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Conflict management in a multinational firm's production shifting decisions

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Conflict Management in a Multinational Firm’s Production
Shifting Decisions

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Conflict Management in a Multinational Firm’s Production Shifting Decisions

Abstract: In recent years, many apparel multinational firms (MNFs) have shifted their production from traditional manufacturing bases (e.g., China) to the emerging ones located in Southeast Asia (e.g., Vietnam and Bengal). The interactions among market sizes, MNF’s competition with local rival and the global tax rules play key roles in the MNF’s decisions. In this paper, we study the preferences of a MNF and its contract manufacturer (CM) over two manufacturing outsourcing structures and investigate whether their objective conflicts can be reconciled. The MNF relies on the CM for production and sells goods in both Chinese and Southeast Asian markets. It is optional for the MNF to use a CM located in China, but has to suffer from the CM’s differential prices because of China’s partial value-added tax (VAT) refund policy. It is also optional for the MNF to use a CM located in Southeast Asia, resulting in uniform production fee for the goods sold in two markets. The former is traditional outsourcing structure (TS), and the latter is shifted outsourcing structure (SS). Interestingly, we find that, the MNF may first prefer SS, then prefer TS, and back to prefer SS, as the relative market potential between the Southeast Asian market and the Chinese market increases. The CM’s preferences may switch twice, too. We identify the opportunities where the preferences of the MNF and the CM are aligned, which are driven by China’s partial VAT refund policy.

Keywords: Objective conflict; Manufacturing outsourcing; Partial VAT refund policy; Coordination opportunities
1. Introduction

It is common practice for the multinational firms (MNFs) to outsource their manufacturing to contract manufacturers (CMs), which is particularly prominent in the apparel industry (Sodhi and Tang, 2013; Xu et al., 2018). Traditionally, because of China’s low labor cost and huge market potential, many apparel MNFs have outsourced manufacturing to Chinese CMs. A typical example is UNIQLO, which relies on Chinese CMs such as Shenzhou Group as its long-term manufacturing partners (Shenzhou Group, 2006). Next Insight reports that, UNIQLO’s products manufactured in Shenzhou Group’s factories are of large volume because they are for both Chinese and Southeast Asian markets (Zhang, 2009).

However, it is witnessed that many apparel MNFs have shifted their production to Southeast Asian countries such as Bengal and Vietnam, because of the increasing labor cost in China (Fibre2Fashion, 2012). According to an industrial report in 2019, the percent of Southeast Asian countries’ CMs in the world has accounted for 37.67% in 2017, 39.13% in 2018 and 42.15% in 2019 (Fast Retailing, 2019). Many popular fashion brands such as UNIQLO, Steve Madden, Coach, and Deckers are shifting their production to Southeast Asian countries (Pino, 2018), which motivates their Chinese CMs to close the factories in China and open new ones in Southeast Asian. For example, Shenzhou Group, the biggest apparel CM in China, has built factories in Vietnam to continue providing contract manufacturing services for UNIQLO (China Daily, 2015).

What are the driving forces behind the decisions of the apparel MNFs and their CMs to shift production out of China? Many discussions have been conducted. We summarize the key points as follows. (1) If the CMs are located in China, they will follow China’s partial value-add tax (VAT) refund policy when exporting products to Southeast Asian. In recent studies such as Hsu and Zhu (2011) and Xu et al. (2018), this specific VAT policy will significantly affect MNFs’ supply chain decisions, when the products are made in China and sold in both Chinese and Southeast Asian markets. That is, if a firm uses inputs sourced in China to produce an exported product, it will receive a partial refund of the paid input VAT, resulting in a tax burden (the details of “partial VAT refund policy” can be found in Section 3: Model Settings). Therefore, Chinese CMs have the incentives to price differentially for the products sold in Chinese and Southeast Asian markets, so as to mitigate the profit loss because of partial VAT refund policy (Xu et al., 2018). (2) From the
perspective of the MNFs, they have to suffer from the impact of price discrimination from the CMs, and the CMs’ pricing flexibility helps themselves better squeeze profits from the MNFs. (3) On the contrary, if the CMs are located in Southeast Asian, the MNFs benefit from the low labor costs, and there are no partial VAT refunds policies\(^1\). The CMs have no reasons to charge two manufacturing prices for the goods sold in Chinese and Southeast Asia markets. This eventually benefits the MNFs.

It seems that the MNFs always prefer production shifting to Southeast Asian, but the CMs do not. This induces objective conflicts between these two supply chain parties. Several natural questions arise: Will apparel MNFs really benefit from production shifting? Whether the Chinese CMs have incentives to shift production too? How to manage the objective conflicts between the MNFs and their CMs?

To answer the aforementioned research questions, we build a stylized model comprising a CM, a MNF and a Chinese local competitor of the MNF. The MNF sells goods in both Chinese and Southeast Asian markets and competes with the local competitor in the Chinese market. The MNF can either outsource manufacturing to the CM located in China, referred to as traditional outsourcing structure (TS), or outsource manufacturing to the CM located in Southeast Asian, referred to as shifted outsourcing structure (SS). Our focus is the MNF and the CM’s preferences over two outsourcing structures and whether the objective conflict can be reconciled. The main findings are as follows.

First, the MNF’s preference over TS and SS depends on the relative market potential between the Southeast Asian market and the Chinese market. That is, the MNF is better off under SS when the relative market potential is either low or high, while it is better off under TS when the relative market potential is in a moderate range. The driving force for the MNF to prefer SS is that, under SS, the CM can only set a uniform manufacturing price and hence lose the pricing flexibility. This benefits the MNF. It is interesting to find that the MNF may benefit from TS even though it

\(^1\) Southeast Asian countries also have export tax refund policies, but they return all the VAT (in China, it is partial refund VAT). Taking Vietnam as an example. According to the guidance document (Circular No. 94/2010/TT-BTC) provided by Vietnam Customs, the tax authorities should refund VAT in full to the companies with export business (Vietnam Customs, 2010). Similar policies have been adopted by Malaysia, Thailand and other Southeast Asian countries.
suffers from the CM’s differentiated prices because of China’s partial VAT refund policy. The intense downstream competition under SS because of the uniform manufacturing price holds the key.

Second, interestingly, the CM’s preference over TS and SS shows an opposite trend to the MNF’s. The CM benefits from SS when the relative market potential is in a moderate range, which is contrary to the intuition that the CM always benefits from TS. The key is still China’s partial VAT refund policy. The tax burden under TS becomes heavier as the relative market potential increases, resulting in the deviation from TS for the CM. We then investigate the incentive alignment opportunities of the MNF and the CM, finding that win-win solutions can be achieved where both of them benefit from TS or SS.

The rest of this paper is organized as follows. In Section 2, the related literature is reviewed. Section 3 presents the model settings and notations. In Section 4, we first analyze the preferences of the MNF and the CM over SS and TS. Section 5 provides two extensions considering the impact of the CM’s non-negative manufacturing cost under TS and the local competition the MNF faces in Southeast Asian. Section 6 concludes this paper. All the proofs are in the Appendix.

2. Literature Review

Our work is closely related to the studies on conflict management. There are mainly three sub-streams of literature. The first one is on channel conflicts because of upstream companies’ direct sales, which results in competition with their existing retail partners. Some studies demonstrate that, the retailer might benefit from channel conflict because the double marginalization effect can be weakened (Chiang et al., 2003; Kumar and Ruan 2006; Arya et al., 2007). Some other studies try to find ways to mitigate channel conflicts by designing coordination mechanisms using sales effort, pricing scheme, linear quantity discount contract, subsidy, markup pricing strategies et al. See Tsay and Agrawal (2004), Cai et al. (2009), David and Adida (2015), Yoon (2016) and Wang et al. (2017) for the details.

The second sub-stream of literature is on system conflicts because supply chain parties’ decisions usually do not align with the system optimal one. How to design supply chain contracts hence become the research focus. For example, Cachon and Lariviere (2005) design revenue-sharing contracts to coordinate the supply chain and compare the coordination effect with the
other contracts (e.g., buy-back contracts (Pasternack, 1985), quantity flexibility contracts (Tsay, 1999) and sales-rebate contracts (Taylor, 2002). See Cachon (2003) for an excellent review of this sub-stream of literature. We note that, there is a growing body of literature that investigates how to maximize a MNF’s after-tax profit and balance the conflicts between the MNF and its retail division (Liu et al., 2015; Shunko et al., 2017; Kim et al., 2018; Niu et al., 2019a). Our paper is related to these studies but our focus is the objective conflict between the CM and the MNF on production shifting, which is important in today’s global operations. We investigate the role of China’s partial VAT refund policy in aligning the preferences of the MNF and the CM, which appears new in the literature.

The third sub-stream of literature is on objective conflicts, especially on that between profit objective and social responsibility objective. In terms of corporate social responsibility, previous studies mostly concern environmental sustainability (Shen and Li 2015; Dong et al., 2016; Lam et al., 2016; Yang et al., 2019). However, their studies do not study how to achieve the coordination of “economic sustainability” and “environmental sustainability” (Choi and Chiu, 2012). This motivates scholars to identify ways to coordinate these two objectives. See Krass et al. (2013) and Niu et al. (2019b) for two typical examples.

Our work is closely related to the studies on tax rules and MNFs’ global operations. Most recent studies include Hsu and Zhu (2011), Huh and Park (2013), Shunko et al. (2014), Xiao et al. (2015), Shunko et al. (2017), Xu et al. (2018) and Hsu et al. (2019). Among them, Huh and Park (2013), Shunko et al. (2014), Xiao et al. (2015), Shunko et al. (2017), Hsu et al. (2019) focus on tax-planning that helps a MNF obtain more after-tax profits, so their concern is the corporate income tax. There is a line of research that considers China’s import-export tax rules such as Hsu and Zhu (2011) and Xu et al. (2018). Specifically, Hsu and Zhu (2011) demonstrate that China’s import-export tax rules will affect the logistics strategies of a MNF, which serves both overseas and domestic markets. Xu et al. (2018) consider the impact of China’s import-export tax rules on a MNF’s procurement outsourcing decisions who sells goods in China confronting local competition but is monopolist in the overseas market. Different from their studies, we study how China’s import-export tax rules affect the MNF and CM’s preferences of production shifting decisions and the opportunities where their objective conflicts can be solved. We build
competition models in both Chinese and overseas markets, which is different from Xu et al. (2018).

The third stream of related literature is on global manufacturing decisions. On the one hand, early literature, such as Kogut and Kulatilaka (1994), Colotla et al. (2003), Kouvelis and Su (2005), Vereecke et al. (2006), Lu and Mieghem (2009) and Sodhi and Tang (2013), focuses on the optimization of global manufacturing network. On the other hand, more recent studies focus on the production location issues, For example, Wu and Zhang (2014) study the tradeoffs between responsive sourcing and efficient sourcing strategies, based on demand variance and competitors’ information correlations. Chen and Hu (2017) investigate a manufacturer’s offshoring-reshoring decisions by formulating its offshore supply dependence and the impact of tariffs. Our work is mostly related to Shao et al. (2019) and Niu et al. (2019c). The former investigates a sourcing game of competing firms that considers cost difference and cost uncertainty issues between the traditional manufacturing country (e.g., China) and the emerging manufacturing countries (e.g., Southeast Asian countries). The latter studies a MNF’s two global manufacturing strategies called “overseas-production-local-sales” (OPLS) and “local-production-local-sales” (LPLS). They focus on the tradeoff between producing in emerging markets for tax concessions and producing overseas for factory establishment cost avoidance. Differently, we study the incentive alignment issues for a MNF and its CM when factories can be shifted from China to Southeast Asian countries. We formulate China’s specific partial VAT refund policy, which is absent in the other countries/regions. We also study the impact of import tariff when the goods are produced in China (Southeast Asian countries) and then sold in Southeast Asian countries (China).

3. Model Settings

We consider a supply chain comprising a MNF, a competitor located in the Chinese market and a CM manufacturing for the MNF. The MNF establishes two divisions that are responsible for the sales in the Chinese market (the retail price is $p_m$) and the Southeast Asian market (the retail price is $p_o$), respectively. In terms of the Chinese competitor, it only sells products that are partially substitutable for the MNF’s (the retail price is $p_c$). We use the subscripts $c$, $m$, $o$ and $cm$ to denote the competitor, MNF’s supply to the Chinese market, MNF’s supply to the Southeast
Asian market and the CM, respectively. We study two outsourcing structures that are defined as follows.

**Traditional outsourcing (TS):** In this structure, the MNF outsources its manufacturing to the CM located in China. The CM charges two different manufacturing prices for the products sold in Chinese and Southeast Asian markets, because of China’s partial VAT refund policies.

**Shifted outsourcing (SS):** In this structure, the MNF outsources its manufacturing to the CM located in Southeast Asian. The MNF pay a uniform manufacturing price \( w \) to the CM.

We here briefly illustrate how China’s partial refund policy works. Consider firm C that purchases one unit input in China at a price \( 10\$ \) (exclusive of VAT). The total payment by firm C to its supplier is \( 10(1 + r_V)\$ \), where \( r_V \) (fixed at 13% in China (China Daily, 2019)) is the standard VAT rate. Then, firm C has two options in sales.

- Suppose firm C sells one unit product to firm D in China at price \( 100\$ \) (exclusive of VAT). Firm C will receive a total payment of \( 100(1 + r_V)\$ \) from firm D, where \( 100r_V\$ \) is firm C’s output VAT. Thus, firm C has to remit \( 90r_V\$ \) to the tax authority as its VAT, and acquires after-tax profit of \( 100(1 + r_V) - 10(1 + r_V) - 90r_V = 90\$. 

- Suppose firm C exports one unit product to an overseas buyer at price \( 100\$ \). In this case, it cannot collect output VAT and will receive a partial refund of its input VAT. Firm C’s VAT payment to the tax authority = output VAT for domestic sales – input VAT paid + nondeductible VAT, where nondeductible VAT = (total export sales – CIF costs of bonded imported inputs) \( \times (r_V - r_R) \). \( r_R \leq r_V \) is the VAT refund rate (Hsu and Zhu, 2011). Clearly, the VAT for domestic sales = \( 0\$, input VAT paid = \( 10r_V\$ \) and nondeductible VAT = \( 100(r_V - r_R)\$ \). Therefore, firm C’s VAT payment to the tax authority = \( 0 - 10r_V + 100(r_V - r_R)\$ \). Thus, firm C can obtain after-tax profit \( 100 - 10(1 + r_V) - [0 - 10r_V + 100(r_V - r_R)] = [100(1 - r) - 10]\$, where \( r = r_V - r_R \) (0 < \( r \) < 0.13).

We see from the above illustrative examples that the firm’s domestic profits are unaffected by VAT, but the unit profit for its export business is affected by the partial VAT refund policy in the

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2 When firm C produces goods in Southeast Asian countries and exports them to China, there is no nondeductible VAT. Therefore, firm C’s VAT payment to the tax authority = output VAT for domestic sales – input VAT paid. And firm C’s after-tax profit is \( 100 - 10(1 + r_V) - (0 - 10r_V) = 90\$, which is unaffected by the VAT.
form of $p(1-r) - c$. Thus, a firm selling its product to both overseas and domestic markets legally prices the exported and domestic products differently (even to the same buyer), in order to mitigate the negative effect of the partial VAT refund policies (see page 255 of Xu et al. (2018)).

Back to our case of the CM located in China. Clearly, the profits from the Chinese market is unaffected by VAT, but the profit from the Southeast Asian market is affected by the partial VAT refund policy. Therefore, the marginal profits of the CM located in China charges manufacturing prices $w_1$ and $w_2(1-r)$ for the goods sold in the Chinese and Southeast Asian markets, respectively. We assume the manufacturing cost of the CM is zero, and the case of non-zero cost is discussed in Section 5.1.

Figure 1. Illustration of outsourcing structures

According to the data from IBISWorld, China’s footwear industry consists of over 14,400 businesses in 2018. The competition in Chinese market is significantly fiercer than that in Southeast Asian countries. Therefore, we follow Xu et al. (2018) by assuming the MNF is a monopolist in the Southeast Asian market but engages in Cournot competition with a local competitor in the Chinese market. This assumption will be relaxed in Section 5.2. The inverse demand functions of the competitor and the MNF are

$$p_c = a - q_c - bq_m;$$

$$p_m = a - q_m - bq_c;$$

$$p_o = a \theta - q_o;$$

Similar to the literature such as Tang et al. (2011), Chen et al. (2012) and Xu et al. (2018), the retail price of products is relevant to the sales quantities. The potentials of Chinese market and the Southeast Asian market are $a$ and $a \theta$. The parameter $\theta \in (0, +\infty)$ represents the relative market potential of the Southeast Asian market to the Chinese market. $\theta \in (0,1)$ ($\theta \in (1, +\infty)$)
indicates that the Southeast Asian market’s potential is smaller (bigger) than the Chinese market’s potential. $q_c$ and $q_m$ are the sales quantities of the local competitor and MNF in the Chinese market, and $q_o$ is the sales quantities of MNF in the Southeast Asian market. $b \in (0,1)$ represents the product substitutability between the local competitor’s product and MNF’s product in the Chinese market.

We present the objective functions of the decision makers as follows. For ease of analyzing, we assume $\frac{2(2-b)}{12-b^2} \leq \theta < \bar{\theta} = \frac{6-b^2}{2+b}$ to ensure positive outputs.

**TS:**

$$\pi_c = p_c q_c$$

$$\pi_m = (p_m - w_1) q_m + (p_o - w_2) q_o$$

$$\pi_{cm} = w_1 q_m + w_2 (1 - r) q_o$$

**SS:**

$$\pi_c = p_c q_c$$

$$\pi_m = (p_m - w) q_m + (p_o - w) q_o$$

$$\pi_{cm} = w (q_o + q_m)$$

The sequence of events is presented in Figure 2. In SS (TS), at the first stage, the CM sets the uniform (different) unit manufacturing price $w$ ($w_1$ and $w_2$) to the MNF. At the second stage, the MNF and the competitor decide the sales quantities.
We use backward induction to solve the games (see Appendix A.1 for more solution details). The equilibrium outcomes are summarized in Lemma 1 and 2.

**Lemma 1.** Under TS, the equilibrium wholesale prices, order quantities, and profits are:

1. \( w^T_1 = \frac{a(2-b)}{4}, \quad w^T_2 = \frac{a\theta}{2}; \)
2. \( p^T_c = \frac{a(4+b)}{4(2+b)}, \quad p^T_m = \frac{a(6-b^2)}{4(2+b)}, \quad p^T_o = \frac{3a\theta}{4}; \)
3. \( q^T_c = \frac{a(4+b)}{4(2+b)}, \quad q^T_m = \frac{2a}{4 + 2b}, \quad q^T_o = \frac{a\theta}{4}; \)
4. \( \pi^T_m = \frac{a^2(4+(2+b)^2\theta^2)}{16(2+b)^2}, \quad \pi^T_m = \frac{a^2(2-b+(2+b)(1-r)\theta^2)}{8(2+b)}, \quad \pi^T_o = \frac{a^2(4+b)^2}{16(2+b)^2}. \)

**Lemma 2.** Under SS, the equilibrium wholesale prices, sales quantities, and profits are:

1. \( w^S = \frac{(2-b)(2+(2+b)\theta)a}{2(8-b^2)}; \)
2. \( p^S_c = \frac{2(8+(1-b)(b)+b(2+b)a\theta(2(2+b)+(2+b)^2)a\theta)}{2(2+b)(8-b^2)}, \quad p^S_m = \frac{4(5-b^2)a+(2+b)(2-b^2)a\theta^2)}{2(2+b)(8-b^2)}, \quad p^S_o = \frac{2(2-b)^2a+(2-3b^2)a\theta}{4(8-b^2)}; \)
3. \( q^S_c = \frac{2(8+(1-b)(b) + b(2+b)a\theta)(2+b)(8-b^2)}{2(2+b)(8-b^2)}, \quad q^S_m = \frac{(6-b^2)a-(2+b)a\theta^2}{(2+b)(8-b^2)}, \quad q^S_o = \frac{12(b^2)a\theta-2(2+b)a}{4(8-b^2)}; \)
4. \( \pi^S_m = \frac{4(8-b^2)a+(2+b)^2a\theta^2}{16(8-b^2)^2}, \quad \pi^S_m = \frac{2(2-b)^2a+(2+b)^2a\theta^2}{8(2+b)(8-b^2)}; \)

\[ \pi^S_c = \frac{(2(8-b^2)a+b(2+b)a\theta)^2}{4(2+b)^2(8-b^2)^2}. \]

**4 Analysis**

In this section, we first present the comparison results of wholesale prices and sales quantities between two structures. Then, we show the MNF and the CM’s preferences over two structures and discuss the incentive alignment opportunities.

**4.1 Analysis of wholesale prices**

Define \( \theta_1 = \frac{2-b}{2}, \) we summarize the comparison results in Proposition 1.

**Proposition 1.** When \( \theta < \theta_1, \) we have \( w^T_2 < w^S < w^T_1; \) Otherwise, we have \( w^T_1 < w^S < w^T_2. \)

Proposition 1 indicates that, the order of three wholesale prices is determined by the relative market potential \( \theta. \) As \( \theta \) increases, the wholesale price charged for the MNF’s Southeast Asian division under TS (i.e. \( w^T_2 \)) changes from the lowest to the highest, while that for the MNF’s Chinese division under TS (i.e. \( w^T_1 \)) shows the opposite trend. The uniform wholesale price under SS (i.e. \( w^S \)) is always in the middle. The reasons behind Proposition 1 are clear. When \( \theta \) is small,
the Southeast Asian market is negligible compared to the Chinese market. Under TS, the CM has
pricing flexibility and hence, charges a high wholesale price for the MNF’s Chinese division
because of the large market potential. On the contrary, the wholesale price for the MNF’s
Southeast Asian division is low on account of the small market potential. Under SS, the CM sets a
uniform wholesale price for the MNF’s two divisions. From the perspective of selling to the
MNF’s Southeast Asian division, the CM has the incentives to decide a low wholesale price.
However, from the perspective of selling to the MNF’s Chinese division, the reversed incentives
arise. The CM has to balance the profits from Chinese market and Southeast Asian market by
setting a moderate wholesale price. In contrast, when $\theta$ is sufficiently large, the Southeast Asian
market becomes more significant because of the MNF’s monopolistic position. Therefore, the CM
would charge a higher wholesale price for the MNF’s Southeast Asian division than that for the
Chinese division under TS.

As we have stated, the wholesale price under SS is determined by balancing those for the
MNF’s two divisions under TS. One natural question arises: How do the differences between
wholesale prices under TS (i.e. $w^T_1$ and $w^T_2$) and that under SS (i.e. $w^S$) change with the relative
market potential $\theta$? We derive the following Lemma.

**Lemma 3.** When $\theta < \theta_1$, we have \( \frac{\partial |w^T_1 - w^S|}{\partial \theta} < 0 \) and \( \frac{\partial |w^T_2 - w^S|}{\partial \theta} < 0 \). Otherwise, we have
\( \frac{\partial |w^T_1 - w^S|}{\partial \theta} > 0 \) and \( \frac{\partial |w^T_2 - w^S|}{\partial \theta} > 0 \).

Lemma 3 indicates that, the absolute difference between $w^T_1$ and $w^S$, and that between $w^T_2$
and $w^S$ are both first decreasing and then increasing in $\theta$. When $\theta$ is small, the two wholesale
prices under TS both become closer to the uniform wholesale price under SS, as $\theta$ increases.
However, when $\theta$ exceeds a threshold, the two wholesale prices under TS both deviate from the
uniform wholesale price under SS, as $\theta$ increases. We define $|w^T_1 - w^S|$ and $|w^T_2 - w^S|$ as the
index of *wholesale price effect*. Note that, under TS, according to China’s partial VAT refund
policy, the CM can charge two wholesale prices based on whether the goods are sold to Chinese or
Southeast Asian market. The CM has the pricing flexibility which benefits itself while hurts the
MNF. Therefore, the *wholesale price effect* is always a negative (positive) force that makes the
MNF (CM) prefer TS. Moreover, as the relative market potential increases, the *wholesale price
**effect** is first weakened and then enhanced. It is especially pronounced when \( \theta \) is either small or large.

### 4.2 Analysis of sales quantities

We then investigate how the market potential influences the sales quantities of two firms. See Proposition 2 for the comparison results.

**Proposition 2.** When \( \theta < \theta_1 \), we have \( q_T > q_S, q_m > q_m^S, q_T > q_m^T \) and \( q_T + q_m > q_m^T + q_m^S \).

Proposition 2 indicates that, when \( \theta \) is small, the competitor and the MNF’s Southeast Asian division’s sales quantities are larger under TS than SS, while the MNF’s Chinese division’s sales quantity is smaller under TS than SS. Recall the conclusion in Proposition 1 that, compared to the uniform wholesale price under SS, the CM charges a lower wholesale price for the MNF’s Southeast Asian division and a higher wholesale price for the MNF’s Chinese division under TS, when the relative market potential is small. As such, for a small \( \theta \), SS can boost MNF’s Chinese division’s sales quantity for the lowered wholesale price. As a result, the total sales quantity in the Chinese market is large (i.e. \( q_T^C + q_m^T < q_T^S + q_m^S \)), leading to more intense downstream competition. One might intuitively expect that the intense competition hurts the MNF’s profit. On the contrary, regardless of the intense competition, we observe that the MNF can occupy a larger Chinese market share under SS than TS (i.e. \( \frac{q_m^T}{q_T^C + q_m^C} > \frac{q_m^T}{q_T^C + q_m^S} \), when \( \theta < \theta_1 \)), which acts as a positive force for the MNF to prefer SS. For a large \( \theta \), the MNF enjoys a low wholesale price under TS. Even though the competition is fierce, the MNF obtains a larger Chinese market share under TS than SS (i.e. \( \frac{q_m^T}{q_T^C + q_m^C} < \frac{q_m^T}{q_T^C + q_m^S} \), when \( \theta > \theta_1 \)), inducing the MNF to prefer TS. We define \( |\frac{q_m^T}{q_T^C + q_m^C} - \frac{q_m^T}{q_T^C + q_m^S}| \) as the index of competition effect. The competition effect is a negative force when \( \theta \) is small (i.e. \( \theta < \theta_1 \)), while a positive force when \( \theta \) is large (i.e. \( \theta > \theta_1 \)) that makes the MNF prefer TS. To better understand how \( \theta \) influences the competition effect, we derive Lemma 4.

**Lemma 4.** When \( \theta < \theta_1 \), we have \( \frac{\partial}{\partial \theta} |\frac{q_m^T}{q_T^C + q_m^C} - \frac{q_m^T}{q_T^C + q_m^S}| < 0 \). Otherwise, we have \( \frac{\partial}{\partial \theta} |\frac{q_m^T}{q_T^C + q_m^C} - \frac{q_m^T}{q_T^C + q_m^S}| > 0 \).

Lemma 4 implies that, the increase of relative market potential first weakens and then enhances the competition effect. It seems that \( \theta \) has the similar impact on the competition effect and the wholesale price effect. However, different from the wholesale price effect, which is always
a negative force for the MNF to prefer TS, the *competition effect* appears as a positive or negative force, depending on the value of $\theta$. As $\theta$ increase, a larger $\theta$ makes the MNF benefit more under TS, from the *competition effect*.

Next, we investigate the MNF’s preference over two structures by comparing the equilibrium profits. Define $\theta_2 = \frac{4(6-b^2)}{(2+b)(12-b^2)}$, we have Proposition 3.

### 4.3 Analysis of the MNF’s preference

**Proposition 3.** The MNF prefers TS when $\theta_1 < \theta < \theta_2$. Otherwise, it prefers SS (i.e. $\pi^T_m > \pi^S_m$ if $\theta_1 < \theta < \theta_2$).

Proposition 3 indicates that, the MNF prefers SS when the relative market potential is either small or large, while prefers TS when the relative market potential is in a moderate range (See Figure 3 for illustration). We use the abovementioned effects to explain the MNF’s preference change. When $\theta$ is small (i.e. $\theta < \theta_1$), the Southeast Asian market is negligible, the MNF cares more about the profit from the Chinese market for its huge market potential. The uniform wholesale price under SS is much lower than that for the MNF’s Chinese division under TS, resulting in a heavy *wholesale price effect*. In addition, compared to TS, the low procurement cost under SS boosts the MNF’s Chinese division’s order quantity and hence, leading to a heavy *competition effect*. Clearly, given a small $\theta$, the *wholesale price effect* and the *competition effect* both act as negative forces that make the MNF prefer SS. As $\theta$ increases, the two negative effects are both weakened, reducing the MNF’s incentives to prefer SS.

When $\theta$ is in a moderate range (i.e. $\theta_1 < \theta < \theta_2$), the Southeast Asian market is considerable and the MNF faces two equivalent profit sources. The wholesale prices for the MNF’s two divisions under TS are close to the uniform wholesale price under SS, resulting in weak *wholesale price effect*. However, since the wholesale price for the MNF’s Chinese division under TS is lower than that under SS, the *competition effect* changes from a negative force to positive force, inducing the MNF to prefer TS. In this interval, the benefit from the *competition effect* offsets the loss from the *wholesale price effect*, resulting in MNF’s preference over TS.

When $\theta$ is sufficiently large (i.e. $\theta > \theta_2$), the relative market potential is huge and becomes more appealing for the MNF because of the lack of competition. Due to the heavy *wholesale price effect*...
effect, the MNF benefits from SS for its lower uniform wholesale price, compared to TS. Under this condition, even though the competition effect brings the MNF into an inferior position in the Chinese market competition, the MNF prefers SS because the benefit from the Southeast Asian (monopolistic) market is far greater than the competition loss from the Chinese market.

4.4 Analysis of the CM’s preference

Next, we analyze the CM’s preference over two structures. Define $\theta_1 = \frac{(2-b)[2-(\beta-b)^2]r}{4-(\beta-b)^2}$ and $\theta_2 = \frac{(2-b)[2+(\beta-b)^2]r}{4-(\beta-b)^2}$, where $\theta_1 < \theta_2$.

**Proposition 4.** The CM is better off under SS when $\theta_1 < \theta < \theta_2$ (i.e. $\pi^S_{cm} > \pi^T_{cm}$ if $\theta_1 < \theta < \theta_2$).

Interestingly, similar to the MNF, the CM’s preference changes twice as the relative market potential increases. Intuitively, the CM may always prefer TS because it has the pricing flexibility and can use this pricing weapon to squeeze the MNF’s profits. Why does the CM benefit from SS, even though it loses the pricing flexibility? The key reason is China’s partial VAT refund policy. Note that the CM actually cannot receive the wholesale price it charged for the MNF’s Southeast Asian division. Instead, it can only receive a part of the manufacturing price (i.e. $w_2(1-r)$) because of China’s partial VAT refund policy. We define $w_2r$ as the index of the tax refund effect. The tax refund effect acts as a negative force for the CM to prefer TS and is enhanced as $\theta$ increases.

When $\theta$ is small (i.e. $\theta_1$), the CM cares more about the Chinese market because it can receive large orders from the MNF’s Chinese division. The orders from the MNF’s Southeast Asian division are so inappreciable that the CM doesn't have to worry about the negative effect of tax refund. Under TS, the benefit from pricing flexibility overcomes the loss from tax refund, resulting in CM’s preference over TS. As $\theta$ increases, the orders from the Southeast Asian market increase and hence, the negative effect of tax refund is magnified. Recall that, when $\theta$ is small, the wholesale price effect is weakened while the tax refund effect is enhanced as $\theta$ increases. The benefit from pricing flexibility decreases while the loss from tax refund increases. As a result, when $\theta$ is moderate (i.e. $\theta_1 < \theta < \theta_2$), the negative effect dominates the positive effect. The
CM is better off under SS. In contrast, when \( \theta \) is sufficiently large (i.e. \( \theta > \theta_{r2} \)), even though the orders from Southeast Asian market is large, the CM may undertake a huge loss from tax refund. We find that the CM prefers TS for the more powerful pricing weapon.

4.5 Analysis of the MNF and the CM’s incentive alignment

To better understand how to manage the conflicts between these two supply chain parties, we analyze their incentive alignment opportunities.

**Proposition 5.**

(1) The MNF and the CM both prefer SS if one of the following conditions holds:

\[
\begin{align*}
(\text{a}) & \quad 0 < r < \frac{7}{400}, \quad 0 < b < b_1 \\
& \quad \text{or} \quad r > \frac{7}{400}, \quad 0 < b < 1 \\
& \quad \text{and} \quad \theta \in (\theta_{r1}, \theta_{r2}) \cup (\theta_2, \theta_{r2}); \\
(\text{b}) & \quad 0 < r < \frac{7}{400}, \quad b_1 < b < 1 \\
& \quad \text{and} \quad \theta \in (\theta_{r1}, \theta_1).
\end{align*}
\]

(2) The MNF and the CM both prefer TS if and only if \( 0 < r < \frac{7}{400}, \quad b_1 < b < 1 \) and \( \theta \in (\theta_{r2}, \theta_2) \).

Here, \( b_1 \in (0,1) \) uniquely satisfies \( 576r - 192rb_1^2 + (-8 + 16r)b_1^4 + b_1^6 = 0 \).

Proposition 5 indicates that, there exist several win-win zones for the MNF and the CM (See Figure 3 for an illustration). Interestingly, the MNF and the CM may engage in incentive alignment under both SS and TS, depending on the difference between the VAT rate and the tax refund rate (i.e. \( r \)), and the Chinese market’s competition intensity (i.e. \( b \)).

As Proposition 5 (1) shows, when \( \theta_{r1} < \theta < \theta_1 \), the MNF and the CM both benefit from SS. Considering the *wholesale price effect*, one may conjecture that the MNF and the CM’s preferences over SS and TS are opposite. However, we note that the *wholesale price effect* and the *competition effect* both act as positive forces for the MNF to prefer SS, while the *tax refund effect* acts as a negative force for the CM to prefer TS. As a result, the CM changes its preference earlier than the MNF as \( \theta \) increases, resulting in a win-win situation for the MNF and the CM.

When \( \theta \) goes on increasing, another win-win zone arises, where the MNF and the CM’s common preference depends on \( b \) and \( r \). Note that, higher \( b \) and \( r \) represent stronger *competition effect* and *tax refund effect*, respectively. When \( r \) is high (i.e. \( r > \frac{7}{400} \)), the *tax refund effect* is so
strong that the CM changes its preference later than the MNF. When \( r \) and \( b \) are both low (i.e. \( 0 < r < \frac{7}{400} \) and \( 0 < b < b_1 \)), even though the tax refund effect is weak, it is still a positive force that encourages the CM to prefer SS. For the MNF, the weak competition effect is dominated by the wholesale price effect, inducing it to change from TS to SS.

As Proposition 5 (2) shows, we observe the win-win zone where both the MNF and the CM prefer TS, when \( r \) is low while \( b \) is high (i.e. \( 0 < r < \frac{7}{400} \) and \( b_1 < b < 1 \)). A high \( b \) represents a strong competition effect, which weakens the MNF’s incentives to change from TS to SS. For the CM, a low \( r \) reduces the loss from tax refund and it is more likely to prefer TS for its pricing flexibility. As a result, TS becomes the common preference of the MNF and the CM.

5. Extensions

5.1. Impact of CM’s non-negative manufacturing cost

In this subsection, we explore the impact of the CM’s non-zero manufacturing cost (including the labor cost) by assuming the CM’s cost is \( c_{cm} \) when it is located in China and 0 when it is located in Southeast Asian countries. \( c_{cm} \) can be viewed as the cost difference. Therefore, the
profit functions of the CM, the MNF and the Chinese competitor remain unchanged under SS, but those under TS are as follows. We use TS\(_1\) to denote this case.

\[
\pi_c = (a - q_c - b q_m) q_c; \\
\pi_m = (a - q_m - b q_c - w_1) q_m + (a \theta - q_o - w_1) q_o; \\
\pi_{cm} = (w_1 - c_{cm}) q_m + (w_2(1 - r) - c_{cm}) q_o.
\]

We solve the game by backward induction and derive the equilibrium outcomes in Appendix A.2. We require \(W G X Y DC 1)5, 2) +DC, 2) +DC, Z < % < -) +DC\) to rule out the negative outputs. To demonstrate the impact of manufacturing cost on the MNF’s preferences, we conduct extensive numerical studies. Typical curves are in Figure 4.

We have the following observations.

Observation 1: Given \(\theta \in \left(\frac{4-2b}{12-b^2}, \frac{6-b^2}{24+b}\right)\), which is equivalent to \(c_{cm} < \frac{d(4-2b)(1-r)}{12-b^2}\), the MNF prefers TS\(_1\) if \(c_{cm}\) is sufficiently small. The MNF’s willingness to prefer SS is increasing in \(c_{cm}\).

Observation 2: Given \(\theta \in \left(\frac{c_{cm}}{a(1-r)}, \frac{6-b^2}{24+b}\right)\), which is equivalent to \(\frac{a(4-2b)(1-r)}{12-b^2} < c_{cm} < \frac{a(6-b^2)(1-r)}{24+b}\), the MNF will not prefer TS\(_1\).

Observation 1 and 2 show that, given a sufficiently small manufacturing cost, the MNF will prefer SS when the relative market potential is either small or large. That is, the CM’s small
manufacturing cost will not affect the MNF’s preferences qualitatively (see in Figure 4 (a)). However, given a large manufacturing cost, the MNF is more willing to prefer SS, especially when the CM’s manufacturing cost exceeds an upper bound (see in Figure 4 (a) and (b)). The reason is that, a large manufacturing cost in China results in a high manufacturing price for the MNF. Therefore, TS\textsubscript{1} becomes less attractive for the MNF.

5.2. Impact of the competition in the Southeast Asian market

In the basic model, we assume that the MNF is a monopolist in the Southeast Asian market. In this subsection, we consider the MNF has a rival in the Southeast Asian market. We assume the degree of competition intensities in the Chinese and Southeast Asian markets are heterogeneous, which are noted as \( b_{o} \in (0,1) \) and \( b_{o} \in (0,1) \), respectively. We denote the Southeast Asian competitor’s sales quantity as \( q_{co} \). Therefore, the inverse demand functions in both Chinese and Southeast Asian markets are

\[
p_{i} = a - q_{i} - b_{o}q_{j}, \quad i, j = c, m;
\]

\[
p_{k} = a\theta - q_{k} - b_{o}q_{l}, \quad k, l = co, o.
\]

The profit functions of the MNF, the competitors, and the CM which produces in China (or Southeast Asian countries) under TS and SS are as follows. We use TS\textsubscript{2} and SS\textsubscript{2} in this case.

**TS\textsubscript{2}**

\[
\pi_{c} = (a - q_{c} - b_{o}q_{m})q_{c};
\]

\[
\pi_{co} = (a\theta - q_{co} - b_{o}q_{o})q_{co};
\]

\[
\pi_{m} = (a - q_{m} - b_{o}q_{c} - w_{1})q_{m} + (a\theta - q_{o} - b_{o}q_{co} - w_{2})q_{o};
\]

\[
\pi_{cm} = w_{1}q_{m} + w_{2}(1 - r)q_{o}.
\]

**SS\textsubscript{2}**

\[
\pi_{c} = (a - q_{c} - b_{o}q_{m})q_{c};
\]

\[
\pi_{co} = (a\theta - q_{co} - b_{o}q_{o})q_{co};
\]

\[
\pi_{m} = (a - q_{m} - b_{o}q_{c} - w)q_{m} + (a\theta - q_{o} - b_{o}q_{co} - w)q_{o};
\]

\[
\pi_{cm} = w(q_{m} + q_{o}).
\]
We solve the game by backward induction and derive the equilibrium outcomes in Appendix A.3. Numerical studies illustrate the impact of the competition in the Southeast Asian market on the MNF’s preference. See Figure 5.

(a) $b_D = 0.2$

(b) $b_D = 0.5$

(c) $b_D = 0.9$

Figure 5. Illustration of the MNF’s preference considering the competition in the Southeast Asian market ($a = 10$)

From Figure 5, we have the following observations.

**Observation 3:** When the competition intensity in the Chinese market is equal to that in the Southeast Asian market, the MNF has no incentive to choose TS$_2$ (i.e. $|b_D - b_D^*| = 0$).

**Observation 4:** When there is a difference in competition intensity between the Chinese market and Southeast Asian market, the MNF’s preferences will switch twice from SS$_2$ to TS$_2$ and back to SS$_2$ (i.e. $|b_D - b_D^*| > 0$).
From Observation 4, we know that the MNF prefers \( SS_2 \) when the relative market potential \( \theta \) is small or large if there exists a difference in competition intensity between the Chinese market and Southeast Asian market (i.e. \(|b_D - b_O| > 0\)). That is, the difference in the competition intensity between the Chinese market and the Southeast Asian market will not fundamentally change the MNF’s preference over \( SS_2 \) (in our basic model \( b_D > b_O = 0 \)). However, from the perspective of competition, if there is no different between the Chinese market and the Southeast Asian market (i.e. \(|b_D - b_O| = 0\)), the MNF will absolutely prefer \( SS_2 \) because the Southeast Asian market is more attractive. Therefore, when the competition intensities in both Chinese and Southeast Asian markets are higher, the MNF’s preference over \( SS_2 \) fall into a larger range (see the blue line in Figure 5 (a)–(c)).

5.3. Hybrid outsourcing structure

In this subsection, we investigate the MNF’s incentives to find two heterogamous CMs located in different markets. We denote the manufacturing prices of the CMs located in Chinese and Southeast Asian markets as \( w_C \) and \( w_S \), respectively. This hybrid outsourcing structure is referred to as HS. See an illustration in Figure 6.

![Hybrid Outsourcing (HS)](image)

Figure 6. Illustration of hybrid outsourcing structure

The profit functions of the MNF, the competitor, and the CMs located in the Chinese market and the Southeast Asian market under HS are shown as follows.

\[
\pi_C = (a - q_C - b q_m) q_C;
\]

\[
\pi_m = (a - q_m - b q_C - w_C) q_m + (a \theta - q_o - w_S) q_o;
\]
\[ \pi_{cmC} = w_c q_m; \]
\[ \pi_{cmS} = w_s q_o. \]

We solve the game by backward induction and derive the equilibrium outcomes in Appendix A.4. The proofs for the following outcomes are similar to those of Proposition 1 and 3, thus we omit the details.

Comparing the equilibrium outcomes under TS and HS, we find that the MNF’s preferences under TS and HS are identical (i.e. \( \pi^T_m = \pi^H_m \) (the proof for this outcome is similar to that of Proposition 3)). This is easy to understand. Although the CM located in the Chinese market needs to bear the tax burden because of partial VAT under TS, its manufacturing price will not be directly affected. Therefore, we have \( w^T_1 = w^H_1 \) (the proof for this outcome is similar to that of Proposition 1), and the MNF’s profits and preferences are unchanged.

5.4. Impact of import tariff

In this subsection, we explore the influence of import tariff on the MNFs’ preferences over SS and TS. Note that, the Chinese and Southeast Asian markets (e.g., Vietnam) have different tariff rates, namely, \( t_1 \) and \( t_2 \). It implies that if the MNF’s Southeast Asian retail division purchases each unit of product from China, the import tariff is \( w_2 t_2 \), while that for the imported products to China is \( w t_1 \). Thus, the profit functions of the MNF, the competitor, and the CM under TS and SS are as follows. We use TS\(_3\) and SS\(_3\) to denote this case.

**TS\(_3\)**

\[ \pi_c = (a - q_c - bq_m) q_c; \]
\[ \pi_m = (a - q_m - bq_c - w_1) q_m + (a \theta - q_o - w_2 (1 + t_2)) q_o; \]
\[ \pi_{cm} = w_1 q_m + w_2 (1 - r) q_o. \]

**SS\(_3\)**

\[ \pi_c = (a - q_c - bq_m) q_c; \]
\[ \pi_m = (a - q_m - bq_c - w (1 + t_1)) q_m + (a \theta - q_o - w) q_o; \]
\[ \pi_{cm} = w (q_m + q_o). \]
We solve the game by backward induction and derive the equilibrium outcomes in Appendix A.4. Numerical studies illustrate the impact of import tariff in the Southeast Asian market on the MNF and the CM’s preferences. See Figure 7 and 8. We have the following main observations:

**Observation 5**: As China’s tariff rate $t_{1}$ increases, the MNF’s indifferent curve shifts to the left, indicating the MNF has more incentives to prefer TS$_{3}$ to avoid high import tariff cost.

**Observation 6**: In terms of the CM’s preferences, the most interesting observation is shown in Figure 8 (a) and (b). That is, the CM has more incentives to prefer SS$_{3}$ (TS$_{3}$) when the Southeast Asia’s import tariff $t_{2}$ (China’s import tariff $t_{1}$) is higher.

Observation 5 is intuitive. The underlying reason for Observation 6 can be verified by analyzing the CM’s manufacturing prices under SS$_{3}$ and TS$_{3}$. Given the Southeast Asia’s import tariff $t_{2}$ (China's import tariff $t_{1}$), we find that the CM’s overseas manufacturing price $w_{2}^{T_{3}}$ (uniform manufacturing price $w^{S_{3}}$) is decreasing in $t_{2}$ ($t_{1}$), which means the CM’s marginal profit is hurt by the import tariff under SS$_{3}$ (TS$_{3}$). Therefore, the CM is more willing to select SS$_{3}$ (TS$_{3}$) as $t_{2}$ ($t_{1}$) increases to avoid the reduction of overseas manufacturing price $w_{2}^{T_{3}}$ (uniform manufacturing price $w^{S_{3}}$) under TS$_{3}$ (SS$_{3}$).

![Figure 7](image.png)  
Figure 7. Illustration of the preferences of MNF considering the import tariff ($a = 10$, $b = 0.9$, $r = 0.05$)
Figure 8. Illustration of the preferences of CM considering the import tariff ($a = 10, b = 0.9, r = 0.05$)

6 Conclusion

In this paper, we study objective conflict management between an MNF and its CM towards production shifting China to Southeast Asian countries such as Thailand and Vietnam. The competition, the CM’s pricing power and China’s partial VAT refund policy play important roles in the MNF and their CM’s incentives of production shifting.

We first study the wholesale pricing and quantity decisions under two outsourcing structures. We identify the wholesale price effect, which acts as a positive (negative) force for the MNF (CM) to prefer SS (TS), and the competition effect, which acts as a positive or negative force for the MNF to prefer SS. The interaction of these two effects affects the MNF’s preferences over outsourcing structures, making it first prefer SS, then TS, and finally back to SS.

We then investigate the MNF and the CM’s preferences over TS and SS. We find that, the two firms’ preferences show an opposite trend and both change twice as the relative market potential of the Southeast Asian market to the Chinese market increases. The MNF (CM) prefers SS (TS) when either the relative market potential is small or large. We identify several win-win zones where both the MNF and the CM prefer the same structure.

Our main findings are insightful for the MNFs (e.g., UNIQLO) and CMs (e.g., Shengzhou Group) who are considering to shift their factories to Southeast Asian countries. For the Chinese government and Southeast Asian governments, our main findings, especially those in Proposition 5, have directive significances in their policy-making. The details are as follows:
1. Our finding of the MNF’s preference over shifted outsourcing (SS) is consistent with UNIQLO’s business practices. UNIQLO began to outsource its manufacturing to the Southeast Asian CMs in 1999 (Nikkei, 2019) when Southeast Asian market potential was small. Nowadays, UNIQLO believes Southeast Asian market is very important by observing the rapid economic growth of Southeast Asian countries, so it has placed more orders to Southeast Asian CMs (Fast Retailing, 2019).

2. Comparing the decisions Shenzhou Group, we find that it mainly produced in China before 2014, but built its first overseas factory in Vietnam (China Daily, 2015). However, we suggest Shenzhou to move the factories back to China when Chinese market becomes very large, according to our findings in Proposition 4.

3. Pareto improvement is more likely to be achieved under shifted outsourcing (SS) for the MNF and the CM, but it significantly depends on China’s partial VAT refund policy and the competition intensity in Chinese market. In this sense, Chinese government is suggested to carefully consider adjusting the VAT refund policies to balance the benefits of maintaining CM factories (e.g., tackling the employment problem) and those of improved profit gains from the coordination between the MNF and the CM.

Our work has limitations that result in three future research directions. First, we do not consider the sustainability issues in our model. Some studies (e.g., Ageron and Gunasekaran 2012; Gunasekaran and Spalanzani 2011; Liu et al., 2018) point out that environmental and social sustainability should be integrated and diffused in global manufacturing networks. Therefore, the apparel CM's sustainability performances may influence the MNF’s outsourcing decisions. Second, we do not consider the production constrains of the apparel MNFs in China. In a recent study, Fan et al. (2019) investigate the capacity-reduction initiatives in the Chinese context by analyzing a sample of 113 Chinese listed manufacturing firms. Clearly, production constrains may significantly affect the migration behaviors of the apparel CMs and MNFs which results in higher retail prices but less intense competition in China. Third, the global supply chain risk caused by unpredictable events (e.g., the new COVID-19 virus) can be impactful. As discussed in Zeng and Yen (2019), global operations drive costs down substantially but make the supply chain more unreliable. It can be predicted that, domestic production and domestic sales are safer, which
induces the MNF to prefer TS. However, what’s the impact of local competition? We look forward to more studies along this line.

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Appendix

Appendix A.1

Proof of Lemma 1. We use backward induction to solve the games. Under TS, given the CM’s manufacturing prices $w_1$ and $w_2$, the MNF and the competitor maximize their profits by deciding their sales quantities $(q_m, q_o)$ and $q_c$, respectively.

$$\max_{(q_m, q_o)} \pi_m = (a - q_c - b q_m - w_1) q_m + (a \theta - q_o - w_2) q_o;$$

$$\max_{q_c} \pi_c = (a - q_c - b q_m) q_c.$$\

We have the best response functions $q_m(q_c, w_1) = \frac{a - bq_m - w_1}{2}$, $q_o(w_2) = \frac{a \theta - w_2}{2}$ and $q_c(q_m) = \frac{a - bq_m}{2}$, resulting in the quantities

$$\begin{cases}
q_m(w_1) = \frac{a(2-b)+2w_1}{4-b^2} \\
q_o(w_2) = \frac{a \theta - w_2}{2} \\
q_c(w_1) = \frac{a(2-b)+b w_1}{4-b^2}
\end{cases}.$$
Substituting the results in (3) into the CM’s profit function, we have profit function (4):

\[ \text{Max}_{(w, w)} \pi_{cm} = w_1 q_m(w_1) + w_2 (1 - r) q_o(w_2). \]

The CM maximizes its profit by setting the manufacturing prices \( w_1 \) and \( w_2 \) as

\[ w_1 = \frac{a(2 - b)}{4}; \]
\[ w_2 = \frac{a\theta}{2}. \]

Then the equilibrium outcomes in Lemma 1 become immediate.

**Proof of Lemma 2.** The equilibrium outcomes under SS are similarly derived to those under TS, thus we omit the details.

**Proof of Proposition 1.** Proposition 1 can be derived by comparing the wholesale prices under TS and SS. The comparison results are

\[ w^S - w^T_1 = \frac{a(4 - b^2)(2 + b + 2\theta)}{4(8 - b^2)} \begin{cases} > 0, \text{iff } \theta > \frac{2 - b}{2}, \\ < 0, \text{iff } \theta < \frac{2 - b}{2}, \end{cases} \]
\[ w^S - w^T_2 = \frac{a(2 - b + 2\theta)}{8 - b^2} \begin{cases} < 0, \text{iff } \theta > \frac{2 - b}{2}, \\ > 0, \text{iff } \theta < \frac{2 - b}{2}, \end{cases} \]
\[ w^T_1 - w^T_2 = \frac{a(2 - b + 2\theta)}{4} \begin{cases} < 0, \text{iff } \theta > \frac{2 - b}{2}, \\ > 0, \text{iff } \theta < \frac{2 - b}{2}. \end{cases} \]

Therefore, it is easy to show that \( w^T_1 < w^S < w^T_2 \) if \( \theta > \frac{2 - b}{2} \). Otherwise, we have \( w^T_2 < w^S < w^T_1 \), given \( \theta < \frac{2 - b}{2} \).

**Proof of Lemma 3.** Lemma 3 can be derived by taking the first-order-condition (FOC) of the wholesale prices with respect to \( \theta \) under TS and SS. We have

\[ |w^T_1 - w^S| = \frac{a(4 - b^2)(2 + b + 2\theta)}{4(8 - b^2)} \begin{cases} \frac{a(4 - b^2)(2 - b - 2\theta)}{4(8 - b^2)}, \text{iff } \theta > \frac{2 - b}{2}, \\ \frac{a(4 - b^2)(2 - b - 2\theta)}{4(8 - b^2)}, \text{iff } \theta < \frac{2 - b}{2}. \end{cases} \]
\[ |w^T_2 - w^S| = \frac{a(2 - b - 2\theta)}{8 - b^2} \begin{cases} \frac{a(4 - b^2)(2 - b - 2\theta)}{8 - b^2}, \text{iff } \theta > \frac{2 - b}{2}, \\ \frac{a(4 - b^2)(2 - b - 2\theta)}{8 - b^2}, \text{iff } \theta < \frac{2 - b}{2}. \end{cases} \]

Therefore, if \( \theta < \frac{2 - b}{2} \), the FOCs of \( |w^T_1 - w^S| \) and \( |w^T_2 - w^S| \) with respect to \( \theta \) are

\[ \frac{\partial |w^T_1 - w^S|}{\partial \theta} = -\frac{2a(4 - b^2)}{4(8 - b^2)} < 0; \]
\[ \frac{\partial |w_1^T - w^S|}{\partial \theta} = -\frac{2a}{b-b^2} < 0. \]

If \( \theta > \frac{2-b}{2} \), the FOCs of \( |w_1^T - w^S| \) and \( |w_2^T - w^S| \) with respect to \( \theta \) are

\[ \frac{\partial |w_2^T - w^S|}{\partial \theta} = \frac{2a(4-b^2)}{4(b-b^2)} > 0; \]
\[ \frac{\partial |w_2^T - w^S|}{\partial \theta} = \frac{2a}{b-b^2} > 0. \]

Then we have Lemma 3.

**Proof of Proposition 2.** Proposition 2 can be derived by comparing the sales quantities under TS and SS. The comparison results are

\[ q_T^q - q_S^q = \frac{ab(2-b-2\theta)}{4(b-b^2)} \begin{cases} < 0, \text{iff } \theta < \frac{2-b}{2} \smallfrown \\ > 0, \text{iff } \theta > \frac{2-b}{2} \end{cases} \]
\[ q_m^q - q_m^S = \frac{a(-2+b+2\theta)}{2(b-b^2)} \begin{cases} > 0, \text{iff } \theta > \frac{2-b}{2} \smallfrown \\ < 0, \text{iff } \theta < \frac{2-b}{2} \end{cases} \]
\[ q_m^q - q_m^S = \frac{a(2-b-2\theta)}{2(b-b^2)} \begin{cases} < 0, \text{iff } \theta > \frac{2-b}{2} \smallfrown \\ > 0, \text{iff } \theta < \frac{2-b}{2} \end{cases} \]

\[ (q_m^T + q_m^S) - (q_m^T + q_m^S) = \frac{a(b-2+b+2\theta)}{4(b-b^2)} \begin{cases} > 0, \text{iff } \theta > \frac{2-b}{2} \smallfrown \\ < 0, \text{iff } \theta < \frac{2-b}{2} \end{cases} \]
\[ \frac{q_m^T}{q_m^T + q_m^S} - \frac{q_m^S}{q_m^T + q_m^S} = \frac{a(2+b)(2b+2\theta)}{2(b-b^2)} \begin{cases} > 0, \text{iff } \theta > \frac{2-b}{2} \smallfrown \\ < 0, \text{iff } \theta < \frac{2-b}{2} \end{cases} \]

Therefore, Proposition 2 becomes immediate.

**Proof of Lemma 4.** Lemma 4 can be derived by taking the FOC of the sales quantities with respect to \( \theta \) under TS and SS. According to Proposition 2, we have

\[ \frac{\partial}{\partial \theta} \left( \frac{q_m^T}{q_m^T + q_m^S} - \frac{q_m^S}{q_m^T + q_m^S} \right) = \frac{2(2+b)(2b+2\theta)}{(b-b^2)(2(2+b)(2b+2\theta) - 2b(2-b^2))} \begin{cases} > 0, \text{iff } \theta > \frac{2-b}{2} \smallfrown \\ < 0, \text{iff } \theta < \frac{2-b}{2} \end{cases} \]

Therefore, if \( \theta < \frac{2-b}{2} \), the FOCs of \( \left| \frac{q_m^T}{q_m^T + q_m^S} - \frac{q_m^S}{q_m^T + q_m^S} \right| \) with respect to \( \theta \) is

\[ \frac{\partial}{\partial \theta} \left( \frac{q_m^T}{q_m^T + q_m^S} - \frac{q_m^S}{q_m^T + q_m^S} \right) = \frac{2(2+b)(2b+2\theta)}{(b-b^2)(2(2+b)(2b+2\theta) - 2b(2-b^2))} \begin{cases} > 0, \text{iff } \theta > \frac{2-b}{2} \smallfrown \\ < 0, \text{iff } \theta < \frac{2-b}{2} \end{cases} \]
Thus, we have Lemma 4

**Proof of Proposition 3.** Proposition 3 can be derived by comparing the MNF’s profits under TS and SS. The difference between $\pi_m^S$ and $\pi_m^T$ is

$$\pi_m^S - \pi_m^T = \frac{a^2[2(2+b)(12-b^2)\theta^2-(96-24b^2+b^4)\theta+4(2-b)(6-b^2)]}{4(2+b)(8-b^2)^2}.$$

It is easy to show that

$$A = 2(2+b)(12-b^2) > 0;$$

$$B = (96-24b^2+b^4) > 0;$$

$$C = 4(2-b)(6-b^2) > 0;$$

$$\frac{a^2}{4(2+b)(8-b^2)^2} > 0.$$

Therefore, $A\theta^2 - B\theta + C$ is a quadratic function with positive coefficients, which suggests we have $\pi_m^S > \pi_m^T$ when $A\theta^2 - B\theta + C > 0$. Solving the quadratic function, we obtain two roots as follows

$$\theta_1 = \frac{2-b}{2}, \theta_2 = \frac{4(6-b^2)}{(2+b)(12-b^2)}.$$

Comparing $\theta_1$ and $\theta$ (the lower bound of $\theta$), we have

$$\theta_1 - \theta = \frac{(2-b)(8-b^2)}{2(12-b^2)} > 0,$$ 

that is, $\theta_1 > \theta$. Comparing $\theta_2$, and $\theta$ (the lower bound of $\theta$), we have

$$\theta_2 - \theta = \frac{(8-b^2)(6-b^2)}{(2+b)(12-b^2)} < 0,$$

that is, $\theta_2 < \theta$. Thus, there are two feasible solutions $\theta_1$ and $\theta_2$ within $\theta \in (\theta, \overline{\theta})$, which incur $\pi_m^S > \pi_m^T$ if $\theta \in (\theta, \theta_1) \cup (\theta_2, \overline{\theta})$. Otherwise, $\pi_m^S < \pi_m^T$ if $\theta \in (\theta_1, \theta_2)$.

**Proof of Proposition 4.** Proposition 4 can be derived by comparing the CMs’ profits under TS and SS. The difference between $\pi_{cm}^S$ and $\pi_{cm}^T$ is

$$\pi_{cm}^S - \pi_{cm}^T = \frac{a^2[(4-8r+b^2r)\theta^2-(8-4b)\theta+(2-b)^2]}{8(8-b^2)}.$$ 

We have

$$A_1 = (4-8r+b^2r) > 0$$

for any feasible $b \in (0,1)$ and $r \in (0,0.13)$;
\[ B_4 = (8 - 4b) > 0 \text{ for any feasible } b \in (0,1); \]
\[ C_4 = (2 - b)^2 > 0 \text{ for any feasible } b \in (0,1); \]
\[ -\frac{a^2}{8(8-b^2)} < 0 \text{ for any feasible } b \in (0,1). \]

Therefore, \( A_4\theta^2 - B_4\theta + C_4 \) is a quadratic function with positive coefficients, which suggests we have \( \pi_{cm}^S > \pi_{cm}^T \) when \( A_4\theta^2 - B_4\theta + C_4 < 0. \)

Solving the quadratic function, we have two roots
\[
\theta_{r1} = \frac{(2-b)\sqrt{2\sqrt{(8-b^2)r}}}{4-(8-b^2)r}, \quad \theta_{r2} = \frac{(2-b)\sqrt{2\sqrt{(8-b^2)r}}}{4-(8-b^2)r}.
\]

Comparing \( \theta_{r1} \) and \( \theta \) (the lower bound of \( \theta \)), we have
\[
\theta_{r1} - \theta = (2-b)\left\{ 2\sqrt{(8-b^2)r} \right\} - \frac{2}{12-b^2}.
\]

Taking the FOCs of \( \theta_{r1} - \theta \) with respect to \( r \), we have
\[
\frac{\partial (\theta_{r1} - \theta)}{\partial r} = \frac{(2-b)\sqrt{(8-b^2)r} - 2\sqrt{(8-b^2)r}}{2r(4+(8-b^2)r)^2}.
\]

It can be verified that \( \text{Max}\sqrt{(8-b^2)r} \big|_{b=0, r=0.13} = \sqrt{1.04} \) because the Hessian Matrix of \( \sqrt{(8-b^2)r} \) is negative definite, that is
\[
\begin{vmatrix}
0r^2 & \frac{b}{2\sqrt{(8-b^2)r}} \\
\frac{b}{2\sqrt{(8-b^2)r}} & \frac{2\sqrt{(8-b^2)r}}{4r^2}
\end{vmatrix} = \frac{1}{4r} > 0.
\]

Taking the FOCs of \( \sqrt{(8-b^2)r} \left( 4 - \sqrt{(8-b^2)r} \right) \) with respect to \( \sqrt{(8-b^2)r} \), we have
\[
\frac{\partial \sqrt{(8-b^2)r} \left( 4 - \sqrt{(8-b^2)r} \right)}{\partial \sqrt{(8-b^2)r}} = 4 - 2\sqrt{(8-b^2)r} < 0 \text{ (because } \text{Max}\sqrt{(8-b^2)r} = \sqrt{1.04}).
\]

So there exists \( \text{Max}\sqrt{(8-b^2)r} \left( 4 - \sqrt{(8-b^2)r} \right) \big|_{\sqrt{(8-b^2)r} = \sqrt{1.04}} \approx 0.96 > 0. \)

Thus, we have \( 4 - \sqrt{(8-b^2)r} \left( 4 - \sqrt{(8-b^2)r} \right) > 0 \) and \( \frac{\partial (\theta_{r2} - \theta)}{\partial r} > 0 \) for any feasible \( b \in (0,1) \) and \( r \in (0,0.13). \)

As \( \theta_{r2} - \theta \) is increasing in \( r \) for any feasible \( r \in (0,0.13) \). So the minimum of \( \theta_{r2} - \theta \) is
\[
\theta_{r1} - \theta \big|_{r=0} = \left\{ \frac{1}{2} - \frac{2}{12-b^2} \right\} = \frac{(2-b)(8-b^2)}{2(12-b^2)} > 0 \text{ for any feasible } b \in (0,1).
\]

Therefore, we have \( \theta_{r1} > \theta \) for any feasible \( b \in (0,1) \) and \( r \in (0,0.13). \)

Similarly, comparing \( \theta_{r2} \) and \( \theta \) (the lower bound of \( \theta \)), we have
\[ \theta_{r2} - \bar{\theta} = \frac{(2-b)(2+\sqrt{(8-b^2)r})}{4-(8-b^2)r} - \frac{6-b^2}{2+b} < 0, \] that is, \( \theta_{r2} < \bar{\theta} \).

Taking the FOC of \( \theta_{r2} - \bar{\theta} \) with respect to \( r \), we have

\[ \frac{\partial (\theta_{r2} - \bar{\theta})}{\partial r} = \frac{(2-b)(2+\sqrt{(8-b^2)r})}{2r(4+(8-b^2)r)^2} < 0. \]

It means that \( \theta_{r2} - \bar{\theta} \) is decreasing in \( r \) for any feasible \( r \in (0,0.13) \). So the maximum of \( \theta_{r2} - \bar{\theta} \) is

\[ \theta_{r2} - \bar{\theta}\big|_{r=0} = \frac{2-b}{2} - \frac{6-b^2}{2+b} = -\frac{b-2}{2(2+b)} < 0 \]

for any feasible \( b \in (0,1) \).

Therefore, we have \( \theta_{r2} < \bar{\theta} \) for any feasible \( b \in (0,1) \) and \( r \in (0,0.13) \).

Thus, there are two feasible solutions \( \theta_{r1} \) and \( \theta_{r2} \) within \( \theta \in (\bar{\theta}, \bar{\theta}) \), which incur \( \pi_{cm}^T > \pi_{cm}^T \) if \( \theta \in (\theta_{r1}, \theta_{r2}) \). Otherwise, \( \pi_{cm}^T < \pi_{cm}^T \) if \( \theta \in (\bar{\theta}, \theta_{r1}) \cup (\theta_{r2}, \bar{\theta}) \).

**Proof of Proposition 5.** Proposition 5 can be derived by comparing \( \theta_1, \theta_{r1}, \theta_2 \) and \( \theta_{r2} \). The difference between \( \theta_1 - \theta_{r1} \) and \( \theta_2 - \theta_{r2} \) is

\[ \theta_1 - \theta_{r1} = \frac{(2-b)(2+\sqrt{(8-b^2)r})}{2r(4+(8-b^2)r)^2} > 0. \]

Then, solving \( \theta_2 - \theta_{r2} = 0 \), we have

\[ r = \frac{b^4(8-b^2)}{16(6-b^2)^2}. \]

Throughout this paper, \( r = r_V - r_R \) represents the difference between VAT rate and tax refund rate, where \( r_V \) (fixed at 13% in China (China Daily, 2019)) is the standard VAT rate and \( r_R \) (0 ≤ \( r_R \leq r_V \)) is the VAT refund rate (Hsu and Zhu, 2011). Therefore, the difference \( r = r_V - r_R \) ranges from 0 to 13% and the maximum of \( r \) is 13%. In the Proof of Proposition 5, we substitute the maximum value of the nondeductible VAT rate \( r = 0.13 \) to derive the up bound of the feasible condition.

Comparing \( r = \frac{b^4(8-b^2)}{16(6-b^2)^2} \) and \( r = 0.13 \), we have two conditions that make \( \theta_2 < \theta_{r2} \)

(a) \( 0 < r < \frac{7}{400} \) and \( 0 < b < b_1 \);

(b) \( \frac{7}{400} < r \) and \( 0 < b < 1 \).

Where \( b_1 \) uniquely satisfies \( 576r - 192rb_1^2 + (-8 + 16r)b_1^4 + b_1^6 = 0 \).
Proof of Proposition 6. Proposition 6 can be derived by comparing the environmental impact ($EI$) under TS and SS. The difference between $EI^S$ and $EI^T$ is

\[
EI^S - EI^T = n^c(q_m^S + xq_m^S + xq_0^S) - n^c(q_m^T + xq_m^T + xq_0^T) = ab(-2+b+2\theta)n^c > 0, \text{iff } \theta > \frac{2-b}{2},
\]

\[
< 0, \text{iff } \theta < \frac{2-b}{2}.
\]

Thus, Proposition 6 is immediate.

Appendix A.2

Equilibrium outcomes in Structure TS:

\[
\begin{align*}
W^{T_1}_1 &= \frac{(a(2-b)+2c_{cm})}{4}, & W^{T_1}_2 &= \frac{a\theta(1-r)+c_{cm}}{2(1-r)}, \\
q_m^T &= \frac{(a(2-b)+2c_{cm})}{4(4-b^2)}, & q_m^T &= \frac{(a(2-b)-2c_{cm})}{2(4-b^2)}, & q_o^T &= \frac{a(1-r)\theta-c_{cm}}{4(1-r)}, \\
p_c^T &= \frac{(a(2-b)+2c_{cm})}{4(4-b^2)}, & p_m^T &= \frac{a(12-6b-2b^2+4\theta)(2-b-c_{cm})}{4(4-b^2)}, & p_o^T &= \frac{3a(1-r)\theta+c_{cm}}{4(1-r)}, \\
p_m^{T_2} &= \frac{a^2\theta^2}{16} + \frac{ab\theta c_{cm}}{8(1-r)} + \frac{a(2-b)-4c_{cm}}{2(4-b^2)} + \frac{16(2(1-r)+r^2-b(8-b^2))c_{cm}}{16(4-b^2)^2(1-r)}, \\
p_m^{T_3} &= \frac{a^2(1-r)\theta^2}{8} + \frac{ab\theta c_{cm}}{4} + \frac{a(2-b)-4c_{cm}}{4} + \frac{(8-b^2-4r)c_{cm}}{8(4-b^2)(1-r)}, \\
p_c^{T_3} &= \frac{(a(2-b)+2b^2c_{cm})}{16(4-b^2)^2}.
\end{align*}
\]

Appendix A.3

Equilibrium outcomes in Structure TS:

\[
\begin{align*}
W^{T_1}_1 &= \frac{(a(2-b_d)+2c_{cm})}{4}, & W^{T_1}_2 &= \frac{a\theta(1-r)+c_{cm}}{4(2-b_d)}, \\
q_m^T &= \frac{(a(2-b_d)+2c_{cm})}{4(2-b_d)}, & q_m^T &= \frac{a(1-r)\theta-c_{cm}}{4(2-b_d)}, & q_o^T &= \frac{a(4+b_o)}{4(2-b_o)}, \\
p_c^T &= \frac{(a(2-b_d)+2c_{cm})}{4(2-b_d)}, & p_m^T &= \frac{a(4+b_o)}{4(2-b_d)}, & p_o^T &= \frac{a(6+b_o)}{4(2+b_o)}, & p_o^T &= \frac{a(4+b_o)}{4(2+b_o)}, \\
p_m^{T_2} &= \frac{a^2(4+b_o)^2}{4(2+b_o)^2(2-b_o)^2}, & p_c^{T_2} &= \frac{(2-b_o)(2+b_o)(2-b_o)\theta^2}{b(2+b_o)(2-b_o)}, & p_c^{T_3} &= \frac{a^2\theta^2(4+b_o)^2}{16(2+b_o)^2}, \\
p_c^{T_3} &= \frac{(a(2-b_d)+2b^2c_{cm})}{16(2-b_d)^2}, & p_o^T &= \frac{a(6+b_o)(2-b_o)(2+b_o)+2\theta b_o-b_d}{2(2+b_o)(8-b_d^2-b_o^2)},
\end{align*}
\]

Equilibrium outcomes in Structure SS:

\[
\begin{align*}
W^{S_1}_1 &= \frac{(a(2-b_d)(2-b_o)+2+b+2\theta+b_b+b_o)}{4(8-b_d^2-b_o^2)}, \\
q_m^S &= \frac{2a+b_d(a-w^{S_1})}{4-b_d}, & q_m^S &= \frac{a(4(3-\theta)-2b^2\theta b_d(2-b_o)+2\theta b_o-b_d)}{2(2+b_o)(8-b_d^2-b_o^2)}.
\end{align*}
\]
\[ q_{o} = \frac{a(\theta \, b_t^2 + b_d(2a + 2b_d) - 2(2 - 6\theta + 2b_d + \theta b_t^2))}{2(2 + b_d)(b_t^2 - b_d^2)}; \quad q_{c} = \frac{2a\theta + b_d(a\theta - \theta^2)}{4b_d^2}, \]

\[ p_{c} = \frac{a(\theta_d(2b_d - 2a + 2b_d - 4b_d + \theta b_t^2) + 4(2 + b_d)(b_t^2 - b_d^2))}{4(2 + b_d)(b_t^2 - b_d^2)}, \]

\[ p_{m} = \frac{a(8(5 + \theta) - 2\theta b_d(2a + 2b_d) + 2 + \theta b_t^2(2a + 2b_d) - 4(2a + 2b_d) - 4(2\theta b_d + b_d^2))}{4(2 + b_d)(b_t^2 - b_d^2)}, \]

\[ p_{o} = \frac{a(40\theta(4 + 2b_d) - 4 - 4\theta b_d - 2b_d^2 + 2b_d^2 + 4a + 4b_d + \theta b_t^2)}{4(2 + b_d)(b_t^2 - b_d^2)}, \]

\[ q_{c} = \frac{a(32\theta + 4(1 + \theta)b_o(2a + 2b_d) - \theta b_t^2(4 + b_d))}{4(2 + b_d)(b_t^2 - b_d^2)}, \]

\[ n_{m} = \frac{1}{(b_t^2 - b_d^2)^2} \left[ \frac{a^2(160 - 24b_t^2 + 2b_d^2 + 56b_d^2 + 4b_d^2b_t^2 + 5b_t^2 + \theta^2)}{(2 + b_d)^2} \right] - \frac{2a^2(96 - 24b_t^2 + 2b_d^2 + 4b_d^2b_t^2 + 5b_t^2 + \theta^2)}{(2 + b_d)(2 + 2b_d)} \]

\[ n_{s} = \frac{a^2(2b_d - 2a + 2b_d - 4b_d + \theta b_t^2)}{8(2 + b_d)(2 + 2b_d)(b_t^2 - b_d^2)^2}; \quad \!
\]

\[ n_{c} = \frac{a^2(-b_d(2a + 2b_d) + b_d(4 - 2a + 2b_d) - 4(2 + b_d))}{16(2 + b_d)^2(2 + 2b_d)(b_t^2 - b_d^2)^2}; \]

\[ n_{c} = \frac{a^2(2 - 4\theta - 2b_d + 4a + 4b_d + \theta b_t^2 - 4(1 + \theta)b_d)}{16(2 + b_d)^2(b_t^2 - b_d^2)^2}; \]

**Appendix A.4**

Equilibrium outcomes in Structure HS:

\[ w^H_C = \frac{a(2 - b)}{4}; \quad w^H_O = \frac{a\theta}{2}; \]

\[ p^H_C = \frac{a(4 + b)}{4}(2 + b); \quad p^H_O = \frac{a(6 - b^2)}{(2 + b)}; \]

\[ q^H_C = \frac{a(4 + b)}{4}(2 + b); \quad q^H_O = \frac{a}{4 + 2b}; \]

\[ n^H_{cmC} = \frac{a^2(2 - b)(2a + 2b_d + 2b_d) - 4(2a + 2b_d) - 4(2 - 4\theta - 2b_d + 4b_d + \theta b_t^2)}{16(2(2 + b_d)(2 + 2b_d)(b_t^2 - b_d^2)^2); \]

\[ n^H_{cmS} = \frac{a^2\theta^2}{8}; \quad n^H_{m} = \frac{a^2(4 + 2b + 2b_d + 4b_d + \theta b_t^2)}{16(2 + b_d)^2}; \]

**Appendix A.5**

Equilibrium outcomes in Structure TS:

\[ w^T_1 = \frac{a(2 - b)}{4}; \quad w^T_2 = a\theta; \]

\[ q^T_C = \frac{a(4 + b)}{4}(2 + b); \quad q^T_O = \frac{a}{4 + 2b}; \]

\[ p^T_C = \frac{a(4 + b)}{4}(2 + b); \quad p^T_O = \frac{a(6 - b^2)}{(2 + b)}; \]

\[ n^T_{m} = \frac{a^2(4 + 2b)(b_d)^2}{8(2 + b_d)(2 + 2b_d)(2 + b_d)^2}; \]

\[ n^T_{c} = \frac{a^2(4 + b)^2}{16(2 + b_d)^2}; \]
Equilibrium outcomes in Structure SS:

\[ w_{SS}^* = \frac{a(2-b)(2+(2+b)\theta)}{2(8-b^2+4\ell_1)}; \]

\[ q_{c}^*_{SS} = \frac{a(16-b^2(2-\theta)+2b(1+\theta)+(8+b(2+(2+b)\theta))\ell_1)}{2(2+b)(8-b^2+4\ell_1)}; \]

\[ q_{o}^*_{SS} = \frac{1}{2} \left( a\theta - \frac{a(2-b)(2+(2+b)\theta)}{2(8-b^2+4\ell_1)} \right); \]

\[ p_{c}^*_{SS} = \frac{a(16+2b(1+\theta)+(8+b^2(2+(2+b)\theta))\ell_1-b^2(2-\theta))}{2(2+b)(8-b^2+4\ell_1)}; \]

\[ p_{m}^*_{SS} = \frac{a(45-b^2(2-\theta)+(2+b)(2-b^2)\theta+(2(6-b^2)+(2+b)(2-b^2)\theta)\ell_1)}{2(2+b)(8-b^2+4\ell_1)}; \]

\[ p_{o}^*_{SS} = \frac{a(4-2b+2b\theta-3b^2\theta+8\theta\ell_1)}{4(8-b^2+4\ell_1)}; \]

\[ \pi_{c}^*_{SS} = \frac{a^2(60-56b^2+5b^4)-4(2+b)\left(96-24b^2+b^4\right)\theta+(2+b)^2(160-24b^2+b^4)\theta^2}{16(2+b)^2(8-b^2+4\ell_1)} + \frac{16\ell_1 a^2(-4(-6+b^2)+4(2+b)(6-b^2)\theta-(2+b)^2(-14+b^2)\theta^2+(4+(2+b)\theta(-4+5(2+b)\theta))\ell_1)}{16(2+b)^2(8-b^2+4\ell_1)}; \]

\[ \pi_{m}^*_{SS} = \frac{a^2(16+2b(1+\theta)+(8+b^2\theta+2b(1+\theta))\ell_1-b^2(2-\theta))^2}{4(2+b)^2(8-b^2+4\ell_1)^2}; \]

\[ \pi_{o}^*_{SS} = \frac{a^2(2-b)(2+(2+b)\theta)^2}{8(2+b)(8-b^2+4\ell_1)}; \]