CHINESE SEED FIRM'S LOBBYING ACTIVITY ON BIOTECHNOLOGY

by

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ABSTRACT OF THE THESIS

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Induced institutional innovation could provide more technological advantages, but it calls for government's support as well as the demand for change from interest groups. It has been proved that some seed firms have profited from bacillus thuringiensis (Bt) crops. Thus, it is reasonable to believe that Chinese seed firms should have positive profit expectation in biotech crops and the motivation to lobby for biotechnology in order to benefit from preferred policies. This thesis examines (1) Did Chinese seed firms lobby for biotechnology? (2) What are the key factors that affect Chinese seed firms' lobbying activity towards biotechnology?

The analysis was based on a survey data from 50 top Chinese seed firms and following results were generated: (a) firms located in Beijing are more likely to lobby than firms that locate outside of Beijing; (b) State-owned firms are more likely to lobby than private seed firms; (c) seed firms who have GM breeding research and development (R&D) have a higher likelihood of lobbying for biotech than firms without GM breeding R&D. (d) Positive attitude of managers towards the adoption of GM crops is positively related to

firm's lobbying activity positively compared to non-positive attitude.

This thesis suggests that if Chinese government wants to generate more supports for biotechnology, the government needs to help seed firms conducting GM R&D and enhance the enforcement of IPR in order to make seed firms be more confident of profiting from GM technology. In addition, if the Chinese government hopes to hear policy-making suggestions from interst groups, government needs to provide more channels for private seed firms to lobby and establish lobbying channels for seed firms located out of Beijing in order to motivate seed firms' lobbying activity.

Key words: lobby, GM, biotech, profit, R&D, agriculture, China, policy

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Chapter 1 Introduction

GM food products were first introduced in mid-1990s. Consumers have been expressing resistance and controversies to biotech ever since GM food products were first introduced in mid-1990s. (Falkner 2008). Most controversy about GM food concentrated on three concerns: allergenicity, toxicity, and antibiotic resistance. Chinese consumers also expressed their concerns about potential harm to the environment, social ethics and safety issues (Zhao and Ho 2005), despite the long-term ecosystem effects could not be completely examined (Falkner 2008). As more and more media coverage on negative of GMOs, sometimes even approved to be wrong accusations, the controversy became more intense and the GM safety regulation has become stricter and stricter. The controversy in China criticized biotech companies for selfishly increasing profit by taking risk of harming consumers' health (Chen 2001).

Chinese government has issued regulation policies on GMOs, but managers of Chinese agricultural firms are still unhappy with current GM policies, especially with biosafety regulations (Hu and Deng 2015). The Regulations on the Safety Management of Agro-GMOs was issued on May 23rd, 2001. It regulates the experimentation, production, process, import and export of GMOs. The regulation aims to ensure safety, labeling and licensing. On January 5th 2002, the Ministry of Agriculture (MOA) issued the Administration Measures on Safe Importation of Agri-GMOs (Zhang and Zhou 2003). In 2009, the MOA of China granted biosafety certificates to two GM Bt rice lines and one

GM phytase maize lines, but Bt rice has not been commercialized yet (Li et al. 2014). Foreign GM corn, soybean and canola have been permitted to import for consumption by Chinese biosafety regulatory system, but these traits are not allowed to produce in China. In General, China has made impressive investments in GM R&D (Talbot 2014) but Chinese government is still on a contradictory position toward biotech safety management (Zhao and Ho 2005).

Agricultural biotechnology has been developed aiming to solve the global hunger issue as well as the excessive pesticide applications. GMOs have brought significant benefits to farmers: plants could be modified to resist pests and diseases and therefore enhancing productivity and reducing input (Zhang and Zhou 2003). For example, Bt technology induces plants to produce a protein that is toxic to certain insect pests which enhances yield and reduces the pesticide applications. From the experience from both China and Mexico, Bt cotton increases profit and is good to the environment and human health since Bt technology could reduce the use of pesticide (Pray et al. 2001, Traxler et al. 2001, Thirtle et al. 2003). Evidence from Bt cotton planted in South Africa also shows that though the Bt seed price is relatively high, the additional cost could be outweighed by the higher yield and the reduction of chemical costs. Moreover, during wet season, Bt cotton's performance was better than none-Bt cotton (Thirtle et al. 2003). From previous experience with cotton seed, seed prices were very low and seed companies were not interested in selling them. However, after Bt-cotton was developed, seed prices increased

rapidly and seed companies made much profit (Huang et al. 2003). Based on the data from China Academy of Agricultural Sciences (CAAS), Bt cotton saved 10.6% labor and 60.0% cost of pesticide compared to ordinary cotton and almost doubled the net income from ordinary cotton in Hebei province, China during 2000 (Zhang and Zhou 2003). Another transgenic technology involves a gene that confers resistance to herbicides is called herbicide-tolerant (Ht). Experience from Ht corn in Philippines and South America suggests that technology could not only increase yield but also reduce labor input production cost and capital spent. And the farm-level economic impact could be even more significantly positive in Kenya. Data from South Africa in 2009 and 2010 shows that farmers in the research sample all shifted to Ht corn or Ht/Bt stacks (Kalaitzandonakes et al. 2015). Data from US also suggests that Ht soybeans sold by Monsanto increased farmer's profit by an average of $5.65 per acre (Carlson et al. 1997, Matthew et al. 2000).

Most of the world's agricultural biotechnology research came from private companies, which in particular, have more demands for biotechnology innovation which can help them increasing profits. Farmers also have a demand for biotechnology which could save their cost (Huang et al. 2002). Indeed, the purpose of agricultural technological innovation is to reduce constraints on relatively inelastic supply. Farmers and firms could gain more profit by adopting technological innovations, therefore, they are expected to have the incentive to press the public sectors to develop new technology (Hayami and

Ruttan 1971). As many developing countries such as China still depend much on agriculture and benefit a lot from technology innovation, the GM technology can have a large positive impact (Matthew et al. 2000).

China has an expanding GM crops market, international and domestic biotechnology corporations are competing in the seed market. Previous study shows that seed companies made profits by selling Bt cotton indeed (Huang et al. 2003). It is reasonable to believe that China's biotechnology industry has a bright future and Chinese seed firms should have positive expectation in biotechnology and this positive expectation should drive them to lobby for biotechnological institutional innovations. An example of public sectors' action is the investment on biological technology research which is an institutional innovation designed to realize the potential society-wide benefit from advanced agricultural technology (Hayami and Ruttan 1971).

1.1 Objective

China has a growing market in GM product and it has been proved that some seed firms have experience in profiting from GM crops (Huang et al. 2003). Since firms are driven by profit, it is reasonable to believe that Chinese seed firms have a motivation to lobby for biotechnology in order to gain more profits since lobbying for biotech would allow the commercialization of new biotech variety. This thesis examines the following questions: (1) Did Chinese seed firms lobby for biotechnology? (2) What are the key factors that affect Chinese seed firms' lobbying activity towards biotechnology?

1.2 Thesis structure

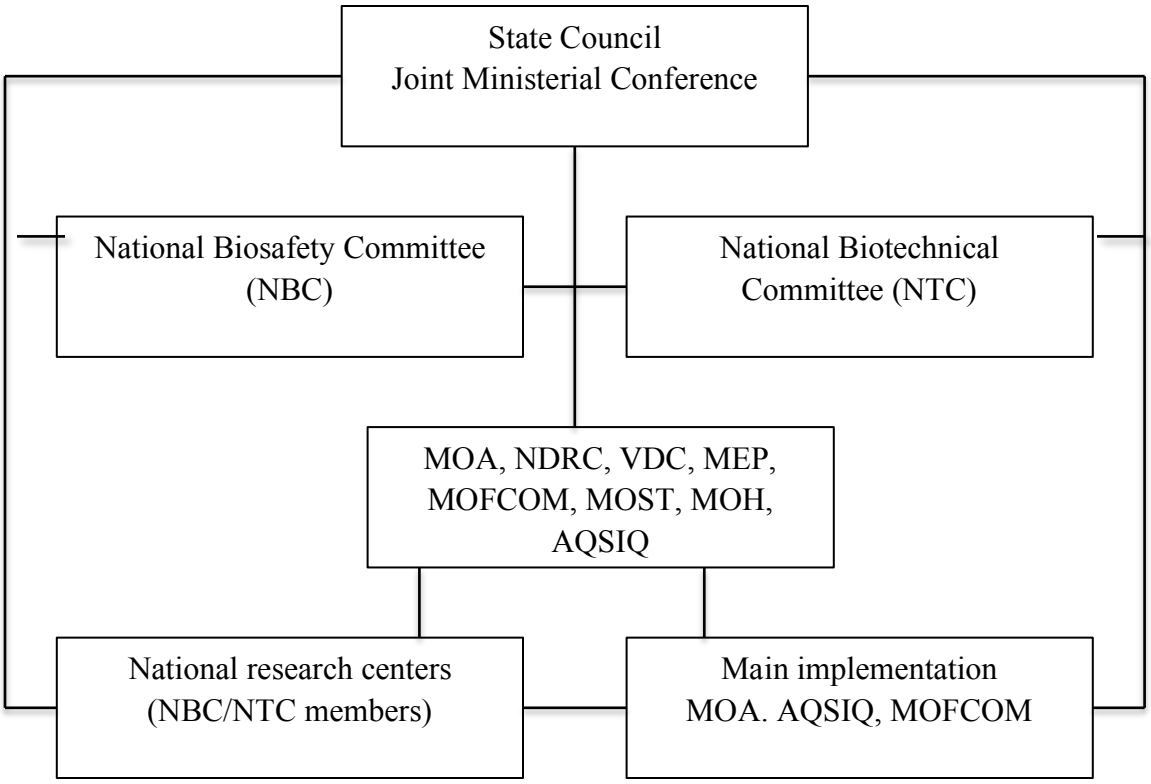
Chapter 2 introduces the development of Chinese seed market, some key biotech regulations and the background of lobbying system in China which is different from the lobbying system in developed countries including United States, due to the special political institutions and society structure. Chapter 3 discusses consumers' attitude towards biotechnology and literature reviews on the theoretical evidence of factors that affect corporate's lobbying activities. Chapter 4 presents a conceptual framework that used to analyze lobbying activity and helps to formulate hypothesis. Chapter 5 explains survey questionnaire data sources and Chapter 6 presents the empirical analysis and results. Chapter 7 concludes this thesis and offers policy implications.

Chapter 2 Background of Chinese Lobbying System, Seed Market Development and Biotech Regulation

2.1 Background of Chinese Lobbying System

In the U.S., senators help firms with lobbying using their voting power. In return, firms raise funds to help senators with election. However, Chinese legislation is dominated by the central government but not the voting system. The financial power and political power in "Chinese style lobbying" is highly complicated (Zhang 2011). Decision-making process of lobbying in China differs from that in most of the other countries. General policy-making process is given below: Communist Party of China (CPC) central committee together with State Council decides the issues to be considered by National People's Congress (NPC). The State Council then prepares plan based on the outcome, and the plan needs to be approved by NPC before State Council starts to implement the plan. China's agri - biotech decision-making system is shown in Figure 1. The State council established Joint Ministerial Conference (JMC) which consists of several government agencies such as MOA, National Development and Reform Commission (NDRC), Ministry of Health (MOH), etc. Major role of JMC includes high-level discussion of biosafety and examination and approval of biotech applications. It also discusses topics concerning the commercialization of GM plant varieties. National Biosafety Committee (NBC) and National Biotechnical Committee (NTC) work together with JMC on agri-biotech developments. NBC focuses on biosafety issues while NTC works on the standardization of biosafety management.

Figure 1 Key institutions of China's agri-biotech decision-making system



Source: (Gilmour et al. 2015) compiled based on the available information from Chinese publications, 2013. Notes: MOA=Ministry of Agriculture; NDRC=National Development and Reform Commission; MEP=Ministry of Environment Protection; MOFCOM=Ministry of Commerce; MOST=Ministry of Science and Technology; MOH=Ministry of Health; AQSIQ=General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China.

The political lobbying has never been a common activity in China. Key research institutes and think-tanks have far more powerful influence in decision-making than private sectors such as agribusiness firms, producers and consumers. Representatives of Chinese citizens are even vested with CPC, the State Council and NPC as well (Huang et al. 2013). Chinese people are disgusted with lobbying activity, as it is well known that the Opium War resulted from some British business men's lobbying activity. Some interest groups who tend to influence policy making or manipulate regulations are under

suspicion of immoral. Due to the lack of formal legislation to regulate, lobbying is still in grey zone. Chinese style lobbying for policy change is an activity which has been existing in China for a long time though it typically takes place during business conversation or is manipulated as a business conversation. There is no formal regulation. In order to lobby, it is critical for interest groups to establish "relationship" or network with government sectors or officers. The more political relationship power the interest group has, the easier to lobby for favorite policies. As a result, interest always skews to powerful interest groups, and it would be hard to balance society economics (Gao 2014).

Here introduces 3 main types of typical lobbying activities from private sectors in China:

1. Industry association's lobbying activity. Industry associations lobby for policy-making and policy enforcement.

2. Stakeholder's lobbying activity. Some enterprises or organization lobby together driven by similar interests.

3. Political broker. Political broker is a connector between government officer and local residents, they earn money from both sides (Zhang 2011).

The three types of lobbying mentioned above could be directly go to the central government or indirectly go to central governments by local governments on behalf of private companies. One role of local government’s liaison offices in Beijing is a representative of lobbying.

2.2 Chinese seed market and biotech regulations

Chinese seed market evolves by 4 stages. During the first stage (1949-1977), farmers depended on self-sufficiency. The second stage is from 1978 to 2000, Chinese seed industry began to form and develop, the improved variety covered 90% of all varieties. During the third stage (2000-2011), new seed law was issued. Private seed firms became the main producer and improved variety coverage reached 95%. The fourth stage (2011 – present), the State Council issued The Opinions on Accelerating the Development of Modern Crop Seed Industry, signaled that the modern development period of Chinese seed industry began. Now, China is the second largest seed market, according to MOA in 2012, Chinese seed market had a value of approximately $17 billion of which 65% was hybrid corn, hybrid rice, vegetable and fruit seeds (Mueller 2015, Yap 2015). From the report of International Service for the Acquisition of Agri-biotech Applications (ISAAA), China ranked 6th in the list of global area of biotech crops (calculated by cultivated hectares) in 2014, with grown biotech crops such as cotton, papaya and poplar (ISAAA 2014). Chinese seed market has been growing rapidly due to 4 main factors: technology development, increasing commercial rate of seeds, extension of after-sales service, and currency inflation (APSA 2014). Top 3 Chinese seed firms in 2015 are Chinese Seed Corp, Yuan Longping High-tech Agriculture Co., and Shandong Denghai Seed Co. (Chinese-Industrial-Information 2015) that is state-owned, joint venture and joint venture, respectively.

Chinese seed market is believed to be the world's largest food consumer by 2018 according to the Association of Food Industry (Yap 2015). State-owned companies are developing new seed varieties recently, and private seed companies are growing rapidly as well. In the meantime, foreign seed firms have been trying to capture the market share of Chinese seed market for two decades and as of December, 2013, the number of multinational seed firms has reached 35, including Monsanto, DuPont, Syngenta, etc. (Li and Yi 2013). Firms with foreign ownership are prohibited to engage in biotech investment without having a Chinese joint venture partner because of the heated controversy on food safety concerns and the political sensitivity on crop seeds. This restriction has been maintained in the 2015 version of the Catalogue For the Guidance of Foreign Investment and Negative List in Use in the Free Trade Zones (Elsinga 2015, Yap 2015). According to Loren Puette, director of agricultural consulting firm ChinaAg, Chinese seed firms are concerned that they are not able to compete with these foreign seed firms because of the lack of technology. In order for local seed firms to meet the domestic seeds demand and to have the ability to compete with foreign products, Chinese government made a development plan which calls domestic top 50 seed firms to share 60% of Chinese seed market by 2020. Chinese government has cut the number of domestic seed firms from 8700 in 2011 to about 5200 in 2014. Firms are pushed to triple their number of agricultural technology patents by 2020 compared with the number in 2013, and state-owned firms will lead the charge. Yuan Longping High-Tech Agriculture Co. bought at least 3 smaller seed firms since 2013 and as Chinese largest producer, it is the

fourth-biggest seed maker with a measure of market value of 20.2 billion RMB ($3.25 billion). Chinese government forced seed firms to list R&D spending in annual reports from 2011 and Longping reports $15 million R&D spending in 2013. However this amount is still less than 1% of what Monsanto spent (Yap 2015).

China has issued biotech R&D regulations since the 1990s. In December 1993, the Ministry of Science and Technology (MOST) issued "Measures for the Safety Administration of Genetic Engineering" for the first time. Some biotech safety issues such as safety assessment, biotech application and approval procedure, safety control and legal concerns were included in the regulation. In July 1996, MOA issued "Implementation Measures for the Safety Control of Agricultural Genetic Engineering". Regulation on Safety Administration of Agricultural Transgenic Organism was released by State Council in May, 2001 and became the main regulation since China has no more laws to regulate agri-biotech practice. This regulation mainly restricts research and testing, production and processing, marking, import and export and supervision and inspection of transgenic organisms. The Chinese government started to invest in agri-biotech studies since 1982. Until 2015, there were about 30,000 scientists working in publicly funded labs related to biotech. China invested 1.5 billion RMB in biotech related R&D in 1980s, and $238 million USD in 1990s. In the 2011-2015 five-year plan, biotech is identified as the priority for development and China invested $308.5 billion USD in biotech related R&D (Gilmour et al. 2015). Most biotechnology research are financed

privately all over the world except China. China has a public-dominated research system - government funds most of the biotechnology research (Huang et al. 2002). Foreign firms who have a local joint venture partner conducted almost all the private biotech research in China(Pray 1999). However, the expenditure was no more than 1.7% of the nation's total agricultural research spent in 2004 (Huang et al. 2004).

Chapter 3 Literature Review

3.1 Consumer's attitude on GMOs

Together with the fast growing of the GM-food market, intense controversies about biotechnology and biotech crops are arousing. As the world's leading GM tech developer and GM crops grower, especially soybean, corn, cotton and canola, U.S. still has debates over GMOs even though GM food has been eaten all around the U.S. for over one decade and there has shown no evidence that GMOs harm human health. People have been being afraid of having human beings clone ever since the sheep Dolly was cloned by Britain. European critics treats GM technology as a threaten to global agriculture, health system and ecosystem (Chen 2001). In China, Early permits to produce GM tobacco, cotton, sweet peppers, tomatoes, and petunia aroused no political controversy. This was primarily due to timing - before 1997 there was very limited knowledge about biotechnology in China. When virus-resistant papaya and insect-resistant poplar trees were approved in 2006 for cultivation, there aroused very little controversy. As many varieties of GM maize, GM soybeans, and GM canola are being extensively imported and are labeled as GM. Consumption of GM-labeled soybean oil has aroused relatively little controversy from consumers. However, GM rice has created far more political controversy in China than any other GM crops such as cotton, tobacco, or vegetables (Lin et al. 2006, Pray and Huang 2007).

The percentage of Chinese consumers who perceive GM foods as unsafe has increased dramatically from 2002 to 2012 by 30% though Chinese consumers hold a more positive attitude than consumers in the rest of world (Huang et al. 2002, Li et al. 2002, Huang et al. 2006, De Steur et al. 2010, Zhang et al. 2010, Qiu et al. 2012, Huang and Peng 2015). The percentage of consumers who perceived GM food as unsafe was 13% in 2002, 18% in 2010 and reached 45% in 2012. Some key factors were examined to affect consumer's perception on GM food. For example, consumer with high education level is more likely to have negative attitude on GM food, consumer who works in government organizations has a perception that GM food is unsafe than consumer who does not work in such organizations, and consumer with higher household income tends to perceive GM food as unsafe compared to consumer with lower household income (Huang and Peng 2015). Most consumer's perception changed in recent years between 2010 and 2012. The reason might be the excessive negative media reports and some food safety scandals that raised consumers' safety concern on GM food (Huang and Peng 2015). Moreover, according to a survey on consumer reactions to GMOs conducted by Zhang & Zhou in 2003, 37.4% respondents believed there would be a long-term risk in human health, 29% believed there would be a long-term effect on the environment, 22.4% believed China had no legislation to regulate GM food, 68.6% did not know whether there was a GM regulation in China at all (Zhang and Zhou 2003). As a matter of fact, there are very few controversies when genetically modified products are applied to medical biotechnology, but when it comes to food biotechnology, things changed totally. Therefore, Scientists are

suggesting to government to issue reasonable regulations and rules to continue boosting the healthy development of biotechnology (Chen 2001).

3.2 The Advantage of Lobbying and Factors that Affect Lobbying Activity

It requires both the interest groups' demand for change and public sector's support for any Induced institutional innovation. The potential gains from agricultural innovations could be realized by public sector's institutional innovation such as conducting research leading to innovation in biological technology (Hayami and Ruttan 1971, Pray et al. 2006). Biotech regulations create costs and benefits to different interest groups. In order to reduce cost and increase profit, these interest groups would support or oppose institutional changes by lobbying (Pray et al. 2006). Lobbying refers to activity such as transferring resources or information to public sector. Interest groups transfer information including their preference to decision makers in order to get benefit from new policies (Spiller and Liao 2006). For instance, firms who expect losses or potential losses would lobby for accelerating the release of policy which can bring more benefits (Pray et al. 2006). Large firms may lobby for stricter regulations which could bring more barriers to smaller firms (Bernauer and Meins 2003). Lobbying also benefits corporates by securing favorable policies, enhancing business performance, and bringing more rates of return compared with other investments. Through corporate political activities, firms expect to get appropriations, policy maintenance, policy change and/or new policy release (Baysinger 1984, Hillman et al. 2004, Lux et al. 2012).

Technological innovation has been shown to increase with the protection of IPRs in a developing country (Chen and Puttitanun 2005). The lack of a functioning market system could be the biggest obstacle to the economic development. IPRs is a key factor that help establishing a well-functioning market system for technology and a well-developed economy (Stiglitz 1989, Chen and Puttitanun 2005). China issued the first patent law in 1985. More than 25000 agricultural biotechnology invention patent applications have been submitted by 2011(Liu and Cao 2014, Deng et al. 2015). IPRs have positive effects on Chinese private R&D research, the weak IPRs enforcement limits firms' investment in R&D (Mansfield 1995, Naseem et al. 2010, Deng et al. 2015). Since firms expect a monopoly market, they are willing to invest in R&D to get IPRs which gives them exclusive rights and protection on their own invented technologies. However, currently IPRs enforcement in China is relatively weak though the IPR law has met the international standard (Athanasakou 2007, Shi et al. 2012, Deng et al. 2015). Study has shown that agribusiness firms lobbied for better protection and enforcement of IPRs in order to benefit from the technology that they own developed (Hayami and Ruttan 1971, Pray et al. 2006).

China is a transition economy and due to the institutional features, CPC party membership may play a much more important role than it would do in a country with mature economy. Tighter connections with Chinese government would help firms to benefit more and suffer less. Empirical result has proved that party membership or say,

political connections affect firm performance through a number of mechanisms in China's weak institutional environment (Li et al. 2006, Li et al. 2008). U.S firms with more lobbying activities in a given year paid lower tax rates in the next year (Richter et al. 2009). In transition economies, such as China, firms with good political connections pay lower tax rates (Wu et al. 2012), have easier access to financing (Mian and Khwaja 2004, Li et al. 2008, Zhou 2013) and have longer debt maturities (Boubakri et al. 2012, Boubakri et al. 2012). Political connections are reported to facilitate trade expansion, increase the likelihood of government bailout (Faccio et al. 2006) and allow firms to pay relatively lower premiums for privatization targets. Political connections exists more in larger firms, Largely because larger firms have better economic opportunities and benefit more from government (Faccio et al. 2006, Zhou 2013). Larger firms tend to engage in more political activities (Masters and Keim 1985, Keim and Baysinger 1988, Boddewyn and Brewer 1994, Hillman et al. 2004), and have great likelihood of success from lobbying (Alt et al. 1999).

Some research has shown that R&D spending determines the corporate political activities. Firms who invest more in R&D are more likely to be active in lobbying to influence public policy (Taylor 1997, Alt et al. 1999, Hart 2001). Empirical results also have indicated that there is statistically significant relationship between R&D and firm productivity. Chinese government put largest fraction of R&D expenditure into state-owned firms, but still not as much as they would like to. Empirical evidences

concluded that state-owned firms are less profitable than private-owned firms, and they are less efficient in developing high productivity with R&D than none state-owned firms even though Chinese government favors state-owned firms when allocates technology innovation resources (Hu 2001). Private Chinese firms faced severe financial constraints while there is no such constraints for state-owned and foreign firms (Poncet et al. 2010).

Chapter 4 Conceptual Framework

This chapter introduces economic and statistical models to analyze Chinese seed firms' lobbying activity for biotechnology and presents hypothesis for empirical analysis.

4.1 Economic model

As discussed previously in literature review, interest groups lobby for policy changes in order to get more profit or reduce potential loss. Lobbying could also result in more rates of return compared to other investment (Pray et al. 2006). Policy changes can enhance firm's performance by providing more advantages to the firm in a competitive market and increasing barriers to other firms that intend to entry the market (Mahon and McGowan 1996, Pray et al. 2006, Lux et al. 2012). From a previous study based on S&P 500 firms, political activity can affect firm's market share. Firms with average political activities versus aggressive political activities experienced very different performance. Firms with aggressive political activities attracted a 14% larger market share than firms with average political activities (Shaffer et al. 2000, Lux et al. 2012). In order to learn that if firms satisfy with current regulations and if they have a knowledge of where or how to lobby, some questions in the survey were designed to asked firms' satisfactory or unsatisfactory about Chinese current policies. The results are as following: 35 of 50 firms (70%) of the firms answered that all of biotech safety regulation, biotech intellectual property rights regulation and biotech R&D regulation need to be improved and 11 (22%) answered that only biotech safety regulations need to be improved. When asked about

which government sectors are expected to take the charge to make policy improvement (multiple choice question), 42 of 50 firms (84%) selected the Ministry of Agriculture, 14 (28%) selected R&D staffs from relative department, 9 (18%) selected province-level or local government officials, and 7 (14%) selected industry associations. Overall, all firms believe that one or more government sectors could help to make regulation and policy improvements, and some of the seed firms has lobbied to some government sectors already. 11 out of 50 firms lobbied to government sectors. As shown in Table 1, 8 out of 11 firms have lobbied to MOA, 2 have lobbied to R&D staffs from relative department, 2 have lobbied to industry associations, and 4 have lobbied to local government officials.

Table 1 Government sectors that seed firms lobbied to

Firm Number	Lobby to government sectors	MOA	R&D staffs from relative department	Industry associations	Local government officials
1	√	√			√
2	√	√			√
3	√				
4	√	√			
5	√		√		√
6	√	√			
7	√	√			
8	√	√			
9	√				
10	√	√		√	√
11	√	√	√	√	
Total	11	8	2	2	4

Source: Calculated by author.

In addition to lobbying to government sectors about biotechnology, 1 interviewed Chinese seed firms have held biotech press conference and 4 firms have sponsored

biotech academic conferences.

When asked about their opinion towards the effect of intellectual property protection's on the development of biotechnology and the R&D of new biotech varieties, only 7 of 50 firms (14%) answered there would be negative effect, while 33 (66%) said there would be no negative effect, and 10(20%) answered they are uncertain. 20 of 50 firms (40%) said they have problem in getting patented technology from government or other private firms. 12 of 50 firms (24%) said they have no problem in getting patented technology and others (36%) answered uncertain. When asked that if they would be more likely to accept the commercialization of biotech crops when they have cheaper and easier access to patented GM technology, 22 of 50 firms (44%) said yes, 10 of 50 firms (20%) said no and others (36%) said uncertain.

These above results show that most firms are unsatisfied with current biotech policies or regulations and they believe some government sectors can take the charge of policy improvements Almost half of the interviewed seed firms are expecting easier access or lower cost on buying patented GM technology. Thus, it is reasonable to believe that these seed firms have the motivation to lobby for biotechnology.

When Chinese seed firms take actions to lobby, the result could be success or failure. Successful lobbying could either increase the unit price or the sales quantity, or both and increase revenue. Whether it is successful or not, lobbying will incur costs. Assume that the possibility of success is θ, the possibility of failure is $1-\theta$. The expected revenue with

lobbying is given below:

$$(4.1)\quad ER=\theta\cdot[P_1\cdot Q(L,K,Lobby)]+(1-\theta)\cdot[P_0\cdot Q(L,K)]$$

Where P_1 denotes the price after successful lobbying and P_0 denotes the price after unsuccessful lobbying. Labor and capital inputs are denoted by L and K, respectively.

The marginal expected revenue from lobbying (MER) is:

(4.2)

$$MER=\frac{\partial ER}{\partial Lobby}=\frac{\partial\theta}{\partial Lobby}P_1\cdot Q(L,K,Lobby)+\theta\cdot(P_1\cdot\frac{\partial Q(L,K,Lobby)}{\partial Lobby})-\frac{\partial\theta}{\partial Lobby}P_0\cdot Q(L,K)$$

As equation (4.2) show, the marginal revenue of lobbying consists of three components. First, an increase of lobbying is expected to increase the probability of a success denoted by θ. Second, a successful lobbying will affect revenue by changing product quantity as lobbying is modeled as one of the inputs. Third, an increase of lobbying will indirectly affect the revenue through the decreased probability of lobbying failure. Using equation (4.2) as a guideline, I expect the following factors will impact the marginal revenue of lobbying. Fro example, R&D investment has been proved to be a determinant of corporate political activity and positively affect firms' lobbying activity (Carlson et al. 1997, Taylor 1997, Alt et al. 1999, Hart 2001). Higher R&D investment could enhance firm productivity (Hu 2001). Firms with GM R&D investment could produce and sell more quantities of GM traits with successful lobbying. Larger firms tend to be more

active in political activity and have higher probability to succeed in lobbying (Faccio et al. 2006, Zhou 2013), so that firm size can affect MER by changing firm's lobbying activity. IPR gives firm exclusive rights and protection on their own invented technologies. Due to the weak IPR enforcement in China, agribusiness firms lobbied for better protection and enforcement of IPR in order to benefit more (Hayami and Ruttan 1971, Pray et al. 2006). Firms that have more IPRs will benefit more from stricter IPR enforcement and would be more likely to lobby.

On the other hand, the expected cost of lobbying is given below:

$$EC = \theta \cdot C[Q(L,K,Lobby),Lobby] + (1-\theta) \cdot C[Q(L,K),Lobby] \quad (4.3)$$

The marginal expected cost of lobbying (MEC) is:

(4.4)

$$MEC = \frac{\partial \theta}{\partial Lobby} \cdot (C_1 - C_0) + \theta \cdot [\frac{\partial C_1}{\partial Q(L,K,Lobby)} \cdot \frac{\partial Q(L,K,Lobby)}{\partial Lobby} + \frac{\partial C_1}{\partial Lobby}] + \frac{\partial C_0}{\partial Lobby} \cdot (1-\theta)$$

Where C_1 denotes $C[Q(L,K,Lobby),Lobby]$, C_0 denotes $C[Q(L,K),Lobby]$.

As equation (4.4) show, the marginal cost of lobbying consists of 3 components. First, an increase of lobbying will increase the possibility of success. Second, an increase of lobbying will indirectly affect the cost by changing product quantity as lobbying is modeled as one of the inputs. Third, an increase of lobbying will directly increase the cost on lobbying. For example, CPC membership of managers can affect MEC by having

impact on lobbying activity, such as CPC membership which means a tighter connection to Chinese central government, tighter political connection would help firms to benefit more and suffer less (Li et al. 2006, Li et al. 2008). Because of the tighter connection, there could be more channels for CPC members to lobby and in the meantime, less costs are required. State-owned ownership means a direct connection between firm and the government. State-owned firms would be more likely to lobby because of the easier access to government sectors. Previous research has shown that universities which located inside the districts that were represented by congressional appropriations committee members lobbied more than universities located outside of such districts (De Figueiredo and Silverman 2006, Lux et al. 2012). As Chinese central government is located in Beijing, firms that have a location in Beijing can have easier access to government officials and could be more active in lobbying than firms located out of Beijing. Seed firms' attitude towards biotechnology and there profit expectation on biotech adoption are also important factors that affect their lobbying activity, since positive attitude may motivate firm to lobby for promoting biotechnology and a negative attitude may motivate firm to lobby for rejecting biotechnology.

In conclusion, many factors can affect Chinese seed firm's lobbying activity, such as firm size, number of IPRs, GM R&D investment, etc., and both marginal cost of lobbying and marginal revenue from lobbying would be affected simultaneously with the change of lobbying activity. A function of lobbying activity is generated as:

(4.5) Lobbying =F (CPC membership of manager, firm size, ownership, GM R&D, number of IPRs, Location in Beijing, attitude towards biotech)

As the MER and MEC curves show in Figure 2, firms can benefit from lobbying or lose by lobbying. When MER≥MEC, the firm would lobby because they can profit from lobbying, for example, state-owned firms will have larger MER than MEC so they are willing to lobby. When MER<MEC, the firm would not lobby since lobbying would bring losses, for example, firms who have less IPRs will not lobby because the cost of lobbying can not be outweighed by the revenue from lobbying. When the relationship between MER and MEC is as shown in Figure 3, the MER is always less than MEC, firms would never lobbying since lobbying would never bring profits to them. In general, lobbying activity is a binary dummy variable which has two values: lobby or not lobby. Therefore, Logit model was applied to statistical analysis in order to quantify each factor's effect on the probability that the firm would lobby.

Figure 2 Firm's marginal expected revenue from lobbying and marginal expected cost of lobbying curve with intersection

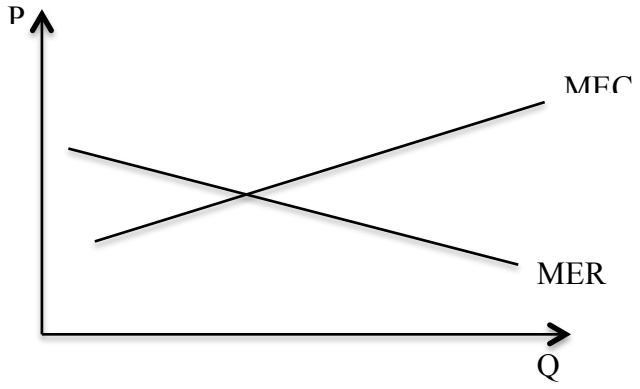
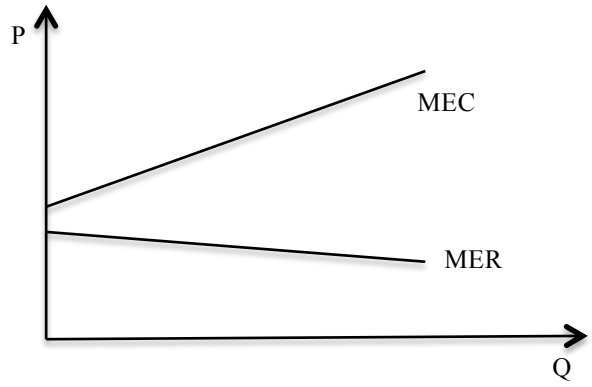


Figure 3 Firm's marginal expected revenue from lobbying and marginal expected cost of lobbying curve without intersection



4.2 Statistical model

The respondent managers were asked to be a representative of the firm, and answer both manager-level questions and firm-level questions. In this thesis, *Mi* denotes as manager-level characteristics and Fj denotes firm-level characteristics

The lobbying activity likelihood is given below:

$$（4.6）\ Lij = \alpha Fi + \beta Mj + \mu ij$$

Where Fi denotes the firm-level characteristics, Mj denotes the manager-level characteristics, μij is the error term. $\alpha\ and\ \beta$ are the parameters to be estimated and reflect the impact of independent variables on the likelihood of lobbying. Lij denotes firm's lobbying activity, A binominal logit model was applied to the estimation. This model assumes that error term is independent and identically distributed to reflect all that cannot be controlled for in this thesis.

The probability of lobbying can be derived from the equation:

$$（4.7）\ Prob(Lij = 1) = F(\alpha' Fi + \beta' Mj) = \frac{e^{(\alpha' Fi + \beta' Mj)}}{1 + e^{(\alpha' Fi + \beta Mj)}}$$

$$（4.8）\ Prob(Lij = 0) = 1 - F(\alpha' Fi + \beta' Mj) = \frac{1}{1 + e^{(\alpha' Fi + \beta Mj)}}$$

The expected likelihood of lobbying is:

$$（4.9）\ E[y] = 0 * [1 - F(\alpha' Fi + \beta' Mj)] + 1 * [F(\alpha' Fi + \beta' Mj)] = F(\alpha' Fi + \beta' Mj)$$

The estimates of α's and $\beta' s$ could not indicate independent variables' marginal effect on dependent variable. The marginal effect of each independent variable on lobbying is:

$$（4.10）\ \frac{\partial E[y]}{\partial xi} = F(\alpha' Fi + \beta' Mj) \cdot [1 - F(\alpha' Fi + \beta' Mj)]\alpha i$$

$$（4.11）\ \frac{\partial E[y]}{\partial xi} = F(\alpha' Fi + \beta' Mj) \cdot [1 - F(\alpha' Fi + \beta' Mj]\beta i$$

Equation of marginal effect provides a quantified measurement of each specific independent variable's effect on dependent variable.

STATA 12.0 was applied to complete the data analysis process.

4.3 Hypothesis

Hypothesis 1: State-owned firms and joint venture firms are more likely to lobby.

In China, if the firm is state-owned, it would have tighter connections to the government and have more channels to lobby than private seed firms. Thus its cost of lobbying would be less. Foreign companies face many limitations on investing in the Chinese seed

industry and R&D, therefore, they would expect more revenue from lobbying and be more eager to lobby for favorite policies than private Chinese seed firms.

Hypothesis 2: Seed firms that locate in Beijing would have more possibility in lobbying.

As Beijing is the political center in China, seed firms that locate in Beijing would have easier access to government officials and better networking with government. This means their costs of lobbying would be less and they would be more likely to lobby compared with firms located outside of Beijing.

Hypothesis 3: Chinese seed firms that have R&D investment in biotechnology would have more likelihood to lobby.

Firms that invest more in R&D are more likely to have lobbying activities to influence policy (Taylor 1997, Alt et al. 1999, Hart 2001). If the seed firm has biotech R&D, they would be preparing for the commercialization of biotech crops. Thus, they would expect to increase their revenue from successful lobbying and be more likely to lobby for promoting biotech than firm that has no biotech R&D.

Hypothesis 4: Chinese seed firms who have more IPRs are more likely to lobby.

If firms hold more IPRs they would expect to increase their revenue from favorable technology policy change. So, it is reasonable to believe that if they have biotech IPRs, they would expect more revenue from favorable biotechnology policies as well. In addition, since current enforcement of IPRs in China is still relatively weak (Athanasakou

2007, Shi et al. 2012, Deng et al. 2015), these seed firms would have the motivation to lobby for a better enforcement of IPR compared with seed firms with fewer IPRs. This kind of lobbying could bring more revenue to the company.

Hypothesis 5: Chinese seed firms that have positive profit expectations on the commercialization of GM crops are more likely to lobby.

Currently, China has approved and given seven bio-safety management certificates to biotech crops: tomato, cotton, petunia, pepper, papaya, rice and maize. However, only biotech cotton and biotech papaya are approved for commercialized cultivation currently (Ministry-of-Agriculture 2013). If Chinese seed firms have positive expectation in the commercialization of GM crops, they could have the motivation to lobby to promote biotech compared with firms that are negative towards the commercialization of GM crops.

Chapter 5 Data

Data for this study comes from a questionnaire survey. To reduce the social desirability bias, all the questions were stated with neutral words, and all respondents were informed about the academic purpose of the project, as well as the confidentiality of their responses.

According to the record of MOA, 70 Chinese seed firms were selected in the survey because they were on a list of top 70 Chinese seed firms[1], and according to the data from MOA, these 70 firms accounted for around 30% of the seed market sales. 70 copies of questionnaire were sent to firms' top manager or decision maker via e-mail. After getting first-round answers back, some questionnaires were sent back for revision because of the lack of information. Finally, 50 completed questionnaires were included in this study. 32 of the 50 firms are private, 14 are state-owned or partial state-owned firms, and 4 are joint venture (partial Chinese ownership and partial foreign ownership) firms.

Respondents were primarily top managers, or the heads of key departments, such as the Director of Research and Development, Vice President, etc. Overall, respondents are knowledgeable of firm operation and industry, since they possessed an average of 19.3 years of employment duration within the firm. Table 2 shows the ownership distribution by lobbying activity, 7 out of 32 (21.9%) of private seed firms, 4 out of 14 (28.6%)

[1] Top 70 Chinese seed firms were identified by the government based on six firm-level characteristics: 1. Net income and revenue; 2. Sales per year; 3. Revenue per year; 4. R&D investment; 5. Self-R&D on breeding; 6. Number of producing base.

state-owned firms, and 1 out of 4 (25%) joint venture seed firms have lobbied.

Table 2 Ownership distribution by lobby

Ownership	Lobbying	%	No lobby	%
Private	7	21.9%	25	78.1%
State-owned	4	28.6%	10	71.4%
Joint venture	1	25%	3	75%

Source: Author's calculations

There are 66 questions in total which include both manager-level and firm-level questions. Each firm only has one respondent manager. Table 3 shows the basic information and characteristics of managers who completed the questionnaire. Most respondent managers (90%) are less than 55-year-old, 84% of them are male, 92% have a bachelor's degree or higher, and 68% are CPC members.

Table 3 Manager-level characteristics

Characteristic	Category	Numbers	% of the
Age	25-35	16	32%
	35-45	16	32%
	45-55	13	26%
	>55	5	10%
Gender	Female	8	16%
	Male	42	84%
Education	PhD	4	8%
	Master	14	28%
	Bachelor	28	56%
	Associate	4	8%
CPC membership	Yes	34	68%
	No	16	32%

Firms-level characteristic details are shown in Table 4. 28% firms are state-owned or partial state-owned, 64% are private firms, and 8% are joint venture firms, Average number of employees of 50 firms is 300, 36% of the firms have GM R&D investment.

Table 4 Firm-level characteristics statistics

Characteristic	Mean or percentage	Standard Deviation
Ownership: Private (%)	64.00	0.48
State-owned and partial state-owned (%)	28.00	0.44
Joint venture (%)	8.00	0.27
Number of Employee	300.71	342.43
Investment in R&D in 2013 (10k RMB)	1904.80	2940.47
GM - R&D (%)	36.00	0.48
Number of GM R&D center	0.54	1.10
Number of patented technologies	9.06	9.60
Number of R&D project (2010-2013)	3.60	6.10
Lobby (%)	24.00	0.43

Dependent Variable

Due to the different society system, there is a significant divergence with 'lobby' between the U.S and China. In China, people who write to or talk to government sectors with their own suggestion or dissatisfaction toward policies or regulations can be regarded as a type of 'lobby'. In this study, three types of activities could be defined as 'lobby' according to 3 questions in part B which directly ask about firm's lobbing activity and the number of firms who answered yes to these 3 questions are shown in Table 5.

Table 5 Types of lobbying activity and firm's ownership

Type of Lobbying	Number of Firms
The firm reported concern or communicated with government sectors regarding biotech	11
Any press conference regarding GM technology has been held directly by the firm	1
Any press conference regarding GM technology has been held directly by the firm	4
Any of the above	12

Source: Calculated by the author based on questionnaire used in this thesis.

In this study, 11 firms lobbied to government sectors such as firm A wrote once and talked twice to the Ministry of Agriculture regarding biotechnology and got response. Firm B spoke to the Ministry of Agriculture twice as well as province-level officers twice about their concern on biotechnology, etc. Only one firm, held press conference but they did not specify any details. 4 firms sponsored academic conferences such as firm C which sponsored one academic conference in 2011 and two academic conferences in 2013. Firm D has sponsored conference in Hainan, China during 2009 and in Beijing, China during 2012. Due to the confidentiality agreements with all respondent firms, any exposure of firms' name is prohibited. Firms with any of the 3 listed activities are defined as with lobbying activity. Thus, after eliminating the overlap, 12 out of 50 firms are with lobbying activities. Table 6 gives summary statistics of key variables.

Table 6 Summary statistics of key variables

Variables	Mean or percentage	Standard Deviation
Lobby (dummy)	0.24	(0.43)
Employee (units)	300.72	(335.37)
Location (dummy)	0.14	(0.35)
Breeding R&D (dummy)	1.02	(0.14)
GM - R&D (dummy)	0.36	(0.38)
Investment in R&D (10k	1770.51	(2892.68)
IPRs	9.06	(9.59)
R&D project	3.6	(6.10)
Ownership (dummy)		
Private	0.64	(0.49)
State-owned and partial	0.28	(0.45)
Joint venture	0.08	(0.27)
Profit expectation	0.28	(0.45)
Manager's education		
Ph.D.	0.08	(0.27)
Master's	0.28	(0.45)
Bachelor's	0.56	(0.50)
Associate's	0.08	(0.27)
CPC (dummy)	0.68	(0.47)
Attitude - biotech	0.50	(0.51)
Attitude – adoption	0.46	(0.50)

Chapter 6 Empirical Results

6.1 Empirical models used in this thesis

Based on conceptual framework, literature review and background of China's lobbying system, the following empirical model are generated for the lobbying activity model and the definition and measurement unites of explanatory variables are shown in Table 7:

Lobby = α_0 + α_1 employee + α_2 location dummy + α_3 profit expectation dummy + α_4 gm-R&D dummy + α_5 IPR + α_6 ownership dummies + α_7 CPC dummy + α_8 attitude-biotech dummy + μ

Lobby = β_0 + β_1 employee + β_2 location dummy + β_3 profit expectation dummy + β_4 gm-R&D dummy + β_5 IPR + β_6 ownership dummies + β_7 CPC dummy+ β_8 attitude-adoption dummy + μ

Table 7 Definition and measurement unites of explanatory variables

Variables	Definition and unit
Lobby activity	1=the firm has/had lobbying activity;0=otherwise
Employee	Number of current employees of the firm
Location	1=firm locates in Beijing; 0=otherwise
Breeding R&D	1=the firm has breeding R&D; 0=otherwise
GM-R&D	1= the firm has GM breeding R&D; 0=otherwise
Number of R&D centers	Number of R&D center the firm has
Number of GM R&D center	Number of GM R&D centers the firm has
R&D investment	Amount of investment the firm spent during 2013(unit=10k RMB)
IPR	Number of IPRs the firm holds
R&D project	Number of R&D projects that the firm conducted during 2010 to 2013
Biotech products	1=the firm has biotech products; 0=otherwise
Ownership	Dummy variable with three values: Private, State-owned or Joint venture
Profit expectation	1=the firm has positive profit expectation in biotech crop's commercialization; 0=otherwise
Manager's education	Education indicates the highest degree that the manager has. This is a dummy variable with four values: Ph.D., Master's, Bachelor's or Associate's.
CPC	1=the manager is CPC member; 0=otherwise
Attitude-biotech	1=the manager holds positive attitude in biotechnology and biotech crops, 0=otherwise
Attitude – adoption	1=the manager holds positive attitude towards the adoption of bio-crop, 0=otherwise

STATA 12.0 software package and data from 50 Chinese seed firms were used to estimate the factors' impact on lobbying activity.

6.2 Empirical results of lobbying model

Table 8 shows regression estimates results and the average marginal effect results of the two models. The first model uses attitude towards biotech dummy and the second model uses the attitude towards bio-crop adoption dummy.

Results from both of the two models show that:

1. Ownership has the largest impact on Chinese seed firms' lobbying activity among all the variables involved. State-owned seed firms are more active than private firms in lobbying. This variable is statistically significant and this result partly supports Hypothesis 1.

2. Chinese seed firms who have GM breeding R&D are more likely to lobby for biotech compared with firms with no GM breeding R&D. This variable is statistically significant and this result supports Hypothesis 3.

3. Manager's CPC membership has positive effect on lobbying activity though this variable is statistically significant in neither of the two models. CPC membership means a tighter connection to government and could help with a firm's performance (Li et al. 2006, Li et al. 2008).

4. Interesting finding is that firm size (evaluated by number of employee) negatively affect seed firms' lobbying activity in both models – firms who have more employees are more unlikely to lobby than firms with less employees. This may be a result of

Chinese-style lobbying which does not require a lot of money, in this case, both small firms and large firm have the ability to lobby as long as they are willing to.

5. Although firms' "profit expectation on the commercialization of biotech crops" is not significant, its average marginal effect on lobbying activity has a positive value which means that if Chinese seed firms are positive towards biotech adoption are more likely to lobby than seed firms that are negative on biotech adoption. This result support hypothesis 5.

In addition to the above, Model 1 also shows that:

6. Chinese seed firms with more IPRs tend to be more active in lobbying than firms with less IPRs. This variable is statistically significant and the result supports Hypothesis 4.

7. Joint venture seed firms are more likely to lobby than private seed firms and positive attitude towards biotech largely affects the lobbying activity positively. This variable is statistically significant, partly supports Hypothesis 1.

In additional to mutual results, Model 2 also shows that:

8. Seed firms locate in Beijing are more likely to lobby for biotech than seed firms locate out of Beijing. This variable is statistically significant and the result supports Hypothesis 2.

9. Positive attitude towards the adoption of GM crops largely affect firm's lobbying activity positively compared to non-positive attitude. This variable is statistically significant.

Table 8 Estimation results of lobbying model

Variable	Model 1		Model2	
	Estimate coefficient	Average marginal effect	Estimate coefficient	Average marginal effect
Employee	-0.0046	-0.0004*	-0.004	-0.0003*
Location	1.752	0.139	2.880*	0.236**
Profit expectation (base=not positive)	1.403	0.112	0.597	0.049
GM – R&D (base=not have)	2.912**	0.232**	2.365*	0.194**
IPR	0.170*	0.135**	0.081	0.007
Ownership (base=private)				
State-owned and partial state-owned	3.815*	0.304**	3.775	0.310*
Joint venture	4.880*	0.388**	3.181	0.261
CPC (base= not a member)	0.856	0.068	2.259	0.185
Attitude - biotech (base=not positive)	5.291*	0.421**		
Attitude - adoption (base= not positive)			4.206*	0.345**
Pseudo R-square	0.5384		0.5490	
Ratio of correct in-sample predictions	80%		98%	

Note: The asterisk, *, **, and *** indicates 10%, 5% and 1% significance level, respectively. Model 1 uses attitude towards biotech dummies while model 2 uses attitude towards biotech crop's adoption dummies.

6.3 Results discussion

In addition to the variables that applied to both model, model one includes the "manager's attitude towards biotechnology" variable which asked if the manager holds a

positive attitude towards biotechnology such as its environmental effect, safety issue and ethic issue, while model 2 includes the "firm's attitude towards the adoption of biotech crops". Although these two questions were asked from difference aspects (one asked from manager's aspect and the second asked from firm's aspect), they are both answered by the same manager and could be highly correlated. Therefore, they are applied to two separate models and present different estimate results.

The pseudo R-square of model 2 is 0.5490 which is almost the same as the pseudo R-square of model 1 (0.5384). 98% of in-sample predictions of model 2 are correct while 80% of in-sample predictions of model 1 are correct. Therefore, it is reasonable to have more confidence in model 2 than in model 1, and results from model 2 would be believed compared with the results from model 1.

Chapter 7 Conclusions

China has a growing market in GM product and it has been proved that some seed firms have profited from Bt crops. Since firms are driven by profit, it is reasonable to believe that Chinese seed firms have a motivation to lobby for biotechnology in order to gain more profits. Moreover, China has issued some policies but still not enough, the enforcement of IPRs is still weak. Some Chinese seed firms have lobbied to government sectors, held biotech press conferences or sponsored academic conferences, and they are believed to do more. This thesis focuses on identifying factors that impact Chinese seed firms' lobbying activities using survey data on 50 top Chinese seed firms across China, and also quantified the impact of these factors. Several key findings are as following:

Chinese seed firms have lobbied indeed. 11 out of 50 Chinese seed firms have lobbied to government sectors, 1 firm has lobbied by holding biotech conference, and 4 firms have lobbied by sponsoring biotech academic conferences. In general, by eliminating the overlaps, 12 out 50 Chinese seed firms participated in the survey had lobbying activities.

The empirical result shows that ownership is a key determinant of seed firm's lobbying activity. State-owned seed firms are more likely to lobby for biotechnology compared with private seed firms. Firms with GM breeding R&D investment are more likely to lobby for biotechnology than firms with no GM breeding R&D investment. This result is consistent with previous results from (Carlson et al. 1997, Taylor 1997, Hart 2001). In addition, the empirical results also show that firm's location also affects lobbying activity.

Seed firms that locate in Beijing have higher likelihood in lobbying for biotechnology compared with seed firms locate out of Beijing. Previous research has shown that universities which located inside the districts that were represented by congressional appropriations committee members lobbied more than universities located outside of such districts (De Figueiredo and Silverman 2006, Lux et al. 2012). The explanation might be that as China's central government locates in Beijing, closer to Beijing could represent an easier access to government sector. Another key finding is that positive attitude towards the adoption of GM crops largely affects firm's lobbying activity positively compared to non-positive attitude. Manager's attitude towards GM adoptions largely affects seed firm's lobbying activity, positive attitude towards GM adoption may lead to lobbying activity on biotechnology compared with negative attitude.

In conclusion, if Chinese government decides to promote biotechnology, it could get the seed firms more involved by helping seed firms conduct GM R&D and enhancing the enforcement of IPR in order to make seed firms more confident of getting profit from GM technology. If Chinese government hopes to hear policy-making suggestions from interest groups, government needs to enhance communication channel for private seed firms and those firms located outside of Beijing.

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