



Firm organizational heterogeneity and market structure: Evidence from the Japanese pesticide market [☆]

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ABSTRACT

This paper empirically investigates the effects of the organizational forms of firms on their entry behaviors and market structure. To exploit the exogenous variation in firm organizational forms, we use Japanese pesticide market data. First, our empirical analysis shows that a model of imperfect competition fits the Japanese pesticide market well despite the existence of regulations. We, then, estimate the effect of organizational heterogeneity on entry behavior. Firms having capital ties with special distribution networks tend to enter this market more readily than do firms without such ties. Furthermore, diversified and vertically nonintegrated firms are more likely to enter this market than are stand-alone and vertically integrated firms. These findings suggest that markets with distribution-related, diversified, and vertically nonintegrated potential entrants are more competitive than those with the same number of potential entrants that have no such characteristics.

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1. Introduction

Entry behavior of firms is one of the key factors influencing market structure and industrial competition. The easier it is for firms to enter, the more competitive the environment will be, which implies that market efficiency is achieved. Nevertheless, it is generally difficult to determine the factors that influence entry behavior, because each market has specific characteristics including historical customs and regulations. Therefore, it is very important to elucidate factors that determine firms' entry into markets.

The characteristics of markets and products, such as scale economies, market size, technology, regulations, and product differentiation, are the factors that possibly determine firms' entry into markets. A seminal paper by Bresnahan and Reiss (1991) examined the relationship between market size and market structure within a strategic entry framework. Recently, using hamburger chain store data, Toivanen and

Waterson (2005) showed that because of expected market expansion, rival presence may induce entry. The effects of firm characteristics on entry have been analyzed by Berry (1992) and Ciliberto and Tamer (2009). Berry (1992) explained entry into airline routes by airport and airline characteristics, and Ciliberto and Tamer (2009) further examined the effects of the types of competitors and regulatory reforms without entry order assumptions. Product differentiation has also been found to be a key determinant of market structure by Mazzeo (2002), who used data on motels along freeways, and Seim (2006), who studied video rental market data in an incomplete information framework.

While these studies shed light on entry strategies, another set of factors is also crucial for the determination of market structure: organizational forms. In particular, following factors influence a firm's entry into a certain product market: (1) whether the firm has a relationship (capital ties) with special distribution networks, (2) whether the firm is stand-alone or diversified, and (3) whether the firm is vertically integrated. Past studies in corporate finance and industrial organization have examined the role of the organizational forms (Baker and Hubbard, 2003; Berger and Ofek, 1995; Lang and Stulz, 1994; Maksimovic and Phillips, 2002). These studies, however, have not directly dealt with strategic interactions and firms' entry decisions. In this study, we address the issue of how the organizational forms affect market structure.

When examining organizational effects on market structure within a strategic entry framework, one important feature that we exploit in this study is the exogeneity of the organizational forms. In general, these can be endogenous factors for firms. Then, the estimates of the

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impact of the organizational forms on firms' entry will be biased because of the correlation between the organizational forms and the error term in profit function. However, this effect can be extracted correctly in industries wherein the organizational forms are determined by historical factors and have been stable. In such cases, organizational form is considered to be an exogenous profit-shifting factor, which helps us to identify the effect on market structure.¹ By analyzing such an industry, we contribute to the literature by revealing whether firm characteristics, such as capital ties with special distribution networks, diversification, and vertical integration, are entry enhancing.

To our knowledge, the Japanese pesticide industry is the most suitable industry for analyzing this important issue. In particular, the final goods market for pesticides has three important features.² First, the three organizational forms that we focus on can be classified as follows and considered to be exogenous: (1) firms that have a relationship with the National Federation of Agricultural Cooperative Associations (ZEN-NOH), which is a type of giant retailer in the distribution network of agrochemicals, or those that have no such relationship, (2) firms that produce only agrochemicals (stand-alone) or those that produce other chemical products or pharmaceuticals as well (diversified), and (3) firms that specialize only in the production of final products (nonintegrated) or those that develop new compounds as well (vertically integrated). These organizational forms are easily observable, and adequate data is available for analysis. Furthermore, these forms were determined by both firm characteristics and industrial conditions before and immediately after World War II (WWII). Therefore, these forms can be treated as exogenous from the current market situation.

Second, each pesticide product has to pass inspection, and is registered under a strict registration system that notes its compound, content, and type of product (powder, granule, liquid, and so on).³ Therefore, it is easy to define a market for each pesticide registration category. Under this registration system, licensed products and patent-expired (generic) products are not distinguished from each other, and they have to follow the same certification process. This implies that, unlike that for medicines, the process for agrochemicals cannot be simplified even for generic products. The registration system has the same effect on the entry of foreign agrochemicals producers into the domestic market because they have to register their products in the same way as do Japanese firms. Thus, we conceive that there exists one homogeneous goods market for each registered final product category.

Third, regarding the entry into the final goods market of agrochemicals, the characteristics of markets and products that have been investigated in the literature are not likely to be key factors. Production of agrochemicals can be divided into two processes: development of chemical compounds and production of final goods. Scale economies work in the development of new compounds because this process requires a large amount of expenditure and is time-consuming.⁴ In contrast, the production of final goods, including the process of mixing compounds, does not require a large production facility, and only small quantities of each final product are produced because a great variety of production methods exists for mixing

compounds. Therefore, for final goods, sunk costs are small and scale economies do not seem to exist.

Each firm that develops compounds supplies its products to more than one final goods producer, and each final goods producer purchases compounds from more than one compound-developing firm. In addition, the production method is easily licensed.⁵ Therefore, we cannot assume that patents and expertise are entry barriers in final goods markets. Furthermore, because substitute products of final goods appear quickly, it is difficult for each final goods producer to differentiate its product from rival products for a long time. Thus, it is easier to measure the effects of firm heterogeneity rather than that of product heterogeneity on final goods market structure.

To analyze the effects of the organizational forms on market entry, we take two steps. First, we examine whether a model of imperfect competition fits the Japanese pesticide market. Following [Bresnahan and Reiss \(1991\)](#), we estimate per-firm market sizes for monopoly, duopoly, and oligopoly markets for various numbers of entrants. It is shown that despite the existence of a strict registration system, oligopolistic competition prevails in the final product markets.

Second, the effect of firm heterogeneity on entry behavior is estimated by using the frameworks of [Berry \(1992\)](#) and [Ciliberto and Tamer \(2009\)](#). Our findings indicate that firms having capital relationships with special distribution networks tend to enter the markets more readily than those having no such relationship. A close manufacturer–retailer relationship may avoid double marginalization, leading to high joint profitability and thus to a good chance of entry. This result implies that the existence of special distribution networks is important for firms' entry into markets and, consequently, for competitiveness of the markets. Because small distributors, other than the special networks, exist in the Japanese pesticide market, entry is not blocked by the special networks. Thus, the characteristic of the distribution relation is entry enhancing.

Furthermore, we find that diversified firms are more likely to enter markets than are stand-alone firms. This suggests that diversified firms are likely to generate enough benefit from scope economies. Finally, nonintegrated firms are more likely to enter the markets than are integrated firms. A possible reason is that nonintegrated firms specialize in the production of final products, and hence they have more information on the needs of consumers, which are, at times, specific to the types of crops and areas. These results imply that markets with distribution-related, diversified, and vertically nonintegrated potential entrants are more competitive than those with the same number of potential entrants that have no such characteristics.

The rest of the paper is organized as follows. [Section 2](#) provides historical background information on the industry, which explains the current organizational forms of manufacturers and the industry structure. [Section 3](#) proposes our hypotheses. [Section 4](#) outlines the data, and [Section 5](#) describes the framework of the empirical analysis. In particular, we outline the method of simulated moments (MSM) and set estimator. [Section 6](#) reports the empirical results, and the final section concludes.

2. Industry background

In this section, we survey the four important characteristics of the Japanese agrochemical industry: distribution routes, diversification, vertical non-integration, and the registration system.

2.1. Distribution

In Japan, two main channels exist for the distribution of agrochemicals: the channel through ZEN-NOH, which is a nationwide organization of agricultural cooperatives, and the channel through the distribution

¹ We consider a market wherein sunk costs are small and the organizational forms are stable. Hence, there is little possibility of mixing up dynamic elements of entry and the effects of the historically determined organizational forms.

² With regard to agrochemical products, there have been many studies on the issue of pesticide use. The economic benefits of pesticide use are estimated by using a food production function or damage abatement cost function. For example, see [Lichtenberg and Zilberman \(1986\)](#). While the pesticide price and regulations are examined by [Freshwater and Short \(2005\)](#), the market structure of pesticides markets has not been examined in the literature.

³ This system is provided by the Agricultural Chemicals Regulation Law. Details will be provided in [Section 2.3](#).

⁴ The probability of a compound being marketed is one in 10,000. The R&D cost is almost \$100 million for the development of one compound if the safety research cost is included. Furthermore, the development period is sometimes more than 10 years. [Ollinger and Fernandez-Cornejo \(1998\)](#) found a negative effect of an increase in the sunk research costs on the number of firms in the industry.

⁵ This type of licensing helps compound-developing firms cover their R&D costs.

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