Apply Global Game Framework to Industrial Organization Study and Policy Making

(A research proposal)

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Abstract

If perfect information game theory is applied to industrial organization study, the result from social planner's view is unique if all the firms are identical. What is more realistic is that firms are asymmetric, with different utility function and different information. Different utility function of different attitude toward uncertainty divides the firms into two groups: innovators and followers. This research applies global game framework to industrial organization study and intends to work out feasible policy.

1 Introduction

Overcapacity reduction ("去产能") is the most important one among five structural reform tasks in 2016 according to the Central Economic Work Conference held last year. Another essential policy is called strategy of innovation-driven development. However, we still have several questions behind those two policies. Why overcapacity exists among some industries, while under-innovation among others? How do firms make decision with imperfect information? How to stimulate investment in some specific industries, and capacity reduction in others?

This research intends to propose an alternative view: information is an essential factor during decision making process of the firms. Suppose, for example, an early mover in a modern industry occasionally develops a new technology or produces a new good which did not exist before. However, the demand of the product and the cost of producing were unclear until the product is made and put into the market, and hence whether the product is a success or failure is unknown ex ante. From the first mover's view, both demand and cost

are unclear. But for a late mover, the cost should be clearer than the movers before it, and the more movers before, the clearer the cost will be. Compared to other industries with fewer movers, the firm is more likely to go into the industry with more movers. This might be an explanation for the wave phenomenon proposed by Lin (2007).

The question here is, why does the firms rush into one industry? Don't they take the competence following the rush into consideration? One possible reason is that, they rush because they do not have enough information about the actual demand neither for the totally new industry, nor for the industry the early mover has already been in. Without the information about demand, they will be driven by low cost. The more movers, the lower the cost because of technology spillover. One example of this is the potential over-construction of industrial parks in many large cities of China. Actually such kind of news can be found from time to time. For instance, the governors of Jieyang[1], Hengshui[2], Bengbu[3], Zhangye[4], Jiangmen[5] and Zoucheng[6] went to other cities to observe and study the experience of the construction of industrial parks. But the low utilization of some industrial parks in some big cities such as Wuhan and Nanjing shows that, the actual demand was unclear, or was ignored when the construction took place. If it is the case, then information structure can be a possible reason that overcapacity and under-capacity can exist simultaneously among different industries. If demand is unknown or with high uncertainty, and if cost can be lower in industries with more movers because of technology spillover, it is likely that even more movers will rush into the same industry, making the entry decision game a strategic supplementary.

Another part of the story lies in the period of overcapacity. Suppose that an industry is faced with overcapacity, like coal, cement and electrolytic aluminium manufacture industry in China. From the view of social planner, some of the manufacturer should quit the market. Even for some of the firms, because of sustained loss, given that other firms continue their business, they should terminate theirs. However, this is far from the reality of China. Despite the sustained loss, most of the manufacturers choose to continue their

[1]The Vice Mayor of Jieyang, Guangdong Province, led the team to Yiwu and Yongkang, Zhejiang Province to learn the experience of Galvanization Industrial Park in November 2012 (*Jieyang News*)

[2]The Vice Mayor of Hengshui, Hebei Province, led the team to Langfang to learn the experience of two industrial parks in June 2013 (*Hengshui Daily*)

[3]The Vice Secretary of Municipal Party Committee of Bengbu, Anhui Province, led the team to Suzhou, Bozhou and Fuyang to learn the status of construction of three industrial parks in October 2013 (*Bengbu Daily*)

[4]The Secretary of County Party Committee of Minle County, Zhangye, Gansu Province, led the team to Wuwei to learn the experience of an industrial park in November 2013 (*Zhangye Government*)

[5]A governor of Heshan, Jiangmen, Guangdong Province, led the team to Shenzhen to learn the experience of Shenzhen Technology Park in February 2014 (*Jiangmen Daily*)

[6]The Vice Mayor of Zoucheng, Shandong Province, led the team to Suzhou, Wuxi and Changzhou, Jiangsu Province, to learn the experience of several industrial parks in November 2015 (*Zoucheng Government*)

business, with the hope that other manufacturers will fail earlier. If others fail earlier, they themselves might survive the overcapacity reduction. Suppose that, from social planner, reduction of 20% of total capacity is the optimal level, then from firms' view, who will be the action taker depends on the strategic choice of each firm. If the firms are faced with imperfect information, a new model should be built to reflect this decision making process. Meanwhile, how should the social planner make the policy to stimulate active overcapacity reduction is also the question to be answered here.

Motivated by the intuition above, this research will try to build several equilibrium models of social planner, innovators and the followers.

Firstly, part of the firms might choose to be innovators. The first model considers the decision by the firm that choose to be an innovator or to be a follower. Some entrepreneurs are born venturesome and some are born prudent, but there are also the third group, whose choice can change. Given different policy, their choice might be different, and hence comparative static analysis may give feasible policy for innovation activity.

Secondly, the followers also have different choices. What they observe are the results of innovators in different industries. According to the example above, they may tend to rush into some industries and seldom enter others. Feasible policy should try to balance them, making marginal product similar among different industries.

Lastly, feasible policy should also work during overcapacity reduction period.

2 Literature Review

Lin (2007) points out the wave phenomenon in developing countries. Due to the advantage of backwardness, the firms in developing countries will easily generate the consensus on which industry will be a promising one, and hence wave into it and soon make the scale of investment much larger than the social optimal level. Hausmann and Rodrik (2003) builds up a general-equilibrium framework with the presence of uncertainty about what a country can be good at producing. The costs of producing are uncertain ex ante, but can be discovered through initial investment, and hence the discoveries of the costs have great social value if they can be easily imitated. They find two failures of the laissez-faire outcome: there is too little investment and entrepreneurship ex ante, and too much production diversification ex post, which are in accordance with what we observe in reality. They argue that the optimal policy should encourage investments in the modern sector ex ante, but rationalize production ex post.

Learning from each other has been studied under complete information framework. D'Aspremont and

Jacquemin (1988) propose that in oligopoly models, relations among firms are seldom of a wholly cooperative or non-cooperative type, but they compete in some fields while cooperate in others in many situations. In the model they develop, the firms cooperate in R&D because the cooperation agreement could reduce the expected R&D expenditure due to less wasteful duplication. With a high R&D externalities or spillovers, the R&D expenditure can be strategic complement among firms. This model explains the incentive for learning from each other within an industry. Empirically, Von Hippel (1988) actually finds that the firms from steel manufacture industry in USA exchange technological information.

If this study is to be extended to incomplete information framework, the global game approach first introduced by Carlsson and van Damme (1993) should be applied. They define a global game as an incomplete information game where the actual payoff structure is determined by a random draw from a given class of games and where each player makes a noisy observation of the selected game. They show that in a two-agent global game, as the noise becomes small, there exists a unique equilibrium using iterated deletion of dominated strategies.

The results by Carlsson and van Damme (1993) is generalized by Frankel, Morris and Pauzner (2003), with many players and many actions. They also prove that, as the signal noise vanishes, the game has a unique strategy profile that survives iterative dominance. Global game framework is very useful in solving games of strategic supplementarities, which usually have multiple equilibria in traditional game theory with complete information, especially in currency attack (Morris and Shin, 1998), bank run (Goldstein and Pauzner, 2005) and debt run (Morris and Shin, 2004).

Most of literature for global games discuss games of strategic supplemetarities. Because by simply passing from the strategic complements model to the strategic substitutes environment could not we obtain the uniqueness of equilibrium, global games with strategic substitutes have not been thoroughly studied. However, Harrison (2003) and Harrison and Jara-Moroni (2015) prove the uniqueness of a class of games with strategic substitutes by adding a minimum of player heterogeneity. This result allows us to analyze a wide class of games of strategic substitutes including entry-exit models in industrial organization.

More interestingly, Karp, Lee and Mason (2004) develop an equilibrium framework with incomplete information and with both strategic substitutes and strategic complements. This framework is quite useful for industrial organization study in the case that, positive network effects may make it more attractive for a firm to enter a new market if a few other firms also enter, while if a large number of firms enter, the market becomes too crowded and further entry is unattractive.

3 Innovation

Traditional research framework for industrial organization usually assumes perfect information. Global game framework is usually applied to financial market, but there is limited study for industrial organization. This research combines them together to study the role of information structure in industrial organization and relevant policy.

4 Expected Result

The major desire for this research is to find out whether and how information plays an important role in social planner's and firms' decision making process. What's more, once the decision making process with imperfect information is studied, how to design feasible policy, both for innovation stimulation and over-capacity reduction, is another essential question to answer. Under the circumstance that Chinese economy is suffering from overcapacity in traditional industries and under-investment in innovative industries, those two questions should be answered the sooner the better.

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