Kumagai, Satoru, ed. 2010. *New Challenges in New Economic Geography.* Chiba: Institute of Developing Economies.

Chapter 5 Product Differentiation versus Geographical Differentiation: Evidence from the Pork Processing Industry in China

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Abstract

This chapter attempts to identify whether product differentiation or geographical differentiation is the main source of profit for firms in developing economies by employing a simple idea from the recently developed method of empirical industrial organization. Theoretically, location choice and product choice have been considered as analogues in differentiation, but in the real world, which of these strategies is chosen will result in an immense difference in firm behavior and in the development process of the industry. Development of the technique of empirical industrial organization enabled us to identify market outcomes with endogeneity. A typical case is the market outcome with differentiation, where price or product choice is endogenously determined. Our original survey contains data on market location, differences in product types, and price. The results show that product differentiation rather than geographical differentiation mitigates pressure on price competition, but 70 per cent secures geographical monopoly.

Keywords: Product differentiation, geographical differentiation, price competition
JEL Code: O14, O53, L13, L11

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1. Introduction: Geography or Product for Promoting Development?

What kinds of behavior by firms lead to what types of economic development? In order to consider this question, this chapter is motivated to identify what kinds of competition strategies firms adopt and produce profit. Firms are always under pressure from competition which may reduce their profit to zero or a negative figure. In order to avoid this outcome and to survive, firms will adopt a strategy of differentiation. Entrepreneurs and firms focus on how to make themselves different from others. Once differentiation strategies are set, firms will start allocating internal resources and shaping their organization. Their strategy will determine how they behave and how they look, and it may affect demand for substantial factors such as labor, capital and the profile of the development process of the economy.

Sources of differentiation are extremely diversified because this diversity is the source of survival of firm. In this chapter, we examine product differentiation and geographical differentiation as two competing strategies. Differentiation in product is a well known strategy, particularly among Japanese industry. To succeed in differentiation of products, a firm needs certain capabilities, for example, precise research on consumers' preferences, research and development to produce new products, and an acute sense of style to give 'trendiness' to their products or services. In contrast, if firms have successfully differentiated geographically in an industry, the firms' products may be quite homogenous because firms have little or no incentive to differentiate. Due to the smaller requirements for production technology in the case of geographical differentiation, firms in developing economies may prefer to adopt this strategy. However, the development of distribution technology or retail strategies may reduce the success of geographical differentiation. This chapter is motivated to present evidence on

what kinds of strategies have been adopted and have benefited the firms in the 'real world' as a means of considering what kinds of strategies by firms may lead to what types of economic development.

This chapter is organized as follows. Section 2 reviews the literature on empirical methods which are undergoing extraordinary development in industrial organization studies. This development is likely to be strongly connected with spatial economy. Section 3 describes the background of this research, the dataset to be used and basic observations from the data. Section 4 reports on the structural model, estimation strategy and results. Section 5 discusses the extant problems and presents the conclusion.

2. Literature Survey

To identify the "source of differentiation," we need a method of estimation for an endogenously determined market structure. The recent development of structural estimation enables us to capture the outcome of strategic interaction. According to Reiss and Wolak (2007), structural estimation can be defined as an approach that economic model is used to develop mathematical statements about how observable "endogenous" variables are related to observable and unobservable "exogenous" variables. By doing this, researcher can estimate unobserved economic or behavioral parameters that could not be otherwise inferred from non-experimental data[1]. This approach is developing in a field called empirical industrial organization. In particular, research on two strands, estimations of demand system and estimation on decision to

[1] Experimental data can allow the researchers to infer structural estimates, but structure that economic theory provide will give more clear relationship with experimental data.

enter a market are accumulating.

If one focuses on a demand system where the products are differentiated and prices are set accordingly, you have to deal with the problem that price is not exogenous to the consumer's decision but rather is endogenous because the firm will set prices according to the expected preference of the consumer. Price is an endogenous variable. Use of an instrument variable to price may be the first idea to hit, but it is not easy to find good instruments that represent the heterogeneous preferences of all consumers in the market. Berry (1994) pointed out that the constants can be included in the choice model by the consumer to capture average effect of product attributes which are most likely unobservable. Berry (1994) and Berry, Levinson and Pakes (1995) demonstrated that by transforming the market shares into a function of the unobservable product attributes that generates endogeneity on price, unobservable attributes appears as a linear term. By doing so, a traditional instrumental variable estimation becomes feasible. This approach forms a major strand of empirical industrial organization (see Nevo 2001, Train 2003: Chapter 13) In order to deal with endogeneity of price-product choice, it may help to conduct an experiment to obtain information on consumers' preferences (see Train 2003).

If one is focusing on the decision to enter a certain market, there again occurs the endogeneity problem. In a standard setting, firms will decided to enter a certain market when they expect profit, and this behavior is estimated by a discrete choice model such as probit. Among structural variables in the profit function, selling price and marginal cost are subject to strategic behavior and may become endogenous. If the price of a firm's products depends on number of rivals, firm's decision on entry to a market may affect the price. Particularly in oligopolistic environment, the number of rivals is

the outcome of strategic interaction among the potential entry firms and consists of essentially endogenous variables. Another problem is that the equilibrium of this entry game could be multiple and not unique.

Berry (1992) dealt with this problem by taking numbers of firms in the market as a target of estimation in the flight route market of the airline industry in United States. Jia (2008) dealt with this problem by transforming a profit maximization problem into a search for the fixed points of the necessary conditions in capturing Walmart, K-mart and small retailers in 2,065 counties. This model allows for flexible competition patterns among all players. Seim (2006) employed a nested fixed-point algorithm solution in estimating the model for location choices in the video retail industry. Mazzeo (2002) proposed a two-stage estimation procedure à la Hekit in estimating the effect of market concentration and product differentiation in an observed configuration of high and low quality types in the motel industry. This chapter employs Mazzeo's (2002) two-step approach.

Marginal cost, too, may become a source of endogeneity in an entry model. This happens when the marginal cost may be reduced when the firm decides to enter. This actually happens in a case of the chain store market, where a large chain may benefit by reducing distribution cost or advertisement cost when it sets off a 'chain effect,' by its decision to enter. Jia (2008) succeeded in capturing this effect.

In relation to spatial economy, the problem of location choice has an affinity with the later literature concerning the entry decision model. Theoretically, product choice and location choice have been considered as analogues in differentiated markets since Hotelling (1929). (See Andersen, De Palma, JF. Thisse 1992, Tirole 1988). Empirical studies on location choice and spatial competition emerged in the 2000s,

benefiting from development of the empirical method of endogenous market outcome. Regarding spatial competition, in addition to Jia (2008) and Nishida (2008) that applied a similar approach to a dataset on convenience stores' network building choices in Okinawa, Japan, Davis (2006) and Smith (2004) are conducting estimation on spatial competition. However, the latter two researches take the firm's location as given, then estimate quantity or price competition. Pinske, Slade and Brett (2002) proposed a semi-parametric approach to spatial price competition.

3. Background of Case Study on Pork Processing Industry

3.1 Background

Pork is one of the most important foods for the Chinese. The industry is currently undergoing a major transition, as prices and quality are now being questioned. In 2007, pork prices skyrocketed in China nationwide, increasing about 70% over the previous year. The direct cause of this price hike was an outbreak of blue-ear pig disease which attacked sows heavily in 2006. The industry was vulnerable to this shock, and production volume decreased drastically. A substantial portion of the production of pork still relies on individual farmer's backyard production; due to rapid economic growth, the opportunity cost of hog production for these farmers rose rapidly, and they easily abandoned hog production and investment in sows. In addition to direct shock of the disease, the high opportunity cost for farmers led to exaggerated shrinkage of pork production.

As concerns about quality arose, this scattered backyard production system was condemned again. The system made it difficult to conduct effective quality control, and the ill-motivated farmers fed poisonous fattener feed to their pigs, which triggered

several the toxic and fatal accidents in 2006. Despite these concerns which the scattered production system has generated, it has persisted so far. Could this be attributable to the nature of competition in the market? Strategies to earn profit may shape the production system both inside and outside of firms. So, identification of the source of profit and the impact of pricing of products became a focal point of the research and led to the launch of this study.

3.2 Data

The research described herein relied heavily on a unique survey conducted by the author and her colleagues. This section describes the data.

3.2.1 Data sources

The data on pork processing market was obtained from an original survey conducted in Jilin and Henan provinces in 2008 by the Institute of Developing Economies, Japan, and the Chinese Academy of Agricultural Science.[2] The target of the survey was pork processing firms. The survey is unique in that it was designed to capture characteristics of transactions between the surveyed firms and their customers and suppliers. Demographic data such as population and fiscal expenditure of the county or city are obtained from 'Guidebook to the Administrative Zone of the People's Republic of China,' and fiscal expenditure, a proxy of economic activity size, is from 'Yearbook of Fiscal Data at the County Level.'

3.2.2 Data description

The dataset contains information on the characteristics of transactions and in both sales

[2] Mariko Watanabe of IDE, Jimin Wang of CAAS and Sachiko Miyata of the World Bank designed the surveys and conducted a pilot survey. The entire survey was conducted with the cooperation with local statistics bureaus.

and procurement. In this chapter, a market is defined as the administrative area in which the buyer is located, such as a particular city, ward, county or village. We have information on demographics and market structure, i.e., the number of competitors, as well. Samples were taken by asking firms to describe characteristics of transactions with a specific partner, not with the market as a whole.

The hog production industry in China roughly flows as follows: Farmers raise the piglets into pigs, middlemen pick up the pigs and transport them to the pork processing firms, and then the firms distribute them to the wholesalers, retailers or the wet market, or directly to the final consumer. Our survey focuses on the pork processing firms because they are an unavoidable link in the industry flow since the Chinese government permits only licensed processing firms to process pigs into pork as well as because they have substantial bargaining power in the flow. The structure of the transaction flow captured by our survey is depicted in Figure 1. The functions filled by the processing firms are as follow: (1) purchasing pigs, (2) slaughtering them (Raw whole body pork will be sold to the customers at this stage. All processing firms fill this function, and some processing firms focus only on this process.), (3) cutting into pieces and cleaning, (4) selling and transporting in a chilled, controlled environment as ‘chilled cut’ pork, or (5) freezing and selling to the customers as ‘frozen cut’ pork (Some processing firms engage in this process.) and (6) cooking the pork into products such as hams or boiled pork with soy sauce, etc. (Some firms do this in-house.). The pork from (6) is sold as ‘cooked products.’ The dataset contains ‘cooked products,’ but the number is very limited and the characteristics of products are similarity of products is more further to other three types consisting of ‘raw whole body,’ ‘frozen cut,’ and ‘chilled cut.’ Thus, the estimations in this chapter omit ‘cooked products.’

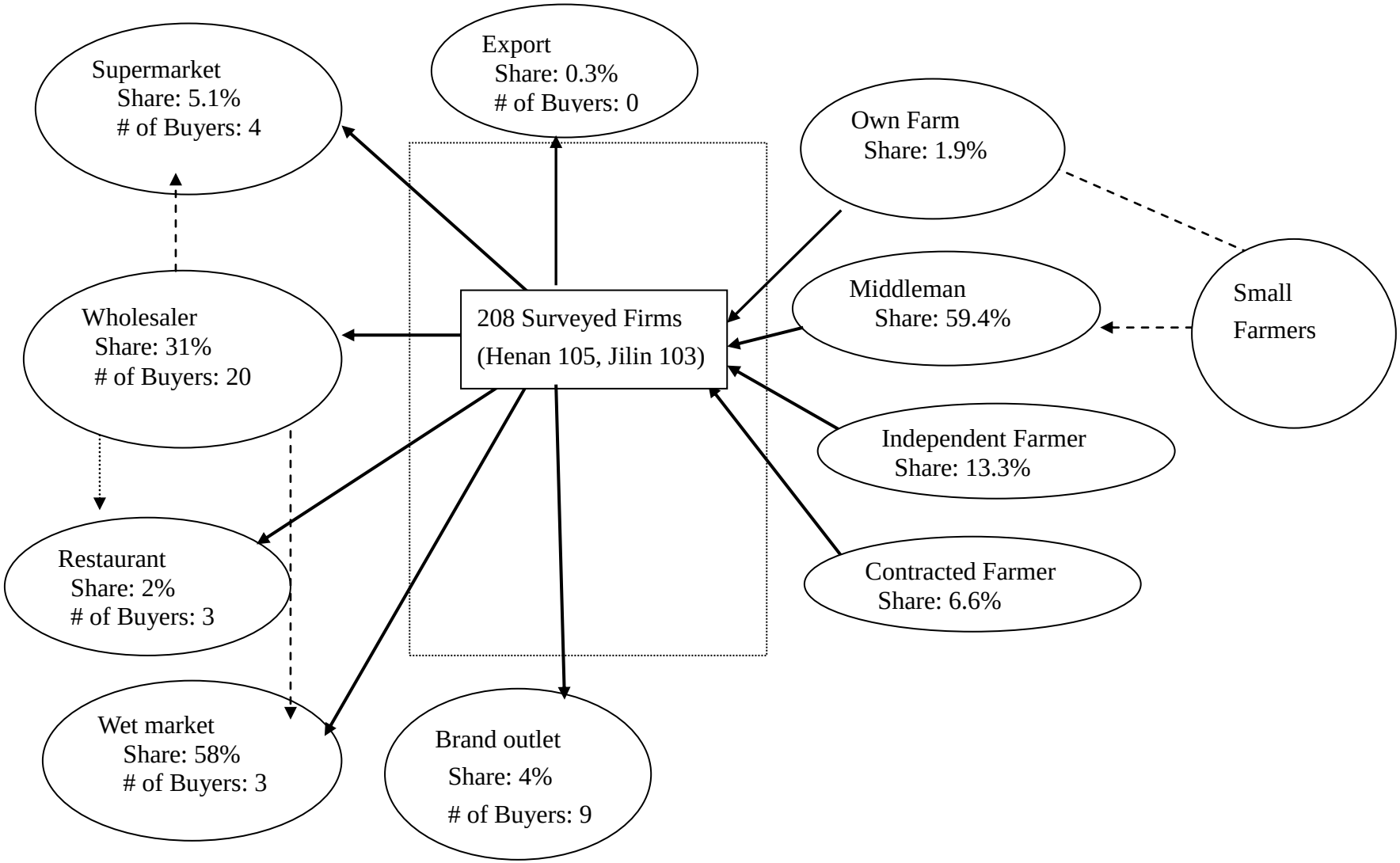

Figure 5-1: Transaction Structure of the Surveyed Firms: Note. Figures for share and the number of buyers are the sample mean.
Source: CAAS-IDE Survey

First, take a look at competitive environment: number of competitors for each transaction. Table1 reports that about 45 per cent of transaction (145 observation) was operating in monopolistic environment that number of competitor is zero. The second largest group are operating in an environment with one to 5 competitors (107 observation, 32 per cent). As a whole, pork processing firms are operating in mono/oligopolistic environment, presumably succeeding in any kind of differentiation. When number of competitors is crossed with product types, raw whole body is listed most in the zero competitor environment (89 per cent, 130 out of 145 observation). When number of competitor is crossed with geographical market types, village markets shares 70 per cent (101 out of 145 observations) of the zero competitor market.

Table 1-1: Number of Competitors by Commodity Type

		# of competitors							
		zero	1-5	5-10	10-30	40-50	51-99	100 above	Total
commodity	1: Raw whole body	130	75	19	8	3	1	1	237
	2: Frozen Cut	1	8	9	3	1	3	2	27
	3: Chilled Cut	13	7	6	3	2	0	3	34
	4: Cooked pork	0	1	0	1	0	0	1	3
	1+2	0	3	0	0	0	0	0	3
	1+3	1	1	2	2	1	0	0	7
	2+3	0	4	0	1	0	0	2	7
	1+2+3	0	6	1	1	0	0	0	8
	1+2+4	0	1	0	0	0	0	0	1
	1+3+4	0	1	0	0	0	0	0	1
	2+3+4	0	0	0	0	0	0	1	1
	Total	145	107	37	19	7	4	10	329

Source: CAAS-IDE Survey

Table 1-2: Number of Competitors by Geographical Market Type

		# of competitors							
		zero	1-5	5-10	10-30	40-50	51-99	100 above	Total
Commodity	1:Urban market	17	22	23	8	4	4	9	87
	2: County market	21	25	5	4	1	0	1	57
	3: Village market	82	41	5	5	0	0	0	133
	1+2	6	5	2	1	1	0	0	15
	1+3	8	3	1	0	1	0	0	13
	2+3	11	11	1	1	0	0	0	24
	Total	145	107	37	19	7	4	10	329

Source: CAAS-IDE Survey

Then, what kind of differentiation was realized in the market? Configurations of product and geographical markets are reported in Table 2. With regard to commodity configuration, about 80% of firms concentrate on a single product. Among them, ‘raw-whole body’ has the largest share in terms of the number of transactions. Regarding the geographical market, the mixture of market types is limited again, and the village market has the largest share in terms of the number of transactions. When looking at crossed commodity and geographical markets’ configurations, there is an apparent trend in which ‘frozen’ and ‘chilled cuts’ are sold more in urban markets, while ‘raw whole body’ pork sells more in village markets.

Table 2: Commodity Types and Geographical Markets

Commodity	Geographical Market						
	1:Urban market	2: County market	3: Village market	1+2	1+3	2+3	Total
1: Raw whole body	35	49	136	3	12	16	251
2: Frozen Cut	21	5	5	3	3	0	37
3: Chilled Cut	16	3	7	8	1	3	38
4: Cooked products	1	0	0	0	0	3	4
1+2	3	0	0	1	0	0	4
1+3	6	0	0	0	0	1	7
2+3	4	3	0	0	0	0	7
1+2+3	5	2	0	0	0	1	8
1+2+4	1	0	0	0	0	0	1
1+3+4	0	0	0	0	0	1	1
2+3+4	1	0	0	0	0	0	1
Total	93	62	148	15	16	25	359

Source: CAAS-IDE Survey

Table 3 reports the results of regressions on commodity type, geographical market type, and marketing method on distance to customers. Distance to the customer determines the choice between ‘raw whole body’ versus ‘frozen cut’ or ‘chilled cut.’ The longer the distance is, the more frozen cut or chilled cut are preferred. Choices between ‘urban market’ versus ‘county’ and ‘village’ are determined by the distance. However, choice among marketing methods, such as ‘customer bears transportation’ or ‘seller bears transportation,’ etc., is independent of the distance to customer.

Table 3: Choice Sets and Distance

Commodity Type					Geographical Markets Types					Marketing Methods				
	Coef.	Std. Err	Z valu	P>z		Coef.	Std. Err	Z valu	P>z		Coef.	Std. Err	Z valu	P>z
1: Raw Wholebody					2: County					1: Self marketing				
distance	**-0.01**	0.00	-4.6	0	distance	**-0.01**	0.00	-2.5	0.01	distance	0.00	0.00	-0.6	0.55
constant	2.74	0.25	10.9	0	constant	0.16	0.20	0.8		constant	-0.37	0.13	-2.8	0.01
2: Frozen cut					3: Village					2: Own outlet				
distance	0.00	0.00	0.8	0.41	distance	**-0.02**	0.01	-3.4	0.00	distance	0.00	0.00	-0.3	0.75
constant	0.01	0.33	0.0	0.98	constant	1.20	0.17	7.0		constant	-2.48	0.30	-8.2	0.00
1+2					1+2					4: Contract with retailers				
distance	0.00	0.00	0.0	0.98	distance	0.00	0.00	1.0	0.33	distance	0.00	0.00	1.3	0.19
constance	-2.09	0.71	-2.9	0.00	constant	-1.88	0.32	-5.9		constant	-2.34	0.27	-8.6	0.00
1+3					1+3					5: Other types of marketing				
distance	0.00	0.00	-0.7	0.48	distance	**0.00**	0.00	-1.9	0.06	distance	0.00	0.00	-1.0	0.34
constance	-1.34	0.55	-2.4	0.02	constant	-1.05	0.28	-3.8		constant	-2.03	0.25	-8.1	0.00
2+3					2+3					1+2				
distance	0.00	0.00	0.3	0.81	distance	**-0.01**	0.01	-1.8	0.07	distance	0.00	0.00	1.3	0.20
constance	-1.45	0.53	-2.7	0.01	constant	-0.44	0.24	-1.8		constant	-5.36	1.12	-4.8	0.00
1+2+3					2+3					2+3				
distance	0.00	0.00	-0.8	0.43	distance	**0.00**	0.00	2.2		distance	-0.24	0.63	-0.4	0.71
constance	-1.15	0.51	-2.3	0.02	constant	-2.33	0.51	-4.6	0.03	constant	-4.22	1.61	-2.6	0.01
					1+2+3					3+4				
					distance	0.00	0.00	0.6		distance	0.00	0.00	0.9	0.39
					constant	-2.02	0.48	-4.2	0.57	constant	-5.26	1.09	-4.8	0.00
					Reference is urban market (1)									
										1+2+3				
										distance	0.00	0.02	-0.2	0.82
										constant	-4.93	1.03	-4.8	0.00
										1+2+4				
										distance	-0.24	0.63	-0.4	0.71
										constant	-4.22	1.61	-2.6	0.01
										1+2+5				
										distance	-0.02	0.10	-0.2	0.82
										constant	-4.79	1.13	-4.3	0.00
										1+2+3+4				
										distance	0.00	0.00	1.5	0.13
										constant	-5.42	1.15	-4.7	0.00
Reference	3: Chilled cut				1: Urban market					3: "customer comes to the factory"				
Prob >chi2	0				0						0.68			
Pseudo Like	-236				-472						-415			
# of obs	344				350						326			
R2	0.10				0.11						0.01			

Source: Author

4. Modeling

4.1 Set Up and Firms' Behavior

The model which we develop here is a two-stage game. In stage 1, firms decide which type of market to enter. We assume here that the firm will enter or stay in the market if it is profitable, or exit if not. In the second stage, firms set prices and compete. We can assume that the game between the firm and the buyer will proceed as follows: A buyer may offer conditions of transaction except price, and the firm will decide to accept it or not. Then, after a number of competitors become observable, the firm will set the price to compete with its rivals. This is a complete-information game in the sense that the player can observe the price, product type, market segmentation and other information that affects the price and profit. We assume that the firm will maximize its profit in a backward reduction. First in the second stage, the firm will set the price level so as to maximize its profit. Next, the firm will decide whether to enter the market according to the price level set in the first stage.

4.2 Payoff Function and Pricing

The payoff of the firm f is a product of price cost margin (price v_{ft} - cost c_{ft} : t = transaction) and demand quantity d_{ft}, which is a function of demographics and economic size of the market m,

$$\pi_{ft} = (v_{ft} - c_{ft})d_{ft}(\beta X_m).$$

Price is set at a level of marginal cost plus monopoly power, which is a function of the number of rivals in the market,

$$v_{ft} = c_{ft} + \delta_t(N_{ftm}).$$

Marginal cost c_{ft} consists of the price of the pig p_f, transportation cost t_{ft} and cost to quality maintenance q_{ft},

$$c_{ft} = p_f + t_{ft} + q_{ft} \ .$$

The firm will set the price v_{ft} as high as possible so as to maximize its profit, and thus the optimal price will be the marginal cost plus monopoly power. Firm-specific factor and market specific factor remained unobservable to researcher.

$$v_{ft}^{*} = c_{ft} + \delta_t(N_{ftm}) + \sigma_f + \omega_m + \varepsilon_{ftm} \qquad (1).$$

Under this pricing strategy, optimal profit would be the product of monopoly power, demographics and economic size of the market,

$$\pi_{ft}{}^{*} = (\delta_t(N_{ftm}) + \sigma_f + \omega_m + \varepsilon_{ftm})d_{ft}(\beta X_m) \quad (2).$$

Purpose of firm in differentiating their product is to maximize their monopoly power, which brings profit maximization. Here the equilibrium is unique. In this chapter, we will try to quantify monopoly power from two differentiation strategies, that is, sizes of coefficients of product differentiation δ_p and that of geographical differentiation δ_g, and compare which is more profitable for the firm.

4.3 Estimation

The final goal of estimation here is to obtain unbiased estimates of monopoly power coefficients δ_p and δ_g in the price function (1). In this chapter, we will take a Heckman two-step approach following Mazzeo (2002).

4.3.1 Correction of Sample Selection Bias due to Differentiation

Econometric problem here is that unobservable term ε_{ftm} may be correlated with

observables, and in particular, coefficients of 'number of competitors' δ_t, could be biased. The source of this bias is a fact that the number of rivals and the competition environment are endogenously determined with firm's differentiation strategy. If the firm decides to operate in the product/geographical market t, the firm will set price v_{ft}. Otherwise, we cannot observe price. This means that price v_{ft} is observable only in an area larger than any critical point z. When applying this to the truncated sample, it is known that we can obtain an unbiased estimator by explicitly introducing a selection mechanism.

Expected value of price with a truncated sample conditional on observables x ($= c_{ft} + \delta_t(N_{ftm}) + \sigma_f + \omega_m$) can be obtained as follows:

$$E(v_{ft}|x) = E(v_{ft}|x, v_{ft} > z)\cdot P(v_{ft} > z|x) + 0\cdot P(v_{ft} = z|x).$$

The conditional probability that price v_{ft} whose variance is σ is larger than any critical value z can be written as follows:

$$P(v_{ft}|v_{ft} > z) = P(\varepsilon_{ftm} > z - x\beta|x) = P\left(\frac{\varepsilon_{ftm}}{\sigma} > \frac{z-x\beta)}{\sigma}\right) = \Phi(\frac{z-x\beta}{\sigma}),$$

If any critical value z follows normal distribution with mean zero and variance 1, the expected value of some variable y with a condition that y is larger than critical value z is as follows,

$$E(y|y > z) = \frac{(z)}{1-\Phi(z)} \text{ if } z \sim \text{Normal}(0,1).$$

Here, the conditional expected value of unobservable ε_{ftm} becomes;

$$E(\varepsilon_{ftm}|\varepsilon_{ftm} > z - x\beta) = \sigma E\left(\frac{\varepsilon_{ftm}}{\sigma}|\frac{\varepsilon_{ftm}}{\sigma} > \frac{z-x\beta}{\sigma}\right) = \sigma\left[\frac{\phi\{(z-x\beta)/\sigma\}}{1-\Phi(z-x\beta/\sigma)}\right],$$

Then, the expected value of price becomes the sum of observable $x\beta$ and σ times of

inverse Mills ratio.

$$E(v|x, v > z) = x\beta + E(\varepsilon_{ftm} | \varepsilon_{ftm} > z - x\beta) = x\beta + \sigma\left[\frac{\phi((x\beta - z)/\sigma)}{\Phi((x\beta - z)/\sigma)}\right]$$

$\frac{\phi(*)}{\Phi(*)}$ is called the inverse Mills' ratio (IMR). $E(v|x, v > z)$ is the sum of observable $x\beta$ and σ times the inverse Mills' ratio. The estimation equation becomes as follows:

$$v_{ft}^{*} = \beta c_{ft} + \delta_t(N_{ft}) + \sigma_f + \omega_m + \sum_{f=1} \sigma_t IMR_t^f + \varepsilon_{ftm} . (1')$$

4.3.2 Estimating probability to select market or geographical types

The next problem is how to obtain probability to select configurations of product or geography. This can be formalized by the following discrete choice: If profit from the configuration is non-negative, firm will take the configuration.

$$\begin{aligned} D_{ft} &= 1[\pi_{ft} = (v_{ft} - c_f)d_{ft}(\beta X_m) \geq 0] \\ &= 1[\pi_{ft} = \left(\delta_t(N_{ft})\right)d_{ft}(\beta X_m) \geq 0] \end{aligned}$$

Since the equilibrium is unique, the sum of the probability for all the product or geographical type configurations is always one. Maximum likelihood selects the parameters of the profit function that maximize the probability of the observed product or geography configurations across the dataset.

The likelihood function of 'geographical differentiation' is,

$$L = \sum_{f=1} Prob[(Urban, County, Village)]_f^{observed} ,$$

and the likelihood function of product differentiation is,

$$L = \sum_{f=1} Prob[(Raw, Chilled, Freezed)]_f^{observed} .$$

To estimate the likelihood function above, we use a maximum simulated likelihood (MSL) approach. As our problems entail more than two choices, ordinary probit cannot be used. Endogeneity correction method of truncated sample requires to the unobservable follows normal distribution, not i.i.d. extreme values, so we cannot use logit. Multinomial probit with simulation can compute the probability.[3]

4.4 Results

Tables 4 and 5 report the estimates of probability for select product/geographical configurations.

Product-choice-probability estimates reveal the following relationship: Estimated parameters indicate the relative effects on profit and choice decision of differentiated market conditions. Firstly, relative values of constants indicate that any single product is preferred to a combination of raw whole body, frozen cut and chilled cut (constant of combination = -1.39 versus constant of raw -.51, frozen -1.33 and -.37 chilled) if all other observed variables are equal. Among choices in a single product, raw whole body is preferred in a markets that population is smaller (the coefficient of population is -.53) , and is in oligopolistic (the coefficient of dummy 1 to 5 rivals is .38) and is preferred by smaller firms (coefficient of sales = -0.1). Chilled cut is the opposite; it is preferred in monopolistic markets (coefficient of dummy of 1 to 5 rivals is -1.02, which is significant and the smallest) and is preferred by the larger firm (the coefficient of sales = .09). Frozen cut is chosen in more competitive environment (coefficient of 5 to 10

[3] Regarding details of multinomial probit, maximum simulated likelihood (MSL), method of simulated moment (MSM) see Stern (2000) and Train (2002). Simulation is used in these estimation methods so as to obtain a dimensional integral part of joint distribution among multi options that cannot be analytically solved.

rivals is 1, which is significant and the largest among choices), other conditions are valued in between those of raw whole body and chilled cut.

The results of geographical market choice estimates are somewhat complicated. The dataset contains six choices of configuration of geographical market choice. The constants of the six choices do not show systematic results. Only the constant of urban market is not statistically significant, and the other coefficients of choice are more or less at the same level. Coefficients for distance to the customers indicate that if the firm can accept longer distances, the firm chooses only the urban market or an urban-county or urban-village combinations. In contrast, a firm that cannot accept a longer distance to the customer prefers to supply at only the village market.

Table 4: Choice Probability of Product Configuration

	Coef.	Std. Err	z	P>|z|	
Probability of selling raw wholebody pork only					
Population(transformed)	**-0.53**	0.10	-5.06	0.00	***
Fiscal expenditure size of the market area (transformed)	0.11	0.15	0.73	0.47	
Total sales of firm in 2007 (transformed)	**-0.10**	0.03	-3.53	0.00	***
Number of competitors (index; "zero" is the reference option)					
1 to 5 rivals	**0.38**	0.22	1.77	0.08	*
5 to 10 rivals	0.30	0.30	0.99	0.32	
10 to 30 rivals	0.10	0.36	0.28	0.78	
more than 30 rivals	0.30	0.37	0.79	0.43	
Jilin Province dummy	0.09	0.18	0.52	0.60	
Constant	**-0.51**	0.24	-2.14	0.03	**
Probability of selling frozen cut only					
Population(transformed)	**0.38**	0.13	2.97	0.00	***
Fiscal expenditure size of the market area (transformed)	-0.23	0.18	-1.27	0.20	
Total sales of firm in 2007 (transformed)	**0.12**	0.05	2.53	0.01	**
Number of competitors (index; "zero" is the reference option)					
1 to 5 rivals	0.20	0.37	0.56	0.58	
5 to 10 rivals	**1.00**	0.37	2.66	0.01	**
10 to 30 rivals	0.49	0.47	1.04	0.30	
more than 30 rivals	0.38	0.45	0.84	0.40	
Jilin Province dummy	-0.18	0.28	-0.62	0.53	
Constant	**-1.33**	0.37	-3.61	0.00	***
Probability of selling chilled cut only					
Population(transformed)	0.10	0.11	0.90	0.37	
Fiscal expenditure size of the market area (transformed)	0.19	0.16	1.18	0.24	
Total sales of firm in 2007 (transformed)	**0.09**	0.04	2.44	0.02	**
Number of competitors (index; "zero" is the reference option)					
1 to 5 rivals	**-1.02**	0.35	-2.91	0.00	***
5 to 10 rivals	-0.43	0.40	-1.07	0.29	
10 to 30 rivals	-0.77	0.49	-1.59	0.11	
more than 30 rivals	-0.11	0.44	-0.26	0.80	
Jilin Province dummy	**-1.05**	0.29	-3.64	0.00	***
Constant	-0.37	0.29	-1.28	0.20	
Probability of selling any combination of raw, frozen and cilled					
Population(transformed)	**0.28**	0.14	2.05	0.04	**
Fiscal expenditure size of the market area (transformed)	0.21	0.16	1.33	0.18	
Total sales of firm in 2007 (transformed)	**0.19**	0.07	2.73	0.01	**
Number of competitors (index; "zero" is the reference option)					
1 to 5 rivals	**0.71**	0.41	1.74	0.08	*
5 to 10 rivals	0.10	0.54	0.18	0.86	
10 to 30 rivals	0.42	0.62	0.68	0.49	
more than 30 rivals	0.19	0.47	0.41	0.68	
Jilin Province dummy	**-0.69**	0.38	-1.81	0.07	*
Constant	**-1.39**	0.41	-3.42	0.00	***
Log likelihood	-310.6				
# of observation	348				
Wald Chi2 (d.f.)	197.1	chi2(32)			
Number of Draws in simulations (GHK simulator)	5.0				

Note: 'Transformed' variables are transformed as follows, so as to improve the efficiency of optimization: X transformed =ln(X/ Sample average of X).

Table 5: Choice Probability of Geographical Market Configuration

	Coef.	Std. Err	z	P>|z|			Coef.	Std. Err	z	P>|z|	
Probability of entering urban market only						**Probability of entering urban-county market**					
Population (transformed)	**0.48**	0.12	4.2	0.00	***	Population (transformed)	-0.08	0.11	-0.7	0.49	
Fiscal expenditure size of the market area (transformed)	-0.25	0.16	-1.6	0.11		Fiscal expenditure size of the market area (transformed)	**-0.21**	0.16	-1.3	0.18	***
Distance to the customer (transformed)	**0.12**	0.05	2.3	0.02	**	Distance to the customer (transformed)	**0.06**	0.08	0.7	0.46	***
Number of competitors (index; "zero" is the reference option)						Number of competitors (index; "zero" is the reference opt	0.08	0.24	0.3	0.74	
1 to 5 rivals	0.07	0.21	0.3	0.75		1 to 5 rivals	-0.45	0.45	-1.0	0.33	
5 to 10 rivals	**0.87**	0.304	2.9	0.00	***	5 to 10 rivals	-0.10	0.52	-0.2	0.85	
10 to 30 rivals	0.19	0.36	0.5	0.61		more than 10 rivals	-26869	.	.	.	
more than 30 rivals	0.63	0.43	1.5	0.14		Henan Province dummy	0.19	0.21	0.9	0.38	
Henan Province dummy	-0.13	0.23	-0.6	0.58		Constant	**-1.32**	0.35	-3.7	0.00	***
Constant	-0.26	0.22	-1.2	0.23							
Probability of entering county market only						**Probability of entering urban-village market**					
Population (transformed)	**-0.22**	0.12	-1.8	0.07	*	Population (transformed)	-0.19	0.13	-1.4	0.16	
Fiscal expenditure size of the market area (transformed)	-0.17	0.13	-1.3	0.19		Fiscal expenditure size of the market area (transformed)	**0.74**	0.20	3.8	0.00	***
Distance to the customer (transformed)	-0.01	0.06	-0.2	0.85		Distance to the customer (transformed)	**0.31**	0.06	5.3	0.00	***
Number of competitors (index; "zero" is the reference option)						Number of competitors (index; "zero" is the reference option)					
1 to 5 rivals	**0.35**	0.20	1.7	0.09	*	1 to 5 rivals	0.17	0.40	0.42	0.68	
5 to 10 rivals	0.20	0.32	0.6	0.54		5 to 10 rivals	-0.47	0.44	-1.06	0.29	
10 to 30 rivals	0.50	0.40	1.2	0.22		10 to 30 rivals	-0.41	0.45	-0.92	0.36	
more than 30 rivals	0.00	0.51	0.0	1.00		more than 30 rivals	-0.14	0.60	-0.24	0.81	
Henan Province dummy	**0.34**	0.18	1.9	0.06	*	Henan Province dummy	-0.02	0.38	-0.06	0.96	
Constant	**-1.58**	0.29	-5.5	0.00	***	Constant	**-1.01**	0.25	-4.02	0.00	***
Probability of entering village market only						**Probability of entering county-village market**					
Population (transformed)	**-0.37**	0.10	-3.6	0.00	***	Population (transformed)	0.08	0.16	0.5	0.61	
Fiscal expenditure size of the market area (transformed)	**0.32**	0.15	2.1	0.03	**	Fiscal expenditure size of the market area (transformed)	0.20	0.20	1.0	0.31	
Distance to the customer (transformed)	**-0.31**	0.07	-4.2	0.00	***	Distance to the customer (transformed)	**0.11**	0.07	1.7	0.09	*
Number of competitors (index; "zero" is the reference option)						Number of competitors (index; "zero" is the reference option)					
1 to 5 rivals	-0.11	0.18	-0.6	0.55		1 to 5 rivals	-0.38	0.27	-1.4	0.16	
5 to 10 rivals	-0.48	0.32	-1.5	0.13		5 to 10 rivals	-0.41	0.57	-0.7	0.47	
10 to 30 rivals	-0.13	0.41	-0.3	0.76		10 to 30 rivals	-17.38	.	.	.	
more than 30 rivals	-8.35	.	.	.		more than 30 rivals	-0.40	0.60	-0.7	0.51	
Henan Province dummy	0.02	0.17	0.1	0.90		Henan Province dummy	**-0.57**	0.28	-2.0	0.05	**
Constant	**-1.38**	0.32	-4.4	0.00	***	Constant	**-0.79**	0.30	-2.7	0.01	***
Log likelihood	-584.9										
# of observation	346										
Wald Chi2 (d.f.)											
Number of Draws in simulations (GHK simulator)	5.0										

Note:Variables 'Transformed' are transformed as follows, so as to improve the efficiency of optimization: X transformed =ln(X/ Sample average of X)

Table 6 reports the results of price regressions. What we focus on in this chapter is the coefficients of number of rivals δ_t. The first column indicates the result of the price regression (1') without correction of endogeneity. The second indicates the result of the endogeneity correction by inserting the inverse Mills' ratio from product configuration choice estimation. Coefficients of the number of rivals δ_p becomes larger than regression without endogeneity correction for more than 5 competitors, but significant only for the case with more than 30 competitors. The coefficients show how much the price would increase/decrease compared to the zero-competitor environment. The magnitude of impact on price reduction is for the group with more than 30 competitors, 2.1 RMB. This implies if product differentiation strategy taken, price is less elastic till the competitors becomes as large as 30. What is interesting is if the customer will do inspection of products, selling price is significantly reduced.

The third column reports the impact of geographical differentiation. The coefficients of the number of rivals δ_g are significant and negative for the group with 1 to 5 competitors. Its magnitude is larger than in the case of product differentiation. With the appearance of competitors numbering 1 to 5, the selling price is reduced by 4.2 RMB, which is the twice of the amount in the case of product differentiation. This suggests that geographical differentiation can mitigate price reduction pressure less than product differentiation.

Coefficients of the inverse Mills' ratio term are not strongly significant for both the product-differentiated and the geographical-differentiated market. Coefficients of the terms for frozen cut only are weakly significant and negative. This suggests that there are unobserved factors which affect both observed price and product choice

probability in the opposite way. For example, if some factor encourages the choice to sell only raw whole body, this will exert pressure on price.

There are some interesting results in relation to spatial economy. First, distance to the customer has no power to explain price level. This is consistent for all the estimation here. Secondly, a certain type of marketing and transportation method matters price. Our data contains information on the transporting-marketing method: (1) it is the seller firm that does marketing to the customer and transports the goods at the seller's cost, (2) firms set up their own marketing outlets, (3) it is the customer who goes to the firm and bears the transport cost, (4) it is the contracted distributor who does the transportation and (5) others. Among these, '(1) the seller firm will bear the marketing and transportation cost' is significant and positive. This means that if the seller firm bears the transportation cost, then the selling price can be raised. However, if the buyer bears the marketing and transportation cost, then the selling price is not affected. Thus, there is asymmetry in the cost-bearing of transportation.

Table 6: Price functions: Two differentiation strategies

	Base					Product differentiation					Geographical Differentiation				
	Coef.	S.E.	t	P>|t|		Coef.	S.E.	t	P>|t|		Coef.	S.E.	t	P>|t|	
Cost : β																
Purchase price of pigs	**0.001**	0.00	2.13	0.03	**	**0.001**	0.00	1.81	0.07	*	0.001	0.001	1.58	0.12	
Distance to the customer	0.00	0.00	0.60	0.55		0.00	0.00	0.48	0.63		0.00	0.00	-0.49	0.63	
Transportation method															
Self marketing- transporation	**2.13**	0.83	2.57	0.01	**	**1.79**	0.85	2.09	0.04	**	1.66	1.36	1.23	0.22	
Own outlet	0.01	1.09	0.00	1.00		0.23	1.15	0.20	0.84		0.20	1.61	0.13	0.90	
Customer does transportation	0.51	0.81	0.63	0.53		0.27	0.82	0.33	0.75		0.12	1.30	0.09	0.93	
Transporation due to contract	0.86	0.95	0.90	0.37		0.95	0.97	0.98	0.33		1.48	1.49	1.00	0.32	
Other types of marketing	1.90	1.34	1.42	0.16		1.71	1.32	1.29	0.20		2.03	1.62	1.25	0.21	
Quality control by the customer															
Customer do inspection on slaughtering	**-0.85**	0.49	-1.75	0.08	*	**-0.88**	0.51	-1.72	0.09	*	-0.85	0.54	-1.58	0.12	
Custmer inspect processing site periodically	**-1.19**	0.50	-2.39	0.02	**	**-1.21**	0.54	-2.24	0.03	**	**-1.02**	0.54	-1.89	0.06	**
Number of competitors: δ															
1 to 5	**-0.81**	0.44	-1.86	0.06	*	-0.6	1.51	-0.42	0.68	**	**-4.84**	2.82	-1.71	0.09	**
5 to 10	-0.21	0.64	-0.33	0.74		-2.2	1.49	-1.50	0.14		-14.7	10.19	-1.44	0.15	
10 to 30	-1.25	0.92	-1.37	0.17		-1.7	1.39	-1.20	0.23	**	72.9	53.0	1.38	0.17	
30 -	-1.18	0.90	-1.32	0.19		**-2.1**	1.20	-1.77	0.08						
Endogeneity correction term															
Mills ratio for raw wholebody only						-2.01	1.68	-1.20	0.23						
Mills ratio for frozen cut only						-2.39	1.53	-1.56	0.12						
Mills ratio for chilled cut only						-0.42	0.96	-0.44	0.66						
Mills ratio for configulation of any three						0.90	0.97	0.92	0.36						
Mills ratio for urban market only											-4.33	3.42	-1.27	0.21	
Mills ratio for county market only											-25.1	16.8	-1.49	0.14	*
Mills ratio for village market only											3.07	2.58	1.19	0.24	
Mills ratio for urban-county											0.91	0.88	1.03	0.31	
Mills ratio for urban-village											-5.11	3.58	-1.43	0.16	*
Mills ratio for county-village											22.5	16.6	1.36	0.18	
Constant	**18.32**	1.23	14.83	0.00		**42.0**	18.12	2.32	0.02		**31.42**	10.52	2.99	0.00	
# of observation	313					313					313				
R-squared	0.118					0.137					0.129				

Source: Author

5. Discussion and Conclusion

This chapter attempted to quantify the impact of the differentiation strategy of firms on price. It then compared the magnitude of price reduction pressure which results from the two differentiation strategies of product differentiation and geographical differentiation. The results suggest that, in the pork processing industry in China, product differentiation exhibits stronger power than geographical differentiation when it comes to mitigating the price reduction pressure exerted by competition. This results suggest

that this difference may encourage firms to invest more in facilities that upgrading product quality rather than securing geographical monopoly. However, the reality is opposite. Most of our data set firms stay in geographical monopolistic positions thanks to some power. The results reject that the power that secures geographical monopoly is not distance to the customer or transportation cost. The results support that small fragmented market may have inhibited spreading of high-quality pork production.

Development of the empirical method to differentiated markets or markets with strategic interaction allows us to identify the location choice of the firms and to quantify the impact of this choice on firms' profit. Henceforth, the combination of the techniques of empirical industrial organization and spatial economy has the potential to produce further valuable research findings.

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