ESSAYS ON VERTICAL RESTRAINTS AND VERTICAL INTEGRATION

by

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A Dissertation submitted to the

Graduate School-New Brunswick

Rutgers, The State University of New Jersey

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

Graduate Program in Economics

written under the direction of

Martin K. Perry

and approved by

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New Brunswick, NJ

October, 2009

ABSTRACT OF THE DISSERTATION

Essays on Vertical Restraints and Vertical Integration

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This dissertation contains three essays which examine vertical integration and vertical restraints. The first essay examines a vertical restraint, Minimum Advertised Price (MAP) which is often observed in vertical relations as a remedy for the horizontal externality in provision of service. Retailers provide a variety of services that affect the sale of their products such as demonstrations and the provision of information and advice. These retail services can generate horizontal externalities among retailers. In such a case, the individual retailer realizes less than the full effect on aggregate profits of his additional retail services and therefore provides less than the optimal level of service. This study shows that MAP can ensure optimal level of service and it duplicates the welfare outcome of vertical integration regardless of the level of service externality.

The second essay explores the private and social desirability of vertical restraints imposed by a manufacturer on its retailers when there is uncertainty in demand or cost. A monopoly manufacturer offers a contract to retailers in an environment where the retailers

compete in quantities and possess superior information about local demand conditions or their costs of distribution. Two vertical restraints are studied: Resale Price Maintenance and Exclusive Territories. In particular, this study shows that resale price maintenance and exclusive territories are not substitutes. If the retailers are infinitely risk averse, the manufacturer prefers resale price maintenance under demand uncertainty, and quantity competition under cost uncertainty. However, if the retailers are risk neutral, the manufacturer prefers resale price maintenance regardless of the type of uncertainty.

The last essay examines affiliations that integrate physicians and hospitals. Managed care organizations shifted financial risks to health care providers by changing the payment method from fee-for-service to capitation. Due to this emerging financial risk, one of the strategies that physicians adopted was establishing affiliations with hospitals. This study performs an empirical analysis of the effect of the affiliation types on three important dimensions of health care: quality, cost, and price. The empirical results show that when the affiliation between a hospital and physicians is strong, the integrated organization operates more efficiently than independent hospitals. However, affiliations that weakly integrate hospitals and physicians produce a lower quality of health care with higher cost and price.

Acknowledgements

Special thanks are owed to my advisor, Martin K. Perry, for his guidance and support during the long Ph.D. process. Marty first introduced me to the field of Industrial Organization and mentored me in many ways. He spent countless hours sharing his valuable knowledge about antitrust issues and other nuances of economics with me. I am indebted to him for his friendship, invaluable advice, providing me with a research assistant position, and for purchasing the data set I used in my research.

I am also grateful to my committee members Jeffrey Rubin, Colin Campbell, and Martin Asher for their insightful comments. Colin Campbell's Industrial Organization and Game Theory classes taught me the fundamentals that were essential to my research. I greatly enjoyed, and benefited from, discussing health care markets with Jeffrey Rubin. He was also an excellent Undergraduate Director, and his advice helped me become a better instructor. I specifically want to thank him and Thomas Prusa for giving me the chance to teach my own courses while I was a graduate student.

Another thanks to the Center of Health Economics and Health Policy at The University of Medicine and Dentistry of New Jersey for their financial support. Working with Jeannette Rogowski and Alan Monheit provided enormous insight about issues in health care markets.

I am thankful to my friends Chiung-Min, Faisal, Geetesh, Hasan, Ilker, Isa, Kemal, Nihat, Sami, Stony, Tim, and Vinay for their encouragement and for making me feel that I was not alone during this arduous journey. I also want to thank Dorothy Rinaldi for her support from the first day of this Ph.D. process.

Finally, I would like to thank my parents and my brother Hakan for their assistance and support. Last, but certainly not the least, I would like to thank my wife Candice. Without her, completing this dissertation would have been nearly impossible.

Dedication

To My Parents, Necla and Aziz Cetinkaya

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1. The Welfare Implications of Minimum Advertised Price Programs

Introduction

Vertical restraints are contractual arrangements between a manufacturer and its retailers. There are different types of vertical restraints ranging from a requirement that retailers are exclusive dealers of a manufacturer's good to a resale price maintenance agreement setting the minimum or maximum price that retailers can charge for the manufacturer's product. The efficacy of vertical restraints depends on their ability to solve various externalities in the distribution process. Ideally a manufacturer would use vertical restraints to duplicate the outcome and profit of vertical integration. One inherent problem in all vertical models arises when both the manufacturer and its retailers independently set their prices. The monopolist manufacturer of a good charges its retailers a wholesale price that is greater than its marginal cost. If the retailing market is not competitive, the price charged by each retailer will be above the wholesale price. This is the double marginalization problem. Double marginalization results in a retail price above the level that would maximize the aggregate profits of a vertically integrated firm. This happens because each firm's decisions generate a vertical externality. When the retailer chooses the retail price, it only considers its profits and not the profits of the manufacturer. Double marginalization decreases the total profit of the vertical structure by reducing the output below the level that would maximize profits.

Another externality arises when retailers provide a variety of services that affect the sale of the manufacturer's good. Retail services which can increase demand include sales efforts, such as the provision of information and advice. A manufacturer of a good expects its retailers to provide such services to consumers since these services increase the consumers' demand for the good by consumers. The manufacturer has an incentive to force the retailers to provide services. However, monitoring the retailer's level of service is often problematic. The reason for the divergence between the manufacturer and retailers' preferred level of service is that the provision of service is costly for the retailer and can generate horizontal externalities among retailers. In such a case, each retailer realizes less than the full effect of its service on aggregate profits and therefore provides less than the optimal level of service.

These inefficiencies create incentives for the manufacturer to impose vertical restraints. Vertical restraints can be used to solve the double marginalization problem and the service externality problem. Resale Price Maintenance (RPM) can be used to set a maximum retail price to solve the double marginalization problem without affecting service (Perry and Porter, 1990). Conversely, the service externality can be solved by using RPM to set a minimum retail price that would widen the retail margin generating a stronger incentive for retailers to provide service (Telser, 1960)[1]. Since minimum RPM prevents price competition, retailers compete to provide more services to attract more consumers. Maximum RPM is a vertical restraint for the double marginalization problem and minimum RPM is a natural vertical restraint for service externality. The potential conflict is clear.

This paper examines another type of vertical restraint, minimum advertised price (MAP) programs which is related to resale price maintenance. I assume that a manufacturer distributes its product through monopolistically competitive retailers. Consumers benefit from the service provided by the retailer from whom they purchase the good, but also

[1] Other relevant studies include Bolton and Bonanno (1988), Klein and Murphy (1988), Marvel (1984), Marvel and McCafferty (1984), Mathewson and Winter (1984), Perry and Groff (1985), Rey and Tirole (1986)

benefit from the service provided by other retailers. Thus, there is a horizontal externality in provision of the service. The classic example is pre-sale informational advertising. Retailers who voluntarily abide by the MAP program are prohibited from advertising prices below some specified amount.[2] The manufacturer reimburses some or all of the retailers' advertising expenses as long as the retailers do not advertise a price lower than the price specified by the MAP program. The manufacturer chooses the wholesale price, the minimum advertised retail price, and the reimbursement rate for the service expenditures of the retailers. Thus, MAP programs are combined with a cooperative advertising policy. In general, retailers would decide whether to accept the MAP program or not. If retailers refused to participate in the MAP program, they would be free to choose their retail price and level of advertising but they would also pay for all their service expenses. Manufacturers can also refuse to sell their goods to retailers who decline to comply with the MAP program. If retailers accept the MAP program, they are free to choose the level of service and the retail price, but they cannot advertise a price different than the MAP price set by the manufacturer. Since the retailers are symmetric in my model, I assume that the manufacturer sets a wholesale price and the reimbursement rate such that all the retailers choose the MAP program.

Unlike MAP, RPM allows the manufacturer to choose the retail price directly. However, with RPM the manufacturer has no direct control over the service by its retailers, and the retailers choose their service expenditures. My results show that MAP is not equivalent to minimum RPM. In particular, MAP provides a different and richer set of control variables by which the manufacturer can duplicate the outcome of vertical

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[2] The Bay Area Consumers' Checkbook Update, 2003 newsletter, examined the MAP program of a vacuum cleaner manufacturer, Miele. Ten online Miele retailers were checked and all ten were found to be charging exactly $569 for a Miele Red Star canister vacuum. See Carlton and Perloff, "*Modern Industrial Organization"*, 4th Ed., 2005

integration. With RPM, the wholesale price combined with a franchise fee attains the outcome of vertical integration. The franchise fee determines the optimal number of retailers, and the manufacturer sets the wholesale price to control the service level. However with MAP, the manufacturer would not need a franchise fee in order to duplicate vertical integration. Instead, the wholesale price is used to obtain the optimal number of retailers while the advertising subsidy ensures the optimal level of service.

Until recently minimum RPM was still evaluated as illegal *per se*.[3] However, the U.S Supreme Court in July, 2007 overturned this nearly century-old rule and decided that minimum (and maximum) RPM would be evaluated under the *rule of reason* in the future.[4] Prior to this ruling, it was unclear whether MAP programs would be evaluated under *per se* illegality or the *rule of reason*. But after this ruling, it seems likely that both RPM and MAP will now be evaluated under the *rule of reason*. Under the *rule of reason*, the court must examine the potential benefits and negative effects of the conduct. However, under the *per se* rule the practice is always illegal. Deciding cases according to *rule of reason* requires an examination of the pro and anti-competitive effects of vertical restraints in great detail. In 1987 The Federal Trade Commission (FTC) stated that MAP programs were not automatically illegal as long as the MAP price refers to the advertised price and not the selling price.[5] In 2003, the five largest music recording companies which account for approximately 85% of the industry's $13.7 billion in domestic sales (Sony Music Distribution, Universal Music & Video Distribution, BMG Distribution, Warner-Elektra-Atlantic Corporation, and EMI Music Distribution) settled charges that their MAP programs on prerecorded music violated the

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[3] RPM was considered as a per se violation of the Sherman Act after Dr. Miles Case.
Dr. Miles Medical Co. v. Park & Sons co. (1911),220, U.S. 373

[4] Leegin Creative Leather Products, Inc. v. PSKS, Inc., 551 US__(2007) (slip op.).

[5] Even though the FTC considers MAP as a legal vertical restraint, some state attorneys such as New York's Deputy Attorney-General Pamela H. Jones and Maryland Assistant Attorney General did not agree with the FTC about MAP.

antitrust laws and illegally fixed prices. In this case, the FTC decided that these five companies violated Section 5 of the Federal Trade Commission Act by engaging in practices that restricted competition in the domestic market for prerecorded music. According to the FTC's estimates, the price per CD increased by $2.00 and this increase harmed consumers to the tune of $480 million dollars when the MAP policy was active. As a result, the companies paid $143 million in compensation to consumers.

In Canada, it is illegal to either refuse to sell a good to retailers who do not want to comply with a MAP program or to discourage a price reduction by agreement, threat or promise. Under the Canadian Competition Act[6], MAP programs are considered a competitive threat because retailers will immediately be terminated if they advertise prices below the MAP price.[7] Thus, MAP programs are actively discouraged in Canada. The maximum penalty is a fine at the discretion of the court (no limit) and/or five years' imprisonment. In the R. v. Epson Canada Ltd. case, Epson was charged for contracting with retailers to prevent advertising of prices lower than their MAP program in 1990. Epson claimed that its new product required a high level of pre-sale service, and without the MAP program the optimal level of service would not be provided because of the free rider problem. The court rejected this explanation and concluded that the offense was committed by the insertion of the clause into the dealer agreements and that possible efficiencies or beneficial marketplace effects were no defense. On appeal, the fine was reduced from C$200,000 to C$100,000.[8]

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[6] The Antitrust Counselor, Volume 22, April 2005

[7] Competition Act § 61(3): "The dealer is under no obligation to accept these suggested resale prices and may sell at any price he chooses. If he chooses to sell at prices other than those suggested, he will not suffer in any way in his business relations with the supplier or any other person over whom the supplier has control or influence."

[8] Competition Law International, Volume 4, No 1, February 2008

Similar to the Canadian competition law, competition law in the European Union states that any direct or indirect price fixing or setting a minimum resale price is unlawful; whereas setting a maximum resale price is legal. Historically, European countries allowed manufacturers to impose a minimum resale price since maintaining a high retail price may be necessary to provide high quality services. However, the political objective to promote one single European market has resulted in stricter European competition laws against minimum resale price.[9] Even though MAP policies do not dictate a specific price, it is highly likely that MAP programs would be considered as an indirect way of setting a minimum resale price. Similar to the FTC, the European Commission had been investigating MAP contracts between distributors and the five largest music recording companies until these recording companies voluntarily cancelled the contracts in 2001.

The remainder of the paper is organized as follows. Section 2 discusses sufficient combinations of vertical restraints that would duplicate vertical integration. Section 3 discusses the assumptions of my model and outlines the retail equilibrium when there are no vertical restraints. Section 4 develops the models of RPM and MAP and compares their efficacy in solving horizontal and vertical externalities in the retail market. The specific MAP programs used in the prerecorded music industry are discussed in Section 5. Finally, Section 6 concludes with the welfare and antitrust implications of MAP programs.

1.1 Minimally Sufficient Sets of Restraints

An extensive literature addresses the social and private desirability of RPM, but no satisfactory explanations for the social and welfare effects of MAP programs have been

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[9] The Metropolitan Corporate Counsel, November 2007. p.6

developed.[10] Mathewson and Winter (1984) identify alternative combinations of vertical restraints called "minimally sufficient sets of restraints" that enable the manufacturer to realize the integrated profit when direct vertical integration is not feasible. Their model considers an environment in which the manufacturer has monopoly power and the retailers are imperfectly competitive in a spatially differentiated market. Retailers provide pre-sale informational service to the consumers, which cannot be provided by the manufacturer and cannot be costlessly monitored by the manufacturer. They consider two retail conjectures: Loschian and Nash. With the Loschian conjecture, each retailer matches price changes by competing retailers on a one-to-one basis. Alternatively, with the Nash conjecture each retailer sets prices given the prices of its rival retailers. Their study shows that a franchise fee and a wholesale price are a sufficient set of vertical instruments to duplicate vertical integration when there is no externality. The wholesale price is set equal to the marginal cost and the franchise fee extracts the retail profit. Quantity forcing is also a sufficient instrument to reach the vertically integrated outcome under the same conditions. In the case of Nash conjectures, a franchise fee with closed territory distribution or quantity forcing with closed territory distribution are equally sufficient combinations of vertical restraints when there is no service externality. However, when there is a service externality in retail markets, RPM would have to be used either with a franchise fee or with quantity forcing under both

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[10] Caillaud and Rey (1987) compare the equilibrium levels of service under wholesale pricing and vertical integration. In their paper, service is assumed to be a variable cost and competitive retailers are supplying the service. They find that vertical integration can be accomplished with either minimum or maximum RPM. Marvel and McCafferty (1986) employ a model with competitive retailers supplying the service. They examine a data set from states with and without "fair trade". The existence of competitive retailers who sell the product at unit cost undermines the ability of full-service retailers to break even when providing service. They find that retailers will provide no service without RPM and that provides an incentive to the manufacturer to impose RPM. Romano (1994)'s study employs a model in which one manufacturer chooses the quality of the good, and one retailer chooses the level of service. Franchise fees allow the manufacturer to extract the retail profit. This study shows that minimum RPM is used to induce higher levels of services, and maximum RPM induces lower levels of services.

Loschian and Nash conjectures. Their results show that territorial restraints and franchise fees are complimentary vertical controls and territorial restraints and RPM are substitute vertical controls.

Perry and Porter (1990) show that without a franchise fee, minimum RPM cannot correct sub-optimal levels of retail service caused by a horizontal externality in the provision of retail service. With a franchise fee, the manufacturer can increase the retail margin with minimum RPM, and induce retailers to provide the optimal level of service, while the franchise fee controls the number of retailers. However, without a franchise fee the manufacturer can only duplicate vertical integration when there is no externality. The service externality lowers the social surplus. RPM alone cannot solve this problem. In my paper, I show that regardless of the service externality MAP can ensure an optimal level of service and duplicate the welfare outcome of vertical integration.

Kali (1998) argues that MAP is a vertical restraint that resembles RPM. Neither RPM nor a cooperative advertising subsidy can maximize the manufacturer's profit unless they are used together. While the study shows that MAP programs lead to an optimal level of service, it does not demonstrate whether increasing the provision of services benefits or harms the consumers. However, my study examines the effect of MAP programs on consumers and also compares the private and social desirability of RPM and MAP. While Kali's model employs a spatial model of retail differentiation, I use the constant elasticity of substitution (CES) model to generate retail differentiation as in Perry and Porter (1990). One of the advantages of the CES model over the spatial model is that the CES model allows us to analytically examine vertical restraints which cannot individually duplicate vertical integration. Another advantage is that the number of retailers in my model is determined by free entry, while Kali (1998)'s model has two retailers and does not allow a change in the number of retailers. Having a varying number of retailers enables us to examine the effect of retail diversity on the social and the consumer surplus.

1.2 The Model

1.2.1 The Utility

As in the model from Perry and Porter (1990), I use a quasi-linear consumer benefit function which is additively separable between a composite commodity, *y* and other income. The utility from the composite commodity is assumed to be isoelastic with declining marginal utility:

$$u(y) = (1-\varepsilon)^{-1} \cdot y^{1-\varepsilon}, \quad 0 < \varepsilon < 1 \tag{1.1}$$

I also assume that the quantity of each good and the level of service attached to the good join to produce a composite commodity by means of a Cobb-Douglas function (Dixit and Norman, 1978):

$$y = \sum_1^m z_i^\alpha \cdot x_i^\beta \tag{1.2}$$

with parameters $0 < \alpha < 1$, $0 < \beta < 1$, and $\alpha + \beta < 1$. Since $\alpha < 1$ and $\beta < 1$, there are diminishing returns in the production of the composite commodity with respect to both the good and the service attached to this product. Let x_i be the quantity of i^{th} good and z_i be the quantity of service received when the i^{th} good is purchased.

A manufacturer produces the good, but retailers provide the service attached to the good. Consumers value the service separately from the good itself. Service has no value if the good is not purchased. But once some units of the good are purchased, there is substitution between the quantity of the good and the level of service. Retailers may provide information to consumers about the good. Alternatively, retailers may provide shorter cashier lines, fitting rooms, organized shelves, and informed personnel.

The manufacturer produces the good and distributes it through retailers. At the retail stage, the good becomes differentiated based on characteristics of the retailer separate from the service. The retail market is monopolistically competitive with *m* retailers, and each of them supplies one differentiated good. The marginal contribution of each retailer to the quantity of composite commodity is diminishing. Since the goods of retailers are not perfect substitutes, consumers prefer more retailers in the market. In other words, consumers prefer retail diversity.

1.2.2 The Horizontal Externality

In my model, consumers benefit from the service provided not only by the retailer from whom they purchase the good, but they can also benefit from the services provided by other retailers. Thus, there can be an externality in provision of service. Pre-sale informational advertising about a good is an example of this type of service. I assume that service is attached to the j^{th} good in the following manner:

$$z_j = \lambda \cdot s_j + (1-\lambda) \cdot \bar{s}\,, \ 0 < \lambda < 1 \quad \text{where} \quad \bar{s} = \frac{1}{m}\sum_{i=1}^{m} s_i \tag{1.3}$$

The service consumers receive when they purchase j^{th} good is a weighted average of the j^{th} retailer's service s_j and the average service for all retailers, $\bar{s}$. The weighting factor λ captures the level of externality. As λ decreases, the externality increases. In other words, when λ=1 there is no externality, whereas when λ=0 service is a pure public good. Pre-sale service is costly, and the marginal cost of service is w. I assume that the service cannot be sold separately by third parties, and that retailers cannot charge for the service. If a retailer who incurs the cost of service sets a higher price, consumers can benefit from the service provided by the retailer, but purchase the good from other retailers who charge a lower price and provide no service. This free rider effect will not occur in the symmetric equilibrium which I will examine. However, even in a symmetric equilibrium the incentives of retailers to provide service will be attenuated by the service externality. The horizontal externality in provision of service results in retailers providing less than an optimal level of service. As a result, the price competition among retailers may be accentuated.

1.2.3 The Retail Demand

Since consumer utility is additively separable, consumers purchase the quantity of each good until the marginal utility from that equals the price. The inverse demand function for the j^{th} retailer can then be expressed as:

$$p_j(x_j, s_j) = \beta \cdot y^{1-\varepsilon} \cdot z_j^{\alpha} \cdot x_j^{\beta-1} \tag{1.4}$$

The demand function for the j^{th} retailer can be obtained by inverting the inverse demand function:

$$x_j(p_j, s_j) = [\beta \cdot q^{-\varepsilon}]^{\left(\frac{1}{1-\beta(1-\varepsilon)}\right)} \cdot z_j^{\left(\frac{\alpha}{1-\beta}\right)} \cdot p_j^{-\left(\frac{1}{1-\beta}\right)} \tag{1.5}$$

where $q = \sum_1^m z_i^{\left(\frac{\alpha}{1-\beta}\right)} \cdot p_j^{-\left(\frac{1}{1-\beta}\right)}$. (1.6)

Expression (1.5) is the demand for the j^{th} retailer. The demand facing each retailer obviously depends on its own price and service, but it also depends on the prices of other retailers through q and the service of other retailers through z_i A change in the j^{th} retailer's price and service also has an indirect effect on its own retail demand though the price-service market variable q. Since I assume that the retail market is monopolistically competitive, I assume that each retailer takes q as given when choosing the retail price and the service. In other words, each retailer is too small to recognize the effect of its price and service decision on market variables such as y and q. The demand function also depends on the number of retailers m. With more retailers carrying the good, consumers benefit from retail differentiation. The assumption $\varepsilon < 1$ ensures that there are decreasing returns to scale in the utility from each retailer. This assumption is necessary to generate an equilibrium degree of retail differentiation. The marginal incentive to provide service decreases when the horizontal service externality increases. If all retailers provide the same quantity of the good and the service, the quantity demanded from each retailer can be written as:

$$x(p, s, m) = \left[\beta \cdot m^{-\varepsilon} \cdot s^{\alpha(1-\varepsilon)} \cdot p^{-1}\right]^{\left(\frac{1}{1-\beta(1-\varepsilon)}\right)} . \tag{1.7}$$

The manufacturer has a constant marginal cost c of producing the good. The manufacturer charges a wholesale price r to retailers. The product is differentiated by the retailers and sold to the consumers. The marginal cost of service by retailers w is constant. The retailers also incur other fixed costs f, such as overhead and rent.

1.2.4 The Social Optimum

I calculate social surplus and consumer surplus as reference points. The social surplus is equal to the utility from the composite commodity minus the industry costs, and consumer surplus is the utility minus the payments to retailers by consumers:

$$v(x,s,m) = (1-\varepsilon)^{-1}\left[m \cdot s^{\alpha} \cdot x^{\beta}\right]^{(1-\varepsilon)} - m \cdot [c \cdot x + w \cdot s + f] \qquad (1.8)$$

$$cs(x,s,m) = (1-\varepsilon)^{-1}\left[m \cdot s^{\alpha} \cdot x^{\beta}\right]^{(1-\varepsilon)} - m \cdot p \cdot x \ . \qquad (1.9)$$

Since the marginal contribution of each retailer is decreasing, social surplus depends on the number of retailers as well as the quantity of product and the level of service provided by each retailer. When I maximize the social surplus function over the quantity of good x, the level of service s, and the number of retailers, m, I find the following socially optimal values:

$$x^* = \frac{\alpha \cdot f^*}{c} \ , \qquad (1.10)$$

$$s^* = \frac{\beta \cdot f^*}{w}, \qquad (1.11)$$

$$m^* = \left[(f^*)^{-1} \cdot (s^*)^{\alpha(1-\varepsilon)} \cdot (x^*)^{(1-\varepsilon)}\right]^{\left(\frac{1}{\varepsilon}\right)} \qquad (1.12)$$

where $f^* = \frac{f}{(1-\alpha-\beta)}$. I can express the socially optimum values of the social surplus and consumer surplus in terms of m^* by substituting the optimum values for x^* and s^* into equations (8) and (9):

$$v^* = \left(\frac{\varepsilon}{1-\varepsilon}\right) \cdot f^* \cdot m^* \quad , \tag{1.13}$$

$$cs^* = \left(\frac{1-\beta(1-\varepsilon)}{1-\varepsilon}\right) \cdot f^* \cdot m^* \, . \tag{1.14}$$

Note that, m^* is the optimal level of retail differentiation. Although the optimal values are independent of the service externality λ, the social optimum is not a feasible policy since it requires setting the retail price equal to the marginal cost of production, $p^* = c$.

1.2.5 The Retail Equilibrium without Vertical Restraints

After the monopolist manufacturer chooses a wholesale price above its marginal cost, $r > c$, the retailers take this wholesale price as their marginal cost and set a higher retail price, $p > r$. Since each retailer maximizes its own profit, ignoring the effect of its retail price on the manufacturer's profit, a double marginalization problem occurs. The retailers also independently set the level of service which they provide. The free entry and exit condition determines the number of retailers. With monopolistic competition, retailers enter the market until profits are driven to zero. The profit function of j^{th} retailer follows:

$$\pi_j(p_j, s_j) = (p_j - r) \cdot x_j(p_j, s_j) - w \cdot s_j - (e + f) \tag{1.15}$$

The retailer chooses the level of service to provide and the retail price. A higher retail price increases the retail margin $(p_j - r)$ but it has a negative effect on retail demand $x_j(p_j, s_j)$. Retailers increase the demand for their product by providing services at a cost of w per unit of service. In addition to setting the wholesale price r above the marginal cost c, the manufacturer can also charge a franchise fee e. It is assumed that retailers take the q and $\bar{s}$ as given when they choose price and service to maximize their profits. Free entry and exit in the retail market drives the profit to zero by shifting each retailer's demand curve downward until it is tangent to the retailer's average total curve (Chamberlin, 1933).

The profit-maximizing price, the profit-maximizing service, and the zero-profit condition jointly determine the symmetric equilibrium for the given wholesale price r.

$$\frac{\partial \pi}{\partial p} = 0 \qquad \rightarrow \qquad p = \frac{r}{\beta} \tag{1.16}$$

$$\frac{\partial \pi}{\partial s} = 0 \qquad \rightarrow \qquad w \cdot s = \frac{(\alpha \cdot \lambda)}{(1-\beta)} \cdot (p - r) \cdot x(p, s, m) \tag{1.17}$$

$$\pi = 0 \qquad \rightarrow \qquad w \cdot s = (p - r) \cdot x(p, s, m) - (e + f) \tag{1.18}$$

Equation (1.16) clearly shows that the retail price does not depend on the service externality and is a constant markup over the manufacturer's wholesale price. However, the level of service that the retailer provides depends on the service externality as well as the retail margin and the demand for the product. A higher retail margin and quantity demanded result in a higher level of service whereas an increase in the service externality reduces the level of service (1.17). By using these three equilibrium conditions, I can solve retail equilibrium quantity $x(r, e)$ and free entry number of retailers $m(r, e)$. When the manufacturer can only set the wholesale price and a franchise fee, the manufacturer's profit function is:

$$\pi(r,e) = (r-c)\cdot m(r,e)\cdot x(r,e) + e\cdot m(r,e)\ . \tag{1.19}$$

Before examining the effects of different vertical restraints on market outcomes, I first examine the situation where a manufacturer cannot use any vertical restraints or even franchise fee. In other words, the manufacturer can set a wholesale price only. If the manufacturer can only set a wholesale price, its profit function can be written as:

$$\pi(r,0) = (r-c)\cdot m(r,0)\cdot x(r,0) = K_1\cdot(r-c)\cdot r^{-\left(\frac{\varepsilon+\beta(1-\varepsilon)}{\varepsilon}\right)}, \tag{1.20}$$

where K_1 is a constant of the parameters which are independent of r. Solving the manufacturer's profit-maximization problem generates the following results for the wholesale price, retail price, and retail margin:

$$r_{wp} = \frac{\varepsilon+\beta(1-\varepsilon)}{\beta(1-\varepsilon)}\cdot c\ , \tag{1.21}$$

$$p_{wp} = \frac{1}{\beta}\cdot r_{wp}\ \ , \tag{1.22}$$

$$p_{wp} - r_{wp} = \frac{\varepsilon+\beta(1-\varepsilon)}{\beta(1-\varepsilon)}\cdot\frac{(1-\beta)}{\beta}\cdot c. \tag{1.23}$$

Without vertical restraints, the wholesale price is a constant markup over the marginal cost of production and does not vary with service externality. When I solve the retail equilibrium conditions with this profit-maximizing price, I can obtain the complete retail equilibrium:

$$x_{wp} = \frac{\beta(1-\varepsilon)}{\varepsilon+\beta(1-\varepsilon)} \cdot \frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)} \cdot x^*, \tag{1.24}$$

$$s_{wp} = \lambda \cdot \frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)} \cdot s^*, \tag{1.25}$$

$$m_{wp} = \lambda^{\left(\frac{\alpha(1-\varepsilon)}{\varepsilon}\right)} \cdot \left[\frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)}\right]^{\left(\frac{(1-\varepsilon)\cdot(\alpha+\beta)-1}{\varepsilon}\right)} \cdot \left[\frac{\beta(1-\varepsilon)}{\varepsilon+\beta(1-\varepsilon)}\right]^{\left(\frac{\beta(1-\varepsilon)}{\varepsilon}\right)} \cdot \beta^{\left(\frac{1}{\varepsilon}\right)} \cdot m^*. \tag{1.26}$$

If the manufacturer can only set wholesale price, the level of service and the quantity of each good are both sub-optimal when a service externality is present: $s_{wp} < s^*$ and $x_{wp} < x^*$ when $\lambda < 1$. Only when there is no externality, $\lambda = 1$, the service and the quantity attain the social optimum values.

The quantity is less than optimal for two reasons. First, double marginalization increases the retail price (1st term in 1.24). Second, the service externality decreases the level of service provided by each retailer, thereby reducing the quantity of good sold (2nd term in 1.24). Social and consumer surplus can be expressed as:

$$v_{wp} = \frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)} \cdot \left[\frac{\beta\left(1-\beta(1-\varepsilon)^2\right)+\varepsilon(1-\beta)\cdot(1-\beta(1-\varepsilon))}{\beta\varepsilon\left(\varepsilon+\beta(1-\varepsilon)\right)}\right] \cdot \frac{m_{wp}}{m^*} \cdot v^*, \tag{1.27}$$

$$cs_{wp} = \beta^{-1} \cdot \frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)} \cdot \frac{m_{wp}}{m^*} \cdot cs^* . \tag{1.28}$$

Both the consumer surplus and social surplus are lower than their socially optimum values The service externality reduces both consumer surplus and social surplus because the higher service externality lowers the service provided by retailers, and therefore decreases the quantity sold by each retailer.

1.3 Vertical Restraints

When vertical integration is not feasible or prohibitively costly, manufacturers have incentives to use various combinations of vertical restraints to achieve the vertically integrated level of profit. The profit-maximizing wholesale price by itself is not capable of achieving the outcome of vertical integration. The reason for the failure of wholesale pricing is that the wholesale price cannot simultaneously control the resulting retail price and the retail service which determine the quantity of the good purchased by consumers in the retail market. The profit-maximizing wholesale price cannot guarantee that the consumers receive the appropriate retail service or purchase the good at the appropriate price. For instance, the manufacturer benefits from the higher sales when retailers provide adequate sales information about the good either by trained store staff or by demonstrations. The problem is that providing informational service is costly and is subject to a service externality especially when discount retailers exist in the retail market. Because of the externality in providing service, the services are typically under-supplied. The service externality in the provision of service might be solved by setting minimum retail price. In order to correct the suboptimal level of service by retailers, the manufacturer could eliminate price competition among retailers by setting a minimum retail price that widens the retail margin, thereby increasing the incentive of retailers to provide service.

While the minimum retail price might solve the service externality problem, the manufacturer would also need to set a maximum retail price in order to remedy the double marginalization problem. Even though the wholesale price is above the marginal cost of the good, retailers set the retail price above the wholesale price. Thus, retailers ignore the effect of the additional markup on reducing the aggregate profit. The double marginalization problem results in a higher retail price and lower profit and social welfare than the outcome of vertical integration. Thus, there is a fundamental conflict for the manufacturer using RPM. A higher retail price could remedy the service externality but exacerbate the double markups. Different combinations of vertical restraints can also solve the misalignment of incentives between the manufacturer and its retailers. This misalignment of incentives is the reason why the manufacturer would employ vertical restraints such as RPM and MAP to replicate vertical integration and extract the profit of the retailers by controlling the retail price and service either directly or indirectly.

In following subsections, I compare RPM and MAP in terms of dealing with the service externality and the double marginalization problems when both problems exist simultaneously. A simple comparison of the retail prices with RPM or MAP is not sufficient to determine potential effects of these two vertical restraints on the manufacturer's profits or total welfare. In some cases, consumers prefer to purchase a good with a higher service at a higher price than purchasing a good with lower service at a lower price. In addition to the retail price and the service, the quantity of the good purchased by consumers and the retail diversity are two other important factors that determine the profits and the welfare. Thus, the question is how well RPM and MAP can simultaneously control the resulting quantity, service and diversity.

1.3.1 Resale Price Maintenance

RPM is an agreement between a manufacturer and its retailers in which the manufacturer can set the retail price of the good either at a minimum price or a maximum price. RPM allows the manufacturer to control the retail price directly and service and diversity indirectly. This subsection examines RPM and its welfare implications. In addition, this section provides a base for comparison with MAP.

The monopolist manufacturer chooses the wholesale price r, and the retail price p. Upon observing the prices, retailers decide the level of service s independently. The demand for the j^{th} retailer's good is $x_j(p, s_j)$. The j^{th} retailer chooses the level of service s_j to maximize its profit:

$$\pi_j(p, s_j) = (p - r) \cdot x_j(p, s_j) - w \cdot s_j - (e + f). \tag{1.29}$$

The manufacturer recognizes the retail equilibrium at the second stage and chooses the wholesale price w and the retail price p to maximize its profits:

$$\pi(p, r) = K_2 \cdot (r - c) \cdot p^{-\frac{1}{\varepsilon}} \cdot (p - r)^{\left(\frac{(1-\varepsilon)\cdot(1-\beta)}{\varepsilon}\right)}, \tag{1.30}$$

where K_2 refers to parameters which are independent of r and p. The manufacturer does not charge a franchise fee, $e = 0$. The equilibrium level of service and the zero profit condition define the retail equilibrium. Differentiating the manufacturer's profit function (1.30) with respect to r and p generates the profit-maximizing level of wholesale price, the retail price, and the retail margin:

$$r_{rpm} = \frac{\varepsilon + \beta(1-\varepsilon)}{\beta(1-\varepsilon)} \cdot c, \tag{1.31}$$

$$p_{rpm} = \frac{1}{\beta(1-\varepsilon)} \cdot c, \tag{1.32}$$

$$p_{rpm} - r_{rpm} = \frac{(1-\beta)}{\beta} \cdot c. \tag{1.33}$$

Under RPM, the manufacturer sets the wholesale price equal to the wholesale price without RPM. However, the manufacturer sets a lower retail price. The retail margin (1.33) is lower under RPM compared to the case without RPM (1.23). The manufacturer reduces the retail price by setting a maximum retail price. Maximum RPM eliminates the distortion caused by double marginalization. A lower retail price increases the demand for the manufacturer's good without changing the wholesale price. Given the profit-maximizing wholesale price and the retail price, the retail equilibrium can now be easily calculated:

$$x_{rpm} = \frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)} \cdot x^*, \tag{1.34}$$

$$s_{rpm} = \lambda \cdot \frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)} \cdot s^*, \tag{1.35}$$

$$m_{rpm} = \lambda^{\left(\frac{\alpha(1-\varepsilon)}{\varepsilon}\right)} \cdot \left[\frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)}\right]^{\left(\frac{(1-\varepsilon)\cdot(\alpha+\beta)-1}{\varepsilon}\right)} \cdot [\beta(1-\varepsilon)]^{\left(\frac{1}{\varepsilon}\right)} \cdot m^*. \tag{1.36}$$

The following proposition can now be stated.

Proposition 1: *When used as the only vertical restraint, RPM results in a lower retail margin and eliminates the double marginalization problem. This results in lower retail diversity. However, the level of service is unchanged and remains sub-optimal when service externality is present,* $s_{rpm} \leq s^*$ *as* $0 \leq \lambda \leq 1$.

When there is no service externality, $\lambda = 1$, the service level and quantity sold attain their socially optimum values, $s^*$and x^*. However, when the service externality is present the retail margin under RPM does not correct service externality. The manufacturer lowers the retail margin and solves the double marginalization problem by setting a maximum retail price. However, lowering the retail margin decreases the incentive to provide service, so RPM does not correct the sub-optimal level of service caused by service externality. As a result of the lower retail margin, retailers exit the market, and the number of retailers is lower than the number of retailers without RPM. The lower number of retailers increases the sales of each. This partially stimulates retail service, but only compensates for the reduction in the retail margin. The total effect of the decrease in the retail margin and the number of retailers on the level of social surplus and consumer surplus is:

$$v_{rpm} = \frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)} \cdot \left[\frac{1-\beta(1-\varepsilon)^2}{\beta\varepsilon(1-\varepsilon)}\right] \cdot \frac{m_{rpm}}{m^*} \cdot v^*, \tag{1.37}$$

$$cs_{rpm} = [\beta(1-\varepsilon)]^{-1} \cdot \frac{(1-\alpha-\beta)}{(1-\lambda\alpha-\beta)} \cdot \frac{m_{rpm}}{m^*} \cdot cs^*, \tag{1.38}$$

$$\pi_{rpm} = \frac{x_{rpm}}{x^*} \cdot \frac{m_{rpm}}{m^*} \cdot v^*. \tag{1.39}$$

As a result of the lower retail price, the manufacturer's profit increases $\pi_{rpm} > \pi_{wp}$. It is important to note that the social surplus and consumer surplus associated with RPM are lower because of the decrease in the number of retailers. Consumers are harmed by the reduction in retail diversity. If the service externality is low, the reduction in the number of retailers encourages the remaining retailers to provide more service. Thus, the higher service associated with lower externality makes the marginal effect of the reduction in retail diversity on consumer surplus and social surplus somewhat less than it would otherwise be.

The manufacturer has incentives to use maximum RPM to solve the double marginalization problem. Maximum RPM results in lower retail prices and higher manufacturing profits. However, the decrease in consumer surplus makes it clear that lower retail price is not sufficient to identify the effect on social welfare. Under a *rule of reason* analysis, one must examine the impact on retail service and diversity. With RPM as the only vertical restraint, retail service is unaffected but retail diversity is reduced. This explains why the net effect of maximum RPM results in lower consumer surplus and total welfare.

1.3.2 Minimum Advertised Price

Under such MAP agreements, retailers can sell goods of the manufacturer for any price they choose. However, the retailers may not advertise a retail price below a specified minimum retail price, called the minimum advertised price. As long as the retailer complies with the MAP restriction, the manufacturer shares some of the retailer's service expenses.

The manufacturer must monitor whether the retailer follows the MAP prices and this may be more or less difficult depending on the industry. One monitoring advantage for the manufacturer is that other retailers could inform the manufacturer if a competing retailer violates the MAP restriction by advertising a lower price than the MAP price. If MAP requirements are violated, the manufacturer could punish the retailer harshly by terminating the contract and ending the subsidies for the retailer's advertising expenses on future advertisements. Of course the threat of terminating the contract and advertising subsides may be all that is needed to obtain compliance by retailers with the MAP prices.

Even though retailers can charge a lower price than the MAP price, they have little or no incentive to do so. The MAP price becomes the effective retail price and determines the demand for the retailer's product since the MAP programs block the advertising channels between the retailer and its consumers. Thus, the retailer has no effective way of informing consumers that they could purchase the product at its lower price. The purpose of setting a lower price is to expand sales. But if the retailer cannot convey the fact that its prices are lower, then consumers cannot respond to the lower prices. Since the MAP restriction only allows a price tag on the good itself, then consumers would not realize that the retail price is lower than advertised unless they were shopping at the retailer's store and examining the good.

My MAP model is a symmetric model with a monopoly manufacturer and m retailers. Recognizing the equilibrium retail price p and the level of service s and the number of retailers m, the manufacturer chooses the wholesale price r, the MAP price p, and the reimbursement rate for retailers' service (advertising) expenses, $0 \leq \delta \leq 1$. In addition, I implicitly assume that there is no punishment other than ending the reimbursements when retailers do not comply with the MAP price. After the manufacturer announces the wholesale price r, the MAP price p, and the reimbursement rate δ for retailers' service expenses, retailers decide whether to accept the MAP program or not. If a retailer rejects the MAP program, the retailer is free to choose and advertise its own retail price and the level of service. But the retailer will not receive any reimbursement for its service expenses. However, if the retailer accepts the MAP program, the retailer remains free to choose the level of service and the retail price, but it cannot advertise a price different than the MAP price. Given the wholesale price, the reimbursement rate and the MAP price, each retailer sets the level of service s and the retail price p. The demand for the j^{th} retailer's product is $x_j(p_j, s_j)$. Retailer *j* maximizes its profit function with respect to the level of service s_j and the retail price p_j:

$$\pi_j(p_j, s_j) = (p_j - r) \cdot x_j(p_j, s_j) - (1 - \delta)w \cdot s_j - f. \quad (1.40)$$

The retail equilibrium is determined by the profit-maximizing level of service and the zero profit condition. For this model, I assume that the manufacturer does not impose any minimum or maximum limit on the level of service. The MAP program enables retailers to pay only a faction $(1 - \delta)$ of their service expenses. The manufacturer maximizes its profit by choosing the wholesale price, the MAP price, and also the reimbursement rate for the retailer's service expenses:

$$\pi(p, r, \delta) = K_3. [m \cdot (r - c) \cdot (p - r)^{-1}(1 - \beta) - m \cdot \delta \cdot \alpha \cdot \lambda \cdot (1 - \delta)^{-1}] \quad (1.41)$$

The first-order condition with respect to the reimbursement rate δ and the manufacturer's profit-maximizing choices of the wholesale price and the MAP price result in the following profit-maximizing value of the reimbursement rate:

$$\delta_{map} = \frac{(1-\beta)\cdot(1-\lambda)}{(1-\alpha\lambda-\beta)}. \quad (1.42)$$

Proposition 2: *If there is no externality in the provision of retail service,* $\lambda = 1$, *the profit-maximizing level of the reimbursement rate is 0. On the other hand, If the retail service is a pure public good, i.e.* $\lambda = 0$, *the profit-maximizing level of reimbursement rate is 1.*

I can also show that $\frac{\partial \delta}{\partial \lambda} < 0$. Thus, an increase in the level of horizontal externality increases the reimbursement rate. A greater externality provides an incentive for the manufacturer to increase the reimbursement rate and share more of the service expenses with the retailers. The reason is that there is a positive relationship between the level of service and the sales of the good, $\frac{\partial x}{\partial s} > 0.$ Since MAP programs include an advertising subsidy, MAP programs can be used by manufacturers to correct a sub-optimal level of retail service.

The manufacturer's profit maximizing choices of the wholesale price and the MAP price values follow:

$$r_{map} = \frac{1}{\beta(1-\varepsilon)} \cdot \frac{(1-\alpha-\beta)\cdot[\beta(1-\varepsilon)+\varepsilon]-\alpha(1-\lambda)}{1-\alpha\lambda-\beta} \cdot c, \tag{1.43}$$

$$p_{map} = \frac{1}{\beta(1-\varepsilon)} \cdot c, \tag{1.44}$$

$$p_{map} - r_{map} = \frac{(1-\beta)\cdot(1-\alpha-\beta)}{\beta\cdot(1-\alpha\lambda-\beta)} \cdot c. \tag{1.45}$$

Proposition 3: *The retail prices are equal with both RPM and MAP. However, the wholesale price with MAP is higher than with RPM,* $r_{map} > r_{rpm}$. *Thus, MAP has a lower retail margin than RPM.*

When there is no externality, the profit-maximizing wholesale price is equal in both cases. However, since $\frac{\partial r}{\partial \lambda} < 0,$ the wholesale price *r* increases and the retail margin declines as the service externality becomes stronger. MAP provides three control variables for the manufacturer: the reimbursement rate δ, the MAP price $p,$ and the wholesale price r. The manufacturer sets the MAP price equal to the price that would be chosen with vertical integration. After considering the quantity sold by each retailer and number of retailers, the manufacturer sets reimbursement rate δ to achieve the level of service that would internalize the service externality and duplicate vertical integration. Unlike RPM, MAP does not need the wholesale price to correct the suboptimal levels of service. Instead, MAP programs can directly use the service subsidy without changing the retail price. Consequently, MAP increases the manufacturer's profit over what it could earn with RPM.

Maximum RPM uses both the retail price and the wholesale price to control the retail margin, but the retail margin provides little control over the level of service when retailers can freely enter or exit the market. Similarly, minimum RPM can achieve the optimum level of service only if the service externality is weak. Even in this case the manufacturer suffers from the double marginalization problem. Proposition 3 also demonstrates that whenever a service externality exists the retail margin is higher with RPM than the retail margin with MAP. The retail margin with MAP can be lower because the manufacturer can also stimulate service with the subsidy. In my model, the manufacturer has two ways to stimulate the service with MAP, but only one with RPM. At the profit-maximizing wholesale price, the MAP price and the reimbursement rate, the retail equilibrium is:

$$x_{map} = x^*, \tag{1.46}$$

$$s_{map} = s^*, \tag{1.47}$$

$$m_{map} = [\beta(1-\varepsilon)]^{\left(\frac{1}{\varepsilon}\right)} \cdot m^*. \tag{1.48}$$

Proposition 4: *MAP programs correct the sub-optimal level of service. In addition, the quantity sold by each retailer equals the socially optimum quantity.*

$$s_{map} = s^*$$

$$x_{map} = x^*$$

MAP provides a remedy for the service externality and generates the optimal level of service. However, RPM cannot correct for sub-optimal levels of service without another vertical restraint. With MAP, the manufacturer can effectively set the retail price by setting the MAP price. If the MAP price of the good differed from the actual retail price, the consumer would not know about that difference prior to purchase. This substantially reduces the incentive of retailers to charge a different price than the MAP price. Moreover, sharing the service expenses generates a greater incentive for retailers to provide more service. The resulting social surplus and consumer surplus are:

$$v_{map} = [\beta(1-\varepsilon)]^{\left(\frac{1}{\varepsilon}\right)} \cdot \frac{1-\beta(1-\varepsilon)^2}{\beta\varepsilon(1-\varepsilon)} \cdot v^*, \tag{1.49}$$

$$cs_{map} = [\beta(1-\varepsilon)]^{\left(\frac{1-\varepsilon}{\varepsilon}\right)} \cdot cs^*. \tag{1.50}$$

Even though the social surplus and consumer surplus are higher under MAP than they are under RPM, they are lower than the socially optimum levels, $v_{rpm} < v_{map} < v^*$ and $cs_{rpm} < cs_{map} < cs^*$. MAP provides higher consumer surplus and social surplus than RPM because the reimbursement rate solves the service externality problem. However, the retail price with MAP is still higher than the marginal cost of production.

1.3.3 Comparison with Vertical Integration

It is important to compare the MAP outcome with the vertical integration outcome to understand why MAP became broadly used in retail markets. As I showed in the section 1.4.2, RPM provides the manufacturer with two independent control variables, but RPM fails to duplicate the vertically integrated outcome. However, the joint use of RPM and a franchise fee could duplicate the results of vertical integration allowing the manufacturer to control the retail output, service, and the number of retailers (Perry and Porter (1990), Mathewson and Winter (1984)).

In this section, I examine whether MAP can also duplicate vertical integration. I compare the previous MAP results with vertical integration where a manufacturer can control quantities, service and the number of retailers. When the manufacturer integrates with retailers, the profit maximizing price levels and the retail margin are:

$$r_{vi} = \frac{\lambda-(1-\varepsilon)\cdot(1-\beta)}{\lambda\cdot\beta(1-\varepsilon)} \cdot c, \tag{1.51}$$

$$p_{vi} = \frac{1}{\beta(1-\varepsilon)} \cdot c, \tag{1.52}$$

$$p_{vi} - r_{vi} = \frac{(1-\beta)}{\beta} \cdot \frac{c}{\lambda}. \tag{1.53}$$

Proposition 5: *The wholesale price with vertical integration is lower than the wholesale price with MAP,* $r_{vi} < r_{map}$ *when the service externality is present* $\lambda < 1$. *Therefore, the retail margin is higher with vertical integration than the retail margin with MAP.*

If there is no service externality, the wholesale price is the same with both vertical integration and MAP. However, with externality, the manufacturer shares some of the retailers' service expenses, $\delta \cdot w \cdot s$. The manufacturer does not necessarily need to widen the retail margin in order to ensure the optimal level of service. Instead the manufacturer can use the reimbursement rate. While the reimbursement rate corrects the suboptimal level of service levels, the manufacturer increases the wholesale price to achieve the optimum number of retailers. The resulting retail equilibrium with vertical integration is:

$$x_{vi} = x^*, \tag{1.54}$$

$$s_{vi} = s^*, \tag{1.55}$$

$$m_{vi} = [\beta(1-\varepsilon)]^{\left(\frac{1}{\varepsilon}\right)} \cdot m^*. \tag{1.56}$$

The profit maximizing quantity, the service, and number of retailers are the same for MAP and vertical integration, $x_{vi} = x_{map}$, $s_{vi} = s_{map}$, $m_{vi} = m_{map}$. When the manufacturer vertically integrates with the retailers, the social surplus and consumer surplus can be expressed as:

$$v_{vi} = [\beta(1-\varepsilon)]^{\left(\frac{1}{\varepsilon}\right)} \cdot \frac{1-\beta(1-\varepsilon)^2}{\beta\varepsilon(1-\varepsilon)} \cdot v^*, \tag{1.57}$$

$$cs_{vi} = [\beta(1-\varepsilon)]^{\left(\frac{1-\varepsilon}{\varepsilon}\right)} \cdot cs^*. \tag{1.58}$$

Proposition 6: *MAP duplicates the welfare outcome of vertical integration and MAP results in the optimum level of service: .* $v_{map} = v_{vi}$, $cs_{map} = cs_{vi}$ *and* $s_{map} = s_{vi} = s^*$.

Proposition 6 demonstrates that MAP duplicates vertical integration. MAP provides the manufacturer with an additional vertical control, the reimbursement rate. The reimbursement rate enables the manufacturer to control the level of service provided by the retailers. Having this extra control variable makes MAP superior to RPM. The manufacturer sets the reimbursement rate such that the retailers provide the optimal level of service that would arise with vertical integration. In my model of MAP, the manufacturer cannot set a franchise fee. This implies that the manufacturer would not be able to control the number of retailers directly with a franchise fee. However, MAP allows the manufacturer to subsidize service directly. Consumer surplus is the same in both cases since both MAP and vertical integration result in the same retail price and level of service. The social surplus is also equal with both MAP and vertical integration. Even though sharing the service expenses with the retailers increases the manufacturer's costs from subsidizing retail service, the manufacturer is able to compensate for this by increasing the wholesale price.

1.4 Discussion: CD Minimum Advertised Price Litigation

As a result of a "price war" in the prerecorded music CD industry, major music companies adopted MAP programs in the early 1990s. Initially, these MAP programs were combined with cooperative advertising programs in which retailers were prohibited from advertising a lower price for CDs. Subsequently, between 1995 and 1996, the requirements in the MAP programs became stricter in that the retailers became ineligible for all of the advertising subsidies even if they advertised a lower price on just one CD product or self-funded the advertisement. Besides losing the eligibility for any subsidies, the retailers who did not comply with the MAP programs were punished harshly. In some cases, the music companies terminated the contract for 60-90 days with retailers who violated the MAP program.[11] During this period, the companies refused to accept any purchase order for their recordings. If the retailer was part of a retail chain, its violation caused all retailers in the chain to lose the eligibility for subsidies and all faced the same severe punishments.

In 2000, a class action law suit was filed against the world's five largest music companies with an 85% market share in total industry and the three biggest music retailers.[12]

[11] "Five Consent Agreements Concerning the Market for Prerecorded Music in the United States", the FTC file no. 971 0070. See http://www.ftc.gov/os/2000/05/index.htm

[12] Sony Music Distribution, Universal Music & Video Distribution, BMG Distribution, Warner-Elektra-Atlantic Corporation, and EMI Music Distribution. Musicland Stores, Trans World Entertainment and Tower Records

The complaints alleged that they engaged in anticompetitive practices by adopting MAP programs and the MAP programs had inflated CD prices between 1995 and 2000. Their MAP programs were alleged to have violated the antitrust laws because they facilitated horizontal collusion and were unreasonable vertical restraints even if done unilaterally.[13] The FTC did not conclude that their MAP programs were illegal *per se*. The FTC noted that there were some cases in which the retailers sold CDs at lower prices than the MAP price used in advertisements. However, the FTC concluded that the MAP programs precluded price competition in the retail market, and therefore they were illegal under *rule of reason*. Since these five music companies had a very large market share together, retailers had almost no other choice but to accept the MAP programs offered by these companies. The FTC also concluded that the MAP programs had the effect of increasing the wholesale prices after stabilizing the prices in the retail market.

In its separate investigation of the recording industry, the FTC estimated that the price per CD increased by $2.00 resulting in $480 million in damage to consumers. Even though the companies did not admit their MAP programs violated the antitrust laws, they settled the case instead of trying to prove in court that their MAP programs were pro-competitive. They agreed to discontinue their MAP programs and pay $67 million to compensate customers who bought CDs between January 1, 1995, and December 22, 2000. Approximately 4.1 billion CDs were sold during that period. Anyone who bought a CD in this period was eligible for between $5-20 per person depending on the number of consumer claims that failed to provide a receipt. If too many consumers filed claims so that each payment would amount to less than $5 per person, then all the money designated for consumer refunds would instead be distributed to nonprofit, charitable or government

[13]Statement of Chairman R. Pitofsky and Commissioners S. Anthony, M. Thomson, O. Swindle, and T. Leary. See http://www.ftc.gov/os/2000/09/musicstatement.html for the complete statement.

organizations. In addition, the recording companies promised to donate CDs to non-profit organizations worth $75 million.

1.5 Conclusion

My results show that MAP is not equivalent to RPM in practice or in theory. Setting a maximum RPM solves the double marginalization problem by ensuring a lower retail price and therefore a lower retail margin. However, lowering the retail margin decreases the incentive of retailers to provide service since providing service is costly. When there is no lower bound on the retail price, the retailers channel their competition from service into the price dimension. Thus, the retail equilibrium results in sub-optimal levels of retail service. Although, minimum RPM can solve the service externality problem depending on the degree of service externality, minimum RPM is not a remedy for the double marginalization problem. Thus, RPM is not adequate to solve the service externality and double marginalization problems simultaneously.

MAP provides a richer set of vertical control variables. A service subsidy enables the manufacturer to achieve an optimal level of service by internalizing the service externality. Even though the retail price is the same with RPM and MAP, the retail margin is lower with MAP since the wholesale price increases with the service externality. The manufacturer controls the level of retail by using the service subsidy. Therefore, the retail margin can be lower than the retail margin with RPM. The wholesale price cannot ensure both the optimum service level and the optimum retail diversity. However, the service subsidy allows the manufacturer to ensure the optimal level of service, while the wholesale price is used to achieve the optimum retail diversity. It is not possible to attain socially optimum outcomes that would require setting the retail price equal to the marginal cost. However, my results show that MAP duplicates the welfare outcome of vertical integration because MAP enables the manufacturer to achieve the same retail price and service level as vertical integration.

My results also show that different sets of three control variables independently can accomplish vertical integration in different ways. When RPM and a franchise fee are used together, the wholesale price is adequate to attain the vertical integration outcome. The franchise fee determines the optimal number of retailers, and the manufacturer sets the wholesale price to control the service level. With MAP, the wholesale price enables the manufacturer to reach the number of retailers in vertical integration because the retail margin is unnecessary for obtaining the optimal level of service. Instead the service subsidy achieves the optimal level of service. Both RPM and MAP with a franchise fee duplicate vertical integration. The only difference is that they use control variables for different purposes and the RPM's ability to reach the outcome of vertical integration depends on the level of service externality.

This model separates the role of RPM and MAP. Previous studies about MAP examine MAP as a vertical control resembling RPM. My model shows that RPM and MAP should be considered as two independent vertical restraints. RPM provides a direct way for the manufacturer to control the retail price. MAP also allows the manufacturer to control the retail price indirectly. MAP then allows an additional dimension of vertical control because the manufacturer can set a reimbursement rate for the service expenses of its retailers.

2. Vertical Restraints with Demand and Cost Uncertainty

2.1 Introduction

This study examines a model of vertical restraints in a market where the manufacturer imposes contractual obligations on its competitive retailers. Vertical restraints are contractual arrangements that enable manufacturers to attempt to duplicate the outcome and profit from vertical integration. These vertical restraints impose restrictions on the retail price or other dimensions of the retail market. The monopolist manufacturer of a good charges its retailers a wholesale price which is greater than the marginal cost of the good. If the retail market is not competitive, the price charged by the retailer is also going to be above its marginal cost, so the double marginalization problem occurs. Double marginalization decreases the total profit of the vertical structure by reducing the output below the optimal level. When the retailer makes pricing decisions, each retailer considers its retail profit, not the aggregate profits of the manufacturer and the other retailers.

Vertical integration between a manufacturer and its retailers would eliminate the double marginalization. However, vertical integration often is not a feasible alternative. It is often more costly for an integrated firm to sell its good to consumer directly without retailers. The integrated firm simply cannot take advantage of economies of scope in the same way that a retailer that sells a variety of other goods. Secondly, firms incur large costs to integrate, such as legal costs and costs to restructure the firm. The inefficiencies from the double marginalization create incentives for the manufacturer to impose vertical restraints when integration is not feasible.

This study examines two commonly used vertical restraints: resale price maintenance and exclusive territories. Resale price maintenance enables a manufacturer to specify the price that retailers charge to customers. Since the retail price affects the manufacturer's profit, the manufacturer has an incentive to control the retail price. Resale price maintenance solves the double marginalization problem by enabling the manufacturer to specify the retail price that he would have chosen if the manufacturer had integrated with his retailers. Exclusive territories impose a restriction on retailers in terms of where they can operate. When a retailer signs an exclusive territory contract, the retailer becomes a monopoly in a specified region. Giving monopoly power to a retailer worsens the double marginalization problem, but the manufacturer can alleviate the problem by using a franchise fee. The manufacturer sets the wholesale price equal to its marginal cost to avoid double marginalization. The manufacturer then extracts the retailer's profit by the franchise fee.

Most of the literature in this subject concentrates on vertical control and the sufficient vertical restraints for the vertical structure to obtain the integrated outcome (see Katz (1989) for surveys). Spengler (1950) provides a basic model to examine the increase in efficiency that occurs with vertical integration when the retailer is a monopolist. If both the manufacturer and the retailer are monopolists in their markets, then this increases the retail price. Since both the manufacturer and retailers set their prices above their marginal costs, the double marginalization problem is created from the two mark-ups. Double marginalization provides an incentive for the manufacturer to attempt to control the retailers' actions with vertical integration. With double marginalization, consumers are worse off because of a decrease in quantity and an increase in price. Additionally, the total profit is lower than the vertically integrated profit. If the retailing market is competitive, the final outcome equals the vertically integrated outcome since the double marginalization is eliminated.

Mathewson and Winter (1984) compare the different types of vertical restraints: franchise fee, resale price maintenance, quantity forcing, and exclusive territories. Their study assumes that a single manufacturer supplies several retailers in a world without uncertainty. They offer an explanation of vertical restraints on distribution by characterizing efficient wholesale market contracts. They examine the case where the manufacturer has monopoly power and the retailers are imperfectly competitive in a spatially differentiated market. Retailers provide presale information services to the consumers which cannot be provided by manufacturers. However, monitoring the retailers' provision of information is costly. Their study offers combinations of vertical restraints called "minimally sufficient sets of restraints" that enable the manufacturer to realize the vertically integrated firm's profit. They conclude that resale price maintenance and territorial restraints can be substitute instruments.

Rey and Tirole (1986) examine vertical restraints where retailers have superior information compared to the manufacturer. In their model, the manufacturer cannot observe the retailers' profit or the quantity sold. They show that vertical restraints may be insufficient to duplicate an integrated outcome in the case of uncertainty. Their model allows for the possibility of demand uncertainty and cost uncertainty in the retail markets. In the absence of vertical restraints, the retailers compete in price and pay franchise fees. They show that competition, resale price maintenance and exclusive territories are equivalent with no uncertainty. However, with demand uncertainty in retail markets, the manufacturer and social planner prefer resale price maintenance to competition, and competition to exclusive territories. With cost uncertainty in retail markets, competition is preferred to exclusive territories, and exclusive territories are preferred to resale price maintenance by the manufacturer and social planner.

In a similar setting, Rey and Stiglitz (1995) argue that vertical restraints can be used to reduce inter-brand competition by affecting intra-brand competition. They argue that vertical restraints may be a device for reducing the degree of competition when competition is imperfect. Exclusive territories change the manufacturer's demand perception in that the manufacturer believes he faces a less elastic demand curve. In their model, these effects are so significant that not only do retailers benefit from the lack of competition, but manufacturers also gain even in the absence of the franchise fees with which they might extract the retailer's profit.

Perry and Groff (1985) show that resale price maintenance is equivalent to forward integration. While both resale price maintenance and forward integration increase profits, forward integration by an upstream monopolist reduces welfare for the industry. They conclude that the results of welfare analysis vary depending on the model of differentiation at the retail level. Welfare increases when the spatial model of differentiation is employed since spatial models generally exhibit excess product diversity. On the other hand, welfare decreases when the CES model of differentiation is employed, because CES models often exhibit inadequate product diversity.

Among the other related literature, Kühn (1997) examines a duopolistic market in which manufacturers compete in wholesale price schedules, and retailers compete in quantity. He shows that nonlinear wholesale pricing in vertically related duopolies generally produces fairly competitive outcomes. When there is quantity competition in the retail market, manufacturers strongly compete for marginal sales from positive demand shocks. As a result, quantity discounts on marginal wholesale prices may be part of an equilibrium contract with quantity competition. In contrast, when retailers compete in price, the intensity of the competition is relaxed, and quantity discounts do not occur. In a linear demand model, the outcomes are never more competitive than those under quantity competition. This suggests that the magnitude of strategic effects is small with price competition. Quantity competition in the retail market with demand uncertainty suggests that the optimal government policy always consists of a nonlinear subsidy.

This study sheds new light on vertical restraints by comparing vertical restraints when retailers compete in quantity. The article is organized as follows: Section 2 discusses the historical perspective of the legality of vertical restraints. Section 3 defines the model when the retailers are infinitely risk averse under demand and cost uncertainty. The model also compares the private and social desirability of vertical restraints. Section 4 examines efficiency of vertical restraints when retailers are risk neutral. Finally, section 5 concludes.

2.2 Legal Status of Vertical Restraints

Since economic theories do not sufficiently consider all dimensions of vertical restraints, they do not offer a shared view concerning vertical restraints. As a result of the lack of agreement, the legal status of vertical restraints has always been highly debated.

Until the early 1900's, resale price maintenance was legal. In 1907, a lower court decided for the first time that resale price maintenance was illegal under common law and the *Sherman Act* because of the lack of evidence showing its necessity[14]. In 1911, the Supreme Court affirmed a lower court's decision stating that the resale price maintenance scheme was unreasonable and thus violated Section 1 of the *Sherman Antitrust Act*. Moreover, the

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[14] J.D. Park and Sons v. Hartman, March 1907, 6th C.C.A., 153 Fed., 24,reversing 145 Fed., 358

Supreme Court ruled that resale price maintenance was illegal *per se*.[15] Despite the Supreme Court's ruling against resale price maintenance, many states legalized resale price maintenance by passing fair-trade laws starting with California in 1931. The Congress passed the *Miller-Tydings Act* in 1937 to amend Section 1 of the *Sherman Act* to allow resale price maintenance contracts affecting interstate trade if resale price maintenance were valid under state laws. The *McGuire Act* in 1952 extended the *Miller-Tydings Act* by allowing enforcement against both signers and nonsigners of resale price maintenance contracts (Overstreet, 1983).

In 1967, the Supreme Court ruled that vertical territorial restraints were also illegal *per se*.[16] However, ten years later in 1977, the Supreme Court overturned the *per se* illegality of vertical non-price restraints. As a result, vertical non-price restraints were subsequently evaluated under *rule of reason*.[17]

Resale price maintenance contracts were enforceable until the *Miller-Tydings Act* and the *McGuire Act* were repealed by the *Consumer Goods Pricing Act* of 1975. After the repeal, resale price maintenance then reverted to its previous status as illegal *per se*. In 1968 the Supreme Court extended the *per se* illegality rule to include maximum resale price maintenance.[18] The Court stated that such contracts always limited the freedom of retailers to price as they wished. The Court also opined that the maximum price could become a minimum price by channeling distribution through a few large retailers and coercing small retailers. However, in 1997, the Supreme Court overruled *per se* illegality for maximum resale price maintenance and decided that maximum resale price maintenance would be evaluated under the *rule of reason*.[19] In evaluating cases based on *rule of reason,* the court examines the

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[15] Dr. Miles Medical Co. v. John D. Park and Sons, Co., 220 U.S.,373 (1911)
[16] U.S. v. Arnold, Schwinn & Co. 388 U.S. 365 (1967)
[17] Continental T.V., Inc. v. GTE Sylvania, Inc., 433 U.S., 36 (1977)
[18] Albrecht v. Herald Co., (1968)
[19] State Oil v. Khan, 522 U.S. 3 (1997)

potential pro-competitive and anti-competitive effects of the conduct. Under the standard *per se* illegality, the practice is always illegal. Most recently, in 2007, the Supreme Court overturned the *per se* illegality in minimum resale price maintenance. The decision in 2007 states that such vertical price restraints are no longer *per se* illegal, but rather, must be evaluated under the *rule of reason*.[20] In conclusion, current U.S. law states that both minimum and maximum resale price maintenance must be evaluated under the *rule of reason* to determine the legality of the practice.

2.3 Model

In this model, consumers are uniformly distributed along a line of one unit length. A single manufacturer produces a homogenous product for two differentiated retailers, and these retailers are located at each end of the line segment. Consumers are indexed based on their distance y from the left-end retailer. Let t be the per unit transportation cost. Each consumer pays a transportation cost, ty when they purchase from the left-end retailer and $t(1-y)$ when they purchase from the right-end retailer. The number of consumers is normalized to one. Let P_r be the retail price of the left-end retailer. The total price paid by a consumer located at y is $P_r + ty$.

I also assume that consumers have the same linear demand function with an intercept d and a slope of unity: $x_1 = d - (P_r + ty)$ where x_1 is the quantity demanded from the left-end retailer by a consumer located at y. First, I consider undifferentiated retailers where the transportation cost is zero, $t = 0$. Hence, the consumer's inverse demand function takes the following form:

[20] Leegin Creative Leather Products, Inc. v. PSKS, Inc., 551 U.S. 877 (2007)

$$P_r = d - x, \tag{2.1}$$

where P_r is the retail price, and the market demand, $x = \sum_1^2 x_i$.

I consider uncertainty in both demand and cost. For demand uncertainty, I assume that the demand parameter d is uniformly distributed on $\left[\underline{d}, \overline{d}\right]$. For uncertainty in the retail cost, I also assume that the retailer's distribution cost γ is uniformly distributed on $\left[\underline{\gamma}, \overline{\gamma}\right]$. I assume that d and γ are independent and that $\underline{d} > c + \overline{\gamma}$. The realizations of d and γ are not observed by the manufacturer. The realizations are also unknown to retailers at the signing of contracts with the manufacturer, but are disclosed before they set their retail prices and quantities. It is assumed that the manufacturer is risk neutral. This study examines both risk averse retailers and risk neutral retailers.

The left-end retailer pays $A + P_w \cdot x_1$ to the manufacturer, where A is the franchise fee and P_w is the wholesale price. In other words, the manufacturer employs a two-part tariff for retailers. For simplicity, I assume that the manufacturer incurs no fixed costs. The manufacturer produces the product at a constant marginal cost, c. Under these conditions, the manufacturer's expected profit can be expressed as follows:

$$\pi_m(P_w, A) = E[2A + (P_w - c) \cdot x]. \tag{2.2}$$

The manufacturer sets the wholesale price P_w to maximize expected profits. In doing so, the manufacturer may also provide insurance to the retailers against their uncertain realizations of demand or retail costs. Since I will compare the monopoly solution to the solution that would maximize aggregate welfare for various vertical restraints, I define aggregate welfare. Aggregate welfare is the sum of the consumer surplus, the manufacturer's profit and the retailers' profits. Since each consumer has a linear demand function, $x = d - P_r$, expected consumer surplus is:

$$CS = E\int_{P_r}^{\infty}(d - z)dz \ . \tag{2.3}$$

Solving equation (3) yields:

$$CS = \tfrac{1}{2}E(d - P_r)^2 \ . \tag{2.4}$$

The aggregate expected welfare function is the sum of consumer surplus, the manufacturer's profit, and the retail profits:

$$W = \tfrac{1}{2}E(d - P_r)^2 + \pi_m + 2\pi_r \ . \tag{2.5}$$

2.3.1 Quantity Competition

I first examine the case of no vertical restraints. The manufacturer cannot control the distribution area, or the retail price charged by each retailer. Instead the manufacturer can offer only a two-part tariff. Retailers are Cournot competitors, and each retailer maximizes its profit by choosing the quantity x_i. In a quantity competition setting with no retail differentiation, the retailer's profit maximization problem is:

$$\pi_{r_i}(x_i) = x_i \cdot (P_r - P_w - \gamma), \ \ i \in \{1,2\}, \tag{2.6}$$

where γ is the marginal retail cost of selling each unit.

This specification contrasts with Rey and Tirole (1986), in which retailers are Bertrand competitors. As a result the retail profit is zero because the retail price is the sum of the wholesale price and the retail cost, $P_r = P_w + \gamma$. Zero profit for the retailers also implies that there can be no franchise fee. In contrast, quantity competition allows positive profits from which the monopolist manufacturer can extract all or some of the retail profit with a franchise fee. After solving the maximization problem (2.6) for profit maximizing output level, I find that the quantity and the retailer's expected profit are :

$$x^{QC}(P_w) = \frac{2}{3}(d - P_w - \gamma), \tag{2.7}$$

$$\pi_r^{QC}(P_w) = \frac{1}{9}(d - P_w - \gamma)^2. \tag{2.8}$$

The manufacturer can extract some of the retail profit by charging a franchise fee. Under the demand and the cost uncertainty, infinitely risk averse retailers would require non-negative profit. Considering the worst case scenario of the lowest demand with the highest retail cost, the maximum franchise fee with the quantity competition can be expressed as:

$$A^{QC}(P_w) = \frac{1}{9}\left(\underline{d} - P_w - \overline{\gamma}\right)^2. \tag{2.9}$$

The manufacturer uses the franchise fee to extract retail profits in the worst case scenario of the lowest demand $\underline{d}$ and the highest cost $\overline{\gamma}$. Now, consider the manufacturer's profit maximization problem. The manufacturer sets the wholesale price to maximize his profit:

$$\pi_m(P_w) = 2A^{QC}(P_w) + E[(P_w - c) \cdot x^{QC}(P_w)]. \tag{2.10}$$

Solving the manufacturer's profit maximization problem with respect to the wholesale price yields the following wholesale price P_{w}^{QC} and the resulting retail price P_{r}^{QC} respectively:

$$P_{w}^{QC} = \frac{3}{4}(d^{e} - \gamma^{e} + c) - \frac{1}{2}(\underline{d} - \overline{\gamma}), \qquad (2.11)$$

$$P_{r}^{QC} = \frac{1}{3}(d + 2\gamma) + \frac{1}{2}(d^{e} - \gamma^{e} + c) - \frac{1}{3}(\underline{d} - \overline{\gamma}). \qquad (2.12)$$

By using the wholesale price P_{w}^{QC} and the retail price P_{r}^{QC}, the manufacturer's expected profit function (10) and the expected aggregate welfare (5) can be rewritten as functions of demand and cost parameters.

$$\pi_{m}^{QC} = \frac{1}{4}(d^{e} - \gamma^{e} - c)^{2} - \frac{1}{3}(\underline{d} - \overline{\gamma} - c) \cdot \left((d^{e} - \underline{d}) + (\overline{\gamma} - \gamma^{e})\right) + \frac{1}{8}\sigma_{d}^{2} + \frac{1}{8}\sigma_{\gamma}^{2}, \qquad (2.13)$$

$$W^{QC} = \frac{11}{72}(d^{e} - \gamma^{e} - c)^{2} + \frac{5}{18}(d^{e} - \gamma^{e} - c) \cdot (\underline{d} - \overline{\gamma} - c) - \frac{1}{18}(\underline{d} - \overline{\gamma} - c)^{2}, \qquad (2.14)$$

where $d^{e} = E[d]$, $\gamma^{e} = E[\gamma]$ are expectations of demand and retail cost parameters; and $\sigma_{d}^{2} = E[(d - d^{e})^{2}]$ and $\sigma_{\gamma}^{2} = E[(\gamma - \gamma^{e})^{2}]$ are the variance of these demand and cost parameters respectively. Both the retail price and wholesale price are sensitive to demand and cost uncertainties. Regardless of the level of uncertainty, the wholesale price is greater than the marginal cost and the two-part tariff fails to solve the traditional double marginalization problem.

2.3.2 Exclusive Territories

Exclusive Territories arise when the manufacturer assigns specific geographic territories to its retailers. Assume that the manufacturer divides the retail market between the left-end retailer and the right-end retailer. The manufacturer assigns area α to the left-end retailer and the area $(1-\alpha)$ to the right-end retailer where $\alpha \in [0,1]$. Each retailer becomes a monopolist in his area. The left-end retailer and the right-end retailer have the demand functions $x_1 = \alpha \cdot (d - P_{r1})$ and $x_2 = (1-\alpha) \cdot (d - P_{r2})$ respectively. Since each retailer is identical and they are monopolists in their area, α has no effect on the equilibrium price levels. For simplicity, it can be assumed that $\alpha = \frac{1}{2}$. It is also assumed that retailers have superior information about demand in their local areas. Under these given assumptions, each retailer's profit function can be written:

$$\pi_{r_i}(x_i) = \big((d - 2x_i) - P_w - \gamma\big) \cdot x_i, \;\; i \in \{1,2\}. \qquad (2.15)$$

The profit maximizing industry output and profits of each retailer are[21]:

$$x^{ET}(P_w) = \tfrac{1}{2}(d - P_w - \gamma), \qquad (2.16)$$

$$\pi_r^{ET}(P_w) = \tfrac{1}{8}(d - P_w - \gamma)^2. \qquad (2.17)$$

Since the retailers are infinitely risk averse, the manufacturer must guarantee each retailer a non-negative profit for all realizations considering the worst case scenario of the lowest demand $\underline{d}$ and the highest distribution cost $\overline{\gamma}$. The maximum franchise fee is:

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[21] With linear demand, the retailers would set the same retail price even when $\alpha \neq \frac{1}{2}$. Of course, $\alpha < \frac{1}{2}$ would reduce the expected profit of retailer 1 and lower the franchise fee.

$$A^{ET}(P_w) = \frac{1}{8}\left(\underline{d} - P_w - \overline{\gamma}\right)^2. \tag{2.18}$$

As in the quantity competition case, the manufacturer offers a two-part tariff to each retailer. Therefore, the manufacturer's profit can be written:

$$\pi_m(P_w) = 2A^{ET}(P_w) + E[(P_w - c) \cdot x^{ET}(P_w)]. \tag{2.19}$$

The manufacturer sets the wholesale price and the maximum franchise fee is then implied by the wholesale price. Under the demand and the cost uncertainty, maximizing the manufacturer's profit over the wholesale price gives the expected wholesale price P_w^{ET} and the expected retail price P_r^{ET} below:

$$P_w^{ET} = \left(d^e - \underline{d}\right) + (\overline{\gamma} - \gamma^e) + c, \tag{2.20}$$

$$P_r^{ET} = \frac{1}{2}\left(d + \gamma + c + \left(d^e - \underline{d}\right) + (\overline{\gamma} - \gamma^e)\right). \tag{2.21}$$

In the presence of demand and cost uncertainty, exclusive territories cannot solve the double marginalization problem since $P_w^{ET} > c$ under demand and cost uncertainty. However, if there is no uncertainty, $d^e = \underline{d}$ and $\gamma^e = \overline{\gamma}$, assigning territories to retailers allows the manufacturer to solve the double marginalization problem, $P_{\mathrm{w}}^{\mathrm{ET}} = c$. Substituting the wholesale price P_w^{ET} and the retail price P_r^{ET} in equation (2.2) and equation (2.5) yields the manufacturer's expected profit function and the expected aggregate welfare function respectively:

$$\pi_m^{ET} = \frac{1}{4}\left(\underline{d} - \overline{\gamma} - c\right)^2 + \frac{1}{4}\left(\left(d^e - \underline{d}\right) + \left(\overline{\gamma} - \gamma^e\right)\right)^2, \tag{2.22}$$

$$W^{ET} = \frac{1}{2}\left(d^e - \gamma^e - c\right) \cdot \left(\underline{d} - \overline{\gamma} - c\right) - \frac{1}{8}\left(\underline{d} - \overline{\gamma} - c\right)^2. \tag{2.23}$$

When there is no uncertainty, the manufacturer's profit in exclusive territories is equivalent to the manufacturer's profit in quantity competition. Introducing demand or cost uncertainty into the model changes the manufacturer's profit. Uncertainty increases the wholesale price $P_w^{ET} > c$ and reduces the retail margin $P_r^{ET} - P_w^{ET} = \overline{\gamma}$. Lowering the retail margin increases the manufacturer's profit.

2.3.3 Resale Price Maintenance

In this section, I assume that the manufacturer sets the retail price, as well as the wholesale price and the franchise fee. Resale price maintenance provides an extra control variable and also an extra condition, $P_r \geq P_w + \overline{\gamma}$ for the manufacturer. This condition ensures that risk averse retailers earn positive profits when their costs are high. Given the wholesale price P_w and the retail price P_r by the manufacturer, the retailers maximize their following profit function by choosing the quantities:

$$\pi_{r_i}(P_w, P_r) = (P_r - P_w - \gamma) \cdot x_i\,, \;\; i \in \{1,2\}. \tag{2.24}$$

Since the retail margin is always positive, the two retailers would choose x_i such that $x_1 + x_2 = x(P_r)$. In particular, I assume a symmetric equilibrium between the retailers so that $x_i = \frac{1}{2}x(P_r)$. The profit maximizing industry output and profits of each retailer are:

$$x^{RPM}(P_r) = d - P_r, \tag{2.25}$$

$$\pi_r^{RPM}(P_w, P_r) = (P_r - P_w - \gamma) \cdot \tfrac{1}{2}(d - P_r). \tag{2.26}$$

Under extreme risk aversion assumption in the retail market, the maximum franchise fee that the manufacturer can charge the retailers is:

$$A^{RPM}(P_w, P_r) = (P_r - P_w - \overline{\gamma}) \cdot \tfrac{1}{2}(\underline{d} - P_r). \tag{2.27}$$

The manufacturer maximizes his following expected profit function with respect to P_w and P_r where $P_r \geq P_w + \overline{\gamma}$:

$$\pi_m(P_w, P_r) = 2A^{RPM}(P_w, P_r) + E[(P_w - c) \cdot x^{RPM}(P_r)]. \tag{2.28}$$

By maximizing the manufacturer's profit function above, I obtain the retail price P_r^{RPM}, the manufacturer's profit in equilibrium π_m^{RPM}, and the aggregate welfare W^{RPM}:

$$P_r^{RPM} = \frac{1}{2}(\underline{d} + \overline{\gamma} + c), \tag{2.29}$$

$$\pi_m^{RPM} = \frac{1}{4}(d^e - \overline{\gamma} - c)^2, \tag{2.30}$$

$$W^{RPM} = \frac{3}{8}(d^e - \gamma^e - c)^2. \tag{2.31}$$

Subject to the pricing constraint, the franchise fee A^{RPM} and the wholesale price P_w^{RPM} can be determined. I assume the wholesale price is as large as it can be under the constraint $P_w = P_r - \gamma$. The franchise fee would then be zero, $A^{RPM} = 0$.

2.3.4 Comparisons

In this section, I compare the two vertical restraints of exclusive territories and resale price maintenance while considering quantity competition between the retailers and simple wholesale pricing by the manufacturer. These comparisons depend on the type of demand or cost uncertainty that is present.

PROPOSITION 1: *Under cost uncertainty, when the retailers are infinitely risk averse, the manufacturer prefers quantity competition to exclusive territories, and exclusive territories to resale price maintenance:*

$$\pi_m^{QC} > \pi_m^{ET} > \pi_m^{RPM} .$$

Under the cost uncertainty, resale price maintenance is the least desirable vertical restraint because the retail price cannot adjust to cost shocks since the manufacturer sets the retail price before the realization of uncertainty in cost. With exclusive territories, retailers may freely choose the quantity in response to cost shocks. As a result the retail price also adjusts to the cost shocks. Thus, exclusive territories perform better than resale price maintenance under cost uncertainty. The problem with exclusive territories is that retailers consider only their own monopoly profit and the resulting quantities chosen by the retailers are less than optimum levels from the view point of the manufacturer. Thus, the manufacturer prefers quantity competition to exclusive territories. With the quantity competition the retail price is more sensitive to cost shocks than with exclusive territories. Note that $P_r^{QC} = \frac{\mathrm{d}+2\left(P_w^{QC}+\gamma\right)}{3}$ and $P_r^{ET} = \frac{\mathrm{d}+P_w^{ET}+\gamma}{2}$. With exclusive territories, the retail price responds to half of the cost shocks, whereas with Cournot duopoly the retail price responds by two-thirds of the cost shock.

Now consider the comparisons under demand uncertainty.

PROPOSITION 2: *Under demand uncertainty, when the retailers are infinitely risk averse, the manufacturer prefers resale price maintenance to quantity competition, and quantity competition to exclusive territories:*

$$\pi_m^{RPM} > \pi_m^{QC} > \pi_m^{ET} \ .$$

Resale price maintenance enables the manufacturer to choose a retail price to maximize the profit of a vertically integrated industry. With quantity competition or exclusive territories, retailers decrease the retail price when demand is low. Thus, the manufacturer's profit is reduced. Conversely, when demand is high, retailers set a high price to maximize the retail profit which also reduces the manufacturer's profit. With resale price maintenance, the retail profit is independent of the demand uncertainty because the manufacturer can set the wholesale price and the franchise fee so that the retail profit is always zero. Therefore, the manufacturer prefers resale price maintenance to other restraints where the retail profit depends on the state of demand. Under demand uncertainty, quantity competition performs better than exclusive territories because the retail price in exclusive territories partially adjusts to demand shocks, but the sensitivity of the retail price in exclusive territories to the demand shock is smaller when compared to the sensitivity of the retail price in quantity competition.

PROPOSITION 3: *Resale price maintenance increases the aggregate welfare, and the aggregate welfare is lowest with exclusive territories regardless of the type of uncertainty:*

$$W^{RPM} > W^{QC} > W^{ET}.$$

Consumer surplus decreases with the retail price. Let us first consider the case of no uncertainty. Assume that $d = \underline{d}$ and $\gamma = \overline{\gamma}$. When there is no demand or cost uncertainty, the retail price is equal to $\frac{1}{2}(\underline{d} + \overline{\gamma} + c)$ with quantity competition, exclusive territories, and resale price maintenance. Therefore, the consumer surplus is equal for all three. Introducing demand or cost uncertainty increases the retail price by the same amount in quantity competition and exclusive territories. As a result, the decrease in consumer surplus with quantity competition is equal to the decrease in consumer surplus with exclusive territories. In addition, the retail profit with exclusive territories is more sensitive to demand and cost uncertainties. Introducing demand or cost uncertainty decreases the retail profit with exclusive territories more than the retail profit with quantity competition. When I compare quantity competition and exclusive territories in terms of the manufacturer's profit, consumer surplus, or retail profit, the quantity competition performs better than the exclusive territories.

With no uncertainty, consumer surplus with quantity competition is equal to consumer surplus with resale price maintenance. Consumer surplus in quantity competition decreases with demand and cost uncertainty, because the retail price increases with these uncertainties. Specifically, both the manufacturer's profit and consumer surplus are higher with resale price maintenance than with quantity competition under demand uncertainty. Therefore the aggregate welfare is higher with resale price maintenance than with quantity competition. Under cost uncertainty, the consumer surplus with resale price maintenance is greater than the consumer surplus with quantity competition, whereas the manufacturer profit's with quantity competition is lower with resale price maintenance. When the cost uncertainty is introduced, the change in consumer surplus is greater than the change in manufacturer's profit. Therefore, the aggregate welfare is higher with resale price maintenance under cost uncertainty.

2.3.5 The Second Type of Uncertainty in Demand

Rey and Tirole (1986) consider only uncertainty of the intercept of the demand where the intercept parameter, d is uniformly distributed on $[\underline{d}, \overline{d}]$. In this section, I examine uncertainty in the slope of the inverse demand function where the slope parameter b is uniformly distributed on $[\underline{b}, \overline{b}]$. As before, the slope parameter b is not known at the time the vertical contracts are signed. With this new parameter, the inverse demand can be written as follows:

$$P_r = d - bx \,. \tag{2.32}$$

Assuming extreme risk aversion in retail markets, solving the retailer's profit maximization problems in equations (2.6), (2.15), and (2.24) yield the following franchise fees for three cases:

$$A^{QC} = \frac{1}{9\overline{b}}\left(\underline{d} - P_w - \overline{\gamma}\right)^2, \tag{2.33}$$

$$A^{ET} = \frac{1}{8\overline{b}}\left(\underline{d} - P_w - \overline{\gamma}\right)^2, \tag{2.34}$$

$$A^{RPM} = \frac{1}{2\overline{b}}\left(\underline{d} - P_r\right) \cdot (P_r - P_w - \overline{\gamma}). \tag{2.35}$$

Note that $\overline{b}$ appears only in the denominator. With quantity competition, the solution of the manufacturer's maximization problem using equation (2.2) yields the wholesale price, the retail prices, the manufacturer's profit and the aggregate welfare:

$$P_w^{QC} = \left(\underline{d} - \overline{\gamma}\right) + \frac{3\overline{b}}{2b-6\overline{b}} \cdot \left(\underline{d} - \overline{\gamma} - c\right), \tag{2.36}$$

$$P_r^{QC} = \frac{d+2\left(P_w^{QC}+\gamma\right)}{3} \quad , \tag{2.37}$$

$$\pi_m^{QC} = \frac{2\overline{b}}{4b^e(3\overline{b}-b^e)} \cdot \left[(d^e - \gamma^e - c)^2 + \sigma_d^2 + \sigma_\gamma^2 + \sigma_b^2\right], \tag{2.38}$$

where $b^e = E_b b$ Given the wholesale price, the retail price has the usual form of Cournot duopoly. The retail price can be easily written as a function demand and cost parameters by substituting for the wholesale price. However, leaving the wholesale price P_w in the equation (2.37) makes the comparisons more convenient.

The uncertainty in slope parameter for demand also changes the aggregate welfare since the manufacturer's profit and quantities are changed. Solving the equation (2.5) gives the following aggregate welfare in terms of the cost and demand parameters:

$$W^{QC} = \left(\frac{7\overline{b}-b^e}{8b^e(3\overline{b}-b^e)}\right) \cdot \left[(d^e - \gamma^e - c)^2 + \sigma_d^2 + \sigma_\gamma^2 + \sigma_b^2\right] \tag{2.39}$$

Now consider exclusive territories. The franchise fee in equation (2.34) and change in demand condition due to the introduction of the uncertainty in slope parameter provides the following solution for the manufacturer's profit maximization problem in (2.19):

$$P_w^{ET} = \left(\underline{d} - \overline{\gamma}\right) - \frac{\overline{b}}{2\overline{b}-b^e} \cdot \left(\underline{d} - \overline{\gamma} - c\right), \tag{2.40}$$

$$P_r^{ET} = \frac{d+P_w^{ET}+\gamma}{2}, \tag{2.41}$$

$$\pi_m^{ET} = \frac{\overline{b}}{4b^e(2\overline{b}-b^e)} \cdot \left[(d^e - \gamma^e - c)^2 + \sigma_d^2 + \sigma_\gamma^2 + \sigma_b^2\right], \tag{2.42}$$

$$W^{ET} = \left(\frac{4\overline{b}-b^e}{8b^e(2\overline{b}-b^e)}\right) \cdot \left[(d^e - \gamma^e - c)^2 + \sigma_d^2 + \sigma_\gamma^2 + \sigma_b^2\right]. \tag{2.43}$$

With the resale price maintenance, the uncertainty in slope parameter does not change the wholesale price and the retail price. The reason is that the monopoly retail price set by the manufacturer is unaffected by the slope of the demand function. However, the slope parameter affects the manufacturer's profit since the demand shocks alter the quantities in equilibrium. The following solution for the manufacturer's profit maximization problem:

$$P_w^{RPM} = \frac{1}{2}\left(\underline{d} - \overline{\gamma} + c\right), \tag{2.44}$$

$$P_r^{RPM} = P_w^{RPM} + \overline{\gamma}\ , \tag{2.45}$$

$$\pi_m^{RPM} = \frac{1}{4b^e} \cdot \left[(d^e - \gamma^e - c)^2 + \sigma_d^2 + \sigma_\gamma^2\right], \tag{2.46}$$

$$W^{RPM} = \frac{3}{8b^e} \cdot \left[(d^e - \gamma^e - c)^2 + \sigma_d^2 + \sigma_\gamma^2\right]^2. \tag{2.47}$$

2.3.5.1 Comparisons

The effect of the uncertainty in the slope varies with vertical restraints. In this section, I compare the two vertical restraints of exclusive territories and resale price maintenance with the reference point of quantity competition considering uncertainty of the slope of the demand.

PROPOSITION 4*: Under uncertainty of the slope of the demand, when the retailers are infinitely risk averse, the manufacturer prefers resale price maintenance to quantity competition, and quantity competition to exclusive territories. The welfare comparisons have the same rankings.*

$$\pi_m^{RPM} > \pi_m^{QC} > \pi_m^{ET}$$

$$W^{RPM} > W^{QC} > W^{ET}$$

Introducing the uncertainty in slope of the demand function changes the equilibrium profit levels and the aggregate welfares. However, the manufacturer's preference and the social planner's preference do not change. When the manufacturer fixes the retail price by employing resale price maintenance, the retail margin is independent of the uncertainty level. With exclusive territories, if there is no uncertainty, the wholesale price would be $P_w^{ET} = c$, and there would be no double marginalization. But as it is seen in equation (2.36), with uncertainty in slope parameter, double marginalization occurs $P_w^{ET} > c$ since the manufacturer increases the wholesale price to share the risk. With exclusive territories, retailers can partially adjust the retail prices to demand shocks. With quantity competition, retailers can adjust the retail prices to demand shocks better than with exclusive territories.

The aggregate welfare is defined as the sum of consumer surplus, the manufacturer's profit, and the retail profit in equation (2.5). When there is an uncertainty in the slope of demand, the retail price responds to demand shocks in exclusive territories and quantity competition. However, the retail price does not respond in the resale price maintenance case. Therefore, the consumer surplus with resale price maintenance is higher than with exclusive territories and quantity competition cases. Since the consumer surplus and the manufacturer's profit with resale price maintenance are higher, the aggregate welfare is also higher in resale price maintenance.

2.4 Risk Neutral Retailers

In this section, I consider the case of risk neutral retailers in which the manufacturer extracts the retail profit in expectation. Solving the retailer's profit maximization problem in equation (2.6) when retailers are risk neutral provides the following retail equilibrium:

$$x(P_w) = \frac{1}{3}(d - P_w - \gamma), \tag{2.48}$$

$$\pi_r^{QC}(P_w) = \frac{1}{9}(d - P_w - \gamma)^2. \tag{2.49}$$

Since the retailers are risk neutral, the manufacturer can set the franchise fee in terms of the expected profits rather than the profits in the worst case scenario:

$$A^{QC}(P_w) = \frac{1}{9}E(d - P_w - \gamma)^2. \tag{2.50}$$

Maximizing the manufacturer's profit function in equation (2.2) with respect to the wholesale price yields the following:

$$P_{\mathrm{w}}^{\mathrm{QC}} = \frac{1}{4}(d^e - \gamma^e - c) + c, \tag{2.51}$$

$$P_r^{QC} = \frac{1}{2}(d^e + \gamma^e + c), \tag{2.52}$$

$$\pi_m^{QC} = \frac{1}{4}(d^e - \gamma^e - c)^2 + \frac{1}{4}\sigma_{\mathrm{d}}^2 + \frac{1}{4}\sigma_{\gamma}^2, \tag{2.53}$$

$$W^{QC} = \frac{3}{8}(d^e - \gamma^e - c)^2 + \frac{3}{8}\sigma_{\mathrm{d}}^2 + \frac{3}{8}\sigma_{\gamma}^2. \tag{2.54}$$

With quantity competition, the double marginalization problem occurs regardless of the type of uncertainty, $P_w^{QC} > c$.

With exclusive territories, risk neutral retailers are monopolies in their assigned regions. Risk neutral retailers require nonnegative expected profits. The solution to the retailer's profit maximization problem in equation (2.15) provides the following retail equilibrium and the franchise fee for the manufacturer:

$$x(P_w) = \frac{1}{4}E(d - P_w - \gamma)^2, \tag{2.55}$$

$$\pi_r^{ET}(P_w) = \frac{1}{8}(d - P_w - \gamma)^2, \tag{2.56}$$

$$A^{ET}(P_w) = \frac{1}{8}E(d - P_w - \gamma)^2. \tag{2.57}$$

Switching from extreme risk aversion to risk neutrality also changes the outcome from maximizing the manufacturer's profit function in equation (2.19) under exclusive territories:

$$P_w^{ET} = c \tag{2.58}$$

$$P_r^{ET} = \frac{1}{2}(d + \gamma + c) \tag{2.59}$$

$$\pi_m^{ET} = \frac{1}{4}(d^e - \gamma^e - c)^2 + \frac{1}{4}\sigma_d^2 + \frac{1}{4}\sigma_\gamma^2 \tag{2.60}$$

$$W^{ET} = \frac{3}{8}(d^e - \gamma^e - c)^2 + \frac{3}{8}\sigma_d^2 + \frac{3}{8}\sigma_\gamma^2 \tag{2.61}$$

Regardless of the uncertainty, the wholesale price is set equal to the manufacturer's marginal cost. When the manufacturer employs exclusive territories, the double marginalization problem is solved.

When the manufacturer employs resale price maintenance, maximizing the manufacturer's profit function in (2.28) yields:

$$P_r^{RPM} = \frac{1}{2}(d^e + \gamma^e + c), \quad (2.62)$$

$$\pi_m^{RPM} = \frac{1}{4}(d^e - \gamma^e - c)^2, \quad (2.63)$$

$$W^{RPM} = \frac{3}{8}(d^e - \gamma^e - c)^2 + \frac{1}{2}\sigma_d^2. \quad (2.64)$$

As in the case of infinitely risk averse retailers, resale price maintenance enables the manufacturer to determine the franchise fee and the wholesale price together.

As in section 2.3.5, introducing the uncertainty in the slope of the demand function changes the profit of the manufacturer for all three cases:

$$\pi_m^{QC} = \frac{1}{4b^e}(d^e - \gamma^e - c)^2 + \frac{1}{4b^e}\sigma_d^2 + \frac{1}{4b^e}\sigma_\gamma^2, \quad (2.65)$$

$$\pi_m^{ET} = \frac{1}{4b^e}(d^e - \gamma^e - c)^2 + \frac{1}{4b^e}\sigma_d^2 + \frac{1}{4b^e}\sigma_\gamma^2, \quad (2.66)$$

$$\pi_m^{RPM} = \frac{1}{4b^e}(d^e - \gamma^e - c)^2. \quad (2.67)$$

Introducing this uncertainty to the model also changes the aggregate welfare for all three cases:

$$W^{QC} = \frac{3}{8b^e}(d^e - \gamma^e - c)^2 + \frac{3}{8b^e}\sigma_d^2 + \frac{3}{8b^e}\sigma_\gamma^2, \quad (2.68)$$

$$W^{ET} = \frac{3}{8b^e}(d^e - \gamma^e - c)^2 + \frac{3}{8b^e}\sigma_d^2 + \frac{3}{8b^e}\sigma_\gamma^2, \quad (2.69)$$

$$W^{RPM} = \frac{3}{8b^e}(d^e - \gamma^e - c)^2 + \frac{3}{8b^e}\sigma_d^2. \quad (2.70)$$

I can now compare the manufacturer's profit and the aggregate welfare with corresponding expressions from the case of infinitely risk averse retailers.

2.4.1 Comparisons

Infinite risk aversion at the retail level is a key assumption in section 2.3. Changing this assumption to risk neutrality affects the wholesale price, the retail price, the manufacturer's profit, and the aggregate welfare. Thus, the manufacturer and the social planner's ranking of vertical restraints change.

PROPOSITION 4(a): *Regardless of the type of uncertainty, the manufacturer is indifferent between quantity competition and exclusive territories, and prefers either to resale price maintenance .*

$$\pi_m^{QC} = \pi_m^{ET} > \pi_m^{RPM}$$

PROPOSITION 4(b): *The social planner is always indifferent between quantity competition and exclusive territories. When retailers are risk neutral, the social planner prefers resale price maintenance to quantity competition and exclusive territories under demand uncertainty. However, under cost uncertainty, the social planner prefers quantity competition and exclusive territories to resale price maintenance.*

Demand uncertainty: $W^{RPM} > W^{QC} = W^{ET}$

Cost uncertainty: $W^{QC} = W^{ET} > W^{RPM}$

When the manufacturer employs exclusive territories, the manufacturer sets the wholesale price equal to the marginal cost, thereby avoiding double marginalization. The retailers set the monopoly price and the manufacturer can then extract all the rents of the retailers with the franchise fee. Exclusive territories enable the manufacturer to realize the vertically integrated firm's profit regardless of the type of uncertainty.

Unlike the infinitely risk averse retailers case, there is a conflict between the manufacturer and the social planner in terms of the desirability of vertical restraints when the retailers are risk neutral.

Under demand uncertainty, the retail price does not respond to demand shocks with resale price maintenance. In the case of quantity competition and exclusive territories, the retail prices adjust partially to demand shocks in quantity competition and exclusive territories. The retailers increase the retail price when demand is high, and they decrease the retail price when the demand is low. Changing the retail price reduces the manufacturer's profit in the case of quantity competition and exclusive territories. However, with resale price maintenance the manufacturer maximizes his profit by choosing the retail price.

2.5 Conclusion

In this study, the private and social desirability of vertical restraints are examined under demand and cost uncertainties. When vertical integration between a manufacturer and its retailers is not feasible, double marginalization creates incentives for the manufacturer to impose vertical restraints. The focus of this study is resale price maintenance and exclusive territories. Resale price maintenance enables the manufacturer to choose the retail price, while exclusive territories give monopoly power to the retailers by assigning them specific regions to operate.

This study shows that resale price maintenance and exclusive territories are not substitutes. These two restraints can be substitutes if there is no uncertainty in demand or cost as in Mathewson and Winter (1984). However, when uncertainty is introduced to the model, resale price maintenance and exclusive territories generate different outcomes.

Under uncertainty in cost, with infinitely risk averse retailers, the manufacturer always prefers quantity competition to exclusive territories, and prefers exclusive territories to resale price maintenance. With resale price maintenance, the manufacturer sets the retail price before the realization of uncertainty in cost, and retailers cannot adjust the retail price to cost shocks. Therefore, resale price maintenance is the least desirable vertical restraint. With quantity competition or exclusive territories, the retailers can partially adjust the retail price to cost shocks, but the retail price in quantity competition is more sensitive to cost shocks than the retail price in exclusive territories. This sensitivity gives quantity competition an edge with cost uncertainty. In addition, with exclusive territories, retailers consider only their own monopoly profit and the resulting quantities chosen by the retailers are undesirable from the point of the manufacturer. Thus, quantity competition performs better than exclusive territories.

Contrary to the cost uncertainty case, the manufacturer prefers resale price maintenance to quantity competition and exclusive territories under demand uncertainty. The profit manufacturer is independent of the demand uncertainty with resale price maintenance. However, with exclusive territories, retailers can set a retail price that maximizes their own profit without considering the total profit of the manufacturer. Quantity competition also performs better than exclusive territories because quantity competition enables the retailers to adjust the retail price better than exclusive territories.

This study also examines the aggregate welfare. The results show that resale price maintenance produces a greater aggregate welfare than exclusive territories and quantity competition. Under demand uncertainty, the manufacturer's profit and consumer surplus are greater with resale price maintenance than exclusive territories or quantity competition. Thus, the aggregate welfare with resale price maintenance is also greater. Under cost uncertainty, the manufacturer's profit is lower with resale price maintenance than exclusive territories or quantity competition, but consumer surplus with resale price maintenance is greater and this compensates for the lower profit of the manufacturer. Therefore, the resale price maintenance again has higher aggregate welfare than exclusive territories and quantity competition.

In this study, I also introduce uncertainty in the slope of the demand function. Uncertainty in the slope changes the equilibrium profit levels and the aggregate welfare. As in the case of uncertainty in the intercept of the demand, resale price maintenance generates a higher profit for the manufacturer and also higher aggregate welfare. With quantity competition, retailers can adjust the retail price to demand shocks. However, with exclusive territories, retailers can adjust the price only partially which reduces the manufacturer's profit. Therefore the manufacturer prefers resale price maintenance to exclusive territories, and quantity competition to exclusive territories. With exclusive territories, the manufacturer sets the wholesale price equal to the marginal cost and avoids double marginalization. The retailer sets the monopoly retail price to maximize his profit, but the manufacturer extracts all the retail rents with a franchise fee. This explains why the manufacturer prefers exclusive territories to quantity competition.

A disagreement about desirability of vertical restraints arises between the manufacturer and the social planner when the degree of risk aversion of retailers changes from extreme risk aversion to risk neutrality. When retailers are risk neutral, the social planner's preference for vertical restraints varies with the type of uncertainty. Under demand uncertainty, the social planner is indifferent between exclusive territories and quantity competition, but he prefers resale price maintenance to them. Introducing cost uncertainty changes this ranking and he prefers exclusive territories and quantity competition to resale price maintenance.

3. Vertical Integration and Affiliations in Health Care Markets

3.1. Introduction

Before managed care, hospitals and physician services were paid based on a fee-for-service system. In fee-for-service system, both hospitals and physicians charge a fee for each service such as an office visit, test, or procedure. In a fee-for-service system, health care providers carry very low financial risk. Some managed care organizations changed the payment method from fee-for-service to capitation in order to control the rising cost of health care. Capitation allows insurers to shift financial risks to the health care providers. Under a capitation system, health care providers receive a fixed amount regardless of their actual cost of treatment. Under the fee-for-service payment system, both hospitals and physicians are cost centers and revenue centers. However, under the capitation payment system, both hospitals and physicians are only cost centers and neither is a revenue center. Therefore, the number of managed contracts they receive determines the revenue independent of the resulting treatment on the enrollees in the plan. The profitability of the organization then depends on the number of patients they treat, and the cost of treatment.

However, this change in payment systems resulted in organizational changes that were neither intended nor expected. Since capitation transferred the financial risk from insurers to health care providers, hospitals and physicians developed new strategies to deal with the risk. One of the strategies that physicians adopted was to establish affiliations with hospitals. Some of these affiliations resulted in a form of vertical integration between the hospitals and physicians. In particular, the physicians maintained their private practices, but the hospitals provided administrative services and negotiated for managed care contracts. On the other hand, some resulted in a stronger form of vertical integration between hospitals and physicians.

Prior studies have focused on horizontal integration in the health care industry. For example, there are studies of hospital mergers, HMO acquisitions, and physician networks. These studies examine the effect of horizontal integration on price and quality. In contrast, vertical integration between hospitals and physicians has not been extensively studied. Despite the fact that the number of affiliations between hospitals and physicians grew substantially during the last decade, only few studies examine the effect of these affiliations on the price and quality of health care.

There are a few theoretical studies designed to explain why hospitals and physicians integrate. Gal-Or (1999) concludes that hospitals and physicians integrate to increase their bargaining power against insurers. In her model, integration would benefit both hospitals and physicians only if the degree of competitiveness in the hospital market and the physician market is similar. Otherwise only the health care provider in a competitive market would gain. On the other hand, Robinson and Casalino (1997) argue that hospitals and physicians integrate to increase their efficiency by pooling their resources. By achieving lower costs and higher quality, integration allows lower prices. Hospitals and physicians can improve quality of care and control costs effectively by achieving economies of scale and scope. When hospitals and physicians contract with managed care as an integrated organization rather than contracting with managed care separately, they can reduce the transaction costs.

In this paper, I perform an empirical analysis of the effects of the type of affiliation between the hospitals and physicians on three important attributes of the health care market: quality, cost, and price. I use data from the American Hospital Association (AHA) Annual

Survey, the Health Care Cost and Utilization Project Nationwide Inpatient Sample (NIS) 1997-2004 data, and the Area Resource File (ARF).

The empirical results demonstrate that when the affiliation between physicians and the hospital is strong, the integrated organization operates more efficiently than the traditional non-integrated structure. However, affiliations that weakly integrate physicians with a hospital result lower quality of health care with no significant change in cost and price. These results have important implications for potential antitrust cases in hospital markets. In addition, strongly integrated hospital and physician organizations have lower mortality rates and more efficient utilization rates than weakly integrated affiliations.

Ciliberto and Dranove (2006) study whether the vertical integration affects hospital pricing by using data from California. They find no evidence of higher prices. They state that integration is associated with lower prices, but these estimated price reductions are not statistically significant.

Using data from Arizona, Wisconsin, and Florida, Cuellar and Gertler (2006) analyze the effect of different types of affiliations on efficiency and quality of health care, as well as hospital pricing. Their results provide some evidence that vertical integration increases the price. They find that integration slightly affects cost which results in higher prices. They find no evidence that integration improves the quality of health care.

The paper is organized as follows. Section 2 explains the type of affiliations. Section 3 provides information about the datasets. In section 4, I explain the empirical methodology of this study. Section 5 discusses the results of the estimation. Finally, I conclude in Section 6.

3.2 Affiliations Between Hospitals and Physicians

Since the early 1980s, there have been several attempts to lower health care expenditures. One of the strategies that hospitals adopted was various types of organizational networks to gain economies of scale by pooling resources.[22] In response to managed care plans, physicians also implemented different types of organizations. Specifically, these organizations include Independent Practice Associations (*IPAs*), Open Physician-Hospital Organizations (*OPHOs*), Closed Physician-Hospital Organizations (*CPHOs*), Management Service Organizations (*MSOs*), Fully Integrated Organizations (*FIOs*), Foundations (*FONs*), and Equities (*EQTs*).(See Brown, M., and Brown, R.(1996))

These organizations provide various services to member physicians, and every organization establishes different requirements for their members to satisfy. Some of the organizations provide simple administrative services. Others assist in the provision of care, as well as provide administrative services. They impose requirements such as exclusivity to certain hospitals. These organizations contract directly with managed care organizations, thereby increasing their bargaining power for the benefit of the member physicians.

In Independent Practice Associations (*IPAs*), physicians maintain their private practices, and simply contract with managed care organizations. As a result, the physicians in the *IPAs* become tied to the specific hospitals that are associated with the managed care plan. *IPAs* represent the weakest affiliation between hospitals and physicians.

Open Physician-Hospital Organizations (*OPHOs*) are another type of affiliation. *OPHOs* represent a joint venture between hospitals and physicians. The hospital and the individual physicians jointly contract with managed care organizations. *OPHOs* maintain some minimum credential requirements for the physicians but member physicians can have

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[22] See Burgess et al. (2005) for more information about hospital's network arrangements

independent offices and own private practices. Physicians also have admitting privileges at the hospital, and share some administrative functions to further reduces costs.

Another joint venture between a hospital and physicians is Closed Physician-Hospital Organizations (*CPHOs*). Unlike *OPHOs* in which the hospital may have quite minimal credential requirements for the physicians, *CPHOs* selectively contract with physicians. In particular, they focus on recruiting physicians based on quality. Physicians are exclusive to the hospital in *CPHOs* but can still maintain a private practice. The exclusivity of the contract with the physicians allows the hospital to negotiate more effectively with managed care organizations.

Management Service Organizations (*MSOs*) are similar to *CPHOs* in that the physicians are exclusive to the hospital and can coordinate care. However, *MSOs* buy the tangible assets of the participating physicians, but physicians keep ownership of intangible assets such as goodwill of practice and patient records. *MSOs* provide administrative services for a fee. These services include patient billings, office support, and information system operations. *MSOs* act as agents for the hospital and physicians in contracting with managed care organizations.

Foundations (*FONs*) are non-profit groups of physicians whose assets are owned by a not-for-profit organization or a not-for-profit hospital. Physicians are exclusive to *FONs*, but they are not employees of *FONs*. Therefore, physicians have autonomy over their practices. *FONs* negotiate contracts with managed care organizations and retains the ownership of contracts. Since *FONs* are not-for-profit organizations, they have tax advantages, and may more easily raise capital than other organizations.

Equities (*EQTs*) are for-profit health systems owned by physicians. The system purchases the tangible and intangible assets of physician practices. Physicians are offered an equity ownership in the system after a few years. *EQTs* negotiate with managed care organizations and own all contract revenues. *EQTs* usually expand investments in the higher growth sectors such as outpatient and ambulatory care. They generally contract with hospitals to provide inpatient services.

The strongest type of affiliation between hospitals and physicians is the Fully Integrated Organizations (*FIOs*) which are considered vertically integrated in this study. *FIOs* directly employ the physicians and pay them a salary. Physicians in *FIOs* do not have their own private practice, but also do not incur any administrative costs or responsibilities. *FIOs* can more effectively coordinate care and have the greatest potential to achieve efficiencies.

In this study, I examine the effects of affiliation types on quality of health care, cost and the price. *FIOs* are considered vertically integrated since they directly employ the physicians. Affiliations between hospitals and physicians are strong when affiliations control revenues and also are owned and operated by physicians. *EQTs* and *FONs* are stronger affiliations because they purchase all of the physician assets, control the revenue stream, and pay highly competitive salaries and bonuses. *MSOs* cannot offer high salaries compared stronger affiliations. Although *MSOs* buy the tangible assets of physicians, the physicians retain ownership of patient revenues and managed care contracts. Therefore, *MSOs* are relatively weak affiliations. *IPAs*, *OPHOs*, and *CPHOs* are weaker affiliations than *MSOs*. These affiliations are not owned and operated by hospitals, so they do not control physician revenue.

3.3 Data

The data sources for this study are from the Nationwide Inpatient Sample (NIS), the Cost-to-Charge Ratio data (CCR), the Hospital Market Structure (HMS), the Area Resource File (ARF), and American Hospital Association Guide (AHA). NIS, CCR and HMS data are developed as part of the Health Care Cost and Utilization Project (HCUP).

In this study, I use NIS data for 1998-2004. The NIS is a database of hospital inpatient stays and is the largest database with charge information on all patients regardless of the payer. The database includes patients covered by Medicare, Medicaid, private insurance, and the uninsured. The data contains 5-8 million hospital stays from about 1000 U.S. community hospitals. This sample size enables analysis of uncommon cases, such as congenital anomalies, unusual treatments, and special patient populations, such as the uninsured. Starting with the 2002 NIS, severity adjustment variables including disease staging and severity measures are also available. The NIS includes more than 100 clinical and nonclinical variables for each hospital stay such as patient demographics, primary and secondary diagnosis, primary and secondary procedures, admission and discharge status, source of payment, total charge, and length of stay. It also includes hospital characteristics including ownership and teaching status.

The CCR contains data on total charges for each hospital in the database. In NIS, the charge information represents the amount that hospitals billed for services, but it does not reflect how much the hospital services actually cost. The CCR enables us to estimate the cost of inpatient care and its variation across hospitals and conditions. The CCR contains hospital-specific cost-to-charge ratios based on inpatient costs for nearly every hospital in the corresponding NIS databases. Cost information was obtained from the hospital accounting reports collected by the Centers for Medicare and Medicaid Services (CMS). The

HMS provides information about hospital market competition and characteristics. These measures broadly characterize the intensity of competition that hospitals face under various definitions of the market area.

I use AHA to collect information about different types of hospital physician affiliations. AHA is a comprehensive reference book for the hospital industry, providing data on hospitals nationwide. This annual publication profiles individual hospitals, healthcare systems, networks, alliances, and other health care organizations, agencies and providers. The American Hospital Association, which is the national organization that represents and serves all types of hospitals, health care networks, and their patients and communities. AHA members include nearly 5,000 hospitals, health care systems, networks, other providers of care, as well as 37,000 individual members that came together to form the AHA.

The ARF data includes information about the number of physicians, population characteristics and Medicare penetration rates. This database contains more than 6,000 variables for each of the nation's counties. ARF contains information on health facilities, health professions, health status, economic activity, health training programs, and socioeconomic and environmental characteristics. In addition, the basic file contains geographic codes and descriptors which enable it to be linked to many other files and to aggregate counties into various geographic groupings.

3.4 Empirical Estimation

3.4.1 Quality of Care

In this study, the first variable for examining the quality of hospital care is the 90-day inpatient mortality. For 90-day mortality, I examine patients who were admitted to hospitals for acute myocardial infarction (**AMI**), congestive heart failure (**CHF**), cerebral vascular accident (**CVA**), gastrointestinal hemorrhage (**GIH**), or diabetes mellitus (**DM**). The reason for choosing these five conditions is that previous studies have shown that the criterias for hospitalization are clearly defined for these five conditions (Rogowski et al. 2007). One advantage of selecting these five conditions is to reduce a possible correlation between severity of illness and certain explanatory variables, particularly penetration and the degree of competition in the hospital market.

The second variable to measure quality of hospital care is the overutilization rate. There are two utilization variables in this study. The first variable is whether a pregnant patient has cesarean section delivery. The second variable is whether an **AMI** patient received one of two complex cardiac procedures either coronary artery bypass graft surgery (CABG) or percutaneous transluminal coronary angioplasty (PTCA) within 90 days of the initial admission. It is quite common to see overutilization of these expensive procedures without convincing evidence of their effectiveness. Since CABG and PTCA require expensive investment, they provide another incentive for hospitals to improve efficiency by taking advantage of economies of scale and scope.

In this study, I estimate logistic regression models for the mortality and overutilization. For mortality analysis, I run regressions for each condition where death within 90 days of admission is the dependent variable. The dependent variable $\mathrm{QUAL}_{\mathrm{iht}}$ is the quality measure of interest for patient *i* admitted for one of the above specified conditions to hospital *h* in year *t*, such as whether the patient died within 90 days of the that admission.

$$QUAL_{iht} = \beta_1 VI_{ht} + \beta_2 PAT_{iht} + \beta_3 HOST_{ht} + \beta_4 ln(VOL_{ht}) + \alpha_h + \gamma_t + \varepsilon_{iht} \quad (3.1)$$

For overutilization, the dependent variable $\mathrm{QUAL_{iht}}$ is for **AMI** patient *i* who was admitted to a hospital *h* in year *t*, such as whether the patient received CABG/PTCA. Another overutilization variable is whether a pregnant patient had a cesarean delivery. The dependent variable $\mathrm{QUAL_{iht}}$ denotes for patient *i* admitted to hospital *h* in year *t*, such as whether the patient received a cesarean delivery.

The vector VI_{ht} refers to dummy variables for the type of hospital physician affiliation. The parameter β_1 represents the effect of different affiliation types on outcomes. The vector PAT_{iht} denotes patient characteristics such as age, gender, and race. PAT_{iht} also includes the type of payment source, diagnosis, number of diagnoses, number of procedures, length of stay, and co-morbidity measures. The variable $ln(VOL_{ht})$ is the volume of relevant procedures at hospital *h* in year *t*. The variable $HOST_{ht}$ is the vector of hospital and time-variant demographic variables such as the Medicare penetration and wage index.

There are differences across hospitals such as profit status that may be correlated with the affiliation type. In order to account for time invariant differences among hospitals, the regression includes hospital characteristics which are fixed over the sample period. Besides hospital fixed effects, the year fixed effect is also included in the regression to control for time invariant differences. Vectors α_h and γ_t are hospital fixed effects and year fixed effects respectively.

3.4.2 Cost and Price

This paper also aims to determine whether the type of affiliation affects the cost of treatment and hospital pricing. As in the quality of outcome analysis in the previous section, regressions must include hospital fixed effects to capture any time invariant factors that may possibly enter into the affiliation decision and affect cost and price.

$$ln(COST_{iht}) = \beta_1 VI_{ht} + \beta_2 PAT_{iht} + \beta_3 HOST_{ht} + \beta_4 ln(VOL_{ht}) + \alpha_h + \gamma_t + \varepsilon_{iht} \quad (3.2)$$

The dependent variable $ln\ (COST_{iht})$ is the estimated cost of patient *i*'s admission to hospital *h* at year *t*. In order to estimate the cost per patient admission, I use the cost-to-charge ratio provided by HCUP's files. This data file provides ratios that will allow the conversion of charge data to cost estimates. The file is constructed using inpatient cost and charge information from the detailed reports by hospitals to the Centers for Medicare and Medicaid Services (CMS). It provides an estimate of inpatient cost-to-charge for nearly every HCUP NIS hospital between 2000 and 2004. This data set also includes a wage index.

Next, I consider the effect of the type of affiliations on price. I examine the change in price in order to find evidence to explain why hospitals and physicians integrate. Vertical arrangements between hospitals and physicians could result in price reductions because of the elimination of a double marginalization problem. Alternatively, vertical integration could result in price increases as a result of increasing market power.[23] Understanding the reasons for price changes is crucial to determine whether affiliations have any anticompetitive effects on hospital markets. I follow Keeler at al. (1999), and I estimate the following regression:

$$ln(Price_{iht}) = \beta_1 VI_{ht} + \beta_2 PAT_{iht} + \beta_3 HOST_{ht} + \beta_4 ln(VOL_{ht}) + \alpha_h + \gamma_t + \varepsilon_{iht} \quad (3.3)$$

[23] Gal-Or (1999).

The variable $Price_{iht}$ denotes the price charged to patient *i* by hospital *h* in year *t*. Again, the vector PAT_{iht} represents patient characteristics, and the vector VI_{ht} is for the dummy variables of hospital physician affiliations. The vector β_1 is the vector of coefficients that measures the effects of vertical affiliations on price. There are also hospital fixed effects, α_h and year fixed effects γ_t.

3.5 Results

3.5.1 Descriptive Data

Table 1 reports the hospital and physician affiliation information for the study years. The number of hospitals varies between 962 and 975. Over 20% of these hospitals have *IPAs* which are the weakest affiliation. The strongest affiliation between hospitals and physicians, *FIOs*, are just as common as *IPAs* . *FIOs* represent vertical integration in this study. The ratio of *FIOs* affiliations varies from year to year. While, the percentage of *CPHOs* decreased from 9.47% in 1998 to 5.95% in 2004, the percentage of *OPHOs* slightly increased. *MSOs* affiliations dramatically declined from 18.95% in 1998 to 10.12% in 2004. From 1998 to 2001, the percentage of *EQT* initially increased and reached its peak of 4.81%. After 2001, it began declining gradually to 0.89% in 2004.

Patient characteristics are reported in Table 2. The percentage of Medicare patients varies between 30.57% and 38.36%, and the percentage of patients with private insurance is between 36.86% and 43.60%. From 1998 to 2004, admission ratios of **AMI**, **GIH**, **CVA** and **DM** patients decreased. However, the number of patients with **CHF** conditions slightly increased. The ratio of patients dying within 90 days of initial admission decreased slightly for all conditions except **CVA** patients. Another notable change occurred in the percentage of cesarean procedures. In 1998, the percentage of cesarean procedures was 2.21%, but in 2004, the percentage was 3.18%. While the ratio of CABG procedures declined during the period of the study, the ratio of PTCA varied irregularly from year to year.

3.5.2 Quality of Health Care: Mortality Analysis

First I examine the effect of hospital physician affiliations on inpatient mortality for five conditions. The estimates of equation (3.1) for these conditions and the odds ratios are reported in Table 3 and Table 4 respectively.

IPAs, *OPHOs*, *CPHOs,* and *MSOs* are weak affiliations. For *IPAs*, the odds of dying from **AMI**, **DM** and **CHF** are higher than they would be for independent hospitals. According to Table 4, the odds of an **AMI** patient dying is 15.3% higher in *IPAs*, and it is significant at the 5% level. *OPHOs* increase the odds of dying for **CVA**, **GIH**, **DM** and **CHF** patients, but this increase is statistically significant at the 10% only for **DM**. The results of this estimation reveal that *CPHOs* affiliations increase the odds of dying for all conditions, and all results are statistically significant except for **GIH**. *MSOs* are relatively stronger than *IPAs*, *OPHOs*, and *CPHOs,* but *MSO's* mortality estimates are similar to the estimates of those weak affiliations. The odds of dying for **AMI**, **GIH**, **DM** and **CHF** patients are higher in MSOs than independent hospitals. Mortality estimates show that weak affiliations have higher odds of dying than independent hospitals.

For strong affiliations, all of the statistically significant results point to lower odds of dying from a given clinical condition. *FONs'* odds of dying for **AMI** and **CHF** patients are 20.7% and 17.4% lower than independent hospitals. An examination of stronger affiliations also produces interesting results. The odds of a **CVA** patient dying is 43% lower in *EQTs* than a **CVA** patient in independent hospitals. Vertically integrated *FIOs,* the strongest affiliation, have lower odds of dying for **DM** patients. The odds of a **DM** patient dying is 22.3% lower in *FIOs* than a **DM** patient in independent hospitals. *FIOs* also have lower mortality rates than independent hospitals for **CVA** and **CHF** patients, but these two results are not statistically significant.

The mortality rates provide evidence that weaker affiliations have higher odds of dying for all clinical conditions specified in this study. There is no evidence that weaker affiliations reduce the odds of dying for any of the conditions specified. Contrary to the weak affiliation results, strong affiliations decrease the odds of dying. While it is not possible to rank different affiliation types, clearly strong affiliations perform better than weak affiliations. However the quality of outcome in weak affiliations is not better than independent hospitals.

3.5.3 Quality of Health Care: Overutilization Analysis

I estimate the effect of hospital physician affiliations on utilization. The coefficient estimates of equation (3.1) for cesarean delivery and CABG/PTCA procedures are given in Table 5. Table 6 shows the odds ratios.

The weakest affiliation, *IPAs* have a higher odds ratio of cesarean delivery than independent hospitals. The probability of a pregnant woman having a cesarean delivery is 11.3% higher in *IPAs* than independent hospitals. Another weak affiliation *OPHOs* also have a higher odds ratio of cesarean delivery than independent hospitals. The ratio is 8.3% higher in *OPHOs*. *CPHOs*' odds ratio of cesarean delivery is 11.5% lower than independent hospitals. This lower odds ratio indicates higher quality in CPHOs than independent hospitals.

The strongest affiliations *FIOs* have the lowest odds ratio of cesarean delivery. The probability of a pregnant woman having a cesarean delivery is 12.7% lower in F*IOs* than in independent hospitals. This result states that *FIOs* provide higher quality of care than independent hospitals. However, another strong affiliation *EQTs* have a higher odds ratio of cesarean delivery. The odds ratio for *EQTs* is 7.1% higher than for independent hospitals. The results from the overutilization regression show that *EQTs* experience lower quality of health care outcomes. Since there are large fixed costs associated with surgical operations, it is not surprising to see a for-profit organization such as *EQTs* respond to this financial incentive and utilize more cesarean deliveries.

The coefficient estimates for CABG/PTCA procedures are given in Table 5. Table 6 shows the odds ratios of having PTCA/CABG surgery.

Except for *OPHOs*, weak affiliations do not have statistically significant overutilization estimates of CABG/PTCA procedures. The odds ratio of having CABG/PTCA surgery is 33.8% higher in *OPHOs* than independent hospitals. This estimate shows that the quality of health care is worse in *OPHOs* than in independent hospitals. There is no evidence that weak affiliations have higher quality of health care than independent hospitals.

For the strongest affiliation FIOs' the odds ratio of having PTCA/CABG surgery is 8.2% lower than independent hospitals. It is another indicator of better quality. However, the other two strong affiliations have mixed results. While *EQTs'* odds ratio of having PTCA/CABG surgery is 19.8% lower than independent hospitals, the odds ratio is 25.7% higher in FONs than in independent hospitals.

3.5.4 Cost and Price

I estimate the effects of affiliation types on the cost of treatment. I examine the effects for all patients and also for Medicare and private insurance patients separately. The estimation results are reported in Table 8.

IPAs, the weakest affiliation type, are associated with higher costs for all three regressions. The cost of treatment is 10.23% higher in *IPAs* than independent hospitals for all patients. In addition, *IPAs* have higher cost of treatment for Medicare and private insurance, but only the former is statistically significant. Similar to *IPAs*, the regression results for *MSOs* show that *MSOs* are associated with significantly higher costs. The costs of treatment for all patients, Medicare patients, and private insurance patients are 12.17%, 13.78%, and 7.98% respectively. Other weak affiliations, *OPHOs* and *CPHOs,* have mixed results, but none of them are statistically significant. All statistically significant results show that weak affiliations have a higher cost of treatment than independent hospitals.

The cost estimates for the strong affiliations reveal two statistically significant results. The cost of treatment for private insurance patients is 4.77% lower in the strongest affiliations *FIOs* than in independent hospitals. *EQTs* also have lower costs for all patients and Medicare patients, but only the latter is statistically significant. The cost of treatment for Medicare patients is 4.57% lower in *EQTs.* These statistics support the results of utilization analysis. The strong affiliations increase efficiency by pooling the resources and coordinating care. Therefore, strong affiliations decrease the cost without sacrificing quality of care. On the other hand, weak affiliations face higher costs of care than independent hospitals due to the lack of coordination and overutilization of expensive procedures.

Table 8 reports the effects of affiliation types on price. Similar to the results from the cost regressions of weak affiliations, *IPAs* result in higher prices. The price estimate for all patients is 8.45% higher in *IPAs* than independent hospitals. Medicare and the private insurance patience pay 5% more in *IPAs*, but these results are not statistically significant. The estimates for *MSOs* indicate that *MSOs* charge higher prices than hospitals that negotiate with managed care independently. All patients pay 12.45%, Medicare pays 11.72%, and private insurance pays 9.06% more in *MSOs*. Another weak affiliation *CPHOs* are associated with higher prices for all patients and Medicare patients, but these results are not significant.

The majority of the strong affiliation estimates suggest that strong affiliations have lower prices than independent hospitals. However, only the strongest affiliations *FIOs* provide statistically significant results. Specifically, *FIOs* have 4.89% lower prices for private insurance. There is no evidence that strong affiliations have higher prices.

3.6 Conclusions

This study provides evidence that strong affiliations between physicians and hospitals increase the quality of health care without increasing the cost and price. Strong affiliations result in better coordination among various units. According to Robinson and Casaliono's (1997), affiliations achieve low cost and high quality by using better incentive mechanism. This is only true if hospitals and physicians have a stronger affiliation. Weak affiliations result in poor quality of health care and higher costs due to lack of coordination. On the other hand, strong affiliations have the advantage of better coordination among various units. Under managed care, where cost controls and performance are important factors affecting the number of managed care contracts, health care providers benefit. Strong affiliations provide a better incentive mechanism for employees. Strong affiliations achieve low cost and high quality by using this better performing incentive mechanism.

In this study, first the mortality rates are examined to compare the quality of health care. Strong affiliations clearly produce lower mortality rates than independent hospitals. Vertically integrated *FIOs* have lower mortality rates for **DM** patients. Each strong affiliation decreases the odds of dying at least for one of the conditions examined in this study. Specifically, *FONs* have lower odds of dying for **AMI** and **CHF** patients, and *EQTs* decrease the odds for **CVA** patients. Strong affiliations require physicians to have certain credentials and their performance are periodically evaluated. In particular, *FIOs* improve the quality of care by using internal quality controls, peer reviews, and incentives for physicians. Therefore, physicians who have financial or professional interests in the affiliation have an incentive to improve their performances.

This study also examines cesarean delivery and CABG/PTCA surgery to determine the effects of various affiliations on quality of health care. This study shows that the strongest affiliations *FIOs* produce better utilization rates than independent hospitals. Hospitals that integrate with physicians through *FIOs* utilize their resources more efficiently. *FIOs* decrease the odds of having a cesarean section delivery for pregnant women, and significantly *FIOs* also decreases the odds of having CABG or PTCA procedures for **AMI** patients. On the other hand, physicians in *EQTs* and *FONs* still tend to use CABG or PTCA operations more than physicians in independent hospitals. Their cesarean section birth rates are also much higher. A very large share of the hospital revenue comes from surgical operations like CABG, PTCA and cesarean section deliveries. In addition, such surgical procedures require high cost investments such as medical equipment. Therefore, it is not surprising to find that physicians in these affiliations tend to employ these surgical operations more often than physicians at independent hospitals or physicians who are salaried employees at hospitals. These results suggest that *EQTs* and *FONs* are better at aligning the financial incentives of physicians than independent hospitals.

There is no evidence that weak affiliations perform better than independent hospitals. In fact, the mortality estimates suggest that the odds of dying for a patient with one of the specified conditions is higher in weak affiliations than in independent hospitals. Specifically, *IPAs* have higher odds of dying for **AMI** patients, *OPHOs* have higher odds of dying for **DM** patients, *MSOs* have higher odds of dying for **GIH** patients, and *CPHOs* have higher odds of dying for all, except **GIH** patients. Weak affiliations tend to use expensive services such as cesarean section delivery and CABG/PTCAs more than independent hospitals. Since these services have high fixed costs; the marginal benefit to most patients is higher than the marginal cost. Physicians in weak affiliations respond to this incentive and over-utilize the services. Pregnant patients in *IPAs* and *OPHOs* have higher odds of having a cesarean delivery. In addition, an AMI patient is more likely to have CABG/PTCA surgery in *OPHOs* than independent hospitals. The estimates for two weak affiliations, *CPHOs* and *MSOs* have lower odds ratios for cesarean delivery. Lower odds of cesarean delivery suggest higher quality of care for *CPHOs* and *MSOs* compared to independent hospitals, *IPAs* and *OPHOs*. *CPHOs* and *MSOs* are considered weak affiliations because they do not control physician revenue, and they are not owned and operated by hospitals. However, both *CPHOs* and *MSOs* are both relatively stronger than *IPAs* and *OPHOs*. Unlike *OPHOs*, *CPHOs* selectively contract with physicians and *CPHOs* focus on recruiting physicians based on quality. Physicians are exclusive to the hospital in *CPHOs* and in *MSOs*. In addition, *MSOs* buy the tangible assets of physicians, and physicians retain ownership of patient revenues and managed care contracts. Therefore, *CPHOs* and *MSOs* are relatively stronger and unsurprisingly they perform better than *IPAs* and *OPHOs*. This result implies that the stronger the affiliation, the higher the quality.

I also compare the affiliations in terms of the cost of treatment. The results of the cost estimates show that the costs of treatment with strong affiliations are lower than independent hospitals. *FIOs* significantly decrease the cost of treatment for private insurance patients. There is also evidence that other strong affiliations decrease the cost of treatment. For instance, *EQTs* decrease the cost of treatment for all-payment patients and Medicare patients. The results from the cost estimates strengthen the results of the utilization analysis. Stronger affiliations are better at coordinating the care of services which results in higher quality and lower cost than independent hospitals. Another reason for relatively lower costs with strong affiliations is that they use their resources more efficiently than independent hospitals. A centralized patient database also lowers cost. Shared databases increase the speed of treatment by avoiding repeated examinations. Integrated hospitals also share some other facilities that significantly reduce their fixed cost of treatments.

This study also demonstrates that the weak affiliations are associated with a higher cost of treatment. The weakest affiliations, *IPAs,* increase the cost of treatment for all patients and Medicare patients. *MSOs* also have significantly higher costs for all patients, Medicare patients, and private insurance patients. Because of lack of coordination and the inability to capture economies of scale and scope, weak affiliations have a higher cost of treatment. Since these affiliations are not owned and operated by physicians, the physicians do not have strong incentives to control cost.

Lastly, I examine the effect of hospital physician affiliations on price. Similar to cost estimates, prices are lower at strong affiliations for all patients and privately insured patients. The lower costs at *FIOs* result in lower prices. Lower cost and higher quality help *FIOs* receive more managed care contracts. Consequently, receiving more contracts lowers the average cost of treatment, and therefore prices decline. *EQTs* decrease the price for all-payment patients and Medicare patients. *FONs* decrease the price for Medicare and private insurance patients. However, the price estimates of *EQTs* and *FONs* are not statistically significant.

As in cost estimates, weak affiliations have higher prices than independent hospitals. *MSOs* prices are higher than independent hospitals for all payment types. The price estimates result in higher prices for all patients in *IPAs*. Weak affiliations result in poor quality of health care and higher costs due to lack of coordination. Higher costs in weak affiliations can result in higher prices.

The empirical results show that when the affiliation between a hospital and physicians is strong, the integrated organization operates more efficiently than independent hospitals. However, affiliations that weakly integrate hospitals and physicians produce a lower quality of health care with a higher cost and price. These results have important implications for potential antitrust cases in hospital market, and policy makers should closely examine affiliations between hospitals and physicians.

3.7 Appendix

Table 1: Hospital Characteristics in Selected Study Years

	1998	1999	2000	2001	2002	2003	2004
Number of hospitals	965	962	965	967	975	967	972
IPA	22.63%	34.38%	20.85%	19.79%	29.09%	22.11%	26.49%
OPHO	17.37%	9.38%	16.86%	21.39%	18.79%	17.44%	19.35%
CPHO	9.47%	9.38%	9.14%	6.42%	4.85%	7.13%	5.95%
FIO	18.42%	6.25%	23.17%	24.06%	20.00%	28.75%	27.38%
MSO	18.95%	21.88%	13.77%	12.83%	13.94%	13.51%	10.12%
EQT	2.11%	0.00%	3.73%	4.81%	1.21%	1.23%	0.89%
FON	5.26%	15.63%	6.44%	4.81%	9.09%	6.14%	6.25%
<100 bed	36.84%	31.25%	35.26%	36.90%	33.94%	41.03%	43.45%
Government, nonfederal	19.90%	20.17%	20.21%	20.48%	19.79%	20.17%	19.55%
Not-for-profit	18.13%	18.30%	19.17%	19.23%	19.79%	19.54%	19.44%
For profit	11.61%	11.75%	11.71%	12.10%	12.00%	12.41%	13.17%
Teaching	19.90%	20.06%	17.41%	17.58%	18.05%	17.79%	17.39%
at least 5% HMO penetration in MSA	38.42%	37.50%	40.41%	41.18%	26.06%	27.03%	31.25%
6% - 10% HMO penetration in MSA	1.58%	3.13%	3.35%	3.21%	3.03%	3.19%	5.06%
11% - 15% HMO penetration in MSA	2.63%	0.00%	3.09%	1.07%	1.21%	2.21%	1.49%
16% - 20% HMO penetration in MSA	2.63%	3.13%	1.93%	3.21%	1.21%	0.49%	1.19%
+ 20% HMO penetration in MSA	5.79%	9.38%	4.63%	5.88%	3.03%	1.97%	2.38%

Table 2: Patient Characteristics	1998	1999	2000	2001	2002	2003	2004
Number of study patients	328,452	64,023	361,184	296,149	313,542	297,535	302,603
Medicare patients	36.71%	30.57%	36.13%	37.37%	35.81%	38.36%	36.52%
Private insurance patients	39.43%	43.60%	41.60%	38.29%	40.92%	36.86%	38.57%
AMI patients	2.84%	2.17%	2.79%	2.72%	2.57%	2.72%	2.39%
CVA patients	2.20%	1.94%	1.95%	1.83%	1.78%	1.81%	1.70%
GIH patients	1.98%	1.96%	1.97%	1.96%	1.91%	1.98%	1.85%
DM patients	4.00%	3.60%	3.59%	3.61%	3.28%	3.30%	3.24%
CHF patients	9.18%	6.75%	8.86%	9.30%	9.12%	9.73%	9.73%
CABG	1.25%	0.85%	1.16%	1.12%	1.00%	1.00%	0.81%
PTCA	1.80%	1.36%	1.97%	2.14%	1.95%	2.30%	2.18%
Cesarean	2.21%	2.81%	2.46%	2.24%	2.94%	2.70%	3.18%
Female	58.78%	59.03%	58.85%	58.11%	59.11%	58.12%	58.40%
Black	9.73%	6.73%	9.97%	8.27%	10.50%	10.40%	10.50%
# Hispanic	7.87%	21.51%	5.78%	7.05%	6.53%	7.72%	7.97%
Age	47.98	43.23	47.28	48.23	47.18	48.95	47.59
Age<65	62.64%	68.55%	64.87%	63.62%	65.65%	64.19%	65.44%
Ages 65 to 69	6.61%	5.47%	6.14%	6.20%	5.83%	6.24%	6.13%
Ages 70 to 74	8.15%	6.60%	7.40%	7.57%	7.01%	7.21%	6.69%
Ages 75 to 79	8.37%	7.35%	7.90%	8.23%	7.74%	7.96%	7.43%
Ages 80 to 84	6.98%	5.74%	6.58%	7.00%	6.68%	7.00%	7.00%
Ages 85 to 89	4.67%	3.95%	4.59%	4.76%	4.53%	4.75%	4.53%
Ages 90 to 99	2.51%	2.29%	2.45%	2.55%	2.49%	2.59%	2.70%
Age>99	0.07%	0.06%	0.07%	0.07%	0.07%	0.06%	0.07%
Dying within 90 days of initial AMI	10.37%	10.31%	10.57%	9.87%	9.71%	9.53%	9.14%
Dying within 90 days of initial CVA	11.52%	10.30%	12.47%	12.26%	12.01%	12.31%	11.52%
Dying within 90 days of initial GIH	6.29%	5.82%	6.38%	6.61%	5.45%	5.65%	5.00%
Dying within 90 days of initial DM	2.97%	2.56%	2.79%	2.40%	1.99%	1.67%	1.81%
Dying within 90 days of initial CHF	6.89%	6.57%	7.18%	6.55%	6.15%	5.97%	5.76%

Notes: AMI=acute myocardial infarction; CVA= cerebral vascular accident; GIH= gastrointestinal hemorrhage
CABG= coronary artery bypass graft; PTCA= percutaneous transluminal coronary angioplasty
CHF= congestive heart failure; DM=diabetes mellitus

Table 3: Mortality Results

	AMI	CVA	GIH	DM	CHF
IPA	0.1427**	-0.0317	-0.0728	0.1538	0.0835
	0.072	0.0889	0.1088	0.1287	0.0546
OPHO	-0.171	0.061	0.1348	0.2597*	0.0581
	0.077	0.099	0.1187	0.1383	0.0579
CPHO	0.1523*	0.2794**	0.1816	0.3839**	0.1934***
	0.0893	0.1138	0.1391	0.1579	0.0685
FIO	0.0498	-0.1105	0.1286	-0.2521**	-0.0342
	0.0693	0.0869	0.1066	0.1277	0.0531
MSO	0.1095	-0.0448	0.2131*	0.0406	0.0538
	0.0802	0.094	0.1165	0.1357	0.0597
EQT	-0.0134	-0.5625***	0.1044	0.2656	0.0097
	0.1348	0.1624	0.2119	0.2174	0.1012
FON	-0.2323**	0.0238	-0.0492	-0.2772	-0.1911**
	0.1033	0.119	0.1593	0.1881	0.0792
Hospital Competition (HHI)	-0.0358	-0.4952**	0.1011	-0.3534	-0.1077
	0.1847	0.2203	0.2637	0.3307	0.139
Penetration 0-5%	-0.2221**	-0.3082***	-0.2881**	-0.3134	-0.1082
	0.1013	0.1187	0.1467	0.196	0.077
Penetration 6%-10%	-0.4265***	-0.3019*	-0.0346	-0.2114	-0.0731
	0.1469	0.1724	0.2269	0.256	0.1084
Penetration 11%-15%	-0.3231**	-0.6301***	0.0297	-0.3023	-0.1186
	0.1539	0.1911	0.221	0.2842	0.118
Penetration 16%-20%	0.4688**	0.3527	0.1529	-0.3966	0.1368
	0.1958	0.2669	0.3135	0.4164	0.1557
Penetration + 20%	-0.0796	-0.271	-0.1053	-0.5708	0.0357
	0.2028	0.2296	0.296	0.4456	0.1534
Age	0.0123	-0.0025	0.0347*	-0.0556*	-0.0287***
	0.0238	0.0111	0.0199	0.0249	0.0108
Female	0.0954	-0.0579	-0.1892**	-0.2259**	-0.2112***
	0.0635	0.0754	0.0965	0.114	0.0481
Black	0.000711	-0.1845	-0.093	-0.3791	-0.3151***
	0.1545	0.1614	0.2191	0.2363	0.1214
Hispanic	-0.2202	-0.4781**	-0.2072	-0.8276***	0.0515
	0.1661	0.1889	0.2354	0.2793	0.1219

Table 3 *continues*

	AMI	CVA	GIH	DM	CHF
Length of Stay	-0.0186***	-0.0752***	-0.0193**	0.00173	-0.00005
	0.0057	0.00734	0.00793	0.0077	0.00367
Medicare	0.3661	-0.4684	-0.9445	-1.3174	-0.1048
	1.0464	1.1552	1.2053	1.1044	0.752
Private Insurance	0.0942	-0.6541	-0.0278	-1.5665	-0.16
	1.0483	1.1588	1.2093	1.1101	0.7546
# of Diagnosis	0.1763***	0.0509***	0.1339***	0.0982***	0.0823***
	0.0135	0.0121	0.0154	0.0184	0.0084
# of Procedures	0.0484***	0.2607***	0.2737***	0.2077***	0.1496***
	0.013	0.0186	0.0217	0.0248	0.0101
Hospital Volume	-0.0621	0.3345***	0.00466	0.0757	-0.0338
	0.0572	0.0722	0.0803	0.0958	0.0401

*** Significant at 1%. ** Significant at 5%. * Significant at 10%

Table 4 : The odds of dying

	AMI	CVA	GIH	DM	CHF
IPA	1.153	0.969	0.930	1.166	1.087
OPHO	0.983	1.063	1.144	1.297	1.060
CPHO	1.165	1.322	1.199	1.468	1.213
FIO	1.051	0.895	1.137	0.777	0.966
MSO	1.116	0.956	1.238	1.041	1.055
EQT	0.987	0.570	1.110	1.304	1.010
FON	0.793	1.024	0.952	0.758	0.826

*** Significant at 1%. ** Significant at 5%. * Significant at 10%

Table 5: Utilization Estimates

	CESAREAN	CABG and PTCA
IPA	0.1066***	-0.0685
	0.0194	0.0567
OPHO	0.0795***	0.2909***
	0.0219	0.0598
CPHO	-0.1217***	-0.0836
	0.0254	0.0719
FIO	-0.1353***	-0.086*
	0.0188	0.0547
MSO	-0.0902***	-0.0673
	0.0214	0.0618
EQT	0.0685*	-0.2211**
	0.0395	0.1091
FON	0.0054	0.2288***
	0.029	0.0771
Hospital Competition (HHI)	-0.0169	0.2601*
	0.0529	0.144
Penetration 0-5%	0.0449*	0.1129
	0.0267	0.0816
Penetration 6%-10%	0.0131	0.6916***
	0.0393	0.1116
Penetration 11%-15%	0.1867***	-0.6259***
	0.038	0.1206
Penetration 16%-20%	0.2479***	-0.7318***
	0.0599	0.203
Penetration '+ 20%	-0.2562***	0.6995***
	0.0537	0.1594
Age	-0.0167***	'-0.0128***
	0.000558	0.00254
Female		-0.2595***
		0.0511
Black	-0.1597***	-0.0327***
	0.035	0.0714
Hispanic	0.12***	-0.4802***
	0.33	0.1238

Table 5: *continues*

	CESAREAN	CABG and PTCA
Length of Stay	0.0153***	-0.0616***
	0.00188	0.00479
Medicaid	0.4257	-0.1548
	0.3175	0.1419
Private Insurance	0.4695***	-0.0289
	0.3171	0.0795
# of Diagnosis	0.2053***	-0.2335***
	0.00374	0.00995
# of Procedures	-0.3676***	0.8404***
	0.008	0.0164
Hospital Volume	0.0825	0.807***
	0.0156	0.0497

*** Significant at 1%. ** Significant at 5%. * Significant at 10%

Table 6: The odds of utilization

	CESAREAN	CABG and PTCA
IPA	1.113	0.934
OPHO	1.083	1.338
CPHO	0.885	0.92
FIO	0.873	0.918
MSO	0.914	0.935
EQT	1.071	0.802
FON	1.005	1.257

*** Significant at 1%. ** Significant at 5%. * Significant at 10%

Table 7: Cost Estimates

	All Patients	Medicare	Private Insurance
IPA	0.1023***	0.0807*	0.07302
	0.03354	0.04991	0.0556
OPHO	-0.019111	-0.003009	-0.0302
	0.03307	0.059	0.048
CPHO	0.201594	0.2188	-0.1422
	0.179879	0.18743	0.4298
FIO	-0.007834	0.0322	-0.0477**
	0.015182	0.02584	0.0231
MSO	0.1217***	0.1378***	0.0798**
	0.0253	0.0386	0.0385
EQT	-0.0313	-0.0457*	0.0232
	0.020228	0.0236	0.0452
FON	0.0280908	0.0259	0.0095
	0.064808	0.0842	0.1069
Hospital Competition (HHI)	0.515462	-61.7051	36.6453
	11.92909	62.4046	72.5779
Wage index	-2.850042	1.3399	-7.7908
	2.22542	2.9347	5.8391
Age	0.0435***	0.0228***	0.046***
	0.000215	0.00124	0.0003
Female	-0.1009***	-0.0250***	-0.1533***
	0.00305669	0.00452	0.0048
Black	-0.0557***	-0.0981***	-0.0454***
	0.010091	0.0175	0.0147
Hispanic	-0.0556***	-0.0691***	-0.0437***
	0.010344	0.0195	0.0153
Length of Stay	0.0569***	0.0551***	0.0602***
	0.000269	0.0042	0.0004
Medicare	-0.1750***		
	0.039509		
Private Insurance	-0.1921***		
	0.0392		
# of Diagnosis	0.0293***	0.0209***	0.0354***
	0.000583	0.00083	0.0009
# of Procedures	0.1413***	0.1417***	0.1322***
	0.000913	0.00125	0.0015
Hospital Volume	-0.1656***	-0.1663***	-0.1707***
	0.03353	0.0563	0.0506

*** Significant at 1%. ** Significant at 5%. * Significant at 10%

Table 8: Price Estimates

	All Patients	Medicare	Private Insurance
IPA	0.0845***	0.050325	0.05763
	0.03275	0.047497	0.05503
OPHO	-0.0442	-0.03178	-0.05988
	0.0322	0.058137	0.04685
CPHO	0.0417	0.21807	-0.45428
	0.167	0.17615	0.340309
FIO	-0.00897	0.014243	-0.0489**
	0.014	0.02312	0.0216
MSO	0.1245***	0.1172**	0.0906**
	0.0246	0.03708	0.037846
EQT	-0.12123	-0.34278	0.571343
	0.1844	0.209343	0.36497
FON	0.0022	-0.02854	-0.00104898
	0.0642	0.08308	0.10534682
Hospital Competition (HHI)	-4.98611	-53.48995	53.392311
	11.76099	57.41925	61.83179432
Wage index	-1.036386	0.112470711	-7.0709*
	1.172702	1.144199	4.266204
Age	0.04308***	0.0222***	0.0460***
	0.000203	0.001166	0.00032372
Female	-0.0936***	-0.0272***	-0.144***
	0.0028	0.00422148	0.0062755
Black	-0.0559***	-0.1045***	-0.0315**
	0.009438	0.016634	0.01404
Hispanic	-0.05123***	-0.08504***	-0.028**
	0.009399	0.01761	0.014251
Length of Stay	0.0573***	0.0559***	0.0613***
	0.0002556	0.00039504	0.00042312
Medicare	-0.1746***		
	0.03887		
Private Insurance	-0.1890***		
	0.038665		
# of Diagnosis	0.0291***	0.0214***	0.0347***
	0.000545	0.000769	0.0009011
# of Procedures	0.1388***	0.1385***	0.1309***
	0.00085901	0.00116492	0.001414
Hospital Volume	-0.1212***	-0.115**	-0.0125353
	0.03313655	0.055467	0.05023

*** Significant at 1%. ** Significant at 5%. * Significant at 10%

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