An Exploration of Product Choices in U.S. Biotech Corn Seed Market

Wenhui Zhang, Guanming Shi

Department of Agricultural and Applied Economics, University of Wisconsin-Madison, Madison, WI 53706

Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2012 AAEA Annual Meeting, Seattle, Washington, August 12-14, 2012

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Abstract: We investigate the market and firm-specific factors that may impact firms' product choices in the U.S. biotech corn seed market. Specifically, we estimate how the competition effects, the conglomeration effect, the similarity effect, and other market shifters influence firms' variety choices under imperfect competition. In addition, we examine and compare such responses among different types of firms, including integrated biotech firms versus seed companies, and the incumbent firms versus the entrant firms.

Key Words: variety choice, imperfect competition, biotech seeds

1. Introduction

The development of the hybrid crops started around 1930s (Fernandez-Cornejo, 2004), when the biotechnology was still growing at a slower pace due to the immaturity of genetic engineering technology. In 1960s and 1970s, the Green Revolution started a new chapter of bio-technology innovation. The farmer-initiated breeding technology was switched to the firm-initiated genetic engineering breeding technology. Besides, large pharmaceutical firms gradually dominated the seed market through mergers, acquisitions and joint ventures, with a large amount of private R&D expenditures on biotechnology. Accordingly in the next thirty to forty years there has been a proliferation of the genetic-modified (GM) seeds. Especially after year 1996 when the first-generation biotechnology seeds with herbicide-tolerant and insect-resistant traits were commercially released, the development and adoption of GM seed varieties have been further facilitated. Actually the product choices have become a successful marketing strategy for seed firms to acquire market power. From our data, over year 2000-2007 firms' carried varieties keep increasing in number and dispersed in distribution (Figure 1). This motivates our interest in two product competition tools--the product scope and the product overlapping, hoping to uncover how the firms adjust their products in response to market structural changes.

This issue is also relevant to the significant transformation in the corn seed market over the last three decades. Several leading biotech firms obtain the patent protection for these GM traits and constituted the upstream trait market. The downstream seed market is relatively more competitive, where both integrated biotech firms and seed companies exist. By means of mergers and acquisitions these integrated biotech firms manage to dominate the downstream seed market. The four firm concentration ratio (CR4) in this market has risen above 70% since 2005 (Shi, Chavas and Stiegert, 2010). This motivates our inquiry of the different responses from those

integrated biotech firms and seed companies, considering their respective positions in the upstream and downstream seed market.

Variety choices have long been discussed in the theoretical literatures in terms of the extent of differentiation that firms seek. In the simplified two-firm Hotelling model (Hotelling, 1929; Lancaster, 1979), firms are choosing the "minimum differentiation" strategy when the transportation cost is linear, and the "maximum differentiation" strategy when the transportation cost is quadratic (D'Aspremont, Gabszewicz and Thisse, 1979). When more than three firms are present, partial clustering and partial differentiation become profitable (Lerner and Singer, 1937; D'Aspremont, Gabszewicz and Thisse, 1979; Eaton and Lipsey, 1984; De Palma et al., 1985; Gupta et al., 2004). Recent progress on multi-product firms adds a new factor into the variety choices—how long is the product line profitable. And the key effect would be the trade-off between more demand and cannibalization of the existing products. Adopting a wider product line will attract more consumers with diverse preferences and soften the competition. However, if the consumers switch from current products to the new adopted products, the sales of current products will drop (Anderson and De Palma, 2006; Feenstra and Ma, 2007; Bernard, Redding and Schott, 2010). Therefore firms could adopt either a wider or a narrower product line, depending on the relative magnitude of the cannibalization effect.

Besides, empirical studies have also begun to analyze the causal relationship between firms' variety choices and the market structure such as mergers, entries, and ownership changes. These literatures allow for the endogeneity of variety choices after the market structure is altered. Alexander (1997), George and Waldfogel (2003, 2006) inquire how the overall variety offered in the industry changes with respect to the market concentration, consumers preferences, and the differentiated penetration of national and local brands on the industry level. A series of recent

papers use firm-level data to investigate how the market structure changes mentioned above affect the firm-specific product choices. Watson (2009) finds an inverse V-shape between variety numbers chosen by individual firms and the increased competition represented by entry firms. Berry and Waldfogel (2001), Thomadsen (2005), Sweeting (2010) are focused on the variety choices of the merging and merged firms, with the conclusions that: 1) market consolidation preempts entry and increases the varieties on the firm level; 2) merging firms are positioning the products more similar to the competitors; 3) mergers' impact is decreasing with the geographical distances. However, the causal relationship is not unanimously found out in the previous literatures. For example, Chisholm, McMillan and Norman (2006) do not find the dissimilarity within the merging firms. Instead, after differentiating the products in more than one dimension, their findings support the "partial clustering" and "partial differentiation" in product positioning, and the similarity of products under the same ownership.

As neither the theoretical nor the empirical studies could reach an agreement on the degree of product differentiation chosen by individual firms, we intend to take a look at two product differentiation strategies—the length of the product line within firms, and the overlapping of product lines across firms. With the application in the U.S. Biotech corn seed market, we find that the presence of the integrated biotech firms induces a longer product line and more differentiated market strategy in order to soften the competition. This is the "partial differentiation" effect we find. Comparably competition from geographically close competitors catalyzes a shorter product line and more overlapping varieties, indicating the "partial clustering" effect. Moreover, as firms conglomerate in nearby neighborhoods, demand will be stimulated so that carried varieties will be increased accordingly. We also find more overlapped product line compositions in recent years, when the genetic technology gets mature. Besides, the different

responses from the integrated biotech firms and the seed companies in the short run indicate that the corn seed market is diverging into two groups over time.

This paper investigates the role of the product scope and product overlapping strategies both conceptually and empirically. Firstly, we will develop a conceptual framework for biotech firms under imperfect competitions and then specify factors affecting product choices including competition effects, firm's observable characteristics and market shifters. Secondly, we will build an empirical model to estimate the impact of these factors we have developed from the conceptual model on the product choices using observations from the U.S. biotech corn seed market over the period from 2000 to 2007. After introducing the data, the estimated results are finally presented and analyzed.

2. Conceptual Model

This conceptual model is specified for a short-run analysis of firms' product line choices. We denote $NV^f{}_t$ as the number of varieties carried by seed company f. We further assume that firms make this product line choice based on the information of last year's market conditions. Firms respond to the market structure in the last year as exogenously given. And they choose the optimal $NV^f{}_t$ in the current year specifically according to: 1) number of competitors in the near and far-away neighborhood, for which we use the vector $N^c{}_{t-1}$ to denote competitor numbers in varied distances to the seed company f; 2) the seed company f's characteristics including market power achieved last year, collapsed into the vector of $Z^f{}_{t-1}$; 3) observable demand shifters represented by the vector $D^f{}_t$; 4) and the seed company f's idiosyncratic unobserved shock $\varepsilon^f{}_t$. t and $t-1$ are time indexes of the current year and last year respectively. The

variables with the subscript $t-1$ are the realized outcomes at the end of last year, while the variables with the subscript t are the realizations of market structures at the end of this year after the firm f makes the product line decisions.

The choices of $NV^f{}_t$ could then be represented by the function $F(.)$, with the factors we have specified:

$$NV^f{}_t = F(N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t) + \varepsilon^f{}_t \quad (1)$$

In particular, we are making the following assumptions for empirical estimation. First, $N^c{}_{t-1}$ is assumed to be uncorrelated with $Z^f{}_{t-1}$. $N^c{}_{t-1}$ is the competition or conglomeration effect in between firms. $Z^f{}_{t-1}$ is firm f's characteristics with market share included in. In the long run with free entry, firms tend to be symmetric so that the market structure could be fully represented by number of firms in varied distances. Each firm's market share is endogenously determined. However, the purpose of this paper is to take a shorter look at the market evolution and focus on the strategic interaction of firms via the product line choice. We justify the exogeneity assumption by the following aurguments: 1) in the short run facing the same number of competitors nearby and far away, firms choose varied product lines mainly due to their own characteristics including market share; 2) firms are much easier to adjust their product line compared to adjust their market entry decisions, which means that $N^c{}_{t-1}$ could be treated as pre-determined. The two arguments finalize our assumption that $N^c{}_{t-1}$ and $Z^f{}_{t-1}$ are not correlated.

Secondly, $D^f{}_t$ is not related to either $N^c{}_{t-1}$ or $Z^f{}_{t-1}$. $D^f{}_t$ is the market shifter vector in the current year, which could be observed both by seed companies and the econometricians. One element is technology availability. We think it is an important measure that needs to be controlled as trait engineering developments are making more and more varieties technologically

available in the market. Seed companies could forecast the technology availability before they make the product line choices. This constraint on their choice set is not dependent on their competitors or their own characteristics. The genetic breeding technology serves as the public information known by each firm at the beginning of each period.

Thirdly, $\varepsilon^f{}_t$ denotes the unobserved firm-specific characteristics that are orthogonal to $N^c{}_{t-1}$, $Z^f{}_{t-1}$ and $D^f{}_t$. The thinkable factors include capital constraint for carrying more varieties, unexpected shocks in their regular business and so on. Furthermore, we assume that conditional on the realizations of $N^c{}_{t-1}$, $Z^f{}_{t-1}$ and $D^f{}_t$, the expectation of $\varepsilon^f{}_t$ for individual firm f is equal to zero, which means:

$$E[\varepsilon^f{}_t \mid N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t] = 0$$

$$\begin{aligned} E[NV^f{}_t \mid N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t] &= E[F(N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t) + \varepsilon^f{}_t \mid N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t] \\ &= F(N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t) \end{aligned} \tag{2}$$

The specification in equation (2) helps us to do the empirical estimation using the Ordinary Least Square regression method.

The other dependent variable we are using is the product overlapping measurement $OVLAP^f{}_t$. Following the same specification for $NV^f{}_t$, the second set of conceptual models could be written as

$$OVLAP^f{}_t = F'(N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t) + \eta^f{}_t \tag{3}$$

where $F'(.)$ is another linear function of $N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t$. And accordingly, we have the following assumptions made for empirical estimation:

$$E[\eta^f{}_t \mid N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t] = 0$$

$$E[OVLAP^f{}_t \mid N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t] = E[F'(N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t) + \eta^f{}_t \mid N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t] = F'(N^c{}_{t-1}, Z^f{}_{t-1}, D^f{}_t) \quad (4)$$

Since the number of varieties to carry and the overlapping of varieties to carry are distinct product positioning strategies, we use separate conceptual models for empirical estimations. In this way, the correlation between the two dependent variables could be circumvented and the estimation results will be unbiased.

3. Data

The data we are using comes from Dmrkynetec (DMR organization) who surveys the US corn seed farmers annually via computers and telephones. It include 13507 firm-level observations in 91 crop reporting districts (CRD), and 16465 farm-level records on seed purchases, acreage, seed types, and seed prices over year 2000-2007. The CRD classification is initiated by U.S. Department of Agriculture (USDA thereafter) by aggregating those intersecting counties with "similar physiographic, soil, and climatic traits"[1] (USDA). One CRD is confined within the boundary of a state. In other words, "county", "CRD", "state" are ordered in the way of geographical size. Our data covers 18 states that consist of the major corn planting areas in the U.S., with details listed in Table 1. We divide the seed types into 16 categories: five basic categories including the conventional seeds (without GM traits) and the seeds containing the four types of biotech trait--European Corn Borer, Corn Rootworm, Herbicide Tolerance type I and Herbicide Tolerance type II, and eleven categories of seeds with various stacking traits from double stacking to quadruple stacking. We call these categories "varieties" or "product type". These "varieties" are featured by the injected genetic modified traits. Each trait is developed for specific purposes such as resisting insects or being tolerant to herbicides. Accordingly firms'

[1] USDA. "Farm Resource Regions." http://www.ers.usda.gov/publications/aib760/aib-760.pdf.

choices of which categories to carry for inventory are referred to "variety choices" or "product choices" in this paper. We categorize the firms in our data into two groups—the integrated biotech firms who own the patent protection for these GM traits, and the seed companies who do not own the patent protection. In total we have six integrated biotech firms, four of which also sell seeds directly to farmers. Firms' branch locations are recorded on the county level, which is a sub-area of the Crop Reporting District (CRD). The summary statistics for seed types and firm numbers are included in Table 2 and 3.

The markets are specified according to two dimensions. In terms of where the seeds are transacted, we have the upstream trait market which are consisted by those six integrated biotech firms, and the downstream seed market where corn seeds are sold to farmers. The downstream seed market is where our research is focused. In terms of market size, we divide the seed market into local market and national market. Since from the data we observe that firms have branches located in CRDs, and a CRD belongs to a state, it is likely that firms are competing within the same CRD, or within the same state, or more broadly within the national market. If firms are competing on the CRD level, we treat the two branches of the same firm located in two different CRDs as two different firms, while the two branches of the same firm located in the same CRD are treated as one firm. Similarly if firms are assumed to be competing on the state level, we treat the two branches of the same firm located in two different states as two different firms, while the two branches of the same firm located in the same state are treated as one firm. In the same sense, all branches of the same firm are treated as one firm if the assumption that firms are competing on the national level holds. Therefore in total we have two "local markets" and one "national market". Thereafter except being specified, when we use the word "market" we mean the "local markets" are being considered.

Relevant to the differentiation between "local markets" and "national market" is the necessity to redefine individual firm's behavior. In the case of two branches of the same firm located in the same local market, as what have been specified above, these two should be treated as one firm. In accords, if one branch carries variety1, variety 2 and variety3, while the other branch carries variety1, variety2 and variety4, we merge them together into a "headquarter" of the same firm carrying variety1, variety, variety3 and variety4. The selling quantities of each branch are also aggregated by variety. The relationship between "branches" and "firms" by our definition is illustrated in Figure 2.

4. Empirical Model

Our investigation concentrates on the strategic interaction between product line choice and 1) the competition/ conglomeration effect N^c_{t-1}; 2) individual firm's observable characteristics including market shares Z^f_{t-1}; 3) after controlling for the market shifter D^f_t. The first two factors are particularly interesting for us to understand the explanatory power of individual firm's market position on its variety choices.

Based on equation (2) and (3), the empirical model is specified as:

$$log(NV^f_t) = \alpha + \Gamma N^c_{t-1} + \Phi Z^f_{t-1} + \Pi D^f_t + \varepsilon^f_t$$

$$OVLAP^f_t = \alpha' + \Gamma' N^c_{t-1} + \Phi' Z^f_{t-1} + \Pi' D^f_t + \eta^f_t \qquad (5)$$

where $log(NV^f_t)$ is the logarithm of NV^f_t, and Γ, Φ and Π (including Γ', Φ' and Π') are the parameter vectors in front of these vectors-- N^c_{t-1}, Z^f_{t-1} and D^f_t respectively. $F(.)$ function and $F'(.)$ is specified as a linear combination of N^c_{t-1}, Z^f_{t-1} and D^f_t.

The vector of N^{c}_{t-1} is intended to represent the competition/conglomeration effects among firms. The competition comes from two levels—competition between big integrated biotech firms and seed companies, and the geographical competition among firms located in varied distances.

On one hand, as we have discussed before, integrated biotech firms control the trait patents featuring different varieties (or seed types). The presence of these integrated biotech firms in the same market incurs discrepant impacts towards other integrated biotech firms and seed companies. In order to capture this discrepancy, we develop two variables $N^{f}_{b1,t-1}$ and $N^{f}_{b2,t-1}$. $N^{f}_{b1,t-1}$ is designed to capture the competition between two integrated biotech firms co-existing in the same market, while $N^{f}_{b2,t-1}$ is to capture the competition impact of the integrated biotech firms on seed companies. Both $N^{f}_{b1,t-1}$ and $N^{f}_{b2,t-1}$ are the observed results by firm f from last year $t-1$. Therefore if the firm f is one of the integrated biotech firms, $N^{f}_{b2,t-1}$ is zero. In contrast, if the firm f is one of the seed companies, $N^{f}_{b1,t-1}$ is equal to 0.

On the other hand, the geographical competition in varied distances is confined to these "zones"—the whole market, the submarkets within 20 miles, 10 miles and the adjacent neighborhood of where the firm f locates. Accordingly numbers of firms located in these "zones" are represented by the variables $N^{f}_{m,t-1}$, $N^{f}_{20,t-1}$, $N^{f}_{10,t-1}$ and $N^{f}_{0,t-1}$ in the same order as "zones". These four variables are also firm f's observations in the last year.

The vector of Z^{f}_{t-1} denotes firm f's observable characteristics. Ideally we could use firms' daily business information as their characteristics. However, due to the limitation of data,

we could not obtain these detailed statistics. Therefore we construct the following variables to circumvent the problem.

The first is firm f 's observed market share in the last year, $MS^f{}_{t-1}$. This variable is constructed by first aggregating individual firm's selling quantities over all available varieties, serving as each individual firm's "aggregate quantities". The summation of each firm' "aggregate quantities" is defined as "total market size". Then the proportion of firm f 's "aggregate quantities" with respect to the "total market size" is by definition the variable $MS^f{}_{t-1}$. The calculation can be summarized by the following equation:

$$MS^f{}_{t-1} = \frac{\sum_v q^f{}_{v,t-1}}{\sum_f \sum_v q^f{}_{v,t-1}} \tag{6}$$

where $q^f{}_{v,t-1}$ is firm f 's selling quantity for variety v in time $t-1$.

Accordingly we obtain the second variable $MS2^f{}_{t-1}$, which is the square term of $MS^f{}_{t-1}$ designed for nonlinearity. In other words, $MS2^f{}_{t-1}$ is defined by the following equation (5):

$$MS2^f{}_{t-1} = (MS^f{}_{t-1})^2 = \left(\frac{\sum_v q^f{}_{v,t-1}}{\sum_f \sum_v q^f{}_{v,t-1}} \right)^2 \tag{7}$$

The third variable is constructed with the aim of reflecting the additional market power enjoyed by those firms conducting business in more than one local market, under the same firm name. Although previously we assume that two branches of the same firm located in two local markets are treated as two firms, in reality there could still be strategic coordination between these two branches. In order to capture this coordination impact, we design the variable

$MS^{f}{}_{weight,t-1}$ in the following way—firstly we calculate each firm's market share $MS^{f}{}_{t-1}$ in the national market and denote it as $MS^{f}{}_{t-1}{}'$; then for each firm f in the local market, $MS^{f}{}_{weight,t-1}$ is set to be equal to $MS^{f}{}_{t-1}{}'$ for the same f. The basic intuition for this design is to let $MS^{f}{}_{weight,t-1}$ serve as a weighting index for each firm's variety choices in the local market, capturing the extra market power gained outside the current local market. Therefore by this specification those big firms who are doing business across many states could offer more support to their local branches, the extent of which is measured by $MS^{f}{}_{weight,t-1}$ in our model.

The forth variable is aiming at capturing the similarity between two firms in terms of the variety numbers and variety types they carry. The variable $SIM^{f}{}_{t-1}$ is constructed by the following equations:

$$SIC^{f}{}_{t-1} = \sum_{f' \neq f} \frac{V^{f}{}_{t-1} * (V^{f'}{}_{t-1})'}{\sqrt{V^{f}{}_{t-1} * (V^{f}{}_{t-1})'}\sqrt{V^{f'}{}_{t-1} * (V^{f'}{}_{t-1})'}} \tag{6}$$

$$SIM^{f}{}_{t-1} = SIC^{f}{}_{t-1} - \frac{1}{N}\sum_{f=1}^{N} SIC^{f}{}_{t-1} \tag{7}$$

In equation (6) $V^{f}{}_{t-1}$ is a vector of variety choices made by firm f, with entries of either 1 or 0 representing whether the firm carries one variety or not. The length of $V^{f}{}_{t-1}$ is equal to the number of all available varieties in our data. For example, in one local market there are three firms and three varieties to be chosen. Their variety choices are made according to Table 4. In this example, Firm 1 and Firm 2 both carry Variety1 and 2, and Firm 3 carries Variety 3. Accordingly, $V^{1}{}_{t-1} = V^{2}{}_{t-1} = (1,1,0), V^{3}{}_{t-1} = (0,0,1)$. Following Equation (6), the SIC Indexes are calculated to be equal to 1, 1 and 0 respectively for the three firms. It is easy to see that as the

firm-specific SIC Index getting bigger, this firm is more similar to others in the same market. The smallest SIC Index is zero which means this firm carries an entirely different product line compared with others, as the Firm 3 in our example. The biggest SIC Index is equal to the number of firms minus 1, which means this firm carries exactly the same product line as others. Now that we have explained the usage of SIC Index, it will not be hard to understand that the firm-specific SIM Index is just measuring the relative distance of the current firm from the majority. If we represent each firm by a dot in the product line space, a larger positive SIM Index means that the current firm is closer to where the mess is. Otherwise a negative SIM Index represents the current firm as an outlier to the majority.

In particular, the equation (6) is also the basis for us to construct the dependent variable $OVLAP^f{}_t$. The SIC index is larger if two firms have more varieties carried in common. Following Jeffe (1986) and Sweeting (2010), the SIC index could be interpreted as the average angle between the product vectors carried by firm f and its competitors. Hence it could be used as a measurement for the similarity or the overlapping extent between firm f and its competitors in the market. We replace the time index $t-1$ with t, and define the new index as $OVLAP^f{}_t$.

After constructing the vector of $Z^f{}_{t-1}$, we need to specify the market shifter $D^f{}_t$. One element will be the variable TE_t invariant to firms in year t, which defines how large the variety choice set is for each period. The variety choice set cannot be observed directly. We approximate it by counting the number of varieties as long as they are chosen by some firms in the whole national market at the end of period t. In the seed market, genetic available traits are public knowledge by the time each seed company makes its own variety choices—at the beginning of period t. Therefore the varieties that are observed to be actually chosen by the end of period t are realized outcomes, which should be a subset of the choice set known to the firms at the

beginning of period t. Besides, since we are constructing this measure by taking a look at the national market instead of the local ones, we believe that the available and commercially beneficial varieties should ultimately be chosen by some firms. Those varieties that are never chosen by any firm should not affect our empirical estimation. In other words, the variety choice set should be a subset of the one consisting of the varieties that are observed to be actually chosen by the end of period t. In this sense, TE_t is a good approximation to the genuine variety choice set.

The other elements in ${Z^f}_{t-1}$ is the sizes of either local markets or the national market. The first variable SZ_{t-1} is equal to the "total market size" we have discussed when constructing ${MS^f}_{t-1}$. SZ_{t-1} is defined by the following equation:

$$SZ_{t-1} = \sum_f \sum_v {q^f}_{v,t-1} \tag{8}$$

Since it is constructed by the selling quantities, the firms cannot perfectly predict the equilibrium quantities for the whole market at the beginning of year t. To approximate the reality, we instead assume that firms will build their prediction based on the last year $t-1$'s realized equilibrium quantities. That is why here SZ_{t-1} is indexed by $t-1$. We also extract the information from the 2002 and 2007 US. Census of Agriculture on the county and state levels respectively. The variables from the census data in representation for market size include: 1) PA_t --the planting acreage for corn; 2) FN_t --number of farms; 3) LA_t --land acreage in farms. PA_t is more related to the corn seed market, while FN_t and LA_t are capturing the whole farming areas in a specific area. Please note that the census is conducted every five years. Therefore we only have the information of PA_t, FN_t and LA_t for $t = 2002, 2007$.

The summary results for these variables are available in Table 5 and Table 6.

5. Estimation Method

The first econometric issue we need to deal with is how to define the "market". We have integrated firm branches in the three ways according to geographical boundaries of CRD, state and the whole nation. However, in the reality which market is considered by firms when they make choices cannot be observed by us. In order to uncover their strategic considerations, we run the regressions on all the three markets—the CRD, state, and national market, and the results are compared. Besides, we also divide the whole panel data into four sub-groups: 1) containing only the integrated biotech firms during the year 2000-2007; 2) containing only the integrated biotech firms during the year 2005-2007; 3) containing only the seed companies during the year 2000-2007; 4) containing only the seed companies during the year 2005-2007. Here the "seed companies" refer to those without trait patents. The regressions are run separately on these four groups. In this way we could compare the difference between integrated biotech firms and seed companies, as well as the difference between early years and later years.

The second issue is due to the discontinuity of the left-hand variable $NV^f{}_t$. In the empirical model (5), we use the logarithm of $NV^f{}_t$ to solve the problem. Alternatively, we take advantage of the discontinuity property and use Ordered Logit Regression method for robustness check. In particular, as $NV^f{}_t$ can be ordered so that a larger $NV^f{}_t$ means more varieties are chosen, we specify the outcomes of $NV^f{}_t$ are $\{1,2,\ldots,\mathrm{K}\}$. Following Green (2003), the empirical model of Ordered Logit Regression takes the following form:

$$\ln\left(\frac{prob(NV^f{}_t = k)}{1 - prob(NV^f{}_t = k)}\right) = \Gamma'' N^c{}_{t-1} + \Phi'' \mathrm{Z}^f{}_{t-1} + \Pi'' D^f{}_t \qquad (9)$$

from which we can get the probability of observing a given outcome k as:

$$prob(NV^f{}_t = k) = \frac{1}{1+\exp(-\varepsilon_k + \Gamma'' N^c + \Phi'' Z^f + \Pi'' D^f)} - \frac{1}{1+\exp(-\varepsilon_{k-1} + \Gamma'' N^c + \Phi'' Z^f + \Pi'' D^f)},$$

$\forall k \neq 1, K$

$$prob(NV^f{}_t = 1) = \frac{1}{1+\exp(-\varepsilon_1 + \Gamma'' N^c + \Phi'' Z^f + \Pi'' D^f)}$$

$$prob(NV^f{}_t = K) = 1 - \frac{1}{1+\exp(-\varepsilon_{K-1} + \Gamma'' N^c + \Phi'' Z^f + \Pi'' D^f)} \quad (10)$$

Γ'', Φ'' and Π'' are a new set of parameter vectors in front of the independent variables $N^c{}_{t-1}$, $Z^f{}_{t-1}$ and $D^f{}_t$ respectively.

The third concern is the geographical fixed effects that may affect the length of product line and the overlapping degree of product positioning. For instance, for those firms doing business in the corn-belt areas where most corn planting focus, their carried varieties might be much more than those firms located in the remote areas. We do not know if there is anything influential in the variety choice but cannot be absorbed in $N^c{}_{t-1}$. In order to answer this question, we include the geographic markets' fixed effects in the regression and compare the resulting differences in the estimated parameters.

Last but not the least, the endogeneity issue between firm numbers in varied distances and each firm's market share in the last year has aroused great concern in industrial organization literatures. It could be argued that in a market where a lot of firms entering and settled down, no one can enjoy a much bigger market share. It will end up being more like a competitive market, with each firm having a small market share. However, as we have emphasized, this paper allows for a much shorter-run change. Firms are assumed to make choices just based on their own as well as their competitors' performance in the last period. Besides, we still do not know whether the seed market is converging uniformly so that firms are more like each other, or at a varied

paces for integrated biotech firms and seed companies respectively. Actually this is one of our motivations to divide the whole data into the four groups along the size and time dimensions at the beginning of this section. In order to alleviate the endogeneity problem, we take advantage of the panel data property by comparing the cross-sectional regression results on those firms only observed to be new entries, with the results on those only observed to be incumbents at the end of each period t. Our argument is, once observed to retent in the market at the end of each period firms' product choices are not related to the entry decisions, and therefore the regression results for variety choices are solely due to product line considerations. On the contrary, for those observed to enter, their regression results for variety choices are likely to be mixed with entry considerations. Besides, as N^c_{t-1} is evaluated from the last period, it can be treated as pre-determined for the decisions made in period t. This also helps us to circumvent the endogeneity concerns.

6. Results

The first set of regression results is summarized in Table 7, where we run the Ordinary Least Square (OLS) regressions on the whole data, sub-group data, and with fixed effects. The market is defined on the CRD level. Table 8 contains the regression results using ordered logit method. In the similar way, Table 9 and Table 10 are the results in the state market, using OLS and Ordered Logit method respectively. After comparison, we find that the patterns suggested by the two regression methods are consistent. Therefore we will focus on the OLS regression results thereafter.

1. Competition effects

We observe competition from two aspects—due to the presence of integrated biotech firms in the downstream seed market, and due to the clustering of seed companies. The first effect is exerted through the patent protection of GM traits enjoyed by these integrated biotech firms. Since these integrated biotech firms are also competing in the upstream trait market, the front-to-front competition between them in the downstream market should be larger than the competition between integrated biotech firms and seed companies. Moreover, the downstream corn seed market is more competitive compared with the trait market, and is mainly comprised of seed companies. Hence the competition in between two seed companies should be the most intense.

We are interested in how the competition among firms impacts their variety choices. Theoretically as the competition increases, firms are more likely to avoid the competition by adopting more varieties. However, their capability of carrying more varieties is constrained so that big firms and seed companies may choose different marketing strategies in order to soften the competition.

Our results confirm the diverging strategies for integrated biotech firms and seed companies. In the first column of Table 7, we record the OLS regression results after controlling for the CRD market fixed effects. Both the coefficients in front of $N^f_{m,t-1}$ and $N^f_{10,t-1}$ are significant and negative for the whole data and the sub-group consisted of seed companies from year 2000-2007, , meaning that in the CRD market, when another firm enters in this market, or enters in the market that is within ten miles from this one, the incumbent firms are inclined to reduce their varieties. Meanwhile, after observing that the absolute value of the coefficients in front of $N^f_{10,t-1}$ is significant and smaller than that of $N^f_{m,t-1}$, we could conclude that as the competition softens with one competitor moving from the current market to its 10-mile

neighborhood, the current firm tends to increase their varieties. These two results confirm the relationship between geographical competition and variety number—as the competition increases, firms are carrying less varieties. However, this is not the complete story. We also need to take the impacts from the trait market into consideration—the coefficients in front of $N^f_{b1,t-1}$ and $N^f_{b2,t-1}$. The results show that both coefficients are significant and positive. Besides, the coefficient in front of $N^f_{b1,t-1}$ is larger than $N^f_{b2,t-1}$. This indicates that under the entry threaten from one integrated biotech firms, other incumbent integrated biotech firms will respond by carrying more varieties. The incumbent small seed companies will carry more as well, but not as many as the integrated biotech firms do. Please note that this impact from trait market is way exceeding the geographical competition effects, especially after year 2005. Actually in the later years after year 2005, the geographical competition effects are not significant for either integrated biotech firms or seed companies. These patterns confirm our opinion on the divergent marketing strategies adopted by integrated biotech firms and seed companies. That is, the entry threaten from a small seed firm will not affect the varieties choices of integrated biotech firms, while the incumbent seed companies will decrease their varieties due to more competition; besides, the entry threaten from a integrated biotech firms will cause the incumbents to adopt more varieties, and the incumbent integrated biotech firms will adopt more compared with the incumbent seed companies.

Basically our results indicate diverging marketing strategies when integrated biotech firms and seed companies choose the number of varieties to buy, considering both the geographical competition effects and the impacts from the upstream trait market. The above paragraph is taking the CRD markets for example. The results in the state markets reinforce our conclusions, and the detailed analysis is omitted here for conciseness.

2. Conglomeration effect

Conglomeration effect intends to measure the demand increase and hence the variety increase, brought by firms conglomerating in one market. This effect is obtained by comparing the first two columns with the other two columns in Table 7 and Table 9. The coefficients in front of $N^f_{m,t-1}$ and $N^f_{10,t-1}$ are changed from positive to negative after controlling for the market fixed effects. This is because the competition effects discussed above are mixed with the conglomeration effect we are talking about. Seed market is so related to geographical locations that in those areas suitable for corn planting like Corn Belt districts, farmers and firms tend to conglomerate there. Since the increase in market will motivate firms to carry more varieties, it is not a surprise for us to observe a positive relation between number of varieties taken by individual firms and number of firms in the market. This simultaneity issue could be partly alleviated by using fixed effects, where the market conditions are fixed except for the changes in firm numbers over years. Therefore by comparing the estimated differences with and without fixed effects, we could roughly figure out how large the conglomeration effect is. It turns out the conglomeration effect is overall in the range from 1% to 2%, which is about 5 to 10 times less than the competition effect brought by the upstream trait market. The conglomeration effect is approximately once or twice bigger than the geographical competition effect. The conglomeration effect is also observed increasingly important after year 2005, especially for integrated biotech firms.

3. Similarity effect

The similarity effect is measure by the SIM Index, which means how similar one firm is to the majority, in terms of the composition of the varieties. This estimation is consistent when we use or do not use fixed effects, on both CRD and state markets. As we do not really know

what kinds of firms comprise the "majority", we only compare the estimations for the whole data for all years and for later years. The results show that for all years, the coefficient in front of the SIM Index is negative, while for later years it becomes positive. The explanation for this pattern is, for all years from 2000-2007, if one firm is observed to be so different from the other firms, it tends to carry more varieties in the coming year. However, after year 2005, if one firm is observed to be similar to the majority, it inclines to carry more in the next year. One implication that could be achieved is, over years especially in the recent years firms are becoming more and more homogenous to each other. We could also infer that firms are carrying more varieties on average, especially in recent years. Since in the local markets most are seed companies, we would also expect seed companies are more homogeneous in the recent years.

4. Market power effect

This effect is captured by the coefficients in front of the three variables MS^f_{t-1}, $MS2^f_{t-1}$, and $MS^f_{weight,t-1}$. We observe significant and positive coefficients in front of MS^f_{t-1} and $MS^f_{weight,t-1}$, while significant and negative estimators in front of $MS2^f_{t-1}$. This implies a nonlinear relationship between variety number and individual firm's market power. In particular, from the estimation results when a firm is small, the gain in the market power will motivate it to carry more varieties. However, once its market power passes certain thresholds, the gain in the market power will cause them to reduce the carried varieties. These results conform to the theory that more varieties will help to deter further entry and enhance the market power by inducing more demand. Once the individual firm has gained enough market power, it will not have incentives to carry more. Instead, it will be satisfied with current product line or even reduce the supplied varieties in order to enjoy the oligopolistic market power. This result is also helpful for us to understand the diverging product line strategies adopted by integrated biotech firms and

seed companies since integrated biotech firms have much larger market shares than the seed companies. This inferred pattern is rather consistent with and without fixed effects. It is also unchanged even if we drop the geographical competition variables, from which we could tell that the driving force in firms' product positioning decisions is the market power consideration, not the geographical competition.

5. Technology development

The significantly positive coefficients in front of TE_t and market shifters PA_t indicate that as the technology is becoming more available, as the market is growing over years, the firms tend to carry more varieties in response to the demand increase. We also try using other shifters such as FN_t and LA_t as well in the cross-sectional regressions. It turns out not quite different from what we have in Table 11 to Table 14.

6. Endogeneity issue

To deal with the endogeneity issue we conduct the estimation on those incumbent firms and entry firms separately. We also use the information from the year 2002 and 2007 census data as the market shifters. The parameters are estimated on the cross-sectional data in 2002 and 2007, with the results recorded in Table 11 to Table 14. Since we have the census data as market shifters, the fixed effects and the number of firms in the market are dropped because of high correlation with the shifters.

Consistently with the panel data regression results, the SIM index changes from negative to positive from year 2002 to year 2007 both on the CRD and the state level, meaning that firms get homogenous over years in terms of the composition of product lines, as well as the increasing number of varieties they carry. Besides, the market power effect is also consistent with the panel

data regression, so that seed companies tend to increase varieties while big firms tend to reduce varieties.

Several differences can be found in comparison of using incumbents/entries in the cross-sectional regression and using all firms in the panel data regression. First, the competition effects are not significant in year 2002 but significant in year 2007, indicating that the competition concerns only emerge recently as the market gets more mature. Second, the SIM Index is significantly negative for incumbents in year 2002, and turns positive in year 2007. It is not significant for entries in year 2002, and turns significantly positive in year 2007. This again confirms our conclusion that firms, no matter incumbents or entries are getting similar over years. Third, in most cases the competition effects are not significant for entry firms, but significant for incumbent firms. This indicates that entry firms carry one more variety mostly for an expansion of the market share. Instead when the incumbent firms choose variety numbers, they tend to be aware of both the market power effect and the competition effects.

7. Overlapping index

As has been explained in the "Empirical Model" section, $OVLAP^f{}_t$ measures the similarity of carried varieties among firms. Specifically if the two firms carry a larger portion of the same varieties, the value of $OVLAP^f{}_t$ will be larger. Similarly, if more firms carries the same varieties as the current firm f, then the $OVLAP^f{}_t$ for the current firm f will also be larger. This overlapping index tells us whether the current firm f is homogenous to or differentiated from other firms in terms of the composition of its product line. This overlapping index complements the previously estimated dependent variable—variety numbers, helping us to figure out whether the "minimum differentiation" or the "maximum differentiation" strategies are accepted by seed firms in the particular market.

Empirically, we conduct the OLS estimation on the panel data based on equation (5) in order to uncover the relationship between this overlapping index in the current period and the pre-determined variables in the last period. To deal with the endogeneity problem, we also conduct the cross-sectional OLS regression on incumbents and entries separately, following the same logic as the estimation of NV^f_t.

The estimation results are included in Table 15 - Table 20. In general the estimated coefficients conform to our stories of NV^f_t. The signs in front of the competition effects, market power effect, and the size of choice set are found to be opposite when the dependent variable is switched from NV^f_t to $OVLAP^f_t$, indicating that when firms decide to carry a longer product line, their chosen varieties are more differentiated accordingly. In contrast, when firms decide to carry a shorter product line, they are mainly focused on several commonly adopted varieties other than the niche markets.

7. Conclusion

This paper has analyzed the relationship between number of varieties firms choose and the impacting factors mainly include competition effects, conglomeration effect, similarity effect and market power effect. We have used ordinary least square and ordered logit regression methods with and without fixed effects to deal with the simultaneity issue. The property of panel data has also been taken advantage of in order to alleviate the endogeneity issue. We find strong evidence for the discrepancy of variety choices made by integrated biotech firms and the seed companies: 1) the competition threaten from the entry of seed companies makes seed companies carry less varieties in avoidance of peer competition; in contrast, the competition threaten from the entry of big integrated biotech firms causes the existing firms to carry more varieties in

response, especially for big integrated biotech firms; 2) the conglomeration effect motivates both the integrated biotech firms and the seed companies to increase the varieties, but only to a small extent; 3) firms are observed to become increasingly similar in terms of the number and compositions of the variety choices, both for integrated biotech firms and seed companies; 4) the non-linearly increasing relationship between market share and variety number means that seed companies have a tendency to increase the variety number in order for a larger market share, while the tendency of integrated biotech firms that already take a large market is not as strong as the seed companies.

This paper is focused on the short-run empirical analysis of firms' variety choices as the marketing strategy. This preliminary analysis serves as a start of understanding how the firms react to a variety of current market conditions for more profits in the next period. We contribute to the current literature by distinguishing integrated biotech firms from seed companies in the hope of uncovering their different choices for their own product lines in the oligopolistic market.

This paper also finds that other than the competition effects, the market share is also another important factor when firms choose varieties. This could help to understand the current polarization between the upstream trait market and the downstream seed market as well.

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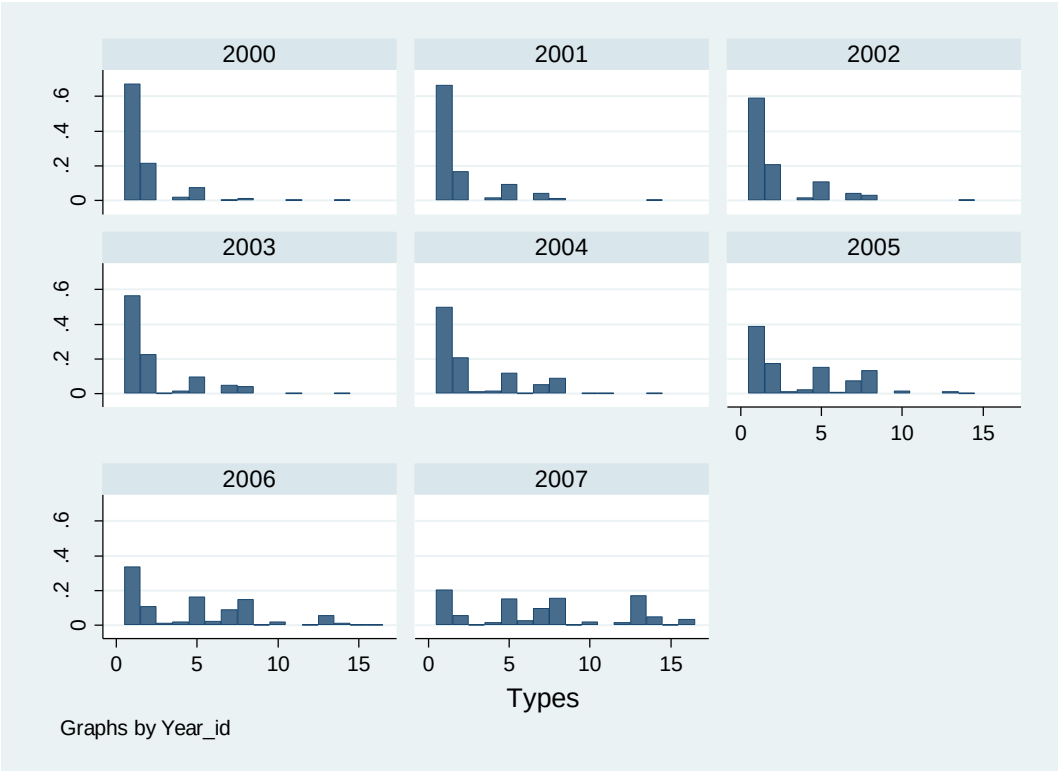
Appendix

Figure 1 Variety Carrying Shares in the National Market



Note: the horizontal axle stands for the 16 categories. The number 0-15 represents the category numbers. The vertical axle is the market share of each category sold in the national market.

Figure 2 The Relation Between "Branch" and "Firm" in the Local Market

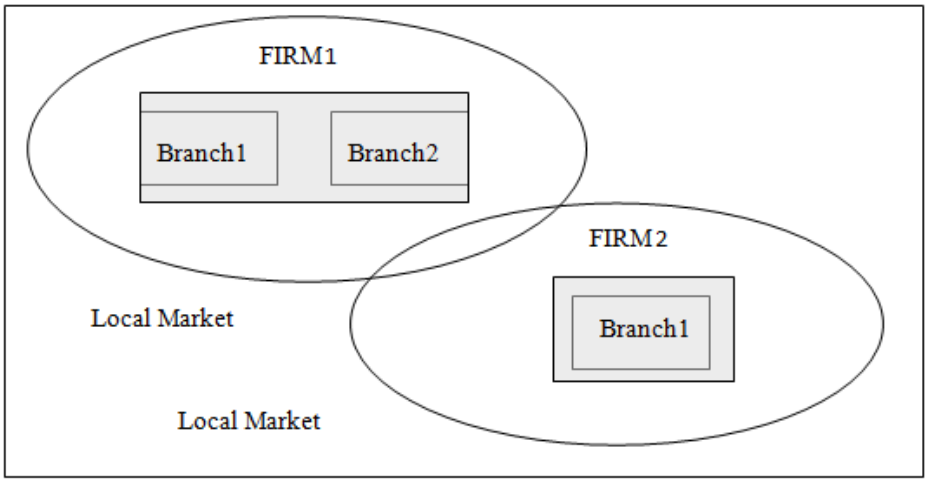


Table 1 The States Covered in the Data

State Number	State name	State Number	State name	State Number	State name
1	California	7	Kentucky	13	North Dakota
2	Colorado	8	Michigan	14	Ohio
3	Illinois	9	Minnesota	15	Pennsylvania
4	Indiana	10	Missouri	16	South Dakota
5	Iowa	11	Nebraska	17	Texas
6	Kansas	12	New York	18	Wisconsin

Table 2 Summary Statistics of Variety Numbers Carried by Seed Firms in the CRD, State and National Markets

Year	In the CRD market					In the state market					In the national market				
	Firm Obs.	Mean	Std Dev.	Min.	Max.	Firm Obs.	Mean	Std Dev.	Min.	Max.	Firm Obs.	Mean	Std Dev.	Min.	Max.
2000	1800	1.66	.95	1	6	685	1.81	1.14	1	7	229	1.89	1.17	1	7
2001	1730	1.70	.98	1	5	660	1.9	1.14	1	6	213	2.01	1.21	1	7
2002	1763	1.82	1.06	1	7	655	2.09	1.23	1	7	218	2.23	1.29	1	7
2003	1708	1.97	1.20	1	7	637	2.31	1.45	1	7	203	2.40	1.52	1	8
2004	1754	2.15	1.39	1	8	664	2.66	1.77	1	8	211	2.96	1.97	1	10
2005	1604	2.56	1.92	1	11	640	2.99	2.31	1	11	219	3.30	2.41	1	11
2006	1666	2.89	2.36	1	14	639	3.47	2.78	1	15	216	3.81	2.82	1	15
2007	1482	3.32	2.63	1	14	560	3.94	3.09	1	15	194	4.35	3.14	1	15
In total	13507	2.23	1.74	1	14	5140	2.61	2.09	1	15	1703	2.85	2.21	1	15

Table 3 Summary of Firm Numbers in the CRD, State and National Markets

Year	Mean value in the CRD market		Mean value in the state market		Mean value in the national market	
	Total Firms	Trait Firms	Total Firms	Trait Firms	Total Firms	Trait Firms
2000	19.78	2.86	38.06	2.94	229	3
2001	19.01	2.93	36.67	3	213	3
2002	19.37	2.90	36.39	2.94	218	4
2003	18.77	2.82	35.39	2.94	203	4
2004	19.27	2.79	36.89	3.06	211	4
2005	17.63	3.79	35.56	3.89	219	4
2006	18.31	3.82	35.5	3.89	216	4
2007	16.29	3.69	31.11	3.78	194	4

Table 4 Three Firms' Variety Choices Example

Firm Name	Variety 1	Variety 2	Variety 3	SIC Index	SIM Index
Firm 1	yes	yes	no	1	1/3
Firm 2	yes	yes	no	1	1/3
Firm 3	no	no	yes	0	-2/3

Table 5 Summary Statistics for the Empirical Model in the CRD Market

Variable Description (values from last period)	Observations	Mean	Standard deviation	Min.	Max.
Number of varieties chosen by individual firms (log)	8488	.74	.66	0	2.64
Number of integrated biotech firms's impact on seed	8488	2.43	1.39	0	4
Number of integrated biotech firms's impact on	8488	.74	1.38	0	4
Number of firms within 10 miles	8488	29.11	11.40	0	56
Number of firms within 10-20 miles	8488	3.61	2.89	0	13
SIM Index (measuring firm's relative similarity)	8488	.03	2.85	-22.11	6.25
Number of firms in the market	8488	22.38	7.81	4	42
Firm's market share	8488	.07	.11	.00005	.98
Firm's weighted market share	8488	.05	.09	0	.37
Square of firm's market share	8488	.02	.06	0	.96
Size of variety choice set	8488	9.51	2.60	7	15

Table 6 Summary Statistics for the Empirical Model in the State Market

Variable Description (values from last period)	Observations	Mean	Standard deviation	Min.	Max.
Number of varieties chosen by individual firms (log)	3458	.88	.70	0	2.71
Number of integrated biotech firms's impact on seed	3458	2.89	1.13	0	4
Number of integrated biotech firms's impact on	3458	.38	1.08	0	4
Number of firms within 10 miles	3458	39.12	18.26	0	70
Number of firms within 10-20 miles	3458	3.83	2.88	0	12
SIM Index (measuring firm's relative similarity)	3458	.14	5.52	-43.10	8.89
Number of firms in the market	3458	50.67	18.60	7	80
Firm's market share	3458	.03	.08	.00002	.72
Firm's weighted market share	3458	.03	.07	0	.36
Square of firm's market share	3458	.01	.04	0	.51
Size of variety choice set	3458	9.53	2.58	7	15

Table 7 OLS Regression Results in the CRD Markets with and without Fixed Effects

Dependent variable: variety numbers carried by firms	With Fixed Effects						Without Fixed Effects					
	Over year 2000-2007			Over year 2005-2007			Over year 2000-2007			Over year 2005-2007		
Independent Variable	Whole data	Small firms	Trait firms	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms
Number of integrated biotech firms's impact on seed companies	0.028*	0.067***		0.061***	0.123***		0.088***	0.124***		0.111***	0.161***	
	(0.015)	(0.017)		(0.024)	(0.029)		(0.014)	(0.016)		(0.019)	(0.022)	
Number of integrated biotech firms's impact on integrated biotech firms	0.138***		0.049**	0.174***		0.084***	0.196***		0.102***	0.226***		0.151***
	(0.015)		(0.024)	(0.024)		(0.032)	(0.014)		(0.024)	(0.019)		(0.029)
Number of firms within 10 miles	-0.005***	-0.006***	-0.003	0.0001	0.005	-0.004	0.003***	0.003***	0.007***	0.007***	0.007***	0.006***
	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.005)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
Number of firms within 10-20 miles	0.003	0.002	0.009	-0.0001	0.004	-0.008	0.003	0.003	-0.001	0.002	0.000	-0.002
	(0.003)	(0.004)	(0.006)	(0.007)	(0.008)	(0.010)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.006)
SIM Index (measuring firm's relative similarity)	-0.007***	-0.004**	0.008*	0.013***	0.010***	0.003	-0.005***	-0.004**	0.030***	0.015***	0.011***	0.033***
	(0.002)	(0.002)	(0.005)	(0.003)	(0.004)	(0.008)	(0.002)	(0.002)	(0.005)	(0.003)	(0.004)	(0.008)
Number of firms in the market	-0.008***	-0.007***	-0.004	-0.009**	-0.006	-0.002	0.010***	0.0098***	0.020***	0.014***	0.014***	0.027***
	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.006)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)
Firm's market share	3.755***	6.887***	1.229***	4.384***	9.689***	0.959***	3.502***	6.350***	1.586***	3.922***	8.698***	1.297***
	(0.157)	(0.296)	(0.217)	(0.294)	(0.599)	(0.321)	(0.161)	(0.302)	(0.221)	(0.292)	(0.590)	(0.331)
Firm's weighted market share	0.743***	6.470***	1.048***	0.793***	17.42***	1.864***	0.799***	6.689***	0.821***	0.865***	16.98***	1.545***
	(0.123)	(0.366)	(0.132)	(0.219)	(1.634)	(0.198)	(0.129)	(0.375)	(0.142)	(0.227)	(1.653)	(0.218)
Square of firm's market share	-4.726***	-17.48***	-1.050***	-5.497***	-24.58***	-0.792*	-4.291***	-16.05***	-1.292***	-4.591***	-20.90***	-1.001**
	(0.245)	(1.152)	(0.295)	(0.466)	(2.388)	(0.465)	(0.245)	(1.177)	(0.294)	(0.446)	(2.333)	(0.462)
Size of variety choice set	0.054***	0.056***	0.077***	0.026***	0.025***	0.030***	0.052***	0.055***	0.072***	0.021***	0.020***	0.017**
	(0.003)	(0.003)	(0.005)	(0.006)	(0.007)	(0.008)	(0.003)	(0.003)	(0.005)	(0.006)	(0.007)	(0.008)
Observations	8,488	6,555	1,933	3,263	2,342	921	8,488	6,555	1,933	3,263	2,342	921
R-squared	0.454	0.287	0.565	0.476	0.290	0.607	0.394	0.216	0.439	0.417	0.206	0.435

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the whole sample, the seed companies, and the integrated biotech firms separately. And the periods are split into the period from 2000-2007, and the period from 2005-2007. For each sub-group we include and preclude fixed effects for comparison.

Table 8 Ordered Logit Regression Results in the CRD Markets with and without Fixed Effects

Dependent variable: variety numbers carried by firms	With Fixed Effects						Without Fixed Effects					
	Over year 2000-2007			Over year 2005-2007			Over year 2000-2007			Over year 2005-2007		
Independent Variable	Whole data	Seed companie	Trait firms	Whole data	Seed companie	Trait firms	Whole data	Seed companie	Trait firms	Whole data	Seed companie	Trait firms
Number of integrated biotech firms's impact on seed companies	0.117**	0.253***	0.225***	0.462***			0.338***	0.452***		0.415***	0.562***	
	(0.058)	(0.081)	(0.068)	(0.099)			(0.051)	(0.060)		(0.061)	(0.073)	
Number of integrated biotech firms's impact on Integrated biotech firms	0.562***	0.657***			0.419***	0.667***	0.744***		0.505***	0.783***		0.743***
	(0.058)	(0.083)			(0.108)	(0.143)	(0.052)		(0.097)	(0.064)		(0.114)
Number of firms within 10 miles	-0.020***	-0.001	-0.025***	0.013	-0.015	-0.014	0.011***	0.009**	0.027***	0.025***	0.022***	0.030***
	(0.007)	(0.013)	(0.008)	(0.016)	(0.014)	(0.025)	(0.003)	(0.004)	(0.006)	(0.005)	(0.006)	(0.009)
Number of firms within 10-20 miles	0.017	0.006	0.010	0.012	0.072***	0.002	0.012	0.012	0.005	0.010	-0.0002	0.002
	(0.013)	(0.022)	(0.014)	(0.026)	(0.026)	(0.045)	(0.007)	(0.008)	(0.015)	(0.011)	(0.014)	(0.022)
SIM Index (measuring firm's relative similarity)	-0.021***	0.050***	-0.022***	0.031**	0.090***	0.013	-0.010	-0.017**	0.176***	0.055***	0.035***	0.158***
	(0.007)	(0.011)	(0.008)	(0.013)	(0.023)	(0.039)	(0.007)	(0.008)	(0.020)	(0.011)	(0.012)	(0.030)
Number of firms in the market	-0.024***	-0.020	-0.027***	-0.012	-0.001	0.003	0.039***	0.037***	0.095***	0.054***	0.051***	0.125***
	(0.007)	(0.014)	(0.009)	(0.016)	(0.016)	(0.027)	(0.005)	(0.005)	(0.009)	(0.007)	(0.008)	(0.013)
Firm's market share	14.49***	16.66***	27.58***	40.94***	5.656***	4.615***	12.91***	23.51***	6.160***	14.09***	33.48***	4.428***
	(0.623)	(1.076)	(1.306)	(2.847)	(0.971)	(1.455)	(0.604)	(1.229)	(0.896)	(1.023)	(2.588)	(1.321)
Firm's weighted market share	2.498***	3.606***	23.54***	59.44***	4.536***	9.805***	2.621***	23.24***	3.101***	3.790***	53.57***	6.844***
	(0.450)	(0.722)	(1.390)	(5.551)	(0.582)	(0.923)	(0.448)	(1.356)	(0.550)	(0.721)	(5.298)	(0.860)
Square of firm's market share	-19.17***	-21.88***	-75.19***	-136.4***	-5.084***	-3.737*	-16.91***	-63.36***	-4.962***	-17.85***	-106.0***	-2.685
	(1.040)	(1.825)	(5.666)	(15.95)	(1.338)	(2.115)	(1.009)	(5.253)	(1.232)	(1.743)	(14.16)	(1.938)
Size of variety choice set	0.223***	0.096***	0.224***	0.084***	0.410***	0.165***	0.195***	0.196***	0.338***	0.073***	0.063***	0.078**
	(0.011)	(0.020)	(0.013)	(0.024)	(0.023)	(0.036)	(0.010)	(0.012)	(0.021)	(0.019)	(0.023)	(0.033)
Observations	8,488	6,555	1,933	3,263	2,342	921	8,488	6,555	1,933	3,263	2,342	921

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the whole sample, the seed companies, and the integrated biotech firms separately. And the periods are split into the period from 2000-2007, and the period from 2005-2007. For each sub-group we include and preclude fixed effects for comparison.

Table 9 OLS Regression Results in the State Markets with and without Fixed Effects

Dependent variable: variety numbers carried by firms	With Fixed Effects						Without Fixed Effects					
	Over year 2000-2007			Over year 2005-2007			Over year 2000-2007			Over year 2005-2007		
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms
Number of integrated biotech firms's impact on seed companies	0.125***	0.162***		0.113**	0.197***		0.164***	0.188***		0.131***	0.198***	
	(0.031)	(0.032)		(0.045)	(0.046)		(0.030)	(0.032)		(0.040)	(0.041)	
Number of integrated biotech firms's impact on Integrated biotech firms	0.227***		0.052	0.258***		0.099**	0.265***		0.134***	0.275***		0.101*
	(0.032)		(0.037)	(0.049)		(0.046)	(0.032)		(0.042)	(0.044)		(0.053)
Number of firms within 10 miles	-0.007***	-0.007***	-0.005	-0.004	-0.004	-0.003	0.005***	0.006***	0.004***	0.004***	0.005***	0.006**
	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.006)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Number of firms within 10-20 miles	0.016***	0.015**	0.012	0.013	0.009	0.009	0.019***	0.021***	0.011*	0.029***	0.035***	0.014
	(0.006)	(0.006)	(0.009)	(0.013)	(0.013)	(0.015)	(0.004)	(0.004)	(0.006)	(0.008)	(0.008)	(0.011)
SIM Index (measuring firm's relative similarity)	-0.001	0.003**	0.010*	0.014***	0.013***	-0.010	-0.001	0.003**	0.023***	0.014***	0.012***	0.003
	(0.002)	(0.002)	(0.005)	(0.003)	(0.003)	(0.007)	(0.002)	(0.002)	(0.005)	(0.003)	(0.003)	(0.008)
Number of firms in the market	-0.002	-0.0004	-0.001	0.0001	0.008	0.002	-0.001	0.0003	0.009***	0.003*	0.004***	0.009***
	(0.003)	(0.003)	(0.004)	(0.006)	(0.008)	(0.006)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Firm's market share	8.139***	17.30***	0.908**	7.943***	24.51***	-0.202	7.922***	17.43***	0.737	8.280***	24.65***	0.788
	(0.462)	(0.778)	(0.422)	(0.846)	(1.573)	(0.552)	(0.473)	(0.793)	(0.482)	(0.861)	(1.577)	(0.717)
Firm's weighted market share	-0.406	7.608***	0.647**	-1.104*	23.27***	1.342***	-0.281	7.443***	0.811***	-1.291**	22.16***	0.854*
	(0.372)	(0.808)	(0.269)	(0.636)	(3.065)	(0.342)	(0.384)	(0.824)	(0.313)	(0.656)	(3.158)	(0.457)
Square of firm's market share	-11.96***	-60.25***	-0.785	-11.02***	-86.65***	0.902	-11.95***	-62.10***	-0.736	-11.57***	-86.45***	-0.463
	(0.688)	(3.551)	(0.540)	(1.336)	(6.869)	(0.771)	(0.705)	(3.581)	(0.617)	(1.348)	(6.771)	(0.991)
Size of variety choice set	0.052***	0.057***	0.088***	0.025***	0.026***	0.033***	0.051***	0.058***	0.074***	0.026***	0.028***	0.030**
	(0.005)	(0.006)	(0.007)	(0.010)	(0.010)	(0.010)	(0.005)	(0.006)	(0.008)	(0.010)	(0.010)	(0.013)
Observations	3,458	3,058	400	1,364	1,172	192	3,458	3,058	400	1,364	1,172	192
R-squared	0.403	0.361	0.756	0.393	0.377	0.793	0.359	0.317	0.631	0.340	0.316	0.558

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the whole sample, the seed companies, and the integrated biotech firms separately. And the periods are split into the period from 2000-2007, and the period from 2005-2007. For each sub-group we include and preclude fixed effects for comparison.

Table 10 Ordered Logit Regression Results in the State Markets with and without Fixed Effects

Dependent variable: variety numbers carried by firms

	With Fixed Effects						Without Fixed Effects					
	Over year 2000-2007			Over year 2005-2007			Over year 2000-2007			Over year 2005-2007		
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms
Number of integrated biotech firms's impact on seed companies	0.117**	0.253***	0.225***	0.462***			0.583***	0.617***		0.483***	0.678***	
	(0.058)	(0.081)	(0.068)	(0.099)			(0.100)	(0.110)		(0.115)	(0.127)	
Number of integrated biotech firms's impact on Integrated biotech firms	0.562***	0.657***			0.419***	0.667***	0.957***		1.043***	0.971***		1.008***
	(0.058)	(0.083)			(0.108)	(0.143)	(0.107)		(0.255)	(0.130)		(0.293)
Number of firms within 10 miles	-0.020***	-0.001	-0.025***	0.013	-0.015	-0.014	0.017***	0.020***	0.022**	0.0165***	0.022***	0.031**
	(0.007)	(0.013)	(0.008)	(0.016)	(0.014)	(0.025)	(0.003)	(0.003)	(0.009)	(0.005)	(0.005)	(0.014)
Number of firms within 10-20 miles	0.017	0.006	0.010	0.012	0.072***	0.002	0.059***	0.075***	0.046	0.081***	0.117***	0.047
	(0.013)	(0.022)	(0.014)	(0.026)	(0.026)	(0.045)	(0.011)	(0.012)	(0.032)	(0.022)	(0.025)	(0.058)
SIM Index (measuring firm's relative similarity)	-0.021***	0.050***	-0.022***	0.031**	0.090***	0.013	0.001	0.012**	0.167***	0.037***	0.037***	0.035
	(0.007)	(0.011)	(0.008)	(0.013)	(0.023)	(0.039)	(0.006)	(0.006)	(0.033)	(0.008)	(0.009)	(0.052)
Number of firms in the market	-0.024***	-0.020	-0.027***	-0.012	-0.001	0.003	-0.001	0.002	0.064***	0.013***	0.017***	0.060***
	(0.007)	(0.014)	(0.009)	(0.016)	(0.016)	(0.027)	(0.003)	(0.003)	(0.011)	(0.004)	(0.004)	(0.014)
Firm's market share	14.49***	16.66***	27.58***	40.94***	5.656***	4.615***	27.59***	66.42***	5.551**	32.52***	94.02***	2.872
	(0.623)	(1.076)	(1.306)	(2.847)	(0.971)	(1.455)	(1.702)	(3.318)	(2.811)	(3.134)	(6.425)	(4.241)
Firm's weighted market share	2.498***	3.606***	23.54***	59.44***	4.536***	9.805***	-0.346	22.22***	5.596***	-4.219**	75.95***	6.957**
	(0.450)	(0.722)	(1.390)	(5.551)	(0.582)	(0.923)	(1.331)	(2.706)	(1.819)	(2.137)	(9.857)	(2.719)
Square of firm's market share	-19.17***	-21.88***	-75.19***	-136.4***	-5.084***	-3.737*	-43.51***	-284.8***	-6.449*	-47.20***	-408.7***	-0.423
	(1.040)	(1.825)	(5.666)	(15.95)	(1.338)	(2.115)	(2.782)	(21.17)	(3.717)	(5.187)	(46.60)	(6.127)
Size of variety choice set	0.223***	0.096***	0.224***	0.084***	0.410***	0.165***	0.193***	0.218***	0.512***	0.100***	0.118***	0.197***
	(0.011)	(0.020)	(0.013)	(0.024)	(0.023)	(0.036)	(0.018)	(0.020)	(0.052)	(0.029)	(0.032)	(0.075)
Observations	8,488	6,555	1,933	3,263	2,342	921	3,458	3,058	400	1,364	1,172	192

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the whole sample, the seed companies, and the integrated biotech firms separately. And the periods are split into the period from 2000-2007, and the period from 2005-2007. For each sub-group we include and preclude fixed effects for comparison.

Table 11 Cross-Sectional OLS Regression Results in the CRD Markets with and without Fixed Effects for year 2002

	With Fixed Effects					Without Fixed Effects				
Dependent variable: variety numbers carried by firms	Incumbents			Entries		Incumbents			Entries	
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Whole data	Small firms	Trait firms	Whole data	Seed companies
Number of integrated biotech firms's impact on seed companies	0.176	0.180		0.047	0.042	-0.033	0.058		0.015	0.011
	(0.163)	(0.169)		(0.165)	(0.168)	(0.048)	(0.053)		(0.054)	(0.054)
Number of integrated biotech firms's impact on Integrated biotech firms	0.247		0.098	-0.003		0.034		-0.159*	-0.070	
	(0.163)		(0.181)	(0.166)		(0.049)		(0.088)	(0.067)	
Number of firms within 10 miles	0.008*	0.011	0.013	0.003	0.003	-0.002	-0.002	0.004	0.0002	0.0003
	(0.005)	(0.007)	(0.008)	(0.013)	(0.013)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)
Number of firms within 10-20 miles	0.032	0.054***	0.055*	0.003	0.004	0.005	0.006	0.007	0.006	0.006
	(0.023)	(0.020)	(0.032)	(0.040)	(0.040)	(0.004)	(0.005)	(0.009)	(0.005)	(0.005)
SIM Index (measuring firm's relative similarity)	-0.024***	-0.015***	-0.043***	0.002	0.003	-0.022***	-0.016***	0.001	0.001	0.001
	(0.004)	(0.004)	(0.016)	(0.005)	(0.005)	(0.004)	(0.004)	(0.012)	(0.004)	(0.004)
Firm's market share	4.653***	8.919***	2.091***	4.149***	4.127***	4.615***	8.228***	2.537***	3.519***	3.459***
	(0.348)	(0.680)	(0.625)	(1.256)	(1.268)	(0.338)	(0.644)	(0.496)	(1.044)	(1.054)
Firm's weighted market share	0.309	5.202***	-0.037	3.595***	3.632***	0.398	5.173***	0.235	3.822***	4.035***
	(0.282)	(0.661)	(0.346)	(1.289)	(1.386)	(0.285)	(0.653)	(0.329)	(1.184)	(1.269)
Square of firm's market share	-5.820***	-25.52***	-1.719*	-4.151	-4.113	-5.924***	-22.94***	-2.819***	-2.487	-2.265
	(0.540)	(3.156)	(0.882)	(6.319)	(6.364)	(0.511)	(2.965)	(0.650)	(5.343)	(5.372)
Harvest acreage for Corn (million)	-0.031	0.157	0.230	0.117	0.119	0.253***	0.258***	0.323***	0.040	0.038
	(0.215)	(0.112)	(0.172)	(0.250)	(0.251)	(0.029)	(0.031)	(0.064)	(0.039)	(0.039)
Constant	-0.718	-0.975	-0.308	-0.263	-0.253	0.215	-0.196	0.814***	-0.024	-0.016
	(0.507)	(0.600)	(0.588)	(0.593)	(0.597)	(0.145)	(0.159)	(0.270)	(0.167)	(0.168)
Observations	1,337	1,077	260	426	422	1,337	1,077	260	426	422
R-squared	0.435	0.388	0.614	0.293	0.287	0.376	0.313	0.367	0.139	0.133

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the incumbents and the entries separately. Besides, we further divide the data into the incumbents/entries, the seed companies, and the integrated biotech firms separately. For each sub-group we include and preclude fixed effects for comparison.

Table 12 Cross-Sectional OLS Regression Results in the CRD Markets with and without Fixed Effects for year 2007

	With Fixed Effects					Without Fixed Effects				
Dependent variable: variety numbers carried by firms	Incumbents			Entries		Incumbents			Entries	
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Whole data	Small firms	Trait firms	Whole data	Seed companies
Number of integrated biotech firms's impact on seed companies	0.090	0.014		-0.009	-0.010	0.040	0.171***		0.005	0.002
	(0.137)	(0.316)		(0.202)	(0.201)	(0.041)	(0.052)		(0.051)	(0.051)
Number of integrated biotech firms's impact on Integrated biotech firms	0.205		-0.250	-0.0263		0.153***		0.096*	-0.016	
	(0.137)		(0.214)	(0.216)		(0.040)		(0.055)	(0.079)	
Number of firms within 10 miles	0.043***	0.012	0.029***	0.004	0.004	0.006***	0.005**	0.008**	0.001	0.001
	(0.016)	(0.014)	(0.011)	(0.015)	(0.015)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Number of firms within 10-20 miles	0.0004	-0.002	0.050**	0.013	0.012	-0.009*	-0.013**	-0.004	-0.016**	-0.017**
	(0.013)	(0.018)	(0.021)	(0.032)	(0.032)	(0.005)	(0.006)	(0.008)	(0.008)	(0.008)
SIM Index (measuring firm's relative similarity)	0.114***	0.113***	0.012	0.082***	0.081***	0.114***	0.114***	0.030**	0.078***	0.077***
	(0.006)	(0.007)	(0.016)	(0.010)	(0.010)	(0.006)	(0.007)	(0.015)	(0.009)	(0.009)
Firm's market share	5.589***	10.80***	3.952***	17.07***	18.03***	5.004***	10.30***	3.624***	17.73***	18.77***
	(0.421)	(0.867)	(0.571)	(3.922)	(3.984)	(0.409)	(0.842)	(0.484)	(3.255)	(3.309)
Firm's weighted market share	-0.374	7.070***	0.342	6.473	6.449	-0.210	6.994***	0.298	6.722*	6.621*
	(0.274)	(1.954)	(0.308)	(4.046)	(4.035)	(0.286)	(1.996)	(0.299)	(3.691)	(3.683)
Square of firm's market share	-6.778***	-21.53***	-4.743***	-153.3***	-176.2***	-5.814***	-22.25***	-3.928***	-178.4***	-200.8***
	(0.653)	(3.138)	(0.803)	(46.08)	(48.13)	(0.614)	(2.725)	(0.667)	(39.47)	(41.17)
Harvest acreage for Corn (million)	-0.093	0.553**	0.305*	0.358	0.374	0.275***	0.317***	0.352***	0.309***	0.311***
	(0.236)	(0.245)	(0.170)	(0.381)	(0.380)	(0.033)	(0.039)	(0.056)	(0.050)	(0.050)
Constant	-0.692	-0.635	0.764	-0.314	-0.305	0.127	-0.538***	0.350*	-0.032	-0.022
	(0.455)	(0.790)	(0.597)	(0.612)	(0.611)	(0.150)	(0.202)	(0.207)	(0.191)	(0.191)
Observations	1,082	749	333	400	397	1,082	749	333	400	397
R-squared	0.681	0.623	0.701	0.477	0.482	0.612	0.517	0.528	0.303	0.307

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the incumbents and the entries separately. Besides, we further divide the data into the incumbents/entries, the seed companies, and the integrated biotech firms separately. For each sub-group we include and preclude fixed effects for comparison.

Table 13 Cross-Sectional OLS Regression Results in the state Markets with and without Fixed Effects for year 2002

	With Fixed Effects					Without Fixed Effects				
Dependent variable: variety numbers carried by firms	Incumbents			Entries		Incumbents			Entries	
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Whole data	Small firms	Trait firms	Whole data	Seed companies
Number of integrated biotech firms's impact on seed companies	0.524***	0.620***		0.261	0.261	0.099	0.034		0.140	0.140
	(0.141)	(0.178)		(0.205)	(0.205)	(0.092)	(0.098)		(0.142)	(0.142)
Number of integrated biotech firms's impact on Integrated biotech firms	0.560***		0.547***	0.378*		0.137		0.258**	0.228	
	(0.141)		(0.145)	(0.206)		(0.094)		(0.122)	(0.142)	
Number of firms within 10 miles	0.011***	0.016***	0.014**	0.008	0.008	-0.001	-0.001	0.013***	-0.0005	-0.0005
	(0.004)	(0.004)	(0.005)	(0.006)	(0.006)	(0.002)	(0.002)	(0.004)	(0.003)	(0.003)
Number of firms within 10-20 miles	0.037**	0.085***	0.047**	0.084**	0.084**	0.005	0.004	0.025*	0.012	0.012
	(0.018)	(0.022)	(0.020)	(0.040)	(0.040)	(0.007)	(0.008)	(0.014)	(0.012)	(0.012)
SIM Index (measuring firm's relative similarity)	-0.021***	-0.015***	-0.049	0.002	0.002	-0.020***	-0.015***	0.007	0.003	0.003
	(0.005)	(0.005)	(0.031)	(0.004)	(0.004)	(0.005)	(0.005)	(0.014)	(0.004)	(0.004)
Firm's market share	8.268***	15.72***	3.295*	14.99*	14.99*	7.881***	14.46***	2.504*	1.192	1.192
	(1.020)	(1.473)	(1.761)	(8.728)	(8.728)	(1.010)	(1.471)	(1.341)	(6.676)	(6.676)
Firm's weighted market share	-0.148	5.300***	-1.029	5.597	5.597	0.130	5.283***	0.197	9.653**	9.653**
	(0.838)	(1.457)	(1.049)	(5.109)	(5.109)	(0.854)	(1.494)	(0.903)	(4.650)	(4.650)
Square of firm's market share	-12.23***	-47.76***	-3.721*	-87.44	-87.44	-12.18***	-44.98***	-3.271**	52.01	52.01
	(1.421)	(5.438)	(2.186)	(82.22)	(82.22)	(1.406)	(5.370)	(1.586)	(60.45)	(60.45)
Harvest acreage for Corn (million)	-0.029	-0.063***	-0.058	-0.085**	-0.085**	0.020**	0.028***	-0.025	-0.005	-0.005
	(0.020)	(0.022)	(0.036)	(0.036)	(0.036)	(0.010)	(0.009)	(0.022)	(0.014)	(0.014)
Constant	-1.611***	-2.332***	-1.047**	-0.931	-0.931	0.123	0.180	-0.091	-0.262	-0.262
	(0.506)	(0.657)	(0.477)	(0.750)	(0.750)	(0.291)	(0.311)	(0.399)	(0.444)	(0.444)
Observations	531	479	52	124	123	531	479	52	124	123
R-squared	0.382	0.405	0.731	0.245	0.232	0.333	0.343	0.523	0.145	0.130

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the incumbents and the entries separately. Besides, we further divide the data into the incumbents/entries, the seed companies, and the integrated biotech firms separately. For each sub-group we include and preclude fixed effects for comparison.

Table 14 Cross-Sectional OLS Regression Results in the state Markets with and without Fixed Effects for year 2007

	With Fixed Effects					Without Fixed Effects				
Dependent variable: variety numbers carried by firms	Incumbents			Entries		Incumbents			Entries	
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Whole data	Small firms	Trait firms	Whole data	Seed companies
Number of integrated biotech firms's impact on seed companies	1.408***	1.811***				0.385***	0.578***		0.360	0.360
	(0.265)	(0.378)				(0.124)	(0.159)		(0.226)	(0.226)
Number of integrated biotech firms's impact on Integrated biotech firms	1.556***		1.031***			0.543***		0.396***		
	(0.263)		(0.201)			(0.122)		(0.131)		
Number of firms within 10 miles	-0.008	-0.014**	-0.0002	0.021**	0.021**	0.0002	-0.001	0.0037	0.003	0.003
	(0.005)	(0.006)	(0.006)	(0.010)	(0.010)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)
Number of firms within 10-20 miles	0.122***	0.106**	0.137***	0.070	0.070	0.006	0.004	0.033*	0.033	0.033
	(0.036)	(0.051)	(0.029)	(0.049)	(0.049)	(0.014)	(0.016)	(0.018)	(0.024)	(0.024)
SIM Index (measuring firm's relative similarity)	0.074***	0.067***	-0.038*	0.028***	0.028***	0.074***	0.069***	-0.048**	0.029***	0.029***
	(0.004)	(0.004)	(0.022)	(0.008)	(0.008)	(0.005)	(0.005)	(0.022)	(0.007)	(0.007)
Firm's market share	9.526***	21.64***	3.592***	44.70***	44.70***	9.160***	19.02***	1.558	37.63***	37.63***
	(1.335)	(2.550)	(1.230)	(14.86)	(14.86)	(1.381)	(2.466)	(1.409)	(13.43)	(13.43)
Firm's weighted market share	-1.911**	10.26***	-0.631	11.34	11.34	-2.110***	10.47***	0.124	8.917	8.917
	(0.755)	(3.907)	(0.562)	(9.685)	(9.685)	(0.785)	(4.040)	(0.657)	(9.069)	(9.069)
Square of firm's market share	-15.74***	-74.53***	-4.709**	-475.2**	-475.2**	-14.44***	-55.87***	-1.537	-471.5**	-471.5**
	(2.588)	(13.76)	(2.072)	(210.3)	(210.3)	(2.668)	(11.72)	(2.407)	(200.1)	(200.1)
Harvest acreage for Corn (million)	-0.012	0.008	-0.027	0.006	0.006	0.030***	0.042***	0.031	0.018	0.018
	(0.022)	(0.029)	(0.033)	(0.032)	(0.032)	(0.011)	(0.012)	(0.019)	(0.019)	(0.019)
Constant	-4.763***	-6.351***	-2.654***	-0.846**	-0.846**	-0.801*	-1.698***	0.036	-1.455	-1.455
	(0.989)	(1.434)	(0.737)	(0.405)	(0.405)	(0.468)	(0.611)	(0.473)	(0.886)	(0.886)
Observations	429	361	68	131	131	429	361	68	131	131
R-squared	0.649	0.630	0.791	0.290	0.290	0.605	0.577	0.576	0.241	0.241

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the incumbents and the entries separately. Besides, we further divide the data into the incumbents/entries, the seed companies, and the integrated biotech firms separately. For each sub-group we include and preclude fixed effects for comparison.

Table 15 OLS Regression Results in the CRD Markets with and without Fixed Effects

	With Fixed Effects						Without Fixed Effects					
Dependent variable: variety overlaps	Over year 2000-2007			Over year 2005-2007			Over year 2000-2007			Over year 2005-2007		
Independent Variable	Whole data	Small firms	Trait firms	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Trait firms
Number of integrated biotech firms's impact on seed companies	-0.383***	-0.541***		-0.658***	-0.737***		-0.326***	-0.455***		-0.061	-0.136	
	(0.108)	(0.131)		(0.127)	(0.168)		(0.106)	(0.128)		(0.108)	(0.136)	
Number of integrated biotech firms's impact on Integrated biotech firms	-0.221**		-0.023	-0.528***		-0.184	-0.182*		0.169	0.030		0.409***
	(0.110)		(0.138)	(0.130)		(0.144)	(0.108)		(0.138)	(0.111)		(0.142)
Number of firms within 10 miles	0.152***	0.159***	0.089***	0.149***	0.175***	0.070***	0.134***	0.146***	0.080***	0.067***	0.072***	0.051***
	(0.013)	(0.015)	(0.019)	(0.021)	(0.027)	(0.025)	(0.006)	(0.008)	(0.009)	(0.009)	(0.011)	(0.011)
Number of firms within 10-20 miles	0.094***	0.116***	0.044	0.068*	0.080*	0.044	0.034**	0.044**	0.033	0.044**	0.052**	0.020
	(0.024)	(0.028)	(0.035)	(0.035)	(0.044)	(0.045)	(0.015)	(0.018)	(0.022)	(0.020)	(0.026)	(0.028)
Number of firms in the market	0.081***	0.078***	0.084***	-0.022	-0.006	-0.072***	0.380***	0.380***	0.380***	0.305***	0.300***	0.336***
	(0.014)	(0.017)	(0.020)	(0.022)	(0.028)	(0.027)	(0.010)	(0.012)	(0.014)	(0.012)	(0.016)	(0.016)
Firm's market share	-0.809	0.456	1.147	7.809***	14.57***	3.263**	-0.088	4.408*	1.350	8.768***	17.83***	4.931***
	(1.140)	(2.278)	(1.263)	(1.588)	(3.502)	(1.472)	(1.215)	(2.453)	(1.276)	(1.688)	(3.672)	(1.643)
Firm's weighted market share	-4.421***	-24.46***	-1.836**	-3.086***	17.49*	-0.652	-4.623***	-27.87***	-1.721**	-3.258**	11.31	-1.303
	(0.888)	(2.786)	(0.766)	(1.185)	(9.610)	(0.909)	(0.969)	(3.018)	(0.815)	(1.313)	(10.35)	(1.084)
Square of firm's market share	2.678	-11.45	-1.377	-10.49***	-45.37***	-4.275**	1.322	-19.03**	-2.297	-12.67***	-51.61***	-7.101***
	(1.776)	(8.855)	(1.716)	(2.518)	(14.00)	(2.133)	(1.854)	(9.556)	(1.695)	(2.582)	(14.56)	(2.301)
Size of variety choice set	-0.797***	-0.925***	-0.514***	-0.434***	-0.466***	-0.347***	-0.786***	-0.925***	-0.503***	-0.517***	-0.559***	-0.419***
	(0.020)	(0.025)	(0.026)	(0.033)	(0.042)	(0.035)	(0.021)	(0.026)	(0.028)	(0.033)	(0.044)	(0.042)
Constant	13.11***	15.09***	9.361***	11.84***	11.78***	10.27***	8.454***	9.973***	5.158***	6.971***	7.473***	4.267***
	(0.727)	(1.179)	(0.684)	(0.909)	(1.558)	(0.834)	(0.292)	(0.371)	(0.388)	(0.462)	(0.614)	(0.618)
Observations	8,488	6,555	1,933	3,263	2,342	921	8,488	6,555	1,933	3,263	2,342	921
R-squared	0.680	0.667	0.778	0.621	0.572	0.822	0.613	0.591	0.718	0.518	0.457	0.698

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the whole sample, the seed companies, and the integrated biotech firms separately. And the periods are split into the period from 2000-2007, and the period from 2005-2007. For each sub-group we include and preclude fixed effects for comparison.

Table 16 OLS Regression Results in the State Markets with and without Fixed Effects

Dependent variable: variety overlaps	With Fixed Effects						Without Fixed Effects					
	Over year 2000-2007			Over year 2005-2007			Over year 2000-2007			Over year 2005-2007		
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companie	Trait firms	Whole data	Seed companie	Trait firms	Whole data	Seed companie	Trait firms
Number of integrated biotech firms's impact on seed companies	-2.717***	-3.033***		-2.778***	-2.980***		-2.664***	-2.871***		-1.300***	-1.399***	
	(0.347)	(0.387)		(0.468)	(0.538)		(0.349)	(0.390)		(0.413)	(0.470)	
Number of integrated biotech firms's impact on Integrated biotech firms	-2.322***		-0.649*	-2.793***		-0.670	-2.265***		-0.819*	-1.293***		0.026
	(0.365)		(0.391)	(0.508)		(0.446)	(0.370)		(0.432)	(0.455)		(0.529)
Number of firms within 10 miles	0.179***	0.174***	0.094**	-0.023	-0.036	0.041	0.051***	0.044***	0.098***	0.014	0.012	0.058**
	(0.025)	(0.027)	(0.039)	(0.045)	(0.051)	(0.053)	(0.010)	(0.011)	(0.016)	(0.017)	(0.019)	(0.023)
Number of firms within 10-20 miles	-0.186***	-0.168**	-0.038	0.049	0.068	0.031	-0.290***	-0.295***	-0.065	0.077	0.100	0.097
	(0.067)	(0.072)	(0.099)	(0.133)	(0.150)	(0.147)	(0.041)	(0.045)	(0.059)	(0.081)	(0.093)	(0.102)
Number of firms in the market	0.134***	0.148***	0.084**	0.127**	0.170**	-0.054	0.632***	0.646***	0.472***	0.523***	0.538***	0.443***
	(0.032)	(0.035)	(0.041)	(0.058)	(0.067)	(0.055)	(0.010)	(0.011)	(0.016)	(0.015)	(0.016)	(0.022)
Firm's market share	-4.988	3.279	2.937	23.92***	75.01***	7.487	-2.100	10.84	4.541	20.79**	66.39***	8.970
	(5.210)	(9.401)	(4.486)	(8.755)	(18.31)	(5.407)	(5.448)	(9.778)	(4.999)	(8.914)	(18.19)	(7.070)
Firm's weighted market share	-15.07***	-61.27***	-6.054**	-12.11*	39.73	-6.873**	-16.53***	-67.03***	-6.010*	-11.92*	38.74	-7.638*
	(4.191)	(9.700)	(2.830)	(6.577)	(35.82)	(3.322)	(4.408)	(10.09)	(3.201)	(6.792)	(36.57)	(4.486)
Square of firm's market share	15.63**	-34.72	-4.178	-36.19***	-299.9***	-10.16	12.74	-48.02	-7.310	-29.32**	-266.5***	-11.79
	(7.745)	(42.91)	(5.743)	(13.83)	(80.09)	(7.555)	(8.103)	(44.15)	(6.413)	(13.97)	(78.21)	(9.792)
Size of variety choice set	-1.196***	-1.311***	-0.713***	-0.861***	-0.908***	-0.543***	-1.236***	-1.380***	-0.647***	-0.901***	-0.953***	-0.566***
	(0.061)	(0.069)	(0.072)	(0.100)	(0.116)	(0.094)	(0.062)	(0.070)	(0.082)	(0.102)	(0.117)	(0.130)
Constant	24.20***	26.60***	13.76***	23.69***	23.93***	15.11***	17.30***	19.15***	8.690***	12.73***	12.40***	5.841***
	(1.415)	(2.133)	(1.195)	(2.456)	(3.632)	(1.893)	(0.872)	(0.995)	(1.128)	(1.594)	(1.867)	(2.084)
Observations	3,458	3,058	400	1,364	1,172	192	3,458	3,058	400	1,364	1,172	192
R-squared	0.825	0.813	0.947	0.754	0.720	0.961	0.805	0.792	0.923	0.732	0.698	0.916

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the whole sample, the seed companies, and the integrated biotech firms separately. And the periods are split into the period from 2000-2007, and the period from 2005-2007. For each sub-group we include and preclude fixed effects for comparison.

Table 17 Cross-Sectional OLS Regression Results in the CRD Markets with and without Fixed Effects for year 2002

	With Fixed Effects					Without Fixed Effects				
Dependent variable: variety overlaps	Incumbents			Entries		Incumbents			Entries	
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Whole data	Small firms	Trait firms	Whole data	Seed companies
Number of integrated biotech firms's impact on seed companies	0.716	1.527		2.701	2.854	3.981***	4.103***		3.961***	4.098***
	(1.104)	(1.242)		(1.918)	(1.953)	(0.418)	(0.476)		(0.470)	(0.557)
Number of integrated biotech firms's impact on Integrated biotech firms	0.876		1.557*	3.019		4.017***		3.352***	3.991***	
	(1.103)		(0.901)	(1.934)		(0.430)		(0.691)	(0.479)	
Number of firms within 10 miles	0.180***	0.131***	0.124***	0.308**	0.309**	0.320***	0.328***	0.227***	0.323***	0.333***
	(0.032)	(0.050)	(0.035)	(0.145)	(0.146)	(0.012)	(0.014)	(0.022)	(0.013)	(0.015)
Number of firms within 10-20 miles	-0.250	-0.427***	-0.037	-0.305	-0.319	0.214***	0.210***	0.255***	0.198***	0.186***
	(0.155)	(0.149)	(0.162)	(0.466)	(0.469)	(0.039)	(0.044)	(0.072)	(0.043)	(0.049)
Firm's market share	0.711	7.186	-3.834	20.83	21.56	-4.126	7.857	-6.867*	-5.288	7.058
	(2.362)	(4.995)	(3.102)	(14.59)	(14.73)	(3.188)	(6.362)	(3.986)	(3.288)	(6.771)
Firm's weighted market share	-9.975***	-37.08***	-3.094*	-18.14	-20.34	-8.168***	-38.04***	-0.192	-8.106***	-44.00***
	(1.892)	(4.716)	(1.706)	(14.99)	(16.11)	(2.788)	(6.471)	(2.609)	(2.743)	(6.675)
Square of firm's market share	4.867	-25.56	6.701	-46.47	-49.38	10.13**	-46.90	7.259	11.52**	-48.39
	(3.664)	(23.19)	(4.367)	(73.61)	(74.11)	(4.964)	(30.08)	(5.224)	(4.969)	(31.20)
Harvest acreage for Corn (million)	7.171***	3.811***	4.027***	-1.906	-1.989	2.386***	2.278***	3.295***	2.168***	2.000***
	(1.460)	(0.824)	(0.926)	(2.908)	(2.926)	(0.264)	(0.295)	(0.509)	(0.286)	(0.327)
Constant	1.811	1.001	0.769	-2.125	-2.413	-9.202***	-9.595***	-6.249***	-8.876***	-9.153***
	(3.440)	(4.407)	(2.905)	(6.908)	(6.961)	(1.260)	(1.437)	(2.151)	(1.408)	(1.670)
Observations	1,337	1,077	260	426	422	1,337	1,077	260	426	422
R-squared	0.824	0.821	0.925	0.810	0.809	0.601	0.588	0.676	0.512	0.509

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the incumbents and the entries separately. Besides, we further divide the data into the incumbents/entries, the seed companies, and the integrated biotech firms separately. For each sub-group we include and preclude fixed effects for comparison.

Table 18 Cross-Sectional OLS Regression Results in the CRD Markets with and without Fixed Effects for year 2007

	With Fixed Effects					Without Fixed Effects				
Dependent variable: variety overlaps	Incumbents			Entries		Incumbents			Entries	
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Whole data	Small firms	Trait firms	Whole data	Seed companies
Number of integrated biotech firms's impact on seed companies	-0.023	3.204*		-2.302*	-2.316**	1.469***	1.921***		1.335***	1.319***
	(0.716)	(1.830)		(1.172)	(1.172)	(0.263)	(0.360)		(0.394)	(0.394)
Number of integrated biotech firms's impact on Integrated biotech firms	0.030		2.199**	-2.474**		1.407***		1.248***	0.640	
	(0.714)		(0.870)	(1.254)		(0.260)		(0.329)	(0.607)	
Number of firms within 10 miles	-0.008	-0.008	0.037	0.039	0.038	0.113***	0.112***	0.108***	0.069***	0.073***
	(0.082)	(0.079)	(0.044)	(0.086)	(0.086)	(0.013)	(0.017)	(0.018)	(0.023)	(0.023)
Number of firms within 10-20 miles	0.192***	0.160	-0.018	0.252	0.251	-0.026	-0.029	-0.028	-0.097	-0.093
	(0.068)	(0.103)	(0.084)	(0.182)	(0.183)	(0.034)	(0.042)	(0.049)	(0.060)	(0.060)
Firm's market share	17.19***	41.50***	5.774**	92.56***	97.48***	16.44***	41.33***	6.815**	33.34	38.43
	(2.125)	(4.753)	(2.300)	(22.23)	(22.60)	(2.569)	(5.537)	(2.829)	(24.58)	(24.97)
Firm's weighted market share	-3.979***	14.69	0.291	9.832	9.092	-3.073*	3.343	0.735	-11.44	-11.80
	(1.421)	(11.30)	(1.257)	(23.56)	(23.57)	(1.840)	(13.77)	(1.776)	(28.46)	(28.43)
Square of firm's market share	-22.94***	-106.6***	-7.359**	-814.6***	-896.1***	-24.47***	-107.6***	-11.83***	-194.2	-261.5
	(3.326)	(17.69)	(3.242)	(264.5)	(276.5)	(3.885)	(18.32)	(3.908)	(301.3)	(314.3)
Harvest acreage for Corn (million)	2.322*	0.890	0.794	2.934	2.984	2.397***	2.271***	3.202***	1.951***	1.946***
	(1.228)	(1.421)	(0.692)	(2.218)	(2.219)	(0.211)	(0.266)	(0.316)	(0.387)	(0.387)
Constant	3.075	-7.473	-2.456	7.085**	7.088**	-3.247***	-5.325***	-2.883**	-1.934	-1.996
	(2.373)	(4.565)	(2.427)	(3.565)	(3.566)	(0.969)	(1.384)	(1.222)	(1.472)	(1.471)
Observations	1,082	749	333	400	397	1,082	749	333	400	397
R-squared	0.694	0.657	0.888	0.690	0.688	0.431	0.375	0.625	0.276	0.274

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the incumbents and the entries separately. Besides, we further divide the data into the incumbents/entries, the seed companies, and the integrated biotech firms separately. For each sub-group we include and preclude fixed effects for comparison.

Table 19 Cross-Sectional OLS Regression Results in the state Markets with and without Fixed Effects for year 2002

	With Fixed Effects					Without Fixed Effects				
Dependent variable: variety overlaps	Incumbents			Entries		Incumbents			Entries	
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Whole data	Small firms	Trait firms	Whole data	Seed companies
Number of integrated biotech firms's impact on seed companies	-0.159	-0.486		1.725	1.725	1.100	1.216		0.855	0.855
	(1.335)	(1.830)		(5.533)	(5.533)	(1.876)	(2.179)		(5.412)	(5.412)
Number of integrated biotech firms's impact on Integrated biotech firms	0.345		1.923**	2.194		1.512		2.560	0.123	
	(1.337)		(0.837)	(5.577)		(1.922)		(2.451)	(5.437)	
Number of firms within 10 miles	0.227***	0.210***	0.235***	0.332**	0.332**	0.381***	0.366***	0.332***	0.351***	0.351***
	(0.033)	(0.042)	(0.031)	(0.153)	(0.153)	(0.040)	(0.045)	(0.073)	(0.111)	(0.111)
Number of firms within 10-20 miles	-0.348**	-0.411*	-0.346***	-0.091	-0.091	-1.259***	-1.334***	-0.680**	-1.608***	-1.608***
	(0.171)	(0.224)	(0.116)	(1.070)	(1.070)	(0.152)	(0.168)	(0.280)	(0.470)	(0.470)
Firm's market share	-13.64	-12.33	0.065	180.3	180.3	-42.69**	-48.91	-14.02	-166.6	-166.6
	(9.620)	(15.11)	(10.35)	(235.4)	(235.4)	(20.56)	(32.60)	(26.71)	(254.7)	(254.7)
Firm's weighted market share	-22.93***	-59.01***	-13.73**	-59.02	-59.02	-15.91	-98.66***	-0.117	-15.82	-15.82
	(7.850)	(14.70)	(5.656)	(138.0)	(138.0)	(17.26)	(32.50)	(17.27)	(177.6)	(177.6)
Square of firm's market share	36.54***	24.52	6.110	-1,518	-1,518	68.22**	138.3	10.96	1,341	1,341
	(13.33)	(55.81)	(12.80)	(2,218)	(2,218)	(28.49)	(119.0)	(31.83)	(2,307)	(2,307)
Harvest acreage for Corn (million)	2.559***	2.653***	2.028***	1.712*	1.712*	1.971***	2.003***	1.773***	2.280***	2.280***
	(0.191)	(0.230)	(0.194)	(0.980)	(0.980)	(0.194)	(0.208)	(0.436)	(0.514)	(0.514)
Constant	5.740	7.541	1.191	-3.350	-3.350	10.41*	11.48*	3.294	9.625	9.625
	(4.778)	(6.737)	(2.806)	(20.28)	(20.28)	(5.934)	(6.884)	(8.056)	(16.94)	(16.94)
Observations	531	479	52	124	123	531	479	52	124	123
R-squared	0.932	0.930	0.992	0.803	0.801	0.660	0.641	0.828	0.554	0.550

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the incumbents and the entries separately. Besides, we further divide the data into the incumbents/entries, the seed companies, and the integrated biotech firms separately. For each sub-group we include and preclude fixed effects for comparison.

Table 20 Cross-Sectional OLS Regression Results in the state Markets with and without Fixed Effects for year 2007

	With Fixed Effects					Without Fixed Effects				
Dependent variable: variety overlaps	Incumbents			Entries		Incumbents			Entries	
Independent Variable	Whole data	Seed companies	Trait firms	Whole data	Seed companies	Whole data	Small firms	Trait firms	Whole data	Seed companies
Number of integrated biotech firms's impact on seed companies	1.105	4.265				5.687***	7.698***		8.881**	8.881**
	(2.942)	(4.575)				(1.612)	(2.198)		(3.547)	(3.547)
Number of integrated biotech firms's impact on Integrated biotech firms	0.692		-1.266			4.934***		2.089		
	(2.919)		(1.321)			(1.583)		(1.731)		
Number of firms within 10 miles	0.200***	0.195***	0.167***	0.347***	0.347***	0.166***	0.154***	0.182***	0.041	0.041
	(0.056)	(0.069)	(0.038)	(0.126)	(0.126)	(0.037)	(0.043)	(0.058)	(0.078)	(0.078)
Number of firms within 10-20 miles	-0.325	-0.277	-0.280	0.200	0.200	-0.382**	-0.489**	-0.026	-0.338	-0.338
	(0.404)	(0.622)	(0.195)	(0.615)	(0.615)	(0.182)	(0.216)	(0.238)	(0.377)	(0.377)
Firm's market share	50.62***	141.4***	3.306	347.0*	347.0*	48.10***	140.9***	-4.641	280.4	280.4
	(14.58)	(29.93)	(8.271)	(183.4)	(183.4)	(17.70)	(33.31)	(18.61)	(209.0)	(209.0)
Firm's weighted market share	-9.663	54.37	0.448	-109.2	-109.2	-3.268	19.42	9.250	-128.0	-128.0
	(8.361)	(47.25)	(3.783)	(120.9)	(120.9)	(10.20)	(55.92)	(8.735)	(143.1)	(143.1)
Square of firm's market share	-91.54***	-605.2***	-6.056	-3,841	-3,841	-103.1***	-551.1***	-9.728	-3,993	-3,993
	(28.33)	(163.5)	(13.92)	(2,610)	(2,610)	(34.26)	(160.0)	(31.75)	(3,122)	(3,122)
Harvest acreage for Corn (million)	1.967***	1.924***	1.893***	1.392***	1.392***	1.502***	1.590***	1.567***	1.279***	1.279***
	(0.246)	(0.350)	(0.198)	(0.399)	(0.399)	(0.142)	(0.161)	(0.246)	(0.294)	(0.294)
Constant	-1.682	-14.65	8.162*	-3.760	-3.760	-15.18**	-23.60***	-3.622	-25.75*	-25.75*
	(10.96)	(17.35)	(4.856)	(5.027)	(5.027)	(6.085)	(8.456)	(6.273)	(13.90)	(13.90)
Observations	429	361	68	131	131	429	361	68	131	131
R-squared	0.774	0.742	0.982	0.700	0.700	0.650	0.614	0.860	0.489	0.489

Note: Statistical significance is noted by an asterisk (*) at the 10% level, two asterisks (**) at the 5% level, and three asterisks (***) at the 1% level. The values in the brackets are the standard deviations. The estimations are conducted on the incumbents and the entries separately. Besides, we further divide the data into the incumbents/entries, the seed companies, and the integrated biotech firms separately. For each sub-group we include and preclude fixed effects for comparison.