}^{\frac{\alpha}{1-\alpha}-\delta}\right)\right.$$
$$\left. + \left(1 - \beta_O^{\frac{\alpha\eta}{1-\alpha}} (1-\beta_O)^{\frac{\alpha(1-\eta)}{1-\alpha}}\right)\left(\theta_{HV}^{\frac{\alpha}{1-\alpha}-\delta} + \theta_{MV}^{\frac{\alpha}{1-\alpha}-\delta}\right)\right\}^{\frac{1-\alpha}{\alpha(1-\mu)}}. \tag{18}$$

Note that $\theta_{l|k}$, N, and X are solutions of equations (12), (13), (17), and (18), where $l \in \{H, M\}$ and $k \in \{O, V\}$. We also derive the amount of domestic vertical integration and outsourcing under the Pareto distribution.

$$N_{H|V} = \left[\frac{b}{\theta_{H|V}}\right]^{\delta}, \tag{19}$$

$$N_{H|O} = \left[\frac{b}{\theta_{H|O}}\right]^{\delta} - \left[\frac{b}{\theta_{H|V}}\right]^{\delta}. \tag{20}$$

Equations (19) and (20) imply that the amount of domestic vertical integration and that of outsourcing are determined by the cutoff productivities. More concretely, $N_{H|V}$ is negatively related to $\theta_{H|V}$. Conversely, $N_{H|O}$ is positively related to $\theta_{H|V}$ and negatively related to $\theta_{H|O}$.

Moreover, in this section, we assume the following relationship between $f_{M|O}$ and N.

Assumption 2. *A decrease in multinational firms' organizational cost of outsourcing $f_{M|O}$ increases the amount of active firms. Therefore, $\partial N / \partial f_{M|O} < 0$.*

Equations (12) and (17) imply that a decrease in the multinational firms' organizational cost of outsourcing, $f_{M|O}$, directly reduces the cutoff productivity for the multinational firms engaged in outsourcing, $\theta_{M|O}$. This leads to an increase in the amount of active firms, N. Although an indirect effect could arise whereby some domestic firms engaged in outsourcing decide to be inactive (that is, $\theta_{H|O}$ increases), we assume that multinational entry provides a dominant effect in this section.[17] In the next section, by using numerical analysis, we determine large ranges in which the total

[17] Forte (2016) provides a useful survey of the empirical analysis on the effects of multinational entry on the host country's market concentration, entry, exit, and survival of the host country's firms. The summary on the host country's market concentration provides both positive and negative relationships between a multinational presence and the concentration ratio. However, the productive multinational entry may expand the host country's market size, and the increase in the share of the productive multinational presence may increase the evaluation of each supplier's intermediate input in the host country.

amount of active firms, including multinational firms, increases.[18]

The fraction of the domestic firms engaged in vertical integration (outsourcing) is denoted by $\phi_{H|V}$, and that of the domestic firms engaged in outsourcing is denoted by $\phi_{H|O}$. Under the Pareto distribution, using equations (19) and (20), we have

$$\begin{aligned}\phi_{H|V} &= \frac{N_{H|V}}{N_{H|O} + N_{H|V}} \\ &= \left[\frac{(\psi_V - \psi_O) f_{H|O}}{\psi_O (f_{H|V} - f_{H|O})}\right]^{\frac{\delta(1-\alpha)}{\alpha}},\end{aligned}$$

and $\phi_{H|O} = 1 - \phi_{H|V}$ because $\phi_{H|V} + \phi_{H|O} = 1$ holds by definition. Indisputably, $\phi_{H|V}$ and $\phi_{H|O}$ do not depend on X, which results in a simpler analysis. In addition, the change of $f_{M|O}$ affects only ψ_O, which is the degree of the two-sided hold-up problem and is determined by bargaining under outsourcing. To consider the relationship between $\phi_{H|V}$ and $f_{M|O}$, we provide the partial derivative of $\phi_{H|V}$, with respect to $f_{M|O}$, as

$$\frac{\partial \phi_{H|V}}{\partial f_{M|O}} = \frac{\partial \phi_{H|V}}{\partial \psi_O} \frac{\partial \psi_O}{\partial \beta_O} \frac{\partial \beta_O}{\partial N} \frac{\partial N}{\partial f_{M|O}}. \tag{21}$$

Thus, to find the relationship between $\phi_{H|V}$ and $f_{M|O}$, it is necessary to examine the relationships between β_O and N, between ψ_O and β_O, and between $\phi_{H|V}$ and ψ_O.

We first consider how the degree of the two-sided hold-up problem ψ_O affects the fraction of domestic vertical integration $\phi_{H|V}$. The following lemma characterizes this relationship:

Lemma 2. *As the two-sided hold-up problem becomes increasingly serious, the fraction of domestic vertical integration increases; that is,* $\partial \phi_{H|V} / \partial \psi_O < 0$.

From equation (11), the profit under outsourcing π_O is positively related to the value of ψ_O. Therefore, $\partial \pi_O / \partial \psi_O > 0$. Thus, when the two-sided hold-up problem becomes more serious,

[18] Using numerical analysis in the next section, we can determine the sets of parameter values under which this relation holds for all $(\beta, \eta) \in (0,1)^2$. For example, the set of parameters in Table 2 satisfies this property. Conversely, we have difficulty finding $\partial N / \partial f_{M|O} > 0$, although we have conducted huge ranges of simulation trials with various sets of parameter values. Such a relation is observed in only the very limited ranges of $(\beta, \eta) \in (0,1)^2$, even if it exists.

the profit under outsourcing decreases, making the domestic firms more likely to choose vertical integration.

We hereafter consider the relationship between β_O and N. We summarize the relationship as follows:

Lemma 3. *As the amount of the active firms increases, the firms' revenue share under outsourcing decreases. In other words,* $\partial\beta_O/\partial N < 0$.

Lemma 3 implies that as the amount of active firms increases, the outsourcing firms' revenue share decreases as the outside option earnings under outsourcing decrease. Under Assumption 2, a decrease in the multinational firms' organizational cost of outsourcing reduces the revenue share of the firms under outsourcing: $\partial\beta_O/\ \partial f_{M|O} > 0$.

Finally, we explore how the revenue share of firms under outsourcing β_O affects the degree of a two-sided hold-up problem ψ_O. The following lemma demonstrates that this relationship depends on the values of β_O and η.

Lemma 4. *When the firms' revenue share under outsourcing increases, the two-sided hold-up problem becomes more serious (less serious) for a sufficiently high (low) fraction of the firms' revenue share under outsourcing. In other words,* $\partial\psi_O/\partial\beta_O \gtreqless 0$ *if and only if* $\beta_O \lesseqgtr \beta^*_O(\eta)$, *where*

$$\beta^*_O(\eta) = \frac{\eta(1+\alpha\eta-\alpha) - \sqrt{\eta(1-\eta)(1-\alpha\eta)(1+\alpha\eta-\alpha)}}{2\eta-1}, \tag{22}$$

and where $\partial\beta^*_O(\eta)/\partial\eta > 0$ *with* $\beta^*_O(0) = 0$, $\beta^*_O(1) = 1$ *and* $\lim_{\eta\to 1/2}\beta^*(\eta) = 1/2$.

The properties of $\beta^*_O(\eta)$ are summarized in Figure 4.[19] On the line of $\beta^*_O(\eta)$, we have $\partial\psi_O/\partial\beta_O = 0$; that is, the firms' profit under outsourcing is maximized. By interpreting the results in lemma 4 differently, the degree of the two-sided hold-up problem ψ_O becomes considerably more serious for a small or large value of β_O. Under the Cobb-Douglas production technology of the final goods,

[19] The shape of $\beta^*_O(\eta)$ depends on the degree of the product differentiation α. It approaches being linear as the value of α becomes higher.

a small supply level by one party has an indirect effect of reducing the supply level by the other party. This becomes a dominant effect when β_O is close to 0 or 1, because the supply level by one party is close to 0 in such cases. Therefore, the extremely unbalanced revenue share between the outsourcing firms and the suppliers leads to the serious two-sided hold-up problem.

[Figure 4 about here]

By expending the results in lemma 4, we have the relationship between β_O and $\phi_{H|V}$. For $\beta_O > \beta_O^*(\eta)$ ($\beta_O < \beta_O^*(\eta)$), we have $\partial\psi_O/\partial\beta_O < 0$ ($\partial\psi_O/\partial\beta_O > 0$). This implies that if β_O decreases when $\beta_O > \beta_O^*(\eta)$, ψ_O would increase. Because π_O is positively related to ψ_O, a decrease in the revenue share of the firms engaged in outsourcing would induce them to earn larger profits, which, in turn, will induce domestic firms to prefer outsourcing to vertical integration. Thus, $\phi_{H|V}$ decreases, whereas $\phi_{H|O}$ increases. Conversely, if β_O decreases when $\beta_O < \beta_O^*(\eta)$, ψ_O decreases. In this case, as the revenue share of the firms engaged in outsourcing decreases, these firms earn smaller profits, thus facilitating the vertical integration of the domestic firms. Thus, $\phi_{H|V}$ increases.

The intuitive logic underlying this result is as follows. Owing to the two-sided hold-up problem, a decrease in the revenue share of the outsourcing firms β_O has two effects. First, a decrease in β_O directly reduces the revenue of the outsourcing firms $\beta_O R(y,z)$, and hence, outsourcing firms supply a smaller amount of relationship-specific inputs. Thus, the joint profits of the contracting parties decrease. Second, a decrease in β_O increases the revenue share of the suppliers under outsourcing $(1-\beta_O)R(y,z)$, and this induces the suppliers to produce a larger amount of the relationship-specific inputs, increasing the joint profits of the contracting parties. Because the revenue share of outsourcing firms β_O is positively related to β, and the revenue from the sales of the final goods depends on η, the impact from the decrease in β_O depends on the bargaining power and relative intensity of the firm's investment.

When firms have stronger bargaining power (higher β), and the sector is intensive in intermediate inputs (smaller η), the under-investment of the intermediate inputs may present a severe problem. Because a decrease in the outsourcing firms' revenue share can mitigate this problem, the joint profit of the contracting parties π_O increases. Conversely, when the firms have weak bargaining power (lower β), and the sector is intensive in the firm's investment (higher η), the under-investment by the firms can become a more severe problem. In this case, as the revenue share of the outsourcing firms decreases, the under-investment of the firms becomes more severe and thereby reduces the joint profit of the contracting parties.

From Assumption 2 and Lemmas 2, 3, and 4, the relationship between multinational entry and the fraction of domestic vertical integration can be summarized as follows.

Proposition 2. *Suppose that Assumption 2 holds. When the organizational cost of multinational firm's outsourcing $f_{M|O}$ decreases, the fraction of domestic vertical integration $\phi_{H|V}$ changes, depending on the firms' revenue share under outsourcing β_O and the relative intensity of inputs η; that is,*

$$\frac{\partial \phi_{H|V}}{\partial f_{M|O}} \lesseqgtr 0 \Leftrightarrow \beta_O \lesseqgtr \beta_O^* (\eta) \,. \tag{23}$$

More concretely,

1. *if firms have a sufficiently low revenue share, and the sector is relatively intensive in the firms' investments, the fraction of domestic vertical integration increases; and*

2. *if firms have a sufficiently high revenue share, and the sector is relatively intensive in the suppliers' inputs, the fraction of domestic outsourcing increases.*

From the above results, we can conclude that multinational entry is more likely to increase the fraction of domestic vertical integration (outsourcing) (i) when the sector is sufficiently intensive in the firms' investments (supplier's inputs), and (ii) the firms have sufficiently weak (strong) bargaining power. Because the relative input intensity varies across the markets and countries, the results here may explicate the cross-sectoral differences in the pattern of the changes in domestic firms' vertical structures through foreign multinational entry.

5 Numerical Analysis

This section examines how multinational entry affects domestic firms' organizational forms with regard to the amount by using a numerical analysis. As in Section 4, an increase in multinational entry is captured by the decrease in the organizational cost of multinational firms' outsourcing $f_{M|O}$. Equation (19) implies that an increase in the amount of the domestic integration $N_{H|V}$ is equivalent to a decrease in the cutoff productivity of domestic vertical integration $\theta_{H|V}$. Similarly, equation (20) implies that the amount of domestic outsourcing $N_{H|O}$ is negatively related to $\theta_{H|O}$ but positively related to $\theta_{H|V}$. Thus, in this section, we first focus on the relationship between $f_{M|O}$ and $\theta_{H|V}$. Subsequently, we conduct the numerical analysis on the relationship between $f_{M|O}$ and $N_{H|O}$ by focusing on the relationship between $\theta_{H|O}$ and $f_{M|O}$.

For numerical analysis, we theoretically explore the relationships between $\theta_{H|V}$ and $f_{M|O}$ and between $\theta_{H|O}$ and $f_{M|O}$. First, by partially differentiating $\theta_{H|V}$ with respect to $f_{M|O}$, we have

$$\frac{\partial \theta_{H|V}}{\partial f_{M|O}} = \frac{X^{-\frac{\mu}{\alpha}}}{\alpha} \left[\frac{c\left(f_{H|V} - f_{H|O}\right)}{\psi_V - \psi_O} \right]^{\frac{1-\alpha}{\alpha}} \left[\frac{(1-\alpha) X}{\psi_V - \psi_O} \frac{\partial \psi_O}{\partial f_{M|O}} + (\alpha - \mu) \frac{\partial X}{\partial f_{M|O}} \right]. \tag{24}$$

Equation (24) demonstrates that a change in $\theta_{H|V}$ depends on the changes in ψ_O and X, both of which are endogenously determined. As discussed in the previous section, multinational entry affects the two-sided hold-up problem between a firm and supplier under outsourcing, as well as the outsourcing firm's profits π_O, which is positively related to ψ_O. From Lemma 4, an increase or decrease in ψ_O, which is equivalent to an increase or decrease in π_O, depends on the bargaining power of the firms, β, and the relative intensity of inputs η.

In contrast to the previous section, to analyze the relationship between $\theta_{H|V}$ and $f_{M|O}$, we need to consider another effect on the aggregate production (consumption) X. Ordinarily, multinational entry increases the aggregate production (that is, $\partial X/\partial f_{M|O} < 0$), with the following effect on the profit of the firms:

Lemma 5. $\partial \pi_V/\partial X < \partial \pi_O/\partial X < 0$.

Lemma 5 implies that an increase in X induces all firms to earn smaller profits. Moreover, the profit reduction of vertical integration, given a fixed ψ_O, is more serious as compared to that of outsourcing. Thus, domestic firms are less likely to choose vertical integration, which increases θ_{HV} (decreases $N_{H|V}$). Therefore, considering the change in the aggregate production X, we predict that the amount of domestic vertical integration $N_{H|V}$ is less likely to increase as compared to the fraction of domestic vertical integration $\phi_{H|V}$.

Thereafter, by partially differentiating $\theta_{H|O}$ with respect to $f_{M|O}$, we have

$$\frac{\partial \theta_{H|O}}{\partial f_{M|O}} = \frac{X^{-\frac{\mu}{\alpha}}}{\alpha} \left[\frac{c f_{H|O}}{\psi_O} \right]^{\frac{1-\alpha}{\alpha}} \left[(\alpha - \mu) \frac{\partial X}{\partial f_{M|O}} - \frac{(1-\alpha) X}{\psi_O} \frac{\partial \psi_O}{\partial f_{M|O}} \right]. \tag{25}$$

As in the case of $\theta_{H|V}$, a change in $\theta_{H|O}$ is determined by changes in ψ_O and X. A comparison between equations (24) and (25) demonstrates that like $\theta_{H|V}$, the increase in the aggregate production X reduces $\theta_{H|O}$ as the firms' profits under outsourcing decrease. Unlike $\theta_{H|V}$, $\theta_{H|O}$ increases when the two-sided hold-up problem becomes increasingly serious because the firms prefer vertical integration to outsourcing under such environments. From equation (25), the possibility of $\partial \theta_{H|O} / \partial f_{M|O} > 0$ exists when $\partial \psi_O / \partial \beta_O < 0$. Therefore, by considering the properties of $\partial \psi_O / \partial \beta_O$, we predict that the amount of domestic outsourcing increases only when the firms have stronger bargaining power, and the sector is relatively intensive in the intermediate inputs.

The remainder of this section is organized as follows. First, we introduce the parameters under the numerical analysis in Subsection 5.1. Subsequently, we introduce the results of the numerical analysis in Subsection 5.2.

5.1 Parameters

This subsection introduces the parameters to a numerical analysis. For the numerical analysis, we choose $G(\theta)$ to be a Pareto distribution, which is defined in equation (16). In addition, we assume that $\sigma(N)$ has the following functional form:

$$\sigma(N) = 1 - e^{-\tau N},$$

We now introduce the exogenous parameters (see also Table 2).[20] Following Melitz and Redding (2013), we set $\alpha = 0.75$ so that the elasticity of substitution between any two varieties satisfies $1/(1-\alpha) = 4$ and the Pareto shape parameter for the firm productivity $\delta = 4.25$, under which we have $\delta > \alpha/(1-\alpha)$.[21] [22] Following Melitz and Redding (2013), the Pareto scale parameter for the firms' productivity and wage rate are normalized to $b = 1$ and $c = 1$, respectively. As assumed in Section 2, the parameter μ in preference has to satisfy $\mu < \alpha = 0.75$. Thus, we examine the case of $\mu = 0.5$. For the shape of the parameter $\sigma(N)$ and the depletion rate, we choose $\tau = 50$ and $\gamma = 0.5$. As Proposition 2 implies that the result highly depends on the parameter set of the outsourcing firms' bargaining power β and the relative intensity of inputs η, we examine the case of $(\beta, \eta) \in \{0.05, 0.10, .., 0.95\}^2$.

[Table 2 about here]

Within these parameters, we obtain the solutions for an appropriate set of organizational costs $\{f_{H|O}, f_{H|V}, f_{M|O}, f_{M|V}\}$, as follows. Proposition implies that condition (4) is a necessary condition but not a sufficient condition for the existence of an equilibrium. Thus, if we set an erroneous parameter set of $f_{l|k}$, we cannot obtain the set of $\theta_{l|k}$ that satisfies condition (6). Moreover, it would become more challenging to solve the equations. Therefore, by exogenously setting $\theta_{l|k}$ to satisfy condition (6), we determine the set of $f_{l|k}$ in the appropriate order in the numerical analysis. By using this method, we set $f_{H|O} = 0.5$, $f_{H|V} = 10$, $f_{M|O} = 1$, and $f_{M|V} = 20$, and with these organizational costs, we obtain a unique solution for all the cases of $(\beta, \eta) \in \{0.05, 0.10, .., 0.95\}^2$.

[20] We use GAMS for the numerical analysis here.

[21] Their setting on α is consistent with the estimates using the plant-level U.S. manufacturing data in Bernard, Eaton, Jensen, and Kortum (2003).

[22] The value of δ is justified as follows. Because a firm's revenue, R, is a power function of the firm's productivity, R is also a Pareto distributed and $G(R) = 1 - (b^*/R)^{\delta(1-\alpha)/\alpha}$, where b^* is the revenue of the least productive firm. Melitz and Redding (2013) and existing empirical analyses suggest that the firms' size distribution defined by the firms' revenue is well approximated by a Pareto distribution, with a shape parameter $\delta(1-\alpha)/\alpha$ close to one. In addition, a firm's revenue is required to have a finite mean. Therefore, we are required to have $\delta(1-\alpha)/\alpha > 1$. These two conditions are satisfied when $\delta = 4.25$. For $\delta = 4.25$, we have $\delta(1-\alpha)/\alpha = 1.42 > 1$.

For the analysis of comparative statics, we compare these equilibrium outcomes with those for the case of $f_{M|O} = 0.9$; namely, the organizational cost for foreign multinational outsourcing decreases by 10 percent.

5.2 Comparative statics

We first explore how multinational entry affects the amount of domestic vertical integration $N_{H|V}$, which is captured by a change in $\theta_{H|V}$. We obtain the following result.

Result 1. *A decrease in the organizational cost of the multinational firms engaged in outsourcing $f_{M|O}$ increases the amount of domestic vertical integration $N_{H|V}$ for the following environments:*

1. *The sector is intensive in the firm's investments: η is high.*
2. *Firms have sufficiently weak bargaining power: β is low.*

Figure 5 summarizes Result 1. As with the fraction of domestic vertical integration $\phi_{H|V}$, multinational entry increases the amount of domestic vertical integration $N_{H|V}$ for a higher η and a lower β. As per the result of Proposition 2, this result can essentially be expressed by a change in ψ_O.

We hereafter compare the amount of domestic vertical integration captured by $\theta_{H|V}$, with a fraction of domestic vertical integration $\phi_{H|V}$. The comparison results are summarized as follows.

Result 2. *The parameter region of (β, η), in which the amount of domestic vertical integration increases, is narrower than the region in which a fraction of vertical integration increases. Therefore, a region exists where the amount of domestic vertical integration decreases, but a fraction of domestic vertical integration increases.*

Figure 6 describes the change in $\phi_{H|V}$. A comparison of Figures 5 and 6 demonstrates that the parameter region of (β, η), in which domestic vertical integration is facilitated in terms of the amount, is narrower than that in terms of the fraction. This phenomenon can be explained by changing the sector's aggregate production index X, which reduces the possibility that multinational entry increases domestic vertical integration. Therefore, the amount of domestic vertical integration can decrease, even when the fraction of domestic vertical integration increases.

[Figures 5 and 6 about here]

We finally explore how multinational entry impacts the amount of domestic outsourcing. We obtain the following results.

Result 3. *A decrease in the organizational cost of the multinational firms engaged in outsourcing $f_{M|O}$ increases the amount of domestic outsourcing $N_{H|O}$ and that of the active domestic firms ($\theta_{H|O}$ decreases) in the following environments:*

1. *The sector is intensive in intermediate inputs: η is sufficiently low.*
2. *Firms have sufficiently strong bargaining power: β is sufficiently high.*

Figures 7 and 8 summarize Result 3. To understand the result, note that the fraction of domestic outsourcing is defined by $\phi_{H|O} = 1 - \phi_{H|V}$. This implies that the parameter region of (β, η), in which the fraction of domestic outsourcing increases, coincides with the region in which the fraction of domestic vertical integration decreases (see Figure 6). Because an increase in aggregate production has the effect of discouraging less productive firms from being active, the parameter region of (β, η), in which the amount of domestic outsourcing increases, is narrower than the region in which the fraction of domestic outsourcing increases.[23]

[Figures 7 and 8 about here]

[23] We determine that the parameter region of (β, η), in which the amount of domestic outsourcing increases, becomes far narrower for the case of smaller organizational costs under domestic outsourcing. For example, there is no parameter region of (β, η), in which the amount of domestic outsourcing increases for the case of $f_{H|O} = 0.02$. See Appendix A.

6 Conclusion

This study explores the domestic firms' vertical organizational change when they encounter increased openness to new foreign multinational entry. Although the effect of multinational activities on the host country's economy can occur through many different channels, this study provides a simple analysis by emphasizing a two-sided hold-up problem. We find that the two-sided hold-up problem plays a vital role in explaining the changes in each organizational form's share in a market. If the number of firms increases through multinational entry and it increases the suppliers' revenue share at the ex-post bargaining, outsourcing is more likely to be widespread in intermediate-input intensive sectors. Conversely, vertical integration is more likely to be widespread in a firm's investment-intensive sector.

To further understand the organizational changes, this study may imply that some entry deterrence of the foreign multinational firms and some additional exit of the domestic outsourcing firms may occur when vertical integration becomes more widespread than before in a firm's investment-intensive sectors. Such outcomes are due to an indirect effect of the increased vertically integrated firms in a host country. This indirect effect may be derived from comparing the case in which the number of domestic vertical integration firms would be fixed even after a new entry. Our framework may elucidate the difference in the number of multinational entrants across the countries and sectors to a certain extent.

From this perspective, our study may provide an analysis of not only the organizational change but also the indirect effects on some entry barriers. If policymakers disregard these indirect effects of organizational restructuring, it may misevaluate some effects of new foreign multinational entry in developing countries (for example, the spillover effect on the domestic productivity or labor). Thus, it can be essential to analyze domestic firms' organizational changes when experiencing new foreign multinational entry.

The analysis in this study captures the relationship between an intermediate-input supplier and a final-good producer. We can also apply our model to capturing a firm's relationship with a distributor or a retailer instead of an intermediate-input supplier. Vertical integration with a distributor or a retailer may make it possible for a firm to access customer information further. Such vertical linkage may assist a firm in surviving in the competitive market environment. From this perspective, the application of our model for the relationship between a firm and a distributor/retailer may also provide important implications.

Despite these contributions of this study, there remain some recommendations for further research. One of them is that this model may be applied to the analysis of domestic vertical integration's entry deterrence effect against foreign multinational entry. The increase in the number of domestic vertical integration firms may demonstrate a cross-sectoral distinction in the number of foreign multinational entrants. In the business literature, several studies report that strengthening the vertical relation effectively works as a survival strategy of the domestic firms to protect their markets from multinational entry (Dawar and Frost, 1999; Venugopal, 2010; Sanotos and Williamson, 2015).[24] We hope that this study assists researchers in addressing this type of entry deterrence phenomenon.

Appendix A Numerical results under the lower organizational cost for domestic outsourcing

This appendix provides the numerical results when domestic outsourcing's organizational cost $f_{H|O}$ is sufficiently low. Other parameters do not change with the parameter set summarized in Table 2. We set $f_{H|O} = 0.02$ in this appendix instead of $f_{H|O} = 0.05$ in Section 5. In this setting, we obtain the following results.

Result 4. *When the organizational cost of domestic outsourcing $f_{H|O}$ decreases, the relationship between multinational entry and the organizational forms of the domestic firms is summarized as*

[24] One can consult, for example, Kitamura, Matsushima, and Sato (2021), who consider a local firm's survival strategy to protect a local market from multinational entry via exclusive dealing by employing a game-theoretic approach.

follows:

1. *The parameter of* (β, η) *in which the fraction of domestic vertical integration* $\phi_{H|V}$ *increases or decreases does not change.*

2. *The parameter of* (β, η) *in which the amount of domestic vertical integration* $N_{H|V}$ *increases becomes narrower.*

3. *The parameter region of* (β, η) *in which the amount of the active domestic firms* N_H *decreases becomes wider. For* $f_{H|O} = 0.02$*,* N_H *always decreases.*

4. *The parameter region of* (β, η) *in which the amount of domestic outsourcing* $N_{H|O}$ *decreases becomes wider. For* $f_{H|O} = 0.02$*,* $N_{H|O}$ *always decreases.*

Figures 9, 10, 11, and 12 summarize Result 4. Note that Figures 6 and 10 coincide; that is, a decrease in organizational cost of domestic outsourcing does not affect the organizational form of domestic firms in terms of the fraction of the domestic firms. The basic direction of $\phi_{H|V}$'s change is determined by the sign of $\partial\psi_O/\partial\beta_O$. Because equation (22) is determined by α and η, the level of the organizational cost does not affect the change in ψ_O; therefore, the first property of Result 4 holds.

Conversely, a decrease in domestic outsourcing's organizational cost affects the domestic firms' organizational form in terms of the amount. Note that a decrease in $f_{H|O}$ increases the amount of active firms N, affecting bargaining under outsourcing. Because $\partial\sigma(N)/\partial N = \tau e^{-\tau N} > 0$ and $\partial^2\sigma(N)/\partial N^2 = -\tau^2 e^{-\tau N} < 0$, multinational entry does not considerably decrease the revenue share of the outsourcing firms β_O for a lower value of $f_{H|O}$. Equation (21) implies that this effect reduces the level of $\phi_{H|V}$'s change, as compared with the case of the higher value of $f_{H|O}$. Therefore, a change in the aggregate production X becomes more dominant. Because a change in X may discourage domestic vertical integration, the amount of vertical integration decreases. Moreover, a change in X reduces the domestic firms' profit, which decreases the amount of active firms and, hence, the amount of domestic outsourcing.

[Table 2 about here]

[Figures 9, 10, 11, and 12 about here]

Appendix B Proof of All Results

B.1 Proof of Lemma 1

The first-order conditions under vertical integration satisfy

$$R_y\left(y_{l|V}(i), z_{l|V}(i)\right) = R_z\left(y_{l|V}(i), z_{l|V}(i)\right) = c.$$

Note that $y_{l|V}(i)$ and $z_{l|V}(i)$ are the optimal input production levels under the joint profit maximization problem. The input production levels under outsourcing $y_{l|O}(i)$ and $z_{l|O}(i)$ satisfy

$$\beta_O R_y\left(y_{l|O}(i), z_{l|O}(i)\right) = (1-\beta_O) R_z\left(y_{l|O}(i), z_{l|O}(i)\right) = c.$$

By comparing (7) and (11), we have $\psi_V \gtreqless \psi_O$ if and only if $\pi_V(\theta, f) \gtreqless \pi_O(\theta, f)$. Because $\pi_V(\theta, f)$ is the maximized value, $\pi_V(\theta, f) \geq \pi_O(\theta, f)$ must hold for all $\theta > 0$ by definition. However, we show that $\pi_V(\theta, f) = \pi_O(\theta, f)$ never holds. Suppose that in negation, there exists a case in which $\pi_V(\theta, f) = \pi_O(\theta, f)$. Because we have a unique solution, $y_{l|O}(i) = y_{l|V}(i)$ and $z_{l|O}(i) = z_{l|V}(i)$. Thus, we have $\beta_O R_y\left(y_{l|V}(i), z_{l|V}(i)\right) = c$. However, this contradicts first-order condition (B.1). Thus, we have $\psi_V > \psi_O$.

Q.E.D.

B.2 Proof of Proposition 1

Assume that for all $l \in \{H, M\}$, $0 < \theta_{l|O} < \theta_{l|V}$ holds in an equilibrium. Subsequently, from equations (14) and (15), N and X can be determined; thus, β_O and ψ_O can be determined. Because every firm under monopolistic competition is small, a single firm's decision on organizational form does not affect the levels of N and X. Given N and X exogenously, the firms' profits $\pi_k(\theta, f_{l|k})$, where $k \in \{O, V\}$, are summarized in Figure 3, which shows that for sufficiently large f_{lV}, we have $0 < \theta_{lO} < \theta_{lV}$ for all $l \in \{D, M\}$.

Q.E.D.

B.3 Proof of Lemma 2

By partially differentiating $\phi_{H|V}$ with respect to ψ_O, we have

$$\frac{\partial \phi_{H|V}}{\partial \psi_O} = -\frac{\delta (1-\alpha) \psi_V f_{H|O}}{\alpha \psi_O^2 \left(f_{H|V} - f_{H|O}\right)} \left[\frac{(\psi_V - \psi_O) f_{H|O}}{\psi_O \left(f_{H|V} - f_{H|O}\right)}\right]^{\frac{\delta(1-\alpha)-\alpha}{\alpha}} < 0.$$

Q.E.D.

B.4 Proof of Lemma 3

From Assumption 1 and equation (8), we have $\partial \beta_O / \partial N = -\gamma^{\alpha} \sigma' (N) < 0$.

Q.E.D.

B.5 Proof of Lemma 4

By solving $\partial \psi_O / \partial \beta_O \gtreqless 0$ with respect to β_O, we have $\beta_O \lesseqgtr \beta_O^* (\eta)$, which satisfies $\beta_O^* (0) = 0$ and $\beta_O^* (1) = 1$. For $\eta = 1/2$, we can use L'Hôpital's rule, which leads to $\lim_{\eta \to 1/2} \beta^* (\eta) = 1/2$. Finally, we show that $\partial \beta_O^* (\eta) / \partial \eta > 0$. By differentiating $\beta_O^* (\eta)$ with respect to η, we have

$$\frac{\partial \beta_O^* (\eta)}{\partial \eta} = \frac{\sqrt{\lambda} (1 - \alpha (1 - 2\eta (1-\eta))) \left((1 - 2\alpha\eta (1-\eta)) - 2\sqrt{\lambda}\right)}{2 (1-2\eta)^2 \lambda},$$

where $\lambda = \eta (1-\eta) (1-\alpha\eta) (1-\alpha (1-\eta))$. Note that $\partial \beta_O^* (\eta) / \partial \eta > 0$ if and only if $1 - 2\alpha\eta (1-\eta) > 2\sqrt{\lambda}$. Because we have $(1 - 2\alpha\eta (1-\eta))^2 - 4\lambda = (1-2\eta)^2 > 0$, $\partial \beta_O^* (\eta) / \partial \eta > 0$ holds for $\eta \neq 1/2$. For $\eta = 1/2$, by using L'Hôpital's rule, we have $\lim_{\eta \to 1/2} \beta_O^* (\eta) / \eta = 1 / (2 - \alpha) > 0$. Thus, we always have $\partial \beta_O^* (\eta) / \partial \eta > 0$.

Q.E.D.

B.6 Proof of Proposition 2

By applying Assumption 2 and the results in Lemmas 2, 3, and 4 to equation (21), condition (23) can easily be shown to hold.

Q.E.D.

B.7 Proof of Lemma 5

By partially differentiating π_k with respect to X, we have

$$\frac{\partial \pi_V}{\partial X} = -\frac{\alpha - \mu}{1-\alpha} X^{-\frac{1-\mu}{1-\alpha}} \psi_V \theta^{\frac{\alpha}{1-\alpha}} < -\frac{\alpha - \mu}{1-\alpha} X^{-\frac{1-\mu}{1-\alpha}} \psi_O \theta^{\frac{\alpha}{1-\alpha}} = \frac{\partial \pi_O}{\partial X} < 0.$$

for $\psi_O < \psi_V$.

Q.E.D.

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Variable	Definition
X	aggregate production (consumption)
$\theta_{H\|O}$	cutoff productivity for domestic outsourcing
$\theta_{H\|V}$	cutoff productivity for domestic vertical integration
$\theta_{M\|O}$	cutoff productivity for foreign multinational outsourcing
$\theta_{M\|V}$	cutoff productivity for foreign multinational vertical integration
$\phi_{H\|O}$	fraction (relative prevalence) of domestic outsourcing
$\phi_{H\|V}$	fraction (relative prevalence) of domestic vertical integration
N	total amount of operating firms (including foreign multinational subsidiaries)
$N_{H\|O}$	amount of domestic firms under outsourcing
$N_{H\|V}$	amount of domestic firms under vertical integration
ψ_O	degree of two-sided hold-up problem under outsourcing
ψ_V	profit parameter under vertical integration
β_O	revenue share under outsourcing
β_V	revenue share under vertical integration
π_O	profit under outsourcing
π_V	profit under vertical integration
$\sigma(\cdot)$	revenue share at outside option under outsourcing
α	degree of product differentiation
δ	shape parameter of Pareto distribution
b	scale parameter of Pareto distribution
c	unit labor cost
μ	share of consumption spends of each sector
τ	shape parameter of $\sigma(\cdot)$
γ	fraction of loss at outside option under outsourcing
β	bargaining power
η	firm's investment intensity
$f_{H\|O}$	organizational cost of domestic outsourcing
$f_{H\|V}$	organizational cost of domestic vertical integration
$f_{M\|O}$	organizational cost of foreign multinational outsourcing
$f_{M\|V}$	organizational cost of foreign multinational vertical integration
$p(i)$	price of final goods for firm i
$x(i)$	quantity of final goods for firm i
$y(i)$	quantity of firm's investments (firm's inputs) for firm i
$z(i)$	quantity of intermediate inputs for firm i
$R(i)$	revenue of firm i

Table 1: Variable Definitions

Parameter	Value
α	0.75
δ	4.25
b	1
c	1
μ	0.5
τ	50
γ	0.5
β	$\{0.05, 0.10, .., 0.95\}$
η	$\{0.05, 0.10, .., 0.95\}$
$f_{H\|O}$	0.5
$f_{H\|V}$	10
$f_{M\|O}$ (before)	1
$f_{M\|O}$ (after)	0.9
$f_{M\|V}$	20

Table 2: Parameter Values

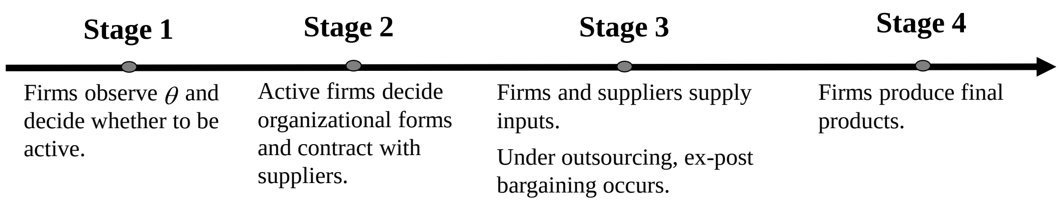

Figure 1: Timing of game

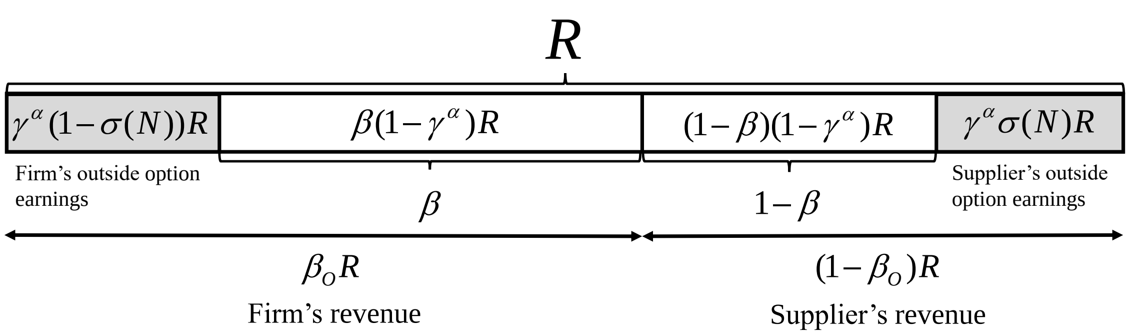

Figure 2: Bargaining over revenue under outsourcing.

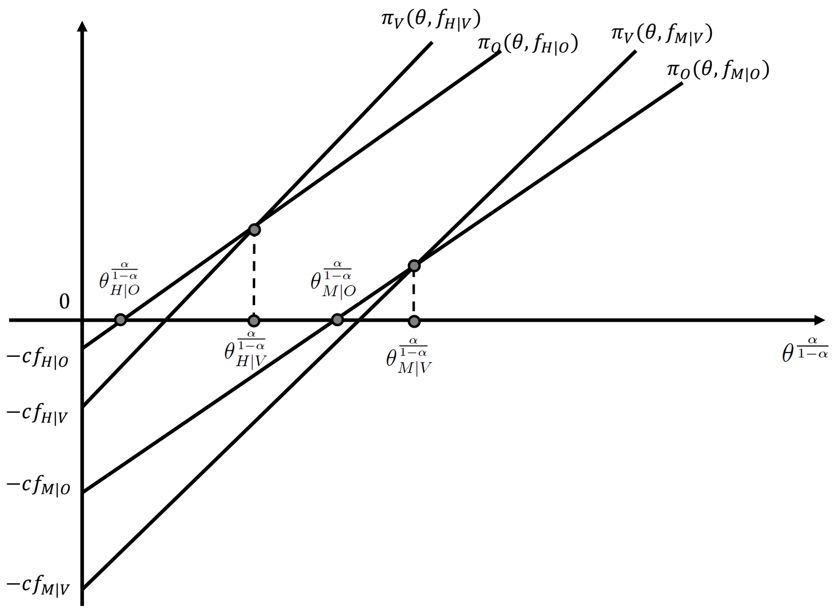

Figure 3: Equilibrium

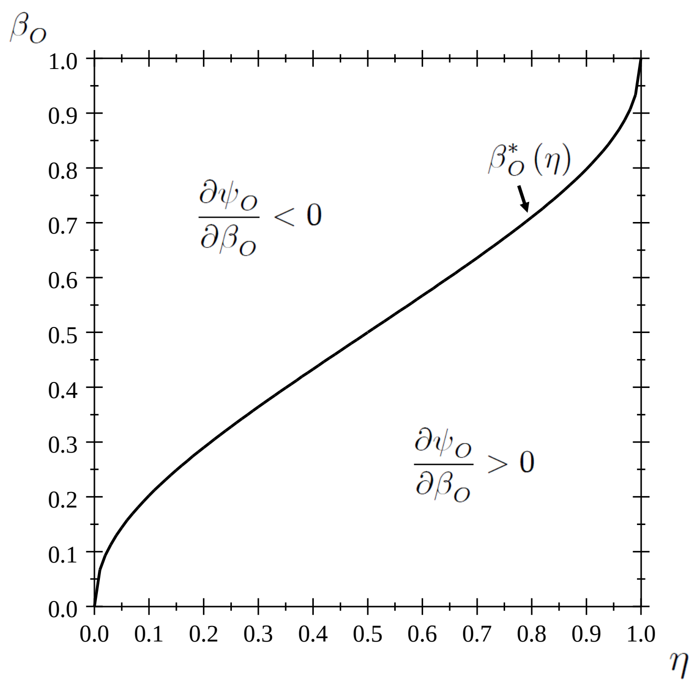

Figure 4: Properties of $\beta_O^*(\eta)$

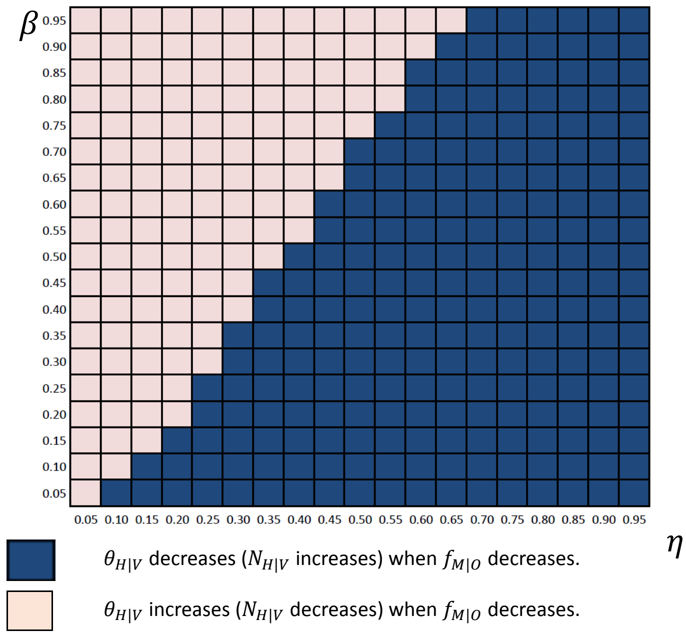

Figure 5: Changes of $\theta_{H|V}$ when $f_{M|O}$ decreases.

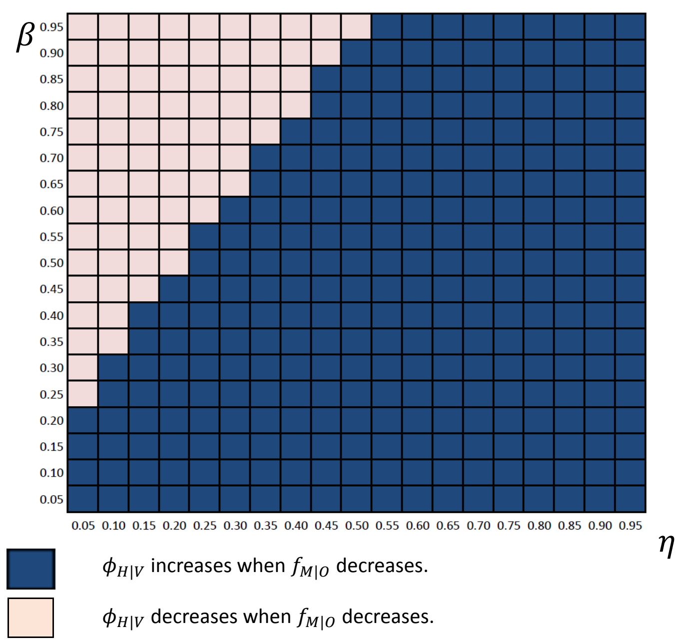

Figure 6: Changes of $\phi_{H|V}$ when $f_{M|O}$ decreases.

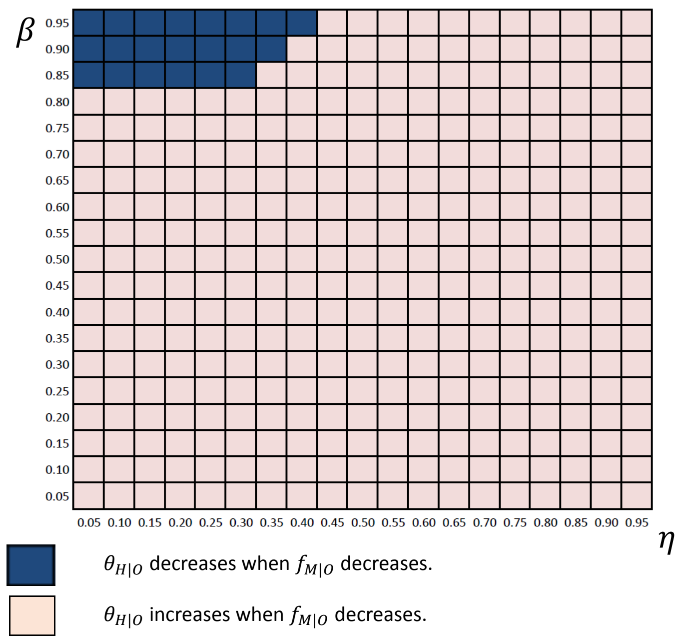

Figure 7: Changes of $\theta_{H|O}$ when $f_{M|O}$ decreases.

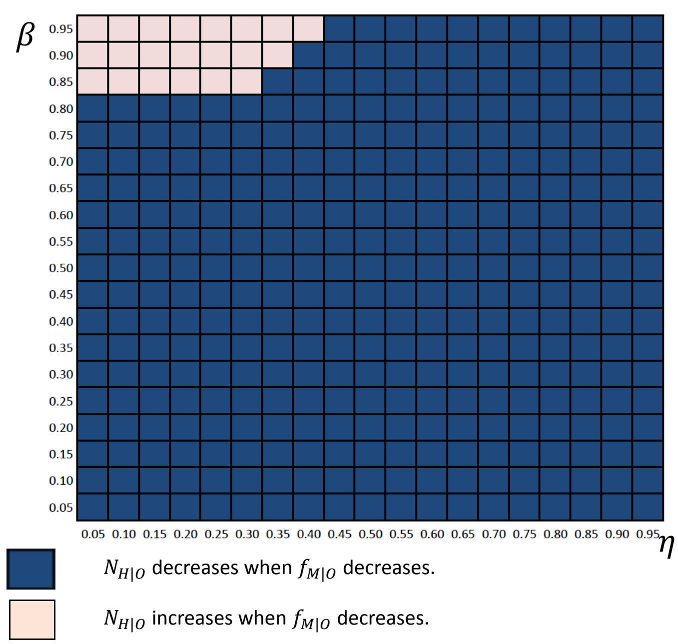

Figure 8: Changes of $N_{H|O}$ when $f_{M|O}$ decreases.

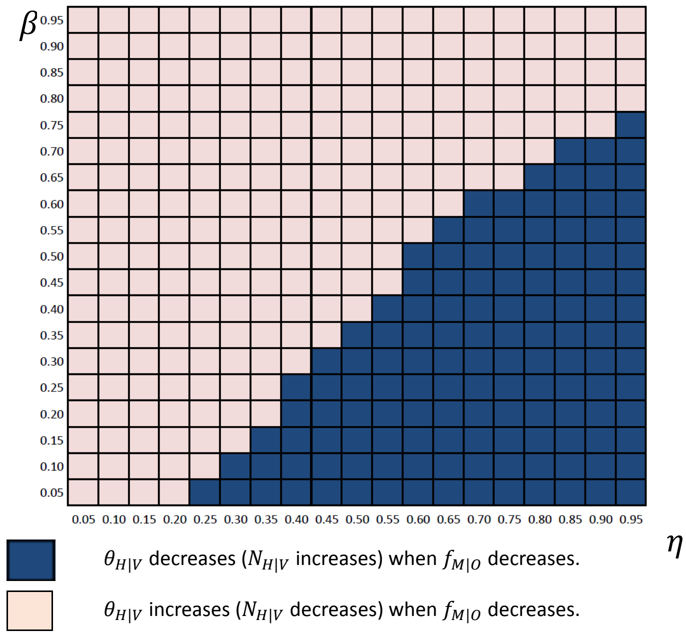

Figure 9: Changes of $\theta_{H|V}$ when $f_{M|O}$ decreases ($f_{H|O}$ = 0.02).

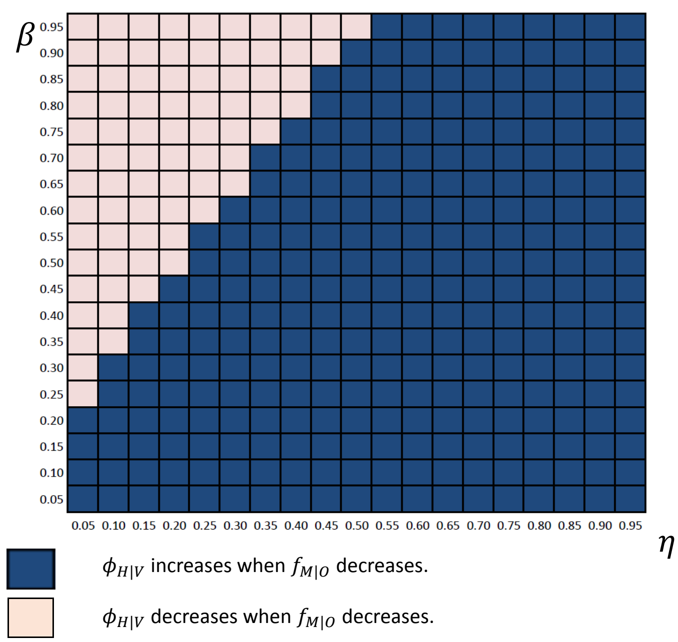

Figure 10: Changes of $\phi_{H|V}$ when $f_{M|O}$ decreases ($f_{H|O}$ = 0.02).

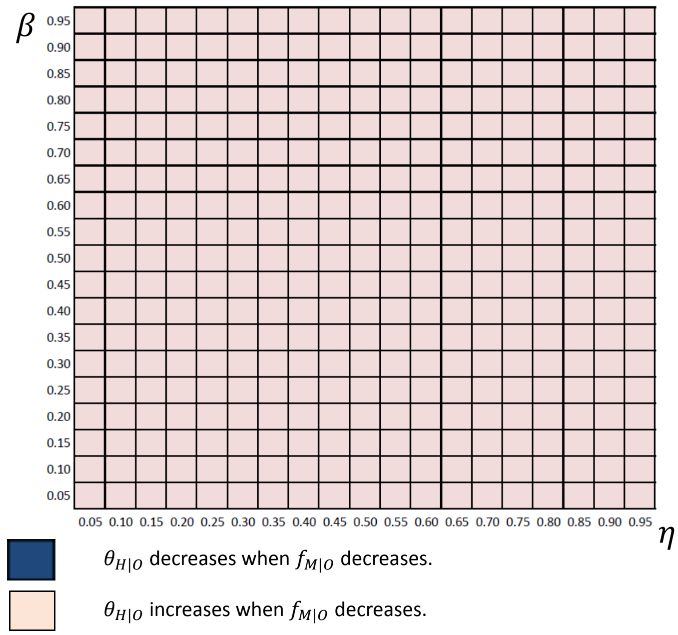

Figure 11: Changes of $\theta_{H|O}$ when $f_{M|O}$ decreases ($f_{H|O}$ = 0.02)

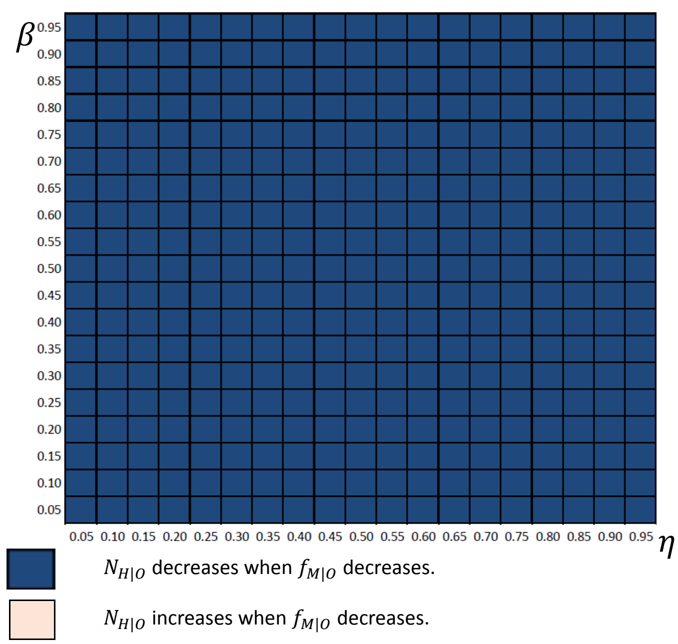

Figure 12: Changes of $N_{H|O}$ when $f_{M|O}$ decreases ($f_{H|O}$ = 0.02).