Does the centralized slaughtering policy create market power for pork industry in China?

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ABSTRACT

In order to ensure safe meat supply and protect consumers' health, the government of China made a law in 1997 which started to enforce centralized slaughtering of hogs in licensed slaughtering houses. We use a structural model and the industrial level data to test the hypothesis that whether the "centralized slaughtering policy" creates market power. The results detect sizable and significant market power (about 0.5% price margin) for the slaughtering industry in the pork supply chain, mainly due to high barriers of entry and stringent license regulations which reduce competition in the market. The total profit markup for the slaughtering industry reaches 1.85 billion *yuan* just in 2016. The welfare transfer and loss from market power should be taken into account for such a policy making.

1. Introduction

> 60% of meat consumed in China is pork. It plays an important role in Chinese agricultural economy and people's daily dietary (Yu & Abler, 2014; Zhang et al., 2017). While total pork supply was only 39.7 million tons in 2002, the figure increased to 54.9 million tons in 2015. As the world largest population, China consumes or produces > 50% of world pork supply with very limited trade volume. Consumers in China are very sensitive to pork prices. Yu (2015) infers that the weights of pork in the CPI could be well above 6%. Supplying enough pork with affordable prices for consumers is one of the food policy priorities. However, many factors could cause pork price volatility in line with the famous "hog cycle", such as feed price, market speculation, animal diseases, etc. (Zhou & Koemle, 2015).

In tandem with the market-oriented economic reform after 1978, it is observed that food supply chains become longer and the concentration ratio of agribusiness firms is higher. Market power in the supply chain could affect food price at different stages. Pork industry is no exception. Chen, Abler, Zhou, Yu, and Thompson (2015) use a meta-analysis and find that average income elasticity and own price elasticity for pork demand are 0.61 and − 0.67, respectively. This implies that pork in China has already been a necessity. A small supply shock could lead to an over-proportional reaction on price. For instance, a 10% reduction in supply will cause a 15% increase in price. Small price elasticities are an intrinsic motivation for firms to seek for market power, which could help them to obtain excessive profit by controlling the supply.

Traditional pig industry in China was characterized by small "backyard" farms, and it gives ways to large commercial pig farms in recent years. However, the small-scale farms (< 500 pigs output per year) are still dominating the supply in China (Yu & Abler,

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2014). Along with the structural change in pig production, the pig slaughtering industry, an important but largely neglected link in the pork supply chain, has experienced a structural transformation as well, transferring from dispersed and nonstandard butchers to designated centralized slaughtering plants in past two decades.

Traditionally, slaughtering was operated by unlicensed butchers, or even small pig farm owners in villages. The quality and safety of meat under the traditional slaughtering system cannot be controlled, so that it posed threats to the public health. In response to the call for safer and better-quality meat supply, the central government of China started to promote "Centralized Slaughtering Policy (CSP)" at the end of 1997, by issuing *the Decree of Pig Slaughtering Administration*. The decree was subsequently amended in August of 2008, January of 2011, and February of 2016, with putting more stringent regulations and stricter penalties for violation.

The basic idea of CSP is to create a system that slaughtering is only allowed to be conducted in "licensed slaughtering plants". Individual butchers or farmers are only allowed to slaughter pigs for own consumption, but forbidden to handle slaughtering for commercial purpose. Each region is allowed to issue a limited number of slaughtering licenses. According to the statistics from the Ministry of Commerce in China, the total number of licensed slaughtering firms was 14,720, in which the number of designated large slaughtering firms was 4585 in 2012. From an economics perspective, the "Centralized Slaughtering Policy" artificially increases the entry cost of the slaughtering industry and creates market power, since the number of licenses is limited. The government encourages small slaughterhouses to be progressively squeezed out of the industry. In a campaign in 2012, the governments reduced the licenses of small slaughtering firms from 14,019 to 10,135, reduced by 27.7%; and the licenses of designated large slaughtering firms from 5919 to 4585, reduced by 22.5%. According to the "Yearbook of Livestock Slaughtering Monitoring System" from the Ministry of Commerce, the proportion of the processing capacity for large-scale slaughtering plants increased from 68% to 78% between 2008 and 2012, and the top firms in the slaughtering industry took up 14% of the total slaughtering amount in 2012 (Ministry of Commerce, 2013a, 2013b). A concentrated market structure is evidential.

It is plausible that the CSP outlines a regional oligopsonistic market in each local area. In such a market structure, it is interesting to know if the slaughtering firms exert their market power, and reap some additional profits from pig farms or upstream of the pork supply chain.

Although pig market in China has been widely studied in different dimensions, such as price transmission, statistical accuracy, and international trade (Yu, 2015; Zhou & Koemle, 2015), little attention has been paid to examine the possible market power of the pig slaughtering industry particularly after the CSP took effect. In order to fill in the literature gap, we use the new empirical industrial organization, specifically the Muth & Wohlgenant Model (1999a, 1999b), to empirically estimate the market power of slaughtering industry in China. Our results find significant evidence to support the hypothesis that the "Centralized Slaughtering Policy" has developed some market power in pig industry.

1.1. Theoretical model

The market power lies at the heart of industrial organization. Aguirregabiria (Aguirregabiria, 2012) defined it as the ability of a firm, or group of firms to get markup profit above competitive market price. There are basically three categories of methods in measuring market power – Solow Residual Based Model (SRB), Nonparametric Model, and New Empirical Industrial Organization Model (NEIO). The first approach was initially applied by Hall (Hall, 1988) to test the excessive profit in 26 industries. Since then, a number of models under alternative assumptions have been developed and conducted (Domowitz, Hubbard, & Petersen, 1986; Norrbin, 1993; Raper, Love, & Shumway, 2007; Roeger, 1995). In 2007, Raper, Love, and Shumway (2007) further came up with an improved Primal-Dual approach based on the SRB model with aggregated data at the industry level, shedding light upon profit allocation between the upstream and downstream process. This method, as a milestone, extended the SRB model from oligopolistic to oligopsonistic market. Since the SRB model does not require a particular function specification or the demand and supply relationships in the opposing market, it has been widely used to examine the industries of agriculture products in China. Dai and Wang (2014) employed the improved Primal-Dual model and discovered China dairy process industry is both strong oligopolistic and oligopsonistic. Guo, Wang, & Chen(2016) re-conducted the research with a sample of 511 firms. By controlling the price heterogeneity, the authors asserted that the dairy industry is competitive in total, though large firms own strong bargaining power. As the SRB is based on an assumption of Hicks-neutral technical progress, the hypothesis is too strong for China slaughtering industry. When the scale of a slaughtering firm increases, technological progress is more likely to bias towards labor saving (Harrod Technological progress). Hence the residual in SRB could be a mixture of an index of market power exertion and an index of technical change, which is a potential risk leading to a biased estimation result. Another alternative is nonparametric test. To our best knowledge, the initial research was conducted by Ashenfelter and Sullivan (1987). Instead of the requirements of *ad hoc* specifications of functional form and a populous data sample, the nonparametric approach is more flexible to estimate the market power based on revealed preference arguments (Noelke & Raper, 1998). The prototype model is continuously revised by followers like Love and Shumway (1994), Raper, Love, & Shumway (2007) by relaxing the assumption of a stable cost function and demand curve in opposing market. However, the nonparametric test follows the basic principle of SRB model where it uses the residual as a measurement of excessive profit growth. The interpretation of unobserved error suffers the similar issue as SRB model. Additionally, Noelke and Raper (1998) compared the NEIO and nonparametric test by the Monte Carlo experiments proposed by Raper, Love, & Shumway (2000)[1], and showed both

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[1] The paper was published in 2000. Noelke and Raper (1998) used the methodology based on the primary working paper in 1997.
Raper, K. C., H. A. Love, and C. R. Shumway. "Determining Market Power Exertion Between Buyers and Sellers" *Department of Agricultural Economics*, Texas A&M University, Working Paper (July 1997)