Resale Price Maintenance in a Corruptible Market*

Kim-Sau Chung
Hong Kong Baptist University
Email: kschung@hkbu.edu.hk

Travis Ng
The Chinese University of Hong Kong
Email: TravisNg@cuhk.edu.hk

October 22, 2018

Abstract

In a model of hospital procurement in which the procurement managers of the hospitals can be "induced" by kickbacks to buy from a certain brand, we study the pricing strategies of a health input manufacturer that sells to the hospitals through the distributors. Each distributor has its own exclusive territories, and it can either carry the manufacturer's products or some other brands but not both. In the absence of the distributor's services, we derive the condition under which the manufacturer finds it optimal to impose a minimum resale price maintenance (RPM). The RPM makes it less likely for the hospital management to find out that other hospitals pay a lower price, reducing the procurement managers' risk of getting caught receiving kickbacks. In turn, the distributors find it easier to "induce" the procurement managers to buy from them. Without the RPM, the distributors would have under-priced. Our theory offers an alternative explanation of the use of RPM by Johnson and Johnson (J&J) in *Rainbow v. J&J*, the first private anti-monopoly litigation in China

Keywords: Resale price maintenance, hospital procurement, corruption, services hypotheses, antitrust.

JEL Classifications: L42, L51

*Financial support from the Hong Kong Research Grants Council General Research Fund (No. 14603217) is gratefully acknowledged.

1. Introduction

We propose a new theory of the use of RPM in the absence of downstream services. The context is a corruptible market. We refer to a market in which an agent can be "induced" to trade with someone as a corruptible market. Rose-Ackerman and Yan (2014) and Tam (2011) suggest that hospital procurement is one such market.

The theory. Hospitals require many inputs. We focus on medical consumables, e.g., band aids, solutions, suturing products, masks, gloves, oxygen, etc. The medical consumables market has two sides. On the demand side are hospitals, and on the supply side are medical consumables manufacturers. The hospital management of course does not procure medical consumables by themselves. They typically delegate a team to do so. Similarly, a manufacturer such as J&J typically relies on independent distributors to (re) sell its products to hospitals. Hence, at least four different parties with potentially misaligned interests are involved.

A hospital's procurement team is tasked to ensure that the medical consumables they procure are of certain quality and are priced reasonably. Where law enforcement against procurement corruption is effective, there would be enough legal deterrence for the procurement team to collect kickbacks from the distributors and to have the hospital pay unnecessarily high prices. However, in a corruptible market where law enforcement against procurement corruption is ineffective, such deterrence would be weak, and procurement corruption can be rampant. To mitigate such an agency problem, a hospital's management needs to resort to various internal monitoring measures. One of the (imperfect) ways to detect kickback is to compare the prices a hospital pays against those other hospitals pay for the same/similar medical consumables.

This measure is not perfect, however, because kickback is not the only reason why a hospital pays more than other hospitals do. Another hospital may pay less because their procurement team is especially good at bargaining, or they deal with a distributor who is weak at bargaining. However, in a corruptible market, where every procurement team looks suspicious, the mere fact that another hospital manages to bargain for a better deal can be devastating to a procurement team.

There is thus an incentive for any procurement team to choose a brand whose prices are less disperse. Imagine that there are two brands of medical consumables with similar quality. Their distributors are asking for similar prices. While the manufacturer of brand A places no restrictions on the prices of its independent distributors, that of brand B practices RPM and sets a price floor for all of its independent distributors. If the procurement team chooses brand A, it runs a higher risk of paying more than do other hospitals and hence makes it look corrupt to its management. Choosing brand B assures the team that all other hospitals pay no lower

than the price floor. It will be less likely for the management to accuse the team of procurement corruption.

Medical consumables manufacturers are thus under market pressure to use RPMs. The motive behind an RPM is not to fix prices on behalf of independent distributors, but to compete in a corruptible market.

Approach. We develop a model to formalize our theory. The model has two identical hospitals, each requiring a batch of medical inputs. Each hospital delegates its own procurement manager to source them. A manufacturer sells to the hospitals through two independent distributors, each dealing with one procurement manager. The manufacturer charges a wholesale price to the distributors, while the distributors offer two prices to the procurement manager. The first price is the official price listed on the invoice, representing the actual expenses of the hospital. The second price is a kickback given secretively to the procurement manager conditional on his choice of the brand. Both the manufacturer and the two distributors are profit-maximizing. The two procurement managers maximize their utility by selecting a brand to buy. Buying from the distributor gains the kickback but risk being caught receiving a kickback.

The following are absent in the model: [1] downstream services, [2] demand asymmetry, [3] information asymmetry, and [4] secretive distributor contracts.

We derive the condition under which the distributors charge a listed price lower than the price that would have been chosen if the manufacturer were to sell directly to the hospitals. The condition is the higher is the transacted price of the same medical inputs in *another* hospital, the less likely for the procurement manager to get caught receiving a kickback. Under such a condition, a minimum RPM plays a role: It raises the distributors' listed price and increases the profit of the whole supply chain.

Our theory has not been studied in the RPM literature. As far as we read, we have not come across any RPM court cases mentioning it. We suspect that our theory is a reason behind the use of RPM by Johnson & Johnson (J&J) in selling staples and suturing products in China. In *Rainbow v. Johnson & Johnson*, J&J was sued and lost. Section 2 discusses more on the legal dispute.

Hospital procurement corruption is not rare.[1] Our theory is a plausible reason behind the other manufacturers' RPMs.[2] Procurement corruption in the health sector

[1] Di Tella and Savedoff (2001) suggests that the extent to which hospitals in South America overpay their medical inputs is a proxy for corruption of the South American countries.

[2] In modeling procurement corruption, Burguet and Che (2004) begin by citing the seriousness of procurement corruption:

> "Bribe taking in competitive procurement, whether public or private, is widespread. During the first half of the 1970s, more than 450 U.S. companies, 117 of which were listed in the Fortune 500, had made over $400 million in questionable payments to foreign concerns, and the U.S. firms allegedly lost nearly 100 foreign contracts worth $45 billion to foreign competitors through graft in 1994-1995."

can result in overpaying of medical inputs and a waste of the taxpayers' money. An indispensable part of addressing the issue is to understand how firms sell to hospitals. The underlying agency problems, if articulated well, can help policymakers formulate anti-corruption policies. For instance, if RPMs are quite likely used in a corruptible market for medical inputs, detecting procurement corruption, oftentimes unobserved, through checking whether RPMs are used in the supply chain, often more observable, is a viable strategy.

After the literature review, section 1 elaborates on the problems of hospital procurement. Section 2 focuses on the first private anti-monopoly lawsuit in China: *Rainbow v. Johnson & Johnson*. We lay out our theory in section 3. The next section shows the condition for the distributor to under-price, giving a role played by RPM. In our concluding remarks, we list some of the cases that suggest that the application of our theory is broader than *Rainbow v. Johnson & Johnson*.

1.1. Literature review

Our paper relates to three strands of literature. The first is the procurement literature. The second is the kickbacks literature. And the RPM literature is the third.

Since the Laffont and Tirole (1993) landmark treaty, the procurement literature becomes huge. McGuire and Riordan (1995) find that whether it is optimal for a public procurement to source from more than one supplier depends on the information structure. Burguet and Che (2004) model a corrupt agent willing to manipulate his evaluation in exchange for bribes from proposal writers, making it harder for the most efficient firm to win the contract. Burguet and Che (2004) differs from Che (1993) in that Che (1993) does not consider a corrupt agent but a scoring rule only. Asker (2008) looks into procurement in the private sector; the author summarizes a variety of ways for private firms to procure inputs across industries. The effects of subsidy(tax) on business procurement are analyzed. Asker and Cantillon (2008) analyzes a procurement situation when both price and quality matter. They show that quality can be biased up or down depending on various factors. Our paper differs from these in that there is no quality concern in our model as the medical inputs we have in mind does not vary much in quality.

Pauly (1979) examines kickbacks in the health industry by examining the kickbacks and fee splitting practices among general physicians and specialists. Inderst and Ottaviani (2012) model kickbacks in the financial product advisory industry in which the advisors may receive hidden kickbacks and disclosed commissions. The paper looks at how firms compete through offering kickbacks to the advisors, which can potentially result in mis-selling of products, an issue they also study in Inderst and Ottaviani (2009). Our paper looks at kickbacks without the issue of whether the

product fits the hospitals.

The RPM literature starts from Telser (1960) who proposes the free-riding argument for the use of RPM, an argument that has been used quite extensively in the court (Mathewson and Winter, 1998; Winter, 2009).[3] Since not all products using RPM can be understood as overcoming certain free-riding problems, Winter (1993) formalizes a model in which there are incentive misalignment between a manufacturer and its retailers. In some situations, even absent free-riding, the retailers can focus more on cutting price than raising services, which is undesirable in the eyes of the manufacturer. RPM can be a solution. Klein (2009, 2014) also argue that while downstream services are important to understand RPM, there is no need for free-riding to exist to explain RPM. Since the significance of downstream services can be hard to ascertain, Mao and Ng (2016) explore the possibility of explaining RPM without services. They find that the asymmetry of demand functions across the retailers can incentivize the manufacturer to impose a RPM. Our paper also examines the reason behind the use of RPM in the absence of services, but differs from Mao and Ng (2016) in that the downstream firms of a manufacturer face the exact same demand function. Thus, no asymmetry is assumed.

2. *Rainbow v. J&J*

In the 2012 case of Beijing Ruibang Yonghe Science and Technology Trade Company ("Rainbow") v. Johnson & Johnson Medical (China) Ltd. ("J&J"), J&J sells staplers and suturing products to hospitals through their independent distributors. These medical consumables, used mainly in surgeries to close wounds, have been used for many decades. The hospitals can choose from among many brands.[4]

J&J is a dominant player in this market outside of China. Since around 1998, J&J has been selling also in China through its distributors, each of whom enjoys an exclusive territory. Rainbow, who is in charge of a part of the Beijing area, was one of J&J's distributors.

J&J charged a wholesale price to its distributors and allowed these distributors to set their own resale prices no lower than a price floor.[5] Such a vertical price floor

[3]The RPM literature also focuses much on the free-riding argument as stated by Mathewson and Winter (1998): "Too much of the literature on RPM tries to force the RPM "square cases" into the free-riding "round holes"."

[4] It would be unprofessional for a doctor not to be able to close a wound simply because she does not have any experience with a particular brand of staplers and suturing products. Of course, above and beyond purely technological view, medical doctors can and do have their own preferences for their favorite brands.

[5]The court documents of *Rainbow v. Johnson & Johnson* do not show the prices. We, however, have found that the court documents of a 2014 case involving the same two parties do provide the price information of J&J's suturing products. The prices are the following: Benchmark Price: RMB 4,650; Wholesale price: RMB 3348 (72% of the benchmark price); Before the bidding: The resale price of

potentially violates Article 14 of the China's Anti-Monopoly Law.

In 2008, Rainbow did offer to sell to some hospitals in Beijing at a price lower than the vertical price floor. As such, J&J first shrank Rainbow's hospital coverage and eventually stopped offering any products to Rainbow. Rainbow claimed to have suffered great loss and sued J&J for the anti-competitive use of RPM. J&J lost.

The Shanghai Higher Court opined that the staplers and suturing products market had a sufficiently high entry barrier, including the technology of the product, the preferences of doctors on the brands they like, and the relationship between the hospitals (buyers) and the distributors (sellers). The Court stated that the market was not that competitive and J&J possessed a strong market power (its China's market share was over 20.4%). J&J had maintained the price for almost 15 years, which the Court interpreted it as showing sufficiently strong market position from J&J's monopoly power. This monopoly power enabled J&J to set a high price; this high price could *not* be defended by services explanations and free-riding explanations because this old brand product was rather standard in the medical consumables market and it rarely required promotion or after-sale services. As such, the RPM could not be seen as pro-competitive. The anti-competitive effects of restricting price competition must outweigh any pro-competitive effect. The minimum RPM was judged as illegal.

Were the downstream services significant? Different from the Shanghai Higher Court, we would not argue that hospitals (end-buyers and end-users) rarely receives any important services or promotion from J&J's distributors when purchasing these medical products. But given the substitutability among the different brands, and the fact that suturing products have long been used, we agree with the Court that it is difficult to view any services to be an overwhelmingly important demand determinant. The significance of the services, therefore, could not be easily ascertained.

Both sides of the case held polar opposite views on the significance of distributors' services.[6] The Court did not reach any consensus on the significance of any distributors' services in determining the sales of the suturing products. The lawyers and economist representing the plaintiff (Rainbow) argued in court that no services can be claimed to be significant except those from J&J, while the defending teams for J&J argues that the distributors' sales services, delivery services, after-sales services are extremely important and that a vertical price floor would induce the distributors to exert more of these services.

Absent in the court document is the details of the procurement system of China's

Rainbow: RMB 4,604 (99% of the benchmark price); After the bidding: the resale price of Rainbow: RMB 4200 (90% of the benchmark price).

[6]For instance, the defending lawyers and economist argued that after-sales services by the downstream distributors were important, but Rainbow's legal team disagreed. Instead, they argued that training and promotions done by J&J were much more decisive a factor in determining their sales.

hospitals. We believe that it is crucial to understand the system in order to understand the incentives of the different players. Appendix A offers more details of the system.

How would our theory be relevant? Our theory may have been a rationale behind J&J's RPM. Each distributor's prices not only influences their own sales, but also the sales of the other Chinese markets of J&J.

Rainbow sold J&J's products at prices lower than the price floor, hoping to grab a bigger market share among its Beijing's hospitals. But we argue that Rainbow's prices could and should *lower* the sales of J&J's staplers and suturing products in other Chinese hospital markets.

An example can illustrate why so. Think of a hospital in Chongqing far away from Beijing. Why a hospital in Chongqing would check and care about the price paid by Beijing's hospitals? Put it in another way, if J&J's distributor in Chongqing has already offered a reasonable price relative to other brands available in Chongqing, why would the Chongqing hospital care at all about the price paid by a Beijing hospital?

It helps to think in the shoes of a hospital's procurement officer rather than the hospital in general. The officer does not necessarily have to buy from J&J; there are other brands available. His job is to buy reasonable products to maintain the hospital services at reasonable prices. Most likely for checks and balances, he would authorize the hospital accounting department to pay for the vendors he picks. The accounting department's job is to make sure the transactions are accurate and records kept.

The hospital management's role is to make sure the prices authorized by the procurement officers are reasonable. The only way for the top management to know, however, is to know the prices other hospitals pay for the same/similar products.

The procurement officer would therefore face the risk of being scrutinized if he authorizes the hospital accounting department to pay J&J a price higher than what other hospitals are paying for the similar products. This is true even if he cannot switch from buying from J&J's Chongqing distributor to another J&J distributor.

Paying a price higher than do another hospitals is understandable if the products come with complementary services. The more important is the service dimensions, the less likely it is for the procurement team to be in trouble even if he does authorize the hospital to pay more for the products relative to other hospitals do. We then have the following situation:

The less significant are services to the products, the more concerned would be the procurement officers if there is a chance that other hospitals pays a lower price.

Paying a higher price raises the eyebrows of the hospital management (think of a band aid costing USD$100), more so if volume or services cannot be an explanation of the procurement officer. The hospital management would wonder if the procurement

officer has received a kickback.

Why might J&J compete using a RPM? To compete, J&J has an incentive to disallow any of its distributor to under-price. J&J has *less* incentives to do so and allow a larger price dispersion among the different regions of China if J&J's products' sales depend *more* on services.

In the case of staplers and suturing products in which the significance of distributors' services is less obvious, avoid getting into trouble is a legitimate concern of the procurement officers. If an procurement officer believes that it is more likely for another hospital to buy similar products from any distributors of J&J at a lower price than he can negotiate, he would switch to other brands.

J&J's vertical price floor is a solution to this problem. A minimum RPM, known to both the procurement officers and all its distributors, seems a reasonable strategy for J&J to compete with other brands. The price floor potentially mitigates the doubt of the procurement officers, making it easier for the procurement officers to select J&J. This is so not in spite of the insignificance of the downstream services, but because of the insignificance of the downstream services.

3. Model

We study a simple model designed to capture the essential features of our theory.

Players. The 5 players are J&J, the 2 distributors (denoted D_1 and D_2), and the 2 procurement managers (denoted H_1 and H_2). We denote the procurement managers as H to signify that they are buying a medical input on behalf of their respective hospitals.

While J&J contracts with both D_1 and D_2, D_1 deals with H_1 only and D_2 deals with H_2 only. Exclusive territories are implied; intra-brand competition plays in explaining the use of RPM. The distributors, however, are competing with other distributors carrying other brands.

Exclusive dealing is assumed, i.e., a distributor either carries J&J's products or other brands but not both J&J's products and any other brand.[7]

In practice, a distributor may offer a variety of "services" when it tries to sell to a procurement manager (Cai, Fang, and Xu, 2011). We assume the absence of services because how important these "services" are is an unanswered question. In court, none argued that "services" do not exist. The two sides, however, debated fiercely on the importance of the "services." J&J argues that they are very important for the sales, while Rainbow argues that they are not important at all. The debatable significance leads us to assume no services. Downstream services, therefore, does not play any role

[7]The court case document also shows that if a distributor carries J&J's suturing products, it is prohibited from carrying other brands. Therefore, exclusive dealing has to be incorporated in the model.

in our model in explaining the use of RPM.

Timing. The game unfolds as follows.

1. J&J chooses an RPM price floor $\underline{p} \geq 0$ and a wholesale price $w \geq 0$.
2. The 2 distributors simultaneously decide whether to carry J&J's products. Those not carrying drop out from the game. Those carrying continue.
3. Distributor i offers a pair of price $p_i \geq 0$ and kickback $k_i \geq 0$ to the procurement manager i, where $i = 1, 2$.
4. The procurement managers received an offer simultaneously decide whether to accept the offer.
5. Payoffs are determined.

3.1. Cost structure and outside options

For simplicity, assume zero production cost for J&J and zero reselling cost for the distributors. If a distributor decides not to carry J&J's products, it can carry other brands. Normalize such an outside option for the distributor to zero.

If a procurement manager decides not to buy J&J's products, he can buy other brands too. Normalize such an outside option for the procurement manager to zero.

Each procurement manager faces a punishment $M \geq 0$ when he is caught receiving a kickback from the distributor carrying J&J's products. Specifically, if D_i gives him a kickback k_i, he faces the following payoffs:

$$U_i = \begin{cases} k_i & \text{if not caught,} \\ -M & \text{if caught.} \end{cases} \tag{3.1}$$

The amount M can be interpreted as the direct fine, the loss of job, the reputation loss, etc.

3.2. Probability of getting caught

Denote $\pi_i \in [0, 1]$ as H_i's probability of getting caught. Suppose the transacted price is p_i Printed on the official invoice, this amount is a real expenditure of the hospital. It is an amount H_i negotiates on behalf of the hospital. We assume it is public knowledge that π_i depends on the pair of transacted prices (P_1, P_2), i.e.,

$$\pi_i = \pi(p_i, p_j) \text{ for } i \neq j. \tag{3.2}$$

The intuition is that if a band aid costs the hospital \$100 to procure, the hospital must know that something phoney is going on between the seller and the procurement

manager. The hospital management may have to investigate and may potentially find out that H_i has received a kickback. If the band aid costs \$10 to procure, it is less likely for the hospital management to start an investigation. It is thus reasonable to expect a positive relationship between π_i and p_i, i.e., $\frac{\partial \pi(p_i,p_j)}{\partial p_i} > 0$. The probability of getting caught should also be related to the price paid by the other hospitals. To investigate, the hospital management has to have a benchmark. It is reasonable to expect that the hospital management would ask how much the other hospitals are paying for a band aid.

3.3. Procurement manager

Each procurement manager is delegated by his hospital to procure a batch of medical inputs; the size of which is normalized to 1.

H_i decides whether to accept or reject an offer of a pair of prices (p_i, k_i). His decision depends on his expectation of the price p_j. Fix p_j, he accepts an offer (p_i, k_i) if and only if $(1 - \pi(p_i, p_j))k_i - \pi(p_i, p_j)M \geq 0$ or

$$k_i \geq \underline{k}(M, p_i, p_j), \tag{3.3}$$

where $\underline{k}(M, p_i, p_j) \equiv \frac{\pi(p_i,p_j)}{1-\pi(p_i,p_j)}M$ defines the minimum kickback for procurement officer H_i to accept.

Lemma 1 *Fix p_j, H_i accepts an offer (p_i, k_i) if and only if $k_i \geq \underline{k}(M, p_i, p_j)$.*

A few comparative statics are worth noting. For any pair of (p_i, k_i), increasing the punishment M would increase this minimum kickback. For a given level of punishment M, fix p_j, increasing the listed price p_i should also increase this minimum kickback. This implies that a higher listed price is more dangerous in the eyes of the procurement manager. He would demand a bigger kickback.

3.4. Distributor

A distributor decides whether to carry J&J's products or another brand. If the decision is to carry J&J's products, the distributor picks a pair of prices (p_i, k_i) to offer to the procurement manager. Its profit is:

$$v_i = \begin{cases} \max\limits_{p_i \geq \underline{p}, k_i \geq \underline{k}(M,p_i,p_j)} (p_i - w) - k_i & \text{if sells for J\&J and offers a kickback,} \\ 0 & \text{otherwise,} \end{cases} \tag{3.4}$$

where $w \geq 0$ is the wholesale price J&J charges for each unit of the medical products, and $\underline{p}$ is the minimum RPM. If J&J is chosen, the distributor chooses a pair (p_i, k_i) to

maximize its profit, with the constraints that p_i has to be at least the minimum RPM $\underline{p}$, and that k_i is at least an amount acceptable by procurement officer H_i.

As $\underline{k}(M, p_i, p_j)$ is the minimum amount of kickback acceptable by H_i, in equilibrium D_i would always choose this minimum amount. Therefore, D_i's problem if it sells for J&J can be simplify to $\max_{p_i \geq \underline{p}}(p_i - w) - \underline{k}(M, p_i, p_j)$ or

$$\max_{p_i \geq \underline{p}}(p_i - w) - \frac{\pi(p_i, p_j)}{1 - \pi(p_i, p_j)} M. \tag{3.5}$$

Suppose the price floor $\underline{p}$ is non-binding, the distributor's pricing must satisfy the following first order condition with respect to p_i:

$$1 - \frac{(1 - \pi(p_i, p_j))\frac{\partial \pi(p_i, p_j)}{\partial p_i} + \pi(p_i, p_j)\frac{\partial \pi(p_i, p_j)}{\partial p_i}}{(1 - \pi(p_i, p_j))^2} M = 0.$$

Rearranging terms and denote the optimal price as p_i^*, we have:

$$\frac{1}{M} = \frac{\partial \pi(p_i^*, p_j)}{\partial p_i} / (1 - \pi(p_i^*, p_j))^2. \tag{3.6}$$

A property is worth noting.

Lemma 2 *Distributor H_i's optimal price p_i^* is independent of the wholesale price w.*

Lemma 2 implies that adjusting the wholesale price does not allow J&J to affect the distributor's pricing.

We now introduce one additional assumption.

Assumption 1 ***The increasing hazard rate assumption.*** *The hazard rate $\frac{\partial \pi(p_i, p_j)}{\partial p_i} / (1 - \pi(p_i, p_j))$ increases with p_i.*

Lemma 3 *Under the **increasing hazard rate assumption**, as long as the price floor is non-binding, increasing the punishment M faced by procurement officer H_i would reduce the optimal price p_i^*.*

3.4.1. The distributor's optimal pair of prices

The optimal pair of prices depends on whether the price floor is binding.

If the price floor is non-binding, the distributor's optimal pair of prices is p_i^* and $\frac{\pi(p_i^*, p_j)}{1 - \pi(p_i^*, p_j)} M$, the latter of which is the minimum kickback, i.e., $\underline{k}(M, p_i^*, p_j) = \frac{\pi(p_i^*, p_j)}{1 - \pi(p_i^*, p_j)} M$.

If the price floor is binding, the distributor's optimal pair of prices is $\underline{p}$ and $\frac{\pi(\underline{p}, p_j)}{1 - \pi(\underline{p}, p_j)} M$.

3.4.2. *The distributor's optimal brand choice*

Given the pair of optimal prices, if the distributor's profit is still negative, the distributor would choose not to carry J&J's product. If the distributor's profit is non-negative, the distributor would choose to carry J&J's product.

3.5. *Johnson & Johnson*

J&J's problem is to maximize its profit by choosing a pair of wholesale price and RPM $(w, \underline{p})$. Since the production cost is assumed to be zero, J&J's profit is the follows:

$$y = \begin{cases} 2w & \text{if both distributors carry J\&J's products,} \\ w & \text{if one distributor carry J\&J's products,} \\ 0 & \text{if no one is on board.} \end{cases} \tag{3.7}$$

Irrespective of the RPM, the optimal wholesale price is such that both distributors will optimally choose to carry J&J's products and they are not getting any profit (i.e., indifferent from carrying other brands). Setting too high a wholesale price discourages both distributors from carrying J&J's products. Setting too low a wholesale price leaves the distributors with positive profit and less for J&J.

An optimal RPM can be anything from zero to the prices that J&J expects their distributors to charge if an RPM plays no role in increasing the profit for the whole supply chain. But if the distributors are expected to charge a price that differs from the price that would have maximized the profit for the whole supply chain, then there will be a unique RPM set at the level of the optimal price for maximizing the profit for the whole supply chain.

Specifying the particular functional form of $\pi(p_i, p_j)$ would allow us to solve the equilibrium and derive the equilibrium outcome. To find out the condition under which an RPM plays a role, however, we do not need to specify a functional form. The next section shows the derivation.

4. When does an RPM plays a role?

4.1. *The vertically integrated benchmark*

Suppose J&J owns the two distributors. There is no RPM to consider. The optimal pair of prices offered to H_1 and H_2 must be the same. Denote it as p^{**}. J&J's problem is

$$\max_{p \geq 0} 2[(p - 0) - \frac{\pi(p, p)}{1 - \pi(p, p)} M]. \tag{4.1}$$

Suppose there exists a positive optimal price, J&J's pricing must satisfy the following first order condition with respect to p holds:

$$1 - \frac{(1-\pi(p,p))[\frac{\partial\pi(p,p)}{\partial p_1} + \frac{\partial\pi(p,p)}{\partial p_2}] + \pi(p,p)[\frac{\partial\pi(p,p)}{\partial p_1} + \frac{\partial\pi(p,p)}{\partial p_2}]}{(1-\pi(p,p))^2} M = 0.$$

Rearranging terms, the optimal price p^{**} solves the following:

$$\frac{1}{M} = [\frac{\partial\pi(p^{**},p^{**})}{\partial p_1} + \frac{\partial\pi(p^{**},p^{**})}{\partial p_2}]/(1-\pi(p^{**},p^{**}))^2. \tag{4.2}$$

4.1.1. No RPM

We can now compare the optimal price p^{**} under the vertically integrated benchmark, with the price that each distributor charges. In equilibrium, both distributor should charge the same price. The modified pricing given by (3.6) becomes:

$$\frac{1}{M} = \frac{\partial\pi(p^*,p^*)}{\partial p^*}/(1-\pi(p^*,p^*))^2. \tag{4.3}$$

Proposition 1 *Under the* ***increasing hazard rate assumption****,* $p^* < p^{**}$ *iff* $\frac{\partial\pi(p_i,p_j)}{\partial p_j} < 0$.

Proposition 1 shows an under-pricing incentive of the distributors in the absence of an RPM. Both distributors optimally charge p^*, which is lower than the benchmark optimal price p^{**}. The condition for this under-pricing incentive is $\frac{\partial\pi(p_i,p_j)}{\partial p_j} < 0$, which means a lower probability for a procurement manager to get caught receiving kickbacks if the transacted price of the *other* hospital of the same medical input is higher.

The intuition is that when J&J owns the distributors, its pricing strategy takes into account the fact that the procurement managers of both hospitals care about how likely they will be caught. If possible, J&J would want this risk to be as low as possible because lower risk implies a smaller kickback can "induce" the procurement managers to buy J&J's products. The price listed in one hospital affects such a risk of the other hospital. While in a benchmark vertically integrated case, J&J takes into account both hospitals' sales, if it sells indirectly through distributors, each distributor would not take into account its price on the risk of the other hospital's procurement manager. Such a mis-alignment of incentive results in under-pricing.

4.1.2. With RPM

Proposition 2 *If* $p^* < p^{**}$*, setting* $\underline{p} = p^{**}$ *can achieve the vertical integration profit.*

A minimum RPM set at p^{**} is sufficient to correct this under-pricing mis-incentive. J&J can benefit from it because overall, the prices charged to both hospitals could have been higher. It would optimally set a wholesale price w such that all the profit from every distributor would be zero, rendering them as well off as if they do not carry J&J's products.

5. Concluding remarks

We propose a new theory of RPM and suspect that it might have been the rationale behind J&J's uses an RPM to sell its staplers and suturing products in China. If the price one hospital pays is relevant to the monitoring of the hospital management of another hospital, procurement managers have to take that into their consideration. Such referencing creates a link between the two hospitals that the independent distributors probably would not take into full consideration. As such, they would price lower than if the manufacturer were to sell directly to the hospitals. The role of RPM is to correct such a mis-alignment of interest.

In this remark, we address two concerns.

Concern 1: Do hospital procurement in China in particular and in other countries in general involve kickbacks?
While Rose-Ackerman and Yan (2014) and Tam (2011) suggest that hospital procurement in China involve kicabacks, we have no direct evidence to substantiate such a claim either in China or in any other country. But we have indirect evidence to support such a claim.

Selling in a corruptible market, it is understandable that some manufacturers may not want to deal with the hospitals directly. The 1977 Foreign Corrupt Practices Act (FCPA), a law enforced by the U.S. Securities and Exchange Commission (SEC) on the publicly listed firms, can incentivize the U.S. publicly listed firms to sell to foreign hospitals indirectly through independent distributors. Outside of the U.S., therefore, we observe some health manufacturers selling to foreign hospitals indirectly through independent distributors. The fact that Johnson and Johnson sells to hospital indirectly through independent distributors rather than selling directly does not contradict with the story that the FCPA makes it undesirable for U.S. listed firms to sell directly in China.

There are cases the SEC indeed use FCPA to prosecute U.S. listed firms, which support the claim that the FCPA is a real threat to the listed firms. One example is Johnson and Johnson in *Securities and Exchange Commission v. Johnson & Johnson, Civil Action No. 1: 11-CV-00686 (D.D.C.)*. The other example is Biomet in *Securities and Exchange Commission v. Biomet, Inc., Civil Action No. 1: 12-CV-00454 (D.D.C.)(RMC)*. Smith and Nephew, too, has been prosecuted by the SEC in *Securities and Exchange*

Commission v. Biomet, Inc., Civil Action No. 1: 12-CV-00454 (D.D.C.)(RMC). These cases are corruption cases done by a U.S. listed firms in the foreign countries to bribe foreign medical officials.

The third piece of indirect evidence is the tables shown in Di Tella and Savedoff (2001) that suggest significant variations in the prices of the medical inputs purchased by hospitals in sevaral Latin American countries. They believe these price dispersions are good proxies for the extent of corruption. Beyond the academic literature, NHS-England (2013) specifically mentions about input price variations among their hospitals and links the variations to potential frauds. Their anti-fraud plans should be something British hospitals' procurement teams should concern about.

It is therefore not unreasonable to claim that hospital procurement involves kickbacks. When health manufacturers sell to hospitals, it then is unreasonable to think that they would not take corruption into explicit consideration.[8]

Concern 2: Is the theory specific to *Rainbow v. Johnson & Johnson* only? We, again, do not have any direct evidence to suggest that other health sector RPM cases involve kickbacks. However, two types of legal cases exist, hinting to us that our theoretical model is unlikely to be only applicable to *Rainbow v. Johnson & Johnson*.

First, there exist other RPM cases involving medical products that hospitals procurement teams procure, rather than acquired directly by end-users. In 2016, Medtronic was fined in China by the National Development and Reform Commission (NDRC) for the use of RPM on their cardiovascular, rehabilitation therapy and diabetes medical devices in China since 2014.[9] Medtronic has paid the U.S. government for an alleged violation of the False Claims Act by "inducing" U.S. physicians to buy their pacemakers and defibrillators.[10] Although we do not have direct evidence, it is not unreasonable to suspect that corruption may also have played a role in Medtronic's sales in China.

W&H Dental Werk has been fined by the Hungarian Competition Authority for imposing a RPM on its dental devices distributors. Dental devices are likely procured by procurement teams rather than the end-users.[11] The Portuguese Competition Authority prosecuted two companies (Baxter and GLINTT) for using RPM on their

[8] Pauly and Burns (2008) find that medical device sellers usually do not want their transaction prices to be disclosed, while policy-makers have legislated for mandatory disclosure. The desire of opaqueness appears to be consistent with the manufacturer needs to "protect" the procurement managers who buy their products by making it more difficult for hospitals to see prices others are paying.

[9] The NDRC's official release of the administrative penalty decision (in Chinese) is here: http://jjs.ndrc.gov.cn/fjgld/201612/t20161209_829716.html

[10] The official release from the U.S. government of this settlement is here: https://www.justice.gov/opa/pr/minnesota-based-medtronic-inc-pay-99-million-resolve-claims-company-paid-kickbacks-physicians

[11] The Hungarian Competition Authority case number: Vj-115/2010. The official press release is here: http://www.gvh.hu/en//data/cms1022284/sk_115_2010_versenykorlatozo__megallapodas_WH_FEJER_FOG_a.pdf

sales of automated medicine dispensers, a device used for automatic dispensing, labelling and packing of individual doses of oral solids drugs that are used in hospitals.[12]

Second, as the FCPA cases listed above suggest, there are several corruption cases involving bribing health institutions' procurement teams.

References

Asker, John. 2008. "Subsidizing (and taxing) business procurement." *Journal of Public Economics* 92 (7):1629–1643.

Asker, John and Estelle Cantillon. 2008. "Properties of scoring auctions." *RAND Journal of Economics* 39 (1):69–85.

Burguet, Roberto and Yeon-Koo Che. 2004. "Competitive procurement with corruption." *RAND Journal of Economics* 35 (1):50–68.

Cai, Hongbin, Hanming Fang, and Lixin Colin Xu. 2011. "Eat, drink, firms, government: An investigation of corruption from the entertainment and travel costs of Chinese firms." *Journal of Law and Economics* 54 (1):55–78.

Che, Yeon-Koo. 1993. "Design competition through multidimensional auctions." *RAND Journal of Economics* 24 (4):668–680.

Di Tella, R. and W.D. Savedoff. 2001. *Diagnosis Corruption: Fraud in Latin America's Public Hospitals*. Latin American research network. Inter-American Development Bank.

Inderst, Roman and Marco Ottaviani. 2009. "Misselling through agents." *American Economic Review* 99 (3):883–908.

———. 2012. "Competition through commissions and kickbacks." *American Economic Review* 102 (2):780–809.

Klein, Benjamin. 2009. "Competitive resale price maintenance in the absence of free riding." *Antitrust Law Journal* 76 (2):431.

———. 2014. "The evolving law and economics of resale price maintenance." *Journal of Law and Economics* 57 (S3):S161–S179.

Laffont, Jean-Jacques and Jean Tirole. 1993. *A theory of incentives in procurement and regulation*. MIT press.

Mao, Wendy and Travis Ng. 2016. "Resale Price Maintenance Without Services." Unpublished Manuscript.

Mathewson, Frank and Ralph Winter. 1998. "The law and economics of resale price maintenance." *Review of Industrial Organization* 13 (1-2):57–84.

[12]The summary of this case from the European Competition Network is here: http://ec.europa.eu/competition/ecn/brief/01_2011/pt_hospital.pdf

McGuire, Thomas G and Michael H Riordan. 1995. "Incomplete information and optimal market structure public purchases from private providers." *Journal of Public Economics* 56 (1):125–141.

NHS-England. 2013. "Tackling fraud, bribery and corruption: policy and corporate procedures."

Pauly, Mark V. 1979. "The ethics and economics of kickbacks and fee splitting." *Bell Journal of Economics* 10 (1):344–352.

Pauly, Mark V and Lawton R Burns. 2008. "Price transparency for medical devices." *Health Affairs* 27 (6):1544–1553.

Rose-Ackerman, Susan and Yingqi Yan. 2014. "Corruption in the Procurement of Pharmaceuticals and Medical Equipment in China." *UCLA Pacific Basin Law Journal* 32 (1):1–54.

Tam, Waikeung. 2011. "Organizational corruption by public hospitals in China." *Crime, Law and Social Change* 56 (3):265.

Telser, Lester G. 1960. "Why should manufacturers want fair trade?" *Journal of Law and Economics* 3:86–105.

Winter, Ralph A. 1993. "Vertical control and price versus nonprice competition." *Quarterly Journal of Economics* 108 (1):61–76.

———. 2009. "Presidential Address: Antitrust restrictions on single-firm strategies." *Canadian Journal of Economics* 42 (4):1207–1239.

A. The procurement system of China's public hospitals

Public hospitals in China buy two types of inputs: [1] medical equipment and [2] drugs and clinical supplies.[13] Medical equipment includes equipment such as X-ray and ultrasound equipment for normal checks, and more specialized and technical apparatus, like the laboratory and occupational therapy equipment. The procurement requires professional knowledge and services both before and after sales. Prices can be less decisive a factor for hospitals than functions, qualities, services, and the brand. Medical equipment procurement of hospitals and related local governmental departments involves forming a procurement team in making the purchase decision through open tender.[14] The team usually learns the properties, price and after-sale services of different brands of equipment through other hospitals who are using the equipment.[15] An open tender opens to all medical companies. There are usually five rounds of back-and-forth inquiry on the negotiation and bargain of the prices and terms. After collecting all the advice and comments from the different parties, the hospital makes the final decision under the supervision of the local Public Health Bureau.

Drugs and clinical supplies include generic and branded drugs, examination gloves, and sutures, and so on. Clinical supplies are also referred to as medical consumables. Before 2015, the National (or Provincial) Public Health Bureau maintained a catalog of the brands for which the hospitals can buy from. According to our interview, the catalog was strictly followed. The hospital could buy from them using their own procurement methods.[16] A common method was open bidding.

After 2015, the Chinese government took over the procurement system of the public hospital. It delegated the right to every provincial Public Health Bureau to implement a system of uniform bidding and procurement.[17] Every provincial Public Health Bureau also carries out an independent open tender within its own province. The groups that implement the bidding are usually chaired by the government officials of the related departments of the government and doctors and professions of some

[13] We discuss the system of public hospitals rather than private hospitals because private hospitals use their own funding to purchase supplies and drugs but public hospitals are funded by the government, which may induce more problems, such as bribery and monitoring of the government, and require a more complex system.

[14] Associated parties: (1) related departments of the local government include Finance Bureau (Department of Purchasing Management) and the Public Health Bureau (Disciplinarian Committee and deputy director of the bureau who is in charge of the procurement system); (2) management of the hospital; (3) related technicians and directors who will use this equipment.

[15] The choice of the other hospitals can be other hospitals within or nearby the city. It can also be hospitals outside the province.

[16] The directory of the National (or Provincial) Public Health Bureau determines the drugs and clinical supplies that hospitals can purchase from.

[17] Different provinces may adopt slightly different systems.

provincial hospitals. After the bidding, the provincial Public Health Bureau is required to publish the price, brand, and properties of every kind of drugs and supplies in the catalog. Each public hospital in the province should purchase drugs and supplies strictly following the provincial uniform procurement system.

Rainbow v. Johnson & Johnson took place before 2015. Thus, the procurement of staplers and suturing products was designed by the individual hospitals. Every procurement system appears transparent and fair, and it looks possible for the hospital to get the cheapest and best products from the medical companies.

However, after we have interviewed several related people, including one in the hospital and one in the medical company, we found that there existed substantial grey areas in the system. Bribery, corruption, fraud and unlawful activities can exist.

The bidding can be insidious. One possibility is that the chosen medical company could first collude with the hospital and forge several other virtual medical companies to attend the bidding. Moreover, it is the person in charge of the procurement system that makes the final decision on which company to purchase from or whether they need to switch to a particular brand. This person-in-charge will collect all the information from different parties, but the purchase decision may be inclined to the medical company that offers the biggest rebate.

These problems might have been the reason behind the Chinese government's 2015 decision to centralize the procurement system of the public hospitals. Without an uniform system, the brand that promises an uniform or minimum sale price could also be a good way to breed this kind of corruption activities.

Outside of China, we also study the publicly funded health-care system in the U.K.—the National Health Service (NHS).[18] According to their official document of a procurement development program, they admit the variation across the NHS, which needs more transparency to improve the productivity and lower cost.[19] They also combat bribery, corruption, fraud and unlawful activities by founding a more transparent data system and carrying on anti-fraud plans. It is fair to say that transparency and appropriate monitoring are required by every country to help the government and the hospital to save the cost and increase the efficiency.

[18]From www.nhs.uk: "It is the largest and the oldest single-payer healthcare system in the world. Primarily funded through the general taxation system and overseen by the Department of Health, the system provides healthcare to every legal resident in the United Kingdom, with most services free at the point of use."

[19]The variation includes different prices for the same product and different solutions to the same problem.