Firms' Strategic Decisions
Theoretical and Empirical Findings

Volume 2

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Kazuhiro Ohnishi

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Edited By

Kazuhiro Ohnishi

Institute for Basic Economic Science,
2-15-12 Hanjo, Minoo,
Osaka 562-0044
Japan

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PREFACE

This book presents recent theoretical and empirical studies by many eminent researchers all over the world and is composed of eleven chapters.

The first five chapters study firms' strategic decisions in oligopolistic industries based on the theory of firm behavior.

Chapter 1 considers an oligopolistic model for parking lots with conjectures concerning the price variations depending upon the agents' offered parking space increase or decrease, given an existing exogenous shop driven demand, which may be affected by a parking discount for shop customers. This chapter introduces the notion of an exterior equilibrium and a special type of an agent's cost function, and establishes the existence and uniqueness of the interior (conjectured) equilibrium. The concept of equilibrium with the conjectures is different from the classical Cournot-Nash one.

Chapter 2 considers unionization structure and shows that in quantity competition, the total utilities of the decentralised unions are higher than the utility of the centralised union only if the centralised union charges a uniform wage and the firms' productivity differences are large irrespective of product differentiation; in price competition, the total utilities of the decentralised unions are higher than the utility of the centralised union only if the centralised union charges a uniform wage with the firms' productivity differences are large and the degree of product differentiation is small.

Chapter 3 uses general models to derive specific price equilibrium applying to collusive price behavior between multi-store and mono-store firms, and shows how the multi-store firm may find strategically advantageous to base its pricing policy on the degree of substitutability of its product line with respect to those offered by its competing rivals. Finally, the chapter shows that the decisive factor in establishing multi-store initiated cartelization may be (i) the number of firms included in the cartelization and (ii) the location of the independent store relative to those owned by the dominant firm. These two elements can indeed be as decisive as the total number of players in the market.

Chapter 4 considers simultaneous and sequential move games in which banks compete non-cooperatively, and shows that an industry characterized by a leader bank and other follower banks moving sequentially may lead to larger volumes of loans and lower loan prices for the borrowers. This chapter also finds that cost reducing investments in banking technologies may generally lead to larger lending activities and lower loan prices for the borrowers, and that banks' net margin (the difference between the price that banks receive by lending and the

cost of making that loan) increases as banks become larger.

Chapter 5 examines a two-stage mixed duopoly model in which a state-owned firm and a foreign labor-managed firm are allowed to offer lifetime employment as a strategic commitment. The main results of this chapter can be summarized as follows. First, though the state-owned firm's reaction function is upward sloping, the slope is gentler when it offers lifetime employment than when it does not. Second, if the foreign labor-managed firm does not offer lifetime employment, then its reaction function slopes upwards, whereas if it does, then its reaction function is downwards. Third, there may be multiple stable Cournot solutions in the international mixed duopoly model.

Chapter 6 considers a two-stage price-setting model of an incumbent firm and a potential entrant. Demand functions are divided into four cases, and each case is correlated with two opposite strategic commitments. This chapter presents the entry-deterring equilibrium outcomes resulting from the strategic commitments of the incumbent firm in all four cases and shows the effectiveness of strategic commitments in Bertrand competition.

Chapters 7-9 investigate strategic interactions in vertically related industries.

Chapter 7 examines a vertical market that is composed of one upstream input supplier and two downstream firms. Moreover, the downstream firms choose their internal channel structures strategically prior to choosing their outputs. The following two main points are revealed. First, uniform pricing by the upstream input supplier leads to higher total welfare than under discriminatory pricing. Second, uniform pricing is more profitable than price discrimination for the upstream input supplier.

Chapter 8 considers a successive monopoly in which a franchisor supplies a product to a franchisee. The franchisee makes a demand increasing investment, and the franchisor can propose either a margin-based royalty (MBR) or a sales-based royalty (SBR). First, the chapter shows that the SBR has the advantage of providing a greater incentive for the franchisee to invest, but has the disadvantage of inducing a greater double-margin distortion. Second, the chapter proves that the MBR has the advantage of influencing a smaller double-margin distortion, but has the disadvantage of weakening the incentive for the franchisee to invest. Finally, the main results of the chapter shows that if the market is non-elastic, then the franchisor enjoys a higher pay-off from SBR than from MBR, and that the investment level under SBR is always larger than that under MBR, regardless of market elasticity.

Chapter 9 considers a vertically related model of patent licensing of eco-technology between an innovator and duopolistic polluting firms where polluting firms may purchase a license of pollution abatement technology from an outside innovator. This chapter shows that eco-innovator can construct the optimal two-part tariff licensing strategies to provide non-

exclusive licensing contracts, while the optimal strategies might yield welfare loss for some ranges of production cost and environmental regulation.

Chapters 10-11 provide recent empirical contributions.

Chapter 10 proposes a method to evaluate financial losses of enterprises caused by breaks of information security systems. The method can be used to estimate the losses as a result of the information system's accidents (for example, computer attacks or unauthorized intrusions), and in addition can evaluate the risk level of any enterprise. As an illustration, a practical example of estimating financial losses based upon a real-life case is presented. Some results of dynamic changes of variables involved in the method are also shown.

Chapter 11 investigates whether the choice of a particular source of funds represented by trade credit is associated to technical efficiency progress for a large sample of Italian manufacturing small and medium enterprises (SMEs) observed from 2003 to 2007. Applying a data envelopment analysis (DEA) approach to firm-level data, this chapter retrieves a measure of technical efficiency change and performs some nonparametric tests to verify whether the differences observed are significant. As a result, it is shown that higher trade credit ratios tend to be associated to firm efficiency gains in almost all the sectors under analysis.

These studies cover and develop a wide and varied range of important aspects of firm behavior, such as Bank competition, Bertrand competition, centralized union, channel structure, complementary goods, consistent conjectural variations equilibrium, credit market, Cournot competition, decentralized unions, eco-technology, eco-innovator, entry deterrence, environmental regulation, exterior equilibrium, financial losses, input price discrimination, international mixed oligopoly, interior equilibrium, sequential move game, simultaneous move game, state-owned firm, subgame perfect equilibrium, technical efficiency change, trade credit, two-part tariff licensing, and vertical control. The theoretical chapters in this book investigate strategic interactions among firms by using the analytical tools of game theory to build models of economic systems.

This book presents many significant and important findings of theoretical and empirical studies on strategic decisions by firms.

Kazuhiro Ohnishi
Institute for Basic Economic Science
Osaka
Japan

List of Contributors

Abdelhakim Hammoudi INRA-ALISS (Alimentation et Sciences Sociales), Institut National de la Recherche Agronomique, Ivry sur Seine, France

Achintya Ray College of Business, Tennessee State University, Nashville, USA

Chenhang Zeng Research Center for Games and Economic Behavior, Shandong University, Jinan, China

Chu-chuan Hsu Department of Marketing and Logistics Management, Yu Da University of Science and Technology, Hsinchu, Taiwan

Daniel Flores Curiel Department of Economics, Autonomous University of Nuevo León (UANL), Monterrey, Mexico

DongJoon Lee Faculty of Commerce, Nagoya University of Commerce and Business, Nissin-shi, Aichi, Japan

Eric Giraud-Héraud INRA-ALISS (Alimentation et Sciences Sociales), Institut National de la Recherche Agronomique, Ivry sur Seine, France

Francesco Trivieri Department of Economics, Statistics and Finance, University of Calabria, Arcavacata di Rende (CS), Italy

Kazuhiro Ohnishi Institute for Basic Economic Science, Osaka, Japan

Leonard F. S. Wang Wenlan School of Business, Zhongnan University of Economics and Law, Wuhan, China

Mariarosaria Agostino Department of Economics, Statistics and Finance, University of Calabria, Arcavacata di Rende (CS), Italy

Nataliya Kalashnykova Department of Physics and Mathematics (FCFM), Universidad Autónoma de Nuevo León (UANL), San Nicolás de los Garza, Mexico

Olexandr Cherevko Bohdan Khmelnytsky National University of Cherkassy, Cherkassy, Ukraine

SangHeon Han Faculty of Management, Nagoya University of Commerce and Business, Nissin-shi, Aichi, Japan

Sang-Ho Lee Department of Economics, Chonnam National University, Gwangju, South Korea

Sergii Kavun Department of Information Technologies, Kharkiv Institute of Banking of the University of Banking of the National Bank of Ukraine, Kharkiv, Ukraine

Seung-Leul Kim Department of Economics, Chonnam National University, Gwangju, South Korea

Vitaliy V. Kalashnikov-Jr.   Department of Economics, Autonomous University of Nuevo León (UANL), Monterrey, Mexico

Vyacheslav V. Kalashnikov   School of Science and Engineering (EIC), Tecnológico de Monterrey (ITESM), Monterrey, Mexico
Central Economics and Mathematics Institute (CEMI), Moscow, Russia
Department of Computer Science, Sumy State University, Sumy, Ukraine

Wassim Benhassine   Ecole Nationale Polytechnique, Algiers, Algeria

Weiwei Wu   Department of Economics, University of Missouri-Columbia, Columbia, USA

X. Henry Wang   Department of Economics, University of Missouri-Columbia, Columbia, USA

YongHoon Choi   Department of Commerce, Doshisha University, Kyoto, Japan

Part I
OLIGOPOLY THEORY

Parking with Discount: Generalized Oligopoly Model with Influence Coefficients

Vitaliy V. Kalashnikov-Jr.[a,*], Daniel Flores Curiel[a] and Vyacheslav V. Kalashnikov[b,c,d]

[a]Department of Economics, Autonomous University of Nuevo León (UANL), Mexico; [b]School of Science and Engineering (EIC), Tecnológico de Monterrey (ITESM), Monterrey Mexico; [c]Central Economics and Mathematics Institute (CEMI), Moscow Russia; [d]Department of Computer Science, Sumy State University, Surny, Ukraine

Abstract: In this chapter, we consider an oligopolistic model for parking lots with conjectures concerning the price variations depending upon the agents' offered parking space increase or decrease, given an existing exogenous shop driven demand, which may be affected by a parking discount for shop customers. Taking into account piecewise linear cost functions, which is quite natural assumption for parking lots, we are able to elaborate existence of an exterior equilibrium. Moreover, under some natural assumptions we are able to introduce conjectured or interior equilibrium. And we prove the existence and uniqueness of it. The concept of equilibrium with the conjectures is different from the classical Cournot-Nash one. We can establish that there exists a unique interior (conjectured) equilibrium (which is different from the classical Cournot-Nash equilibrium) in a model where firms have a piecewise linear cost function.

Keywords: Capacity, consistent conjectural variations equilibrium, demand structure, exterior equilibrium, homogeneous good, influence coefficients, interior equilibrium, mixed oligopoly, parking discount, parking lot.

[*] **Address correspondence to Vitaliy V. Kalashnikov-Jr.:** Department of Economics, Autonomous University of Nuevo León (UANL), Mederos, Ave. Lázaro Cárdenas S/N, Monterrey, Nuevo León, Mexico; Tel: +52-81-8329-4150; Fax: +52-81-8342-2897; E-mail: kalashnikov_de@yahoo.de

1. INTRODUCTION

Parking markets are becoming more and more important in the core of transit-developed cities. As the vehicle pool grows in a city, the price of parking in the areas that concentrate housing, offices and shops increases. However, commercial establishments in these places are usually willing to offer parking discounts for their customers. Recent articles like Dilek and Top (2013) or Hasker and Inci (2014) study the complementarity of parking provision and shopping. Therefore, it is interesting to study the effect of parking discounts for customers in the market for parking.

In this work, we consider an oligopolistic model of the market for parking services with conjectural variations. A key property of the model is the diversity of parking places that offer this service around the area. Also, we have an exogenously given shop-customers demand for parking, which might be affected by the parking discounts offered by shops.

First, we define an exterior equilibrium. Next, we assume that market agent's cost functions are piecewise linear. This is a natural assumption. Parking lots may be distributed over different areas in the core of the city, so they may have different maintainance costs. Under some other technical assumptions, we are able to show the existence and uniqueness of the exterior (conjectured) equilibrium. Once we approximate the piecewise linear cost function with a quadratic function, we can establish the notion of interior equilibrium, which is more natural. Such model can be applied to study segmented markets, *e.g.* markets with customers whose financial abilities are very different. Also, such models may be useful if you face different types of demands: low-elastic demand (sometimes it is called passive demand) and a high-elastic demand (which is called active demand) and you want to study the dependence of the market price upon the passive or active demand components.

The novelty of this work, is that we use the notion of exterior equilibrium and a piecewise linear cost function to characterize the market for parking. By approximating the piecewise linear cost function with a quadratic

polynomial, we can study the behavior of consumers with different characteristics in the interior (stable) equilibrium. Furthermore, we can describe qualitatively the way in which the price of parking depends on demand for shopping.

The classical models that study oligopolistic markets (Ruffin, 1971; Sherali *et al.*, 1983; Novshek, 1985) are usually concerned with the existence of equilibrium and the comparison of this equilibrium with the one that prevails under perfect competition. The idea behind this comparison is determining which model reflects reality in a better way. Also, many researches have examined equilibrium in oligopolies with different applications (*see*, Mai and Hwang, 1989; Horowitz, 1991; Stewart, 1991, 1992; Cremer and Cremer, 1992; Delbono and Rossini, 1992; Chiarella, 1993; Futagami and Okamura, 1996; Lambertini, 1997; Neary and Ulph, 1997; Lambertini and Rossini, 1998; Ireland, 2003; Ohnishi, 2008; Cuccia and Cellini, 2009).

Given the differences between perfect and oligopolistic competitions, Bulavsky and Kalashnikov (1994, 1995) proposed a comparison of classic oligopolistic competition with a modified version of it. In this version of the oligopoly model, every producer has his own degree of influence over the market. These influences are measured by special parameters which are called influence coefficients. Such coefficients may vary between of 0 and 1. If the coefficients are 0 we have perfect competition but if they are 1 we have the classical oligopoly model. If we set the coefficients exogenously, then we won't be able to capture the behavior of certain variables in our model. For instance, it is not possible to obtain a stable price under a growing demand, or sudden jump-like market price changes and many other cases.

Thus, it is more natural to include the determination of the influence coefficient into the definition of equilibrium itself. Taking into account the determined equilibrium volumes and equilibrium price, together with the coefficients it is possible to model the situations mentioned above. As one of the pioneering works in this are one can mention the paper of Bulavsky

Unionization Structure, Profit Differential, and Social Welfare in a Differentiated Duopoly with Heterogeneous Firms

Chu-chuan Hsu[a] and Leonard F. S. Wang[b,c,*]

[a]Department of Marketing and Logistics Management, Yu Da University of Science and Technology, Hsinchu, Taiwan; [b]Wenlan School of Business, Zhongnan University of Economics and Law, Wuhan, China; [c]Sino-Asia Economic and Management Foundation, Kaohsiung 41148, Taiwan

Abstract: In this chapter, we consider unionization structure and show that in quantity competition, the total utilities of the decentralised unions are higher than the utility of the centralised union only if the centralised union charges a uniform wage and the firms' productivity differences are large irrespective of product differentiation; in price competition, the total utilities of the decentralised unions are higher than the utility of the centralised union only if the centralised union charges a uniform wage with the firms' productivity differences are large and the degree of product differentiation is small. Total profits in Bertrand competition are less than Cournot competition under differentiated duopoly with firm heterogeneity and hence, the standard result on the ranking of Cournot and Bertrand profits is not reversed with the productivity difference and unionization structures. In addition, the social welfare is always higher under Bertrand competition than under Cournot competition irrespective of unionization structures.

Keywords: Asymmetric firms, centralised union, consumer surplus, Cournot-Bertrand comparisons, decentralised unions, differentiated products, labour productivity, price competition, productivity differences, quantity competition, right-to-manage model, social welfare, union wage, unionization structure, utility.

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[*] **Address Correspondence to Leonard F.S. Wang:** Wenlan School of Business, Zhongnan University of Economics and Law, 182# Nanhu Avenue, East Lake High-tech Development Zone, Wuhan 430073, China; Tel: +886-7-5916959; Fax: +886-7-5916958; E-mail: lfswang@gmail.com

1. INTRODUCTION

The papers by Horn and Wolinsky (1988) and Davidson (1988) demonstrate that if the workers are close substitutes, they are better off under a centralised union than under decentralised unions.[1] However, often the empirical evidence, suggesting that many countries are moving towards more decentralised unionisation structure, is not consistent with this theoretical result. For example, the countries such as Sweden, Australia, the former West Germany, Italy and the UK are moving towards a more decentralised unionisation structure, as shown in Katz (1993). Haucap *et al.,* (2007) discuss about the labour market reform in Germany towards a more decentralised unionisation structure.[2]

In a seminal paper, Singh and Vives (1984) present the following results: "With a linear demand structure Bertrand competition is more efficient than Cournot competition (in consumer or total surplus terms), regardless of the nature of the goods (substitutes or complements) and independently of the degree of symmetry in the demand structure. With nonlinear demand and under certain assumptions Bertrand prices (quantities) are smaller (larger) than Cournot prices (quantities) if the goods are substitutes (complements)." López and Naylor (2004) show the results as follows: "the standard result that Cournot equilibrium profits exceed those under Bertrand competition-when the differentiated duopoly game is played in imperfect substitutes-is reversible. Whether equilibrium profits are higher under Cournot or Bertrand competition is shown to depend upon the nature of the upstream agents' preferences and on the distribution of bargaining power over the input price." Häckner (2000) extends the analysis of Singh and Vives (1984) allowing for an arbitrary number of firms with vertical product differentiation, and costs are exogenously given and normalised to zero. In that setting, he demonstrates that the results in Singh and Vives are sensitive to the duopoly assumption. In particular, he highlights the following results: "If there are more than two firms, prices may be higher under price competition than under quantity competition. This will be the case if quality differences are large and goods are complements." Hsu and Wang (2005) show the results as follows: "both consumer surplus and total

surplus are higher under price competition than under quantity competition, regardless of whether goods are substitutes or complements." Zanchettin (2006) describes the results as follows: "both the efficient firm's profits and industry profits are higher under Bertrand competition when asymmetry is strong and/or products are weakly differentiated. Therefore, Singh and Vives's ranking of profits between the two modes of competition is reversed in a sizeable portion of the relevant parameter space." In Mukherjee *et al.,* (2012) comparison of equilibrium outcome under quantity and price competition are analyzed in a vertical structure with homogeneous good and production efficiency. The productivity difference between the downstream firms is the key to their analyses, which enriches Zanchettin (2006) because in spite of the homogenous products, Mukherjee *et al.*, (2012) utilizes the productivity differences to justify the cost asymmetry assumed in Zanchettin (2006). López (2007) also makes the similar comparisons in a vertical structure with both horizontal and vertical product differentiation but allows the downstream firm to choose either price or quantity to compete. From the above papers' demonstration, we see that the conventional wisdom on the ranking of profit and welfare under Cournot or Bertrand competition has been challenged on the ground of product substitutability and cost asymmetry. The key feature of this partial equilibrium model is that goods and labour market are imperfect. The equilibrium in the labour market is settled by firm-union wage bargaining, while the outcome of product market is modelled by Cournot/Bertrand oligopolies.

There are few other papers showing that homogeneous workers can be better off under decentralised unions than under a centralised union. Ulph (1989) shows that if the firm and the workers cannot commit to a long-term contract, decentralised unions induce the firm to increase investment, and may make the workers better off under decentralised union than under a centralised union. Mukherjee and Pennings (2011) show that decentralised unions may make the perfectly substitutable workers better off compared to a centralised union if the firms' productivities are different under different unionisation structure – either due to innovation or due to technology licensing.[3]

In this chapter , we consider unionization structure with productivity

Market Power of Multiproduct Firms and Price Coordination in the Industry

Wassim Benhassine[a], Eric Giraud-Héraud[b] and Abdelhakim Hammoudi[b,*]

[a]Ecole Nationale Polytechnique, Algiers, Algeria; [b]INRA-ALISS (Alimentation et Sciences Sociales), Institut National de la Recherche Agronomique, Ivry sur Seine, France

Abstract: The majority of industrial economics works deals with competition between mono-product firms. However, the hypothesis of mono-product competition is a very poor representation of the observed reality in the industry. In this chapter, we revisit two classical examples of merger regulation. We show how the analysis of multi-store competition may be complex and may require a more sophisticated modeling than the classical models used in mono-store framework. We provide notably, an appropriable tool to discuss the power of a multi-store firm to stimulate price co-ordination in the industry. We use general models to derive specific price equilibrium applying to collusive price behavior between multi-store firms and mono-store firms. We show how the multi-store firm may find strategically advantageous to base its pricing policy on the degree of substitutability of its product line with respect to those offered by its competing rivals. Finally, we show that the decisive factor in establishing multi-store initiated cartelization may be (i) the number of firms included in the cartelization and (ii) the location of the independent store relative to those owned by the dominant firm. These two elements can indeed be as decisive as the total number of players in the market.

Keywords: Bertrand-Nash equilibrium, cartelization, circular model, collusion feasibility, location, merger regulation, multi-product firms, multi-store firms, outsiders, price coordination.

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* **Address Correspondence to Abdelhakim Hammoudi:** INRA-ALISS (Alimentation et Sciences Sociales), Institut National de la Recherche Agronomique, 65 Bd Brandebourg, 94205, Ivry sur Seine, France; Tel: +33 1 49 59 69 87; Fax: +33 1 49 59 69 90; E-mail: hammoudi@ivry.inra.fr

1. INTRODUCTION

There is a paradox in the industrial organization literature dealing with competition between differentiated products. The vast majority of academic works deals with competition between mono-product firms. These works aim to explain the motivations which lead the firms to decide their geographical localization or to choose the characteristics of their product, its price and the effect of these strategies from the social welfare point of view (see Eaton (1982); d'Aspremont *et al.*, (1979); Salop (1979); Novshek (1980); Economides (1989), Calvo-Armengol and Zenou (2002)). However, the hypothesis of mono-product competition is a very poor representation of the observed reality in the industry.

Teitz (1968) is the first to study spatial competition among multi-store firms. Considering a linear city model with linear transport cost, he found out that there is no Nash location equilibrium. Later on, Martinez-Giralt and Neven (1988) obtained a surprising result assuming quadratic transport cost in the context of a duopoly where each firm opens up to two stores. They show, for both the linear model and the circular model of spatial differentiation, that even if the firms have the capacity to open several stores (or launch several products), they open only one store at the equilibrium. It is widely admitted that these two results have led economists to focus more on mono-product analysis. The most recent developments in industrial competition would advocate for a careful re-examination of this matter. Indeed, real economic situations in which a firm competes with its rivals through a relatively high number of stores are in fact the most representative of the industrial reality: competition between restaurant chains, hotel chains, food stores, retailers, gas stations.

In general, the assumption of single-store firm is merely a theoretical simplification of a more complex reality. In order to analyze multi-store competition, a number of (classical) works (Shaked and Sutton (1990); Debashis and Sarkar (2002), Klemperer (1992), Champsaur and Rochet (1989)…) have contributed to the literature by modifying different assumptions associated to the original model of product differentiation (Hotelling (1929), Salop (1979), d'Aspremont *et al.* (1979)) with respect to

both the strategic conjectures on the nature of competition (*e.g.* Cournot competition in Debashis and Sarkar., (2002)) and the preferences of consumers (Klemperer (1992), De Fraja (1993), Janssen *et al.*, (2005)). For instance, Debashis and Sarkar (2002) have demonstrated, for the first time, the normative issues raised by multi-store competition in numerous sectors in which the firms directly supply the customer. Unlike Martinez-Giralt and Neven's result, their model based on Cournot's approach[1] shows that each firm chooses distinct locations for its stores. However, Cournot-based spatial competition models clearly do not address the question initially raised in the original Hotelling model, in which the customer pays the transport cost and endogenous demand rises from the trade-off between the transport cost and the product's price. As for Klemperer (1992), he has used Salop's circular model (1979) in the framework of a price competition where each firm sets an identical price for all varieties and each consumer demands the entire range of product varieties.

They show that firms have a preference for "head-to-head" competition[2] where each firm sells the same brands (brands at the same points in the Salop circle) compared to the "interlaced" competition where the firms offer different brand lines. Janssen *et al.*, (2005) have supposed that customers are distributed according to their location in space and according to their initial preference for one seller. Firms then enter a three-step game, during which they choose the number of their stores, their respective locations and finally the unique price of their product. The authors prove the existence of a unique multi-store perfect equilibrium, contrary to Martinez-Giralt and Neven.

However, these few works had to add different constraints which, even if it makes the analysis easier, limit the strategic behavior of the firm. These constraints can be related to the location (characteristic) of store (products) and/or to a unique price that does not vary with the location of the firm's stores (Klemperer (1992), Eaton and Lipsey (1979), Judd (1985), and Schmalensee (1978)).

Effects of Competitive Structure on Loan Pricing and Credit Provisioning in Oligopolistic Banking Industry

Achintya Ray[*]

Department of Economics and Finance, Tennessee State University, Nashville, USA

Abstract: This chapter presents results that contrast outcomes in banking industry following a simultaneous non-cooperative competition among banks of roughly similar sizes *vis-a-vis* a sequential move competition between a leader and other follower banks. We also present results that link credit demand and bank efficiency (*defined as the cost that it takes a bank to make loans*) with liquidity creation and the total supply of liquidity in the market. We find that in a banking industry characterized by a sequential move competition with some leaders and other followers, aggregate credit generation may be larger, and price of loans may be cheaper in comparison to a situation where similarly sized banks compete simultaneously. This critical insight calls for special care that should be taken while regulating banks that are commonly perceived to be "too large" or "too big to fail." We also present results that connect the effects of cost-reducing investments in the banking industry on credit supply and loan pricing. We also briefly review the vast and ever-expanding scholarship on bank competition and its economic impacts.

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[*] **Address Correspondence to Achintya Ray:** Department of Economics and Finance, College of Business, Tennessee State University, Suite J-401, 330 10th Ave. N., Nashville, TN, 37203, USA; Tel: +1-615-669-2020; Fax: +1-615-829-8378; E-mail: aray4@tnstate.edu

1. INTRODUCTION

Competition in the banking industry is an area of high academic and policy-related interests. Banks are important sources of financial intermediation. By working as a financial intermediary between the savers and the borrowers and taking charge of screenings the borrowers, banks not only reduce the cost of financial transactions, they also act as the principal vehicle through which loanable funds (capital) flow from one sector of the economy to another. Hence, they are crucial for maintaining smooth functioning of the credit market. Banks are vital ingredients in the financial development of a country and ultimately determine the economic progress in the country.

In an international capital market, banks provide important channels in capital market transactions across borders. This is especially important for consumers, businesses, and governments in countries where credit facilities are scarce and capital markets are fragile and relatively small. Interestingly, while making the international flow of capital smoother, banks also inadvertently facilitate the transmission of financial shocks across the borders. Banks contribute to the so-called "contagion effect" (*spreading of financial shocks across regions*) by economic integration achieved primarily through banking operations across the regions. Banks also facilitate the global flow of goods and services by providing trade credits that may be vital lifeline both for exporters and importers.

These discussions suggest that banks are far more complex organizations than commonly understood. Banks not only participate in regular deposit maintenance, but they also engage in consumer lending, business lending, investment banking, security trading, options trading, financial consulting, and retirement planning, to name a few. At the same time, because the stability of the financial system crucially depends on the soundness of the banking system, banks are also one of the most tightly regulated entities in the economy.

Recent financial crisis and the ensuing great recession of 2008-09 have renewed interest in the functioning of the banking industry and the effects of competition on the operation of the industry. Regulators especially pay particular attention to

the structure of the competition and market power of banks that are considered "too big" compared to others or, in familiar media terms, "too big to fail." Since banks are the principal vehicles of credit and liquidity, it is also important to understand the role of competition in the banking industry in determining monetary transmission in the economy. This is because the successes and failures of the monetary policies crucially depend on the functioning and efficiency of the banking sector.

The monetary transmission through the banking channel works in the following way. Banks make loans by using the deposits and capital that they have. These loans flow through the economy and get used to meet consumer demand, industrial investments, government projects, *etc*. The recipients of the funds deposit a fraction of their proceeds back with the bank and the cycle continues. Therefore, the multiplier effect of monetary policy ultimately depends on how efficiently banks process the loans and circulate that money among various actors in the economy.

In this context, it is easy to understand intuitively why competition in the banking sector matters. First, an efficient banking sector may make loans readily available at cheaper rates and hence, essentially lubricate the smooth functioning of the financial sector. Second, competition in the banking industry may be significant towards keeping the cost of credit low for the borrowers which in turn is beneficial for the rest of the economy as it helps the investors to expand their operations relatively quickly through credit and also the consumers to create additional demand through access to consumer credit. For these reasons and more, competition in the banking sector is an important and challenging issue.

While the importance of competition in the banking sector has received high attention, scant attention has been paid to the structure of that market competition and whether that structure has implications for the outcomes in the banking industry. The structure of competition can differ significantly from one industry to other. For example, banks can compete non-cooperatively in a simultaneous-move setting much like the Cournot competition in a product market. Alternately, the banking sector can have some "leader" or "major" banks who act as leaders in a

Lifetime Employment and a Mixed Duopoly with a Foreign Labour-Managed Firm

Kazuhiro Ohnishi[*]

Institute for Basic Economic Science, Osaka, Japan

Abstract: This chapter investigates an international mixed duopoly market in which a state-owned firm coexists with a foreign labour-managed firm. The following timing of actions is considered. First, firms decide simultaneously and non-cooperatively whether to use lifetime employment as a strategic commitment device. If a firm provides lifetime employment, then it chooses an output level and enters into a lifetime employment contract with the number of workers necessary to achieve the output level. Second, firms choose actual outputs simultaneously and non-cooperatively. This chapter traces the firms' reaction functions in the mixed duopoly model with lifetime employment. Generally, duopoly reaction functions intersect only once, which yields the stable equilibrium solution. However, this chapter shows that there may be multiple stable Cournot solutions in the international mixed duopoly model.

Keywords: Cournot model, economic welfare, foreign labour-managed firm, income per worker, lifetime employment, mixed duopoly, reaction functions, stable solutions, state-owned firm, strategic commitment.

1. INTRODUCTION

The pioneering work on a theoretical model of a public firm has to date back almost half a century to Merrill and Schneider (1966). Since then, the

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[*] **Address Correspondence to Kazuhiro Ohnishi:** Institute for Basic Economic Science, 2-15-12 Hanjo, Minoo, Osaka 562-0044, Japan; Tel/fax: +81-72-722-8638; E-mail: ohnishi@e.people.or.jp

theoretical contributions of mixed oligopoly markets including state-owned public firms have been made by numerous researchers all over the world. For instance, Nett (1991, 1994), Poyago-Theotoky (1998), and Zhang and Li (2013) investigate mixed oligopoly markets where firms are allowed to invest in R&D. Ware (1986), Willner (1994), Wen and Sasaki (2001), and Lu and Poddar (2005) conduct Cournot mixed oligopoly markets where firms determine capacity levels. White (1996), Poyago-Theotoky (2001), Myles (2002), Fjell and Heywood (2004), and Kato and Tomaru (2007) investigate the interaction between production subsidies and privatization. Bös (1984), Cremer, Marchand and Thisse (1991), Ogawa and Kato (2006), Bárcena-Ruiz (2007), Barcena-Ruiz and Garzón (2007), and Ohnishi (2015c) investigate price-setting competition with homogeneous goods or differentiated goods. In addition, Fjell and Pal (1996) and Fjell and Heywood (2002) consider mixed oligopoly models in which public firms compete against both foreign and domestic private firms.

There are also numerous other related research works (see, for example, Beladi and Chao, 2006; Chao and Yu, 2006; Lu, 2007; Lu and Poddar, 2007, 2009; Kato, 2008; Ohnishi, 2008a; Saha and Sensarma, 2008; Artz, Heywood and McGinty, 2009; Roy chowdhury, 2009; Wang and Wang, 2009; Heywood and Ye, 2010; Ogawa and Matsumura, 2010; Wang and Lee, 2010; Pal and Saha, 2014; Cracau, 2015). However, all these researches focus on mixed oligopoly markets where state-owned firms coexist with profit-maximizing capitalist firms, and do not include labour-managed firms.

After the pioneering contribution by Ward (1958), numerous researchers have investigated the behaviours of labour-managed firms. For instance, Cremer and Cremer (1992) investigate a two-stage game model where firms simultaneously and non-cooperatively choose both the capital stock and the employment level, and demonstrate that the profit-maximizing capitalist firm produces more than the labour-managed firm in a Cournot-Nash duopoly model. Lambertini and Rossini (1998) consider a two-stage quantity-competition duopoly model with capital commitment, and demonstrate that the profit-maximizing firm optimally under-invests whereas the opposite holds for the labour-managed firm. Stewart (1991)

explores strategic interactions both in a labour-managed duopoly and in a mixed duopoly with labour-managed and profit-maximizing firms using excess capacity to deter entry, and shows how the organizational form of potential entrant influences the strategy of an established firm. Ireland (2003) conducts a mixed oligopoly regime with imperfect consumer information, and demonstrates that in the free-entry mixed-strategy Nash equilibrium, profit-maximizing firms set higher prices than labour-managed firms. In addition, Ohnishi (2011a) examines a model in which a profit-maximizing capitalist firm and a labour-managed firm are allowed to use lifetime employment as a strategic commitment device, and shows that if the labour-managed firm does not provide lifetime employment, then its reaction function is upward sloping, whereas if it does, then its reaction function changes downward sloping.

There are also numerous other published research works (see, for example, Lambertini, 1997, 2001; Neary and Ulph, 1997; Okamura and Futagami, 1997; Cuccia and Cellini, 2009; Luo, 2013; Kalashnikov *et al.*, 2015). All these papers consider mixed oligopoly markets where labour-managed firms compete against profit-maximizing capitalist firms, and do not include state-owned public firms.

Only a few studies investigate mixed oligopoly markets that consist of state-owned and labour-managed firms. For instance, Delbono and Rossini (1992) consider a Cournot mixed duopoly model with one labour-managed firm and one state-owned firm, and demonstrate that there exists a unique Cournot-Nash solution in which the state-owned firm produces more than the labour-managed firm. Ohnishi (2009) analyses the behaviours of a state-owned firm and a labour-managed firm in a two-stage mixed duopoly game, and demonstrates that if both firms are allowed to install capacity in the first stage, then there exists a subgame perfect solution where the labour-managed firm installs capacity whereas the state-owned firm does not. Ohnishi (2011b) analyses two three-stage games where a labour-managed firm and a state-owned firm can sequentially use lifetime employment as a strategic commitment device

Price-Setting Games and Entry Deterrence

Kazuhiro Ohnishi[*]

Institute for Basic Economic Science, Osaka, Japan

Abstract: This chapter considers a two-stage price-setting model of an established firm and a potential entrant and investigates whether the use of strategic commitments by the established firm is effective to deter entry. Most studies on entry deterrence examine the situation of strategic complements where goods are substitutes in Bertrand competition. Therefore, the chapter divides demand functions into four cases, and correlates each case with either of two opposite strategic commitments. This chapter examines the entry-deterring equilibrium outcomes resulting from the strategic commitments of the established firm in all four cases and shows that strategic commitments can be used as an effective tool for entry deterrence in Bertrand competition.

Keywords: Complementary goods, donation, entry deterrence, entry-deterring equilibrium, established firm, lifetime employment, potential entrant, price-setting model, strategic complements, strategic substitutes, substitute goods, two-stage game.

1. INTRODUCTION

The classical limit pricing model by Bain (1956, 1968), Modigliani (1958) and Sylos-Labini (1962) is a well-known theory on entry deterrence. A single established firm or a coordinated cartel competes against a single potential entrant. The key assumption of the limit pricing

[*] **Address Correspondence to Kazuhiro Ohnishi:** Institute for Basic Economic Science, 2-15-12 Hanjo, Minoo, Osaka 562-0044, Japan; Tel/fax: +81-72-722-8638; E-mail: ohnishi@e.people.or.jp

model is that the established firm can continue to produce at its pre-entry output level regardless of the potential entrant's actions. However, it was pointed out that the limit pricing model was unrealistic. Irreversible behaviour, such as the installation of machinery and equipment, can be said to be the essence of competition among firms. In other words, the established firm has to alter the post-entry outcomes by changing the pre-entry conditions. Indeed, the established firm's irreversible pre-entry commitments can influence the potential entrant's view of what will happen if it enters. In addition, it is essential not only that the established firm makes a strategic commitment, but also that this commitment is communicated to the potential entrant. Without credible communication, the established firm can obtain no strategic advantage.

The possibility of firms using excess capacity to deter entry has been studied by many researchers (see, for example, Wenders, 1971; Spence, 1977; Dixit, 1979, 1980; Spulber, 1981; Eaton and Lipsey, 1981; Basu and Singh, 1985, 1990; Allen, 1993; Poddar, 2003). Studies of other strategic decisions have also been done concurrently by a large number of researchers.[1] In this chapter, we focus on lifetime employment contracts and donations, and analyse entry deterrence.

In this chapter, we classify demand functions into the following four cases: 'substitute goods and strategic complements', 'substitute goods and strategic substitutes', 'complementary goods and strategic complements' and 'complementary goods and strategic substitutes'. Ohnishi (2001) uses a two-stage duopoly model consisting of an established firm and a potential entrant, and examines the following cases: 'Bertrand competition with strategic substitutes', 'Bertrand competition with strategic complements', 'Cournot competition with strategic substitutes' and 'Cournot competition with strategic complements'. Ohnishi (2007) classifies demand functions into two cases: 'strategic substitutes and complementary goods' and 'strategic complements and complementary goods', and investigates both Bertrand and Cournot markets. In addition, Ohnishi (2015) considers a Cournot duopoly market consisting of an established firm and a potential

entrant, and shows the effectiveness of strategic commitments in Cournot competition.

We investigate a two-stage price-setting model of an established firm and a potential entrant. We correlate each of the four cases with either a lifetime-employment-contract policy (LECP) or a donative most-favoured-nation policy (MFNP).[2] We assume the following timing of actions. In stage 1, the established firm can adopt either LECP or MFNP. At the beginning of stage 2, the potential entrant decides whether or not to enter the market. In stage 2, if the potential entrant enters, a Bertrand duopoly solution is achieved, while if the potential entrant does not enter, the established firm maintains a monopoly.

The goal of this chapter is to analyse the entry-deterring equilibrium resulting from LECP or MFNP in each of four cases by using the price-setting model and to demonstrate the effectiveness of strategic commitments in Bertrand competition.

The balance of the chapter proceeds as follows. In the second section, we describe the model. The third section briefly explains LECP. The fourth section briefly explains MFNP. The fifth section gives a stability condition. The sixth section discusses the entry-deterring equilibrium outcomes of the model. The final section gives concluding remarks.

2. THE BASIC MODEL

There are two players in our model: firm 1 and firm 2. Firm 1 is an established firm, and firm 2 is a potential entrant. In the balance of this chapter, when i and j are used in an expression, they denote firm 1 and firm 2 with $i \neq j$.

We propose a two-stage game with the following timing. In stage 1, firm 1 can adopt either MFNP or LECP. At the beginning of stage 2, firm 2 decides whether or not to enter the market. In stage 2, if firm 2 enters,

On the Welfare Effect of Uniform Input Pricing with Endogenous Choices of Channel Structure by Downstream Firms

X. Henry Wang[a,*], Weiwei Wu[a] and Chenhang Zeng[b]

[a]*Department of Economics, University of Missouri-Columbia, Columbia, MO, USA;*
[b]*Research Center for Games and Economic Behavior, Shandong University, Jinan, China*

Abstract: We study a vertical market in which the upstream input market is monopolized and the downstream is composed of a Cournot oligopoly. The downstream firms also choose their internal channel structures strategically. Two main points are made. First, uniform pricing by the monopoly input supplier leads to higher total welfare than under discriminatory pricing. Second, uniform pricing is more profitable than price discrimination for the monopoly input supplier.

Keywords: Centralized channel, channel structure, Cournot oligopoly, decentralized channel, downstream firms, input price discrimination, monopoly input supplier, subgame perfect Nash equilibrium, upstream input market, vertical market.

1. INTRODUCTION

The present chapter continues the line of studies by Katz (1987), DeGraba (1990) and Yoshida (2000) to lend further support to the view that banning price discrimination in the input market can be welfare improving. We study a vertical market in which the upstream input market is monopolized and the downstream market is composed of a Cournot oligopoly. Moreover, the downstream firms choose their internal

* **Address Correspondence to X. Henry Wang:** Department of Economics, University of Missouri-Columbia, Columbia, MO 65211, USA; Tel: +1-573-882-4954; Fax: +1-573-882-2697; E-mail: wangx@missouri.edu

channel structures strategically prior to choosing their outputs. Two main points are made. First, uniform pricing by the monopoly input supplier leads to higher total welfare than under discriminatory pricing. Second, uniform pricing is more profitable than price discrimination for the monopoly input supplier.

A number of studies have recognized that pricing policy in the input market may affect not only price and output decisions by downstream firms but also other choices. DeGraba (1990) points out that technological choice of downstream firms may be affected by the pricing policy of the input supplier. O'Brien and Shaffer (1994) find that forbidding discriminatory pricing can reduce the bargaining power of downstream retailers and lead to welfare loss. More recently, Liao (2010) investigates how discriminatory input pricing affects delegation decisions by downstream firms. Herweg and Müller (2012) explore the effect of price discrimination in input markets on entry and efficiency in the downstream market. The present chapter extends the work of Arya and Mittendorf (2007) and Liu *et al.,* (2012) in recognizing that the pricing policy in the input market may affect the choice of internal channel structures (centralization or decentralization) of downstream firms.[1]

When a firm switches from centralization to decentralization, the lower division will receive a price that is greater than marginal cost of production. This change makes the lower division less able to compete with the product market competitor. Arya and Mittendorf (2007) and Liu *et al.,* (2012) respectively, study how the incentives of downstream firms in switching between centralization and decentralization are affected by whether the input supplier price discriminates (the former) or not (the latter). These studies point to the importance of pricing policy by the input supplier on channel choices by downstream firms. The present chapter shows that clear welfare implications can be derived. We also find a result that is counter to all previous beliefs that the price discriminator clearly gains from price discrimination. In our context, the upstream input supplier actually has an incentive to commit to a uniform pricing policy if such a commitment device is available.

The rest of the chapter is organized as follows. In Section 2, we present the model with two firms producing two substituting goods and both having to buy an input from an external input supplier. In Sections 3 and 4, we study respectively the equilibrium under discriminatory pricing and uniform pricing by the upstream input supplier. Section 5 examines the welfare effect of uniform input pricing. Section 6 extends the base model to one in which the downstream market is composed of more than two firms and generalizes the results from the base model. Section 7 presents concluding remarks. The appendix contains proofs of propositions and some lemmas in the text.

2. MODEL SETUP

We consider a vertical market that is composed of one upstream firm and two downstream firms. The two downstream firms (1 and 2) face the following symmetric (inverse) demands,

$$p_i = a - q_i - \gamma q_j, \qquad i, j = 1, 2; i \neq j, \tag{1}$$

where p_i and q_i are the price and quantity of firm i's product, $a > 0$ represents the consumers' reservation price for either good, and $\gamma \in (0, 1]$ measures substitutability between the two final goods. The two goods are closer substitutes the larger γ is.

For each downstream final good producer, it uses one unit of the input from the upstream monopoly input supplier and one unit of an internally produced input to produce one unit of its final good. The monopoly external input supplier produces at the constant unit cost c_E. The unit production cost for firm i's internally produced input is c_i. The internal unit costs c_1 and c_2 may be unequal, and without loss of generality, we shall assume throughout the chapter that $c_1 \leq c_2$.[2] Hence, our model setup allows for asymmetry between the downstream firms.

Royalty Structures and Franchisee's Investment Incentive

DongJoon Lee[a,*], YongHoon Choi[b] and SangHeon Han[c]

[a]*Faculty of Commerce, Nagoya University of Commerce and Business, Nisshin-shi, Aichi, Japan;* [b]*Department of Commerce, Doshisha University, Kyoto, Japan;* [c]*Faculty of Management, Nagoya University of Commerce and Business, Nisshin-shi, Aichi, Japan*

Abstract: We analyze two royalty structures in a two-tier industry in which a franchisee makes a demand increasing investment. Suppose the franchisor can propose either a margin-based royalty (MBR) or a sales-based royalty (SBR). We show that the SBR has the advantage of providing a greater incentive for the franchisee to invest, but has the disadvantage of inducing a greater double-margin distortion. On the other hand, the MBR has the advantage of influencing a smaller double-margin distortion, but has the disadvantage of weakening the incentive for the franchisee to invest. Our main claims are two: the first is that if the market is non-elastic, the franchisor enjoys a higher pay-off from SBR than from MBR. The other is that the investment level under SBR is always larger than that under MBR, regardless of market elasticity.

Keywords: Double marginalization, downstream firm, franchisee's investment, franchisor, margin-based royalty, market elasticity, royalty structures, sales-based royalty, successive monopoly, take-it-or-leave-it contract, upstream firm.

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* **Address Correspondence to DongJoon Lee:** Faculty of Commerce, Nagoya University of Commerce and Business, 4-4 Sagamine Komenoki-cho Nisshin-shi, Aichi 470-0193, Japan; Tel:+81-561-73-2111; Fax: +81-561-73-1202; E-mail: dongjoon@nucba.ac.jp

1. INTRODUCTION

Recently, franchise contracts have become a major type of arrangements in the retail industry. In the United States, especially automobile dealerships, gas stations, convenience stores, clothing stores, hotels, restaurants, tax preparation services and car rentals are frequently operated on the franchise system. North American firms are rapidly expanding their overseas franchising. For example, there are McDonald's outlets even on the Tiananmen Square in Beijing and the Red Square in Moscow. Often buying inputs and goods for resale from the franchisor, a franchisee owns and runs a retail business using its franchisor's brand name. The franchisor charges the franchisee for fees and royalties for the use of the brand name and commonly provides training, advertising, and other services. The franchisee typically pays a franchise fee and a royalty as well as the prices of inputs and goods purchased from the franchisor. Among them, the royalty fee is a major source of revenue for the franchisor.

According to statistics released by the Japan Franchise Association, business-format franchising accounted for a market size of about 19.4 trillion yen (US$242 billion) in Japan in 2005.[1] At the year, there were 1146 franchise chains operating in Japan. Table **1** shows an overview of franchise development in Japan over the past 20 years from 1985 to 2005.

Table 1: Overview of franchise development from 1985 to 2005.

Year	Number of Chains	Growth in Number of Chain	Number of Outlets	Growth in Number of outlets	Sales (¥million)	Growth in Sales
1985	596	na	89,267	na	4,515,362	na
1990	680	14%	123,365	38%	8,857,254	96%
1995	755	11%	158,223	28%	13,058,716	47%
2000	1,048	39%	205,609	30%	16,871,437	29%
2005	1,146	9%	234,489	14%	19,388,888	15%

Source: Statistics issued by the Japan Franchise Association.

Generally speaking, royalty structures are divided into three types: fixed amount, sales-based royalty, and margin-based royalty. In America, for example, almost all franchisors assess royalties based on sales achieved by franchisees. In Japan, especially, the margin-based royalty is adopted by many well-known convenience stores. Under this royalty structure, the franchisor collects royalties based on gross margin; *i.e.*, sales price minus purchase cost of goods (hereafter, margin-based royalty or MBR[2]) from the franchisee. Japan Franchise Association released royalty types of franchising sector in 2005. Fig. (**1**) outlines the royalty structures of 127 companies.[3] Fig. (**2**), on the other hand, extracts the royalty structures of convenience sector (hereafter, CVS) from the data presented in Fig. (**1**).

All Franchising Sectors

- Others 1%
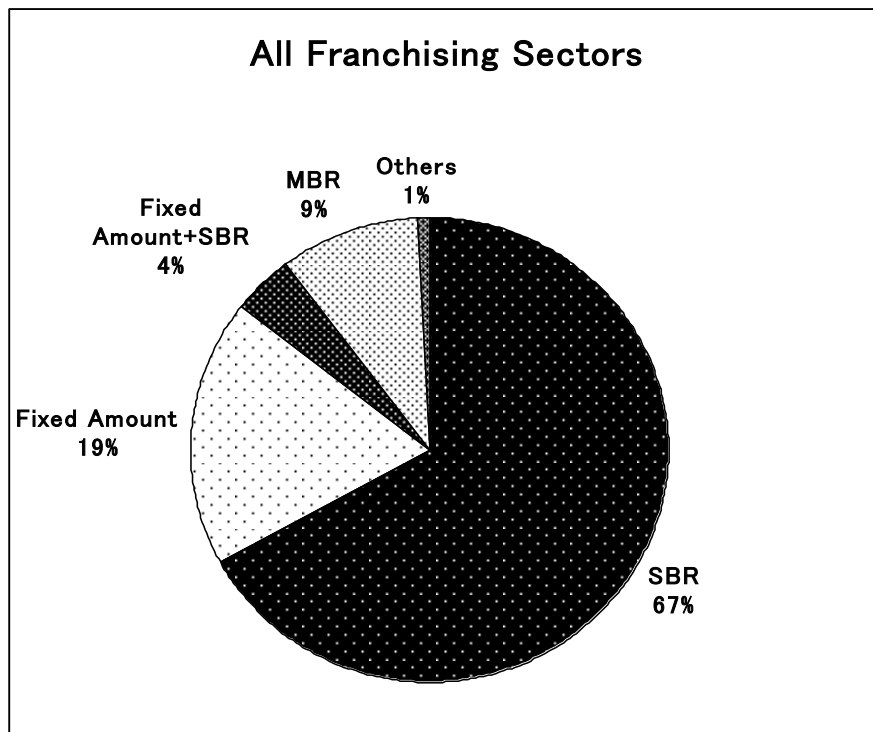- MBR 9%
- Fixed Amount+SBR 4%
- Fixed Amount 19%
- SBR 67%

Fig. (1). Royalty structure overview of all franchising sectors in Japan (Source: Japan franchise association, 2005).

Optimal Two-Part Tariff Licensing Strategies of Eco-Technology

Seung-Leul Kim and Sang-Ho Lee[*]

Department of Economics, Chonnam National University, Gwangju, South Korea

Abstract: This chapter examines the optimal two-part tariff licensing strategies of eco-technology by an eco-innovator toward polluting firms. In the presence of environmental regulation, we analyze the vertically related industries where polluting industry may purchase a license of pollution abatement technology from an eco-industry. We find that eco-innovator can construct the optimal two-part tariff licensing strategies to provide non-exclusive licensing contracts. However, the optimal strategies might yield welfare loss for some ranges of production cost and environmental regulation. Therefore, eco-innovator's two-part tariff licensing strategies should be carefully restricted under the regulatory considerations on environmental policy and industrial policy.

Keywords: Eco-innovator, eco-technology, environmental policy, environmental regulation, industrial policy, licensing contract model, polluting firms, pollution abatement technology, social welfare, two-part tariff licensing.

1. INTRODUCTION

One of the most significant global phenomena is that the volume and value of patent licensing have substantially increased in recent years. (see Zuniga and Guellec, 2009). Patent licensing is an important policy issue in many

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[*] **Address Correspondence to Sang-Ho Lee:** Department of Economics, Chonnam National University, 77 Yongbong-Road, Bukgu, Gwangju, South Korea; Tel: +82-62530-1553; Fax: +82-62-530-1559; E-mail: sangho@chonnam.ac.kr

industries not only for protection of innovator's profit but for improving welfare in the society because patents can provide incentives for economically efficient R&D to develop new product or technology innovation.

The theoretical literature in patent licensing, the innovators can give a license to licensees by means of different licensing contracts such as royalty, fixed-fee licensing, auctioning, two-part tariff licensing and so on. However, with respect to empirical evidence on licensing contracts, it reveals that most of the contracts include a positive royalty and the combinations of up-front fees and royalties. For example, Rostoker (1984) surveyed that two-part tariff licensing (including royalty plus fixed fee) was used 46%, royalty alone 39%, and fixed fee alone 13% among 37 corporations in manufacturing industry.[1]

While previous literature mainly deals with royalty and fixed-fee licensing,[2] recent researches in industrial economics have focused on two-part tariff, basically consisting of a fixed fee plus a per-unit royalty. The theoretical literature has analyzed the relationship between market structure and regulatory policy in order to compare the efficiencies of two-part tariff licensing. Erutku and Richelle (2007) show that an outside innovator always prefers a fixed-fee plus a royalty contract, which gives profit a monopoly endowed with the innovation but can reduce social welfare. Sen and Tauman (2007) show that licensing for a cost reduction innovation under combinations of upfront fees (auctioning fee) and royalties unambiguously leads to improvement of social welfare in a homogenous oligopoly. Fauli-Oller *et al*., (2012) point out that the innovation is licensed to all firms under two-part tariff, regardless of the number of firms, the degree of product differentiation and the type of patentee. Moreover, two-part tariff licensing can be developed by ad valorem royalties with a fee (Hernandez-Murillo and Liobet, 2006; Martin and Saracho, 2015), unionized labor market (Mukherjee, 2010), leadership duopoly model with product differentiation (Li and Yanagawa, 2011), and homogeneous oligopoly market in the presence of tax and subsidy policy

(Mukererjee and Tsai, 2013).[3]

Basically, monopolistic innovator prefers two-part tariff licensing because it the combination of some advantages of both royalty and fixed-fee, but it is more complicated than any other licensing contract. First, two-part tariff licensing provides more profits than royalty licensing which cannot totally gain margins on sales. Also, the innovator is less likely to exclude license under royalty licensing. On the other hand, under fixed-fee licensing, the innovator can exclude some licensees, but it should supply more products to licensees because the unit price for additional usage is zero. This could be a financial burden to produce goods when production cost is high. Thus, two-part tariff licensing can control these two opposite effects in a combined form of a fixed-fee plus a royalty.

On the other hand, as increasing global concerns on climate change, greenhouse gas (GHG) reduction plans mainly focus on industrial R&D activities for reducing emission levels. Moreover, many countries have concern over environmental policy to reduce GHG and to develop eco-technologies which are most patented. That is, most eco-technologies are likely to be patented and thus the eco-industry for abatement equipment can be recently characterized by monopolistic situation. However, very little study of eco-technology licensing had been done, aside from policy instrument. More study is needed between licensing strategies of eco-technology and environmental policy instruments, such as emission tax or emission trading systems.[4]

This chapter considers an eco-technology licensing in the presence of environmental regulation and examines the efficiency of two-part tariff licensing strategies. We formulate a vertically related model of patent licensing of eco-technology between an innovator and duopolistic polluting firms where polluting firms may purchase a license of pollution abatement technology from an outside innovator. We analyze the incentive of an innovator to construct the optimal two-part tariff licensing strategies and find that it always prefers two-part tariff licensing or fixed-fee licensing to royalty licensing contract.

Evaluation of Financial Losses Suffered by Enterprises due to Information System Accidents

Sergii Kavun[a], Vyacheslav V. Kalashnikov[b,c,d,*], Nataliya Kalashnykova[e] and Olexandr Cherevko[f]

[a]Department of Information Technologies, Kharkiv Institute of Banking of the University of Banking of the National Bank of Ukraine, Kharkiv, Ukraine; [b]School of Science and Engineering (EIC), Tecnológico de Monterrey (ITESM), Monterey, Mexico; [c]Central Economics and Mathematics Institute (CEMI), Moscow, Russia; [d]Department of Computing of Sumy State University, Surny Ukraine; [e]Department of Physics and Mathematics (FCFM), Autonomous University of Nuevo León (UANL), San Nicolás de los Garza, Mexico; [f]Bohdan Khmelnytsky National University of Cherkassy, 18037, Schevchenka av.81, Cherkassy, Ukraine

Abstract: We develop a method to evaluate financial losses of enterprises caused by breaks of information security systems. The method can be used to estimate the losses as a result of the information system's accidents (for example, computer attacks or unauthorized intrusions). In addition, this method can evaluate the risk level of any enterprise. As an illustration, a practical example of estimating financial losses based upon a real-life case is presented. Some results of dynamic changes of variables involved in the method are also shown.

Keywords: Computer attacks, enterprise, estimation, financial losses, hacker attacks, information security systems, information system accidents, negative impacts, risks, unauthorized intrusions.

1. INTRODUCTION

In today's world, the question of information security and data (or personal data)

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* **Address correspondence to Vyacheslav V. Kalashnikov:** School of Science and Engineering (EIC), Tecnológico de Monterrey (ITESM), Campus Monterrey, Ave. Eugenio Garza Sada 2501 Sur, Monterrey 64849, Mexico; Tel: +52-818-358-2000 ext. 5548; E-mail: kalash@itesm.mx

protection and the interests of the enterprise (enterprise trade secrets) is of paramount importance. Thus, the responsibility for Information Systems (IS) of the enterprise has its head, who may delegate this responsibility to one of the enterprise's managers. Usually these functions are carried out by the Chief Information Security Officer (CISO), or Chief Security Officer (CSO) or in some cases the Chief Information Officer (CIO) (Kavun, 2008a).

Consider a few examples. At the end of March 2011, Sony filed a lawsuit against several hackers accusing them of hacking into the firmware of one of the most popular consoles in the world – PlayStation 3. In protest against the persecution of hackers by companies, an anonymous group announced a distributed denial-of-service (DDoS-attack) attack on Sony's sites. During this DDoS-attack, several servers on the Playstation Network (PSN) were hacked and data was stolen from 77 million users.

In April 2011, a court in Dusseldorf sentenced a criminal who, in the midst of the FIFA World Cup in 2010, blackmailed six bookmakers in Germany. Three of the six companies agreed to a payout. Bookmakers themselves estimated that the several hours during which their sites were unavailable, could have resulted in very large losses of income: for large ompanies, about EUR 25,000 – 40,000, and for smaller companies EUR 5,000 – 6,000. At the same time, a blackmailer was requested a bit – about 2,000 EUR.

Specialists of the Center for Internet Security (CIS) are busy creating standards by which companies will be able to assess the state of affairs in the field of information security (Ellen Mesmer, Network World, and the USA, 2008). However, as stated in the CIS, the new standards of the safety assessment of corporate computer systems to be published will not be soon. Additionally, they will not include such methods as suggested by the authors. In other companies, such as Pacific Gas & Electric, an applicable Information Security Assurance Capability Maturity Model (IA-CMM) (ISATRP) was developed by the U.S. National Security Agency. However, this model does not contain similar methods to assess financial losses.

Even more research attempts (Gordon and Loeb, 2005; Messmer, 2008; Campbell *et al.*, 2003; Blakely, 2002) and studies (Kavun, 2007b; Wang, 2008; Lindsey, 2010; Meadows, 2001) have been executed by assessment of the financial losses, however, all of them have been made not for the information system incidents.

For example, author (Worrell, 2004) has presented the working paper, which runs as follows: "This paper suggests a strategy designed to make the best use of the available quantitative techniques of financial sector assessment. It incorporates early warning systems, financial sector forecasts, stress tests for systemically important financial institutions, interbank contagion analysis, and corporate and household financial indicators. It will seldom be possible to employ every one of these techniques, but the wider the range of methodologies used, the greater may be the insight into the strengths and vulnerabilities of the financial sector. The quantitative assessment was been always complemented by a qualitative assessment, including reviews of relevant standards and codes."

Other authors (Bojanc *et al.*, 2012) have presented the paper, which runs as follows: "The paper presents a mathematical model to improve our knowledge of information security and risk management in contemporaneous businesses and other organizations. In the world of permanent cyber-attacks to information systems, the knowledge about risk management is becoming a crucial task for minimization of the potential risks that can endeavour their operation. Therefore, it requires a good knowledge of information security. The prevention of the heavy losses that may happen due to cyber-attacks and other failures in an organization is usually associated with knowledge about appropriate investment in different security measures. With the rise of the potential risks from different cyber-attacks the investment in security services and data protection is growing and becoming a serious economic issue to many organizations and enterprises. The paper presents a mathematical model for the optimal security technology investment evaluation and decision-making processes based on the quantitative analysis of security risks and digital asset assessments in an enterprise. The selection of security technology is based on the efficiency of selected security measures. Economic metrics are being applied for the efficiency assessment and comparative analysis of different protection technologies. Unlike the existing models for evaluation of the security investment, the proposed model allows direct comparison and quantitative assessment of different security measures."

2. STATISTICAL FUNDAMENTALS

According to the research of specialists from the University of Maryland (USA), hacker attacks in the global network are constant. After analyzing the recent statistical data at the university, it is estimated that there is a new cyber-attack in the global network every 39 seconds. In addition, the authors obtained results of

CHAPTER 11

Exploring the Relationship Between Supplier Credit and SMEs Technical Efficiency

Mariarosaria Agostino[*] and Francesco Trivieri

Department of Economics, Statistics and Finance, University of Calabria, Arcavacata di Rende (CS), Italy

Abstract: In this chapter, we investigate whether the choice of a particular source of funds represented by trade credit is associated to technical efficiency progress for a large sample of Italian manufacturing small and medium enterprises (SMEs) observed from 2003 to 2007. Applying a data envelopment analysis (DEA) approach to firm-level data, we retrieve a measure of technical efficiency change and perform some nonparametric tests to verify whether the differences observed are significant. According to our results, higher trade credit ratios tend to be associated to firm efficiency gains in almost all the sectors under analysis.

Keywords: Data envelopment analysis (DEA), efficiency gains, firm size, Italian firms, Malmquist index, small and medium enterprises (SMEs), suppliers credit, technical efficiency change, trade credit, trade debt.

1. INTRODUCTION

Supplier credit represents an important source of funds for small and medium enterprises (SMEs), which has been regarded either as a substitute (Petersen and Rajan, 1997; Nilsen, 2002; Danielson and Scott; 2004; Atanasova and Wilson, 2004; De Blasio, 2005; Guariglia and Mateut, 2006; Mateut *et al.*, 2006; Love *et al.*, 2007; Tsuruta, 2008; Yang, 2011; Huang *et al.*, 2011; Ogawa *et al.*, 2011) or as a complement of

[*] **Address correspondence to Mariarosaria Agostino:** Department of Economics, Statistics and Finance, University of Calabria, Ponte Pietro Bucci, Cubo 1C, 87036 Arcavacata di Rende (CS), Italy; Tel: +39 0984 492447; Fax: +39-0984-492421; E-mail: m.agostino@unical.it

bank funding (Biais and Gollier, 1997; Cook, 1999; Burkart and Ellingsen, 2004; Fabbri and Menichini, 2010; Matias Gama and Mateus, 2010; Garcia-Appendini, 2011; Agostino and Trivieri, 2014). Besides, another strand of literature has investigated the non-financial role of supplier credit, as a means to discriminate prices (Schwartz and Whitcomb, 1979; Brennan *et al.*, 1988; Mian and Smith, 1992), curtail transaction costs (Ferris, 1981), verify product quality (Lee and Stowe, 1993; Long *et al.*, 1993; Emery and Nayar, 1998), and manage inventories (Bougheas *et al.*, 2009).

In this chapter we aim at investigating whether there is a significant relationship between this credit source and the technical efficiency of SMEs, defined as the capability of firms to maximize their output given their inputs and technology. Indeed – despite on a priori ground suppliers credit may have an ambiguous influence on firm technical efficiency, and hence the issue represents an open empirical question – the empirical literature investigating the relationship between technical efficiency and trade credit is still scarce (Fisman, 2001).

As just mentioned, from a theoretical perspective, suppliers credit may be both beneficial and detrimental for firm technical efficiency. As far as the positive potential effects are concerned, suppliers credit may help firms to optimize their cash and inventory management thanks to long term agreements on deliveries, which avoid inefficient renegotiations and ease the transaction of goods (Ferris, 1981). Furthermore, supplier credit allows to smooth the production process, preventing raw material shortages and the consequent interruptions in production (Fisman, 2001). Moreover, according to Long *et al.*, (1993) it can allow to check the quality of the inputs before paying. Further, sellers may discipline their customer firms through the threat of not delivering particular materials necessary for the buyers' production (Cunat, 2007).

Besides, Burkart and Ellingsen (2004) point out that suppliers are likely to suffer from limited moral hazard problems, given their monitoring advantage in input transactions in which they are directly involved, and since inputs are generally less liquid than cash.

As regards the negative influence that trade credit may entail on efficiency, sellers may have the perverse incentive to keep financing their clients even when buyers encounter temporary liquidity problems, in order to allow the continuation of their customers' business (Cunat, 2007). Further, according to Sinani *et al.*, (2008) overdue trade credit may entail soft budget constraint problems, altering managers' incentives.

Our work provides some evidence on this issue for a large sample of Italian manufacturing SMEs, which represent more than 99% of the domestic non-financial firms and usually do not have reasonably priced alternatives to banks and suppliers credit channels.

Following Färe *et al.*, (1994) methodology, based on the data envelopment analysis (DEA) approach, we compute a measure of technical efficiency change for a sample of 6,343 firms observed from 2003 to 2007. To account for different technologies, we perform separate estimations for the different sectors (defined at the 2-digit ATECO classification). Then, within each sector, we perform nonparametric Kruskal–Wallis tests to verify whether there are significant differences in technical efficiency along the distribution of the trade credit variable. According to our evidence, higher suppliers credit ratios seem positively associated to productive capacity utilization enhancement.

The chapter is organized as follows: next section depicts the methodology adopted. Section 3 describes the data employed, and discusses the results obtained. Section 4 concludes.

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