Exploring the Potential Effects of Organic Production on Contracting in American Agribusiness

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June 2006

American Agricultural Economics Association Annual Meeting
Long Beach, California
July 23-26, 2006

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Abstract

Organic production, while still a niche market in U.S. agriculture, is growing at a rapid rate. This paper argues that organic producers, particularly those seeking certification to sell at the retail level, share many characteristics with conventional producers who opt for contracting over independence. These include yield risk, search and transaction costs, and technological changes. Depending on the rate at which federal assistance programs grow and evolve to serve organic producers, contracting may become a popular choice within the organic sector. In turn, contracting may come to cover a significantly larger share of agricultural production as the organic sector continues to grow.

I. Introduction

The purpose of this paper is to examine simultaneously the phenomena of contracting and organic production in American agriculture and to establish the possibility of a direct correlation between the two in the near future of American agriculture. Contracting, particularly production contracting, is increasingly being chosen among producers as an alternative to independence and agricultural spot markets. However, this choice of contracting is only popular or gaining traction among producers having certain distinguishing characteristics, including high degrees of risk, steep costs and asset specificity related to inputs, and thin geographical spot markets in which to sell their outputs. The theoretical model presented in this paper is based upon a discussion of the literature on organic production and contracting. It demonstrates that large-scale producers seeking to obtain certification to market organic goods to retail outlets meet many of the criteria typically used to describe farmers who opt for production under contracting.

American agribusiness is changing. At all stages, from production to processing to retail, this change in agribusiness is marked by increased concentration and consolidation as well as an evolution and diversification of the products available to consumers resulting from the major American commodities. This change is being fueled largely by technological improvements that are facilitating cost effective large-scale production, as well as increasing consumer demands for quality, food safety, and product variety. Contractual arrangements forged between producers and processors can be viewed as a form of vertical integration and therefore contracting represents one of the most significant ways in which agribusiness is changing.

The percentage of U.S. agricultural production covered by contracting has increased from 28 percent in 1991 to 39% in 2003. As the number of farms in the U.S. continues to shrink while the average size of farms continues to grow, the growth of contracting is expected to continue in the years to come (MacDonald and Korb (20006. It is vital to make clear the distinction between the two types of contracting available to American producers and the growth patterns observable for each. According to MacDonald, et. al (2004), marketing contracts consist of an agreement between a producer and a processor, specifying quantity and prices before the harvest. Under the terms of marketing contracts, farmers maintain ownership of their stocks, meaning they retain managerial control in addition to all associated yield risks. Production contracts, alternatively, turn managerial control and crop ownership over to contractors. Producer payments are in actuality fees paid for the services provided by farmers, particularly labor. In exchange for their autonomy, farmers involved in such contracts receive inputs, technology, and retail level marketing from contractors. Table 1 reports statistics on the growth of agricultural contracting by commodity and contract type.

Table 1: The share of production under contract, by contract type and commodity, 1991-2003

Item	1991-93	1994-95	1996-97	1998-2000	2001-02	2003
Commodities Produced under Marketing Contract	*Share of Total Sales*					
All Commodities	17.0	21.2	21.5	20.4	19.7	21.7
Crops	22.8	24.0	21.1	22.5	24.7	29.7
Corn	10.2	13.8	12.9	12.6	14.7	13.8
Soybeans	9.6	9.8	13.2	9.7	9.5	13.6
Wheat	5.8	6.2	9.0	6.9	6.4	7.5
Sugar Beets	88.5	83.7	74.6	83.1	95.8	95.1
Rice	19.7	25.2	25.8	30.5	38.6	51.8
Peanuts	45.2	58.3	34.2	44.9	27.9	53.3
Tobacco	0.3	0.6	0.3	1.9	52.6	50.9
Cotton	30.4	44.4	33.8	42.9	52.6	50.9
Other Crops	6.3	14.0	18.7	21.2	30.9	44.7
Livestock	11.6	18.2	22.0	18.4	14.5	13.7
Broilers	5.9	3.4	4.0	3.9	4.2	1.1
Hogs	N/A	2.4	2.7	9.1	6.1	6.8
Cattle	N/A	4.3	5.9	4.6	2.7	3.4
Other Livestock	0.1	6.8	4.9	10.7	3.5	7.4
Dairy	33.6	56.7	58.0	53.4	48.0	50.5
Commodities Produced under Production Contract	*Share of Total Sales*					
All Commodities	11.8	13.0	10.6	16.9	18.0	17.5
Crops	1.9	1.9	1.8	4.2	3.1	1.1
Livestock	21.1	24.7	22.9	12.4	10.6	6.3
Broilers	82.8	81.2	80.1	84.9	88.1	95.5
Hogs	N/A	28.7	47.3	76.3	78.1	84.8
Cattle	N/A	14.7	11.1	19.7	18.3	25.4
Other Livestock	0.1	2.6	N/A	N/A	5.5	N/A
Dairy	0.2	0.2	0.1	0.2	0.7	0.6

Source: Economic Research Service Economic Information Bulletin No. 9 and the USDA's Agricultural Resource Management Survey (ARMS).

As Table 1 shows, marketing contracting maintains a larger share of total production than does production contracting, but the growth in production contracting was more pronounced from the years of 1991 through 2001. In more recent years, the growth of production contracting seems to have stagnated somewhat. This is largely because production contracting has come to cover nearly 100 percent of production for commodities which historically have seen growth in the area, such as broilers, hogs, and eggs.

Concurrently, the U.S. has seen a growth in certified organic production, driven by consumer demand for healthy and safe foods as well as efforts by producers to be more environmentally conscious. While organics remains a niche market and the share of total production under certified organic means is orders of magnitude smaller than that under contracting, the rate of growth has been striking. Table 2 reports the growth in certified organic acreage for the major U.S.-produced crops, which are central to the model presented in this study.

Table 2: Certified organic acreage, by U.S. crop, 1995-2001

	Total certified organic (acres)				*Change, 1997-2001(%)*	*U.S. cropland, 2001*	*Certified organic/ Total(%)*
Item	1995	1997	2000	2001			
U.S. total	914,800	1,346,558	2,029,073	2,343,924	74	828,029,449	0.28
Total pasture and rangeland	276,300	496,385	810,167	1,039,090	109	461,351,095	0.23
Total cropland	638,500	850,173	1,218,905	1,302,392	53	366,678,354	0.36
Grains							
Corn	32,650	42,703	77,912	93,551	119	75,752,000	0.12
Wheat	96,100	125,687	181,262	194,640	55	59,617,000	0.33
Oats	13,250	29,748	29,771	33,254	12	4,403,000	0.76
Barley	17,150	29,829	41,904	31,478	6	4,967,000	0.63
Sorghum	0	3,075	1,602	938	-69	--	--
Rice	8,400	11,043	26,870	31,839	188	3,132,000	1.02
Rye	2,900	4,365	7,488	7,056	62	1,328,000	0.53
Beans							
Soybeans	47,200	82,143	136,071	174,467	112	73,000,000	0.24
Dry Beans	0	4,641	14,010	15,080	225	1,429,900	1.05
Vegetables							
Tomatoes	0	2,322	3,063	3,451	49	381,870	0.90
Lettuce	0	5,743	11,410	16,073	180	335,200	4.80
Carrots	0	3,323	5,665	4,757	43	119,640	3.98
Fruits							
Citrus	0	6,099	6,509	9,741	60	1,089,900	0.89
Apples	0	8,846	9,270	12,189	38	431,200	2.83
Grapes	0	19,299	12,575	14,532	-25	977,970	1.49
Other cropland							
Cotton	32,850	9,974	15,027	11,456	15	15,787,800	0.07
Peanuts	0	2,969	2,085	4,653	57	1,543,000	0.30
Potatoes	0	4,335	5,433	7,533	74	1,267,100	0.59

Source: Economic Research Service Agricultural Information Bulletin No. 780

Table 2 shows that for nearly every major American crop, there has been significant growth in acreage dedicated to certified organic production. Probably most striking is the 74% overall growth in certified organic farmland in only five years, from 1997 to 2001. These acreage calculations do not take into account farms producing organically without production. While these farms greatly outnumber their certified counterparts, they are orders of magnitude smaller than the certified farms on average and they typically market directly to consumers through programs such as local farmers' markets (Dimitri and Greene, 2003).

Despite this boom in organic production, Table 2 also shows that organics remain a niche market in U.S. agriculture. Organic produce has captured the greatest share of total U.S. production yet no organic fruit or vegetable has yet be produced at five percent the level of the conventional substitute. Given that in some states consumer demand for organics is outpacing supply, it is likely that obstacles to more widespread organic production are currently in place. As summarized by Greene and Kremen (2003), these include high managerial costs, risks associated with the new means of production, and a lack of Federally funded insurance or assistance for organic producers. Included in the managerial costs are the costs associated with obtaining certification to market organic commodities to the retail sector, which is a necessity in order to obtain organic premiums.

This study argues that a growing portion of U.S. producers-those seeking organic certification, may come to view contracting as a viable outlet for their wares despite working with commodities that previously have been dominated by spot markets. The process of switching from conventional production to organic production and simultaneously seeking certification involves a period of time involving high costs, considerable yield risk, and uncertain market conditions. Therefore production contracting specifically that has a greater potential to expand into new commodities markets with the growth of organic production than market contracting.

II. The Issues Faced by Organic Producers

A review of the literature on contracting, and in particular production contracting, reveals that there are several major motivation factors in influencing a producer's choice between autonomy and contracting. These include yield risk, price risk, asset specificity and costs related to inputs, search and transaction costs associated with finding markets for outputs, technological change, and farm size. In this section each of these issues is dealt with in turn, and the relevance to transitional organic production is discussed.

Yield Risk

This is likely to be the single greatest factor in motivating transitional organic producers to choose contracting. Organic production in its current manifestation involves a higher degree of yield risk than conventional production, on average (Greene and Kremen, 2003; Wossink and Kuminoff, 2005). This is due to a variety of factors, including the management intensive methods of pest and weed control. Biorational pesticides typically take a period of years to take full effect, implying that the risk of damage to crops from pests or weeds is especially high in the beginning years of organic production.

The despoilment of organic products prior to processing or retail sale is another form of yield risk faced by organic producers. Organic commodities are more perishable than conventional substitutes and are more susceptible to aesthetic defects that deter consumer demand (Dimitri and Greene, 2002).

Despite these risks associated with organic yields, organic producers do not have access to crop insurance or other federally funded assistance programs. Producers responding to surveys have frequently reported these risks as deterrents to making the switch to organic production. There are federal initiatives underway to financially support organic producers and reduce yield risk, such as Certification Cost-Share Support, Marketing Order Exemptions, and several provisions in the 2002 Farm Act.[2] These initiatives remain in their development stages and do not provide aid to all organic producers seeking certification. For example, the Certification Cost-Share Support helps to defray the costs associated with the three-year transitional period for organic producers. But this provision does not cover the state of California, which is the largest state in terms of organic production, and the largest payments offered by this program only cover the costs for small operations.

Organic producers, particular those seeking certification, therefore have a two-fold incentive to seek out contracts. Production contracts for which payment is based solely upon the process of growing and harvesting a crop for a set period of time transfers large amounts of yield risk on to contractors, unlike in the case of marketing contracts which lump all yield risk onto the producers. Further, contracting in general provides producers with guaranteed markets for their wares and reduces the search time for market outlets. Any means by which to reduce the period of time between stages of production is valuable for all parties involved in the case of organics.

Price Risk

Production contracts have become very popular among U.S. livestock producers as a tool with which price risk can be reduced or even eliminated. Under many such contracts,

[2] See Greene and Kremen (2003) for a discussion on the various initiatives being implemented.

the fees paid to producers in the form of grower compensation are agreed upon before the livestock are grown and sold. In such cases, the payment received by producers is largely unrelated to the market price of the slaughtered livestock and hence price risk is eliminated (MacDonald, et. al 2004). Production contracts have remained unpopular among smaller, more diversified crop farms.

The few studies that have looked at prices received for organics reveal that not only is there a significant premium for organics at the retail level. Moreover, this premium results in organic producers receiving higher prices and in many cases higher profits than conventional producers working with the same commodity (Kremen, Greene, and Hanson, 2003). These premiums are not reaped, however, by transitional producers of organics seeking certification. The output from these producers cannot legally be labeled organic and therefore cannot be sold for organic prices (Greene and Kremen, 2003). There remains no evidence that transitional producers face significant price volatility, but incentives remain to use contracting to lock in competitive prices in order to cover the costs of certification. This is especially true given that transitional organic products must compete directly with conventional products, which are of more uniform quality in the eyes of consumers (Thompson and Kidwell, 1998). Overall, output price risk more likely to motivate transitional producers in favor of marketing contracts rather than production contracts.

Asset Specificity and Costs Related to Inputs

Factors related to farming inputs have long been considered as motivating factors in the producer's decision to choose contracting. Survey results have shown producers to utilize contracts as a means by which to reduce risks related to volatile inputs costs

(MacDonald, et. al 2004). Furthermore, it has been shown that high degrees of input asset specificity motivate producers to choose contracts (Key, 2004). The argument for this relationship is as follows: highly specific inputs and capital tend to be expensive and difficult to obtain, and these expenses reduce farmers' ability to diversify production. Diversification is a conventional mean by which to reduce risks, and thus contracting is used as compensation.

Input price volatility and asset specificity are not considered to be major concerns in the case of organic production, which is labor intensive and primarily employs inputs produced on the farm (Greene and Kremen, 2003). The debate as to whether or not organic farm inputs are more efficient than conventional inputs, but there is no question that they are less expensive and commodity specific.

Search and Transaction Costs

The costs that producers face associated with finding outlets for their wares vary depending on the commodities being sold and geographical circumstances, such as the size of the regional spot market. While there is some debate in the literature regarding the costs associated with contracting in general, producers employ contracts to bypass search and transaction costs (MacDonald, et. al, 2004). Roberts and Key (2005) stressed the importance of including search and transaction costs in models explaining producer profits. The authors argued that as spot markets thin, these costs increase and independent farmers become more likely to opt for contracting.

The organic sector comprises less than two percent of the total U.S. agricultural industry (Dimitri and Greene, 2002) and at all stages of production organic agriculture remains marked by constant change. Uncertainty regarding the market structure of the organic industry, including the functionality of organic spot markets, remains an impediment to the continued growth of the sector. For this reason the majority of organic farms are small and sell their products directly to consumers. Organic producers wishing to market their products on a larger scale have incentive to enter into contracts, of either variety, with processors in order to avoid paying relatively high search and transaction costs on top of the certification fees already in place.

Technological Change

Processors who assumed managerial control over commodities in production have incentive to minimize costs by utilizing the most recent and efficient technology. This is a major reason why farmers and ranchers enter into production contracts (MacDonald, et. al, 2004). Moreover, producers undertaking new technology take on increased initial costs due to changing inputs and capital as well as potential risks of failure or inefficiency. The managerial input producers received through production contracts assist in the use of new technology and share the associated risks. The U.S. hog industry is one marked by rapid technology change and a simultaneously growth in the proliferation of production contracting (Martin, 1997).

Organic production is in itself a new technology. Given the rapidly evolving nature of organic production, farmers switching to organics may value access to the latest methods of production over independence. Additionally, any new technology applied to organic production runs the risk of being cost inefficient and organic producers have an incentive to share this risk with processors in order to remain profitable.

Farm Size

Among conventional producers, large farms are more likely to enter into contracts with processors. As of 2001, 61.5 percent of U.S. farms with over $1,000,000 in sales produced under contract, while only 7.7 percent of farms selling under $250,000 had contracts (MacDonald, et. al, 2004). As the number of large, commercial farms in the U.S. continues to grow, the share of total production under contract covered by that demographic is expected to grow.

Organic farms are considerably smaller than conventional farms on average. For example, the average organic farm in California is less than five acres in size (Klonskly, et. al, 2002). However, a considerable range exists among organic farms as large scale certified operations are increasing becoming more common. Despite the fact that most organic producers sell directly to consumers, Krissof (1998) found that large, certified organic producers are the least likely to engage in farmers' markets or CSA's.

Concurrently, the demand for organic foods, particularly produce, is growing rapidly in on the retail level. As of 2000, more than half of all organic production is sold in conventional supermarkets, as opposed to natural food markets or directly from the farmgate (Dimitri and Greene, 2003). Organic producers who are either certified or seeking certification are therefore likely to be among the largest in the organic sector and also the most likely to engage in contracting as a means by which to promote their outputs to the retail level.

III. The Model

When examining the choices that farmers make when considering different approaches to production, the prevailing practice is to consider the infinite time horizon when estimating benefits. Wossink and Kuminoff (2005) followed this approach when weighing conventional against organic production, as did Martin (1997) and Key (2005) when considering the options producers face between independence and production under contract. This is a sound approach, especially when considering the switch to organic production, given that the change in production inputs for a transition to organic farming implies an indefinite commitment to organics. The model presented below allows for farmers to maximize utility over all future time periods, but constrains decisions such that utility for any given time period must not be less than some minimum utility level.

The model representing the implications discussed in Section II makes two simplifying assumptions regarding crop farmers in the United States. The first is that utility increases linearly in expected profits for any given time period, and the second is that all crop farmers have some degree of risk aversion. Therefore, the producer's general problem in the context of this study is given by:

(1) Maximize $U[\Pi, CV] = E_t[\Pi] - F[CV_\Pi]$

such that $U_t \geq \overline{U}, \forall t$

Where *Π* represents profits and *CV* represents the coefficient of variation of profits, or the standard deviation of profits normalized by expected profits. The single constraint on the maximization problem states that farmers make decisions such that for no time period greater than or equal to a single year can utility drop below a benchmark minimum utility value. It is important to note that this benchmark value of $\overline{U}$ is not necessarily uniform among producers of various commodities, nor among producers of identical commodities. For a given producer, it may represent the point at which household debt begins to accrue or that point at which a source of non-farm income becomes necessary to maintain a valued standard of living. The only implicit assumption regarding $\overline{U}$ is that it exists and is finite for all crop producers in the United States.

Central to the analysis of this study is the transitional period of three years during which conventional producers seek official organic certification, as described by Greene and Kremin (2003). Therefore the utility level that must, in particular, not be less than $\overline{U}$, given by:

(3) $U_t[\Pi, CV] = E_t\left[\sum_{i=t+1}^{t+3}\Pi_i\right] - F[CV_\Pi]$

which represents the utility for the three harvest years to come. Producers considering a switch to organic production are assumed to examine in particular their expected utility over the three upcoming years, weighing their expected utility for another three years of conventional production against that for three transitional years of organic production. The formula for total farm profits during a three-year period for conventional crop farmers is thus given by:

(4) $\Pi_c = p_c\overline{q} - R_c \bullet k_c - w\overline{l} - S_c(n_c, u_c)$

Where p_c represents the price received at the farm gate for the commodity produced and $\overline{q}$ represents total quantity produced during the three-year span. In order to represent the price risk that motivates the managerial decisions of crop producers throughout the United States, p_c is assumed to be a random variable with distribution N($\overline{p}, \sigma_p^2$). Quantity, alternatively, is reported as a constant to reflect the presence of production safety nets provided most commonly in the form of government subsidization. That is, conventional farmers are assumed to receive support at times when natural conditions adversely affect yields.

R_c is a vector reporting costs for the inputs used annually in the production process, given by the accompanying vector k_c. Longer term capital expenditures, e.g. tractors and barn structures, are not included this dot product. All farms, both conventional and organic, are assumed to be previously established and without heavily deteriorated capital. R_c is assumed to be another random variable with distribution $N(\bar{r}, \sigma_r^2)$ to represent imperfect input markets.

The wage rate, given by w, is assumed to be a constant in order to represent a labor market that is not necessarily perfect, but identical across both conventional and organic production sectors. The total amount of labor employed, $\bar{l}$, is also given as a constant to represent certainty in the labor hiring decisions made by conventional producers.

Finally, the formula $S_c(n_c,u_c)$ represents the search and transaction costs paid by producers, following the work of Roberts and Key (2005). Search and transaction costs are assumed to be a function of the number of agents involved in the producer's geographical spot markets, n_c, and the producer's general familiarity with the prevailing market structure and the relevant outlets for the commodity produced, given by u_c. S_c is assumed to be strictly decreasing in both n and u. Both n_c and u_c are assumed to be constants throughout the three-year period of interest.

The expected profits for conventional producers can thus be obtained:

(5) $$E[\Pi_c] = \overline{pq} - \bar{R} \bullet k_c - w\bar{l} - S_c(n_c, u_c)$$

Given that the random elements of the profit function for conventional producers are known to be p_c and R_c, an expression can be obtained for the standard deviation of profits during a three-year period:

(6) $$\sigma_c = \sqrt{\sigma_p^2 + \sigma_r^2 - 2Cov(p_c, r_c)}$$

The covariance of output and input prices is not assumed to equal zero, as the general concept of profit maximization the two entities to be positively correlated. Thus there exists a dampening effect on the standard deviation of conventional producer profits.

In the case of conventional production, the three-year time period is intended to be representative of typical conditions faced and typical practices carried out by farmers employing conventional means of production and trading in competitive markets. In the case of organic production, however, the three-year model portrays the profit function of a farmer during the first three years of organic production, following a switch from entirely conventional production. Aggregate profits for transitional; organic producers over this time period are given by:

$$(7) \qquad \Pi_o^T = p_o^T q_o - R_o \bullet k_o - wl_0 - S_o(n_o, u_o) - C$$

In the organic case, p_o is considered to be a constant and strictly greater than $\overline{p}$, the expected conventional price. That is, organic producers are assumed to receive higher prices than their conventional counterparts and to face no price risk due to high organic premiums (Greene and Kremin, 2003) and demand outpacing supply for organics (Kremen, Greene, and Hanson, 2003). But the price obtained by producers seeking organic certification, p_o^T, is strictly less than p_o. While it is possible for transitional farmers to obtain premiums on organically produced products by selling directly to consumers, research on the nature of organic farms suggests this practice to be unlikely among producers seeking certification. As previously discussed, only the largest farms producing organic commodities seek certification due to the costs inherent in the process, and large farms are the least likely to seek directly to consumers through practices such as farmers' markets or CSA's (Krissof, 1998). Therefore, while considering only large organic producers seeking certification, it is assumed that p_o^T is approximately equal to $\overline{p}$.

Output is reported as a random variable, as q_o is a random variable with distribution N($\overline{q}_o, \sigma_q^2$), with $\overline{q}_c < \overline{q}$. This formulation is intended to represent both the smaller average size of organic farms and the risks associated with the yield, including factors such as biorational pesticides and despoliation prior to reaching the market.

There is no randomness associated with the input prices required for organic production, as the majority of the necessary inputs are assumed to be produced internally. Additionally, it is assumed that $R_o \bullet k_o < R_c \bullet k_c$.

The amount of farm labor required for organic production, l_o, is assumed to be a random variable with distribution N($\bar{l}, \sigma_l^2$), where $\bar{l} > l_c$. The probability distribution of organic labor represents the fact that organic production is more labor intensive than conventional production and that at times during the three-year transitional period varying amounts of manual labor are required to deal with acute issues such as infestation or weed control.

The number of agents involved in organic markets, n_o, is assumed to be strictly less than n_c. Further, the typical organic producer is assumed to have less of an understanding of the existing market structure for outputs than producers working with conventional substitutes. This assumption is not intended to reflect organic producers' abilities but rather the new and rapidly changing nature of the entire organic sector in American agriculture. This the distribution of u_o is given by N($\overline{u_o}, \sigma_u^2$), with $\overline{u_o} < u_c$. Given that market understand is the only stochastic component of the search cost function, S_o has the distribution N($\overline{s_o}$,σ_s^2), where $\overline{s_o} < s_c$.

Finally C represents the actual cost of certification. Despite the existence of institutions such Certification Cost Share, the Conservation Security Program, and Marketing Order Exemptions, it is unrealistic to assume this fixed cost away. The aforementioned programs, as discussed previously, are intended to help alleviate these costs for producers seeking certification but they are all in their development stages and they do not cover all organic producers. Hence we have that $C > 0$.

Expected profits for transitional organic producers can thus be obtained by:

$$(8) \qquad E[\Pi_o^T] = p_o^T \overline{q}_o - R_o \bullet k_o - w\bar{l} - \overline{S}_o(n_o, u_o) - C$$

Analogous to the case of conventional production, an expression can also be obtained for the expected standard deviation of organic profits:

$$(9) \qquad \sigma_o^T = \sqrt{\sigma_q^2 + \sigma_l^2 + \sigma_s^2 - 2Cov(q_o, s_o) - 2Cov(q_o, l_o) - 2Cov(l_o, s_o)}$$

The covariance between output and search costs is assumed to be zero, as is the covariance between labor and search costs. However, it stands to reason that as the scale of production increases in organic production, so does the likelihood of acute problems occurring, requiring adjustments to the labor force. Hence the covariance between output and labor cannot be assumed away and the final expression for transitional organic profit standard deviation is thus obtained:

$$(10) \qquad \sigma_o^T = \sqrt{\sigma_q^2 + \sigma_l^2 + \sigma_s^2 - 2Cov(q_o, l_o)}$$

Directly comparing the model's results among the two kinds of producers, it is clear that expected conventional profits are higher than expected transitional organic profits.

That is, unless conventional input costs alone are high enough to outweigh the profit advantages yielded by conventional producers through a greater scale of production, lower average labor costs, significantly lower search and transaction costs, and the absence of certification costs. This is considered to be an unlikely scenario and hence this strict inequality is assumed to hold:

(11) $\quad E[\Pi_c] > E[\Pi_o^T]$,

Moreover, it is assumed that the standard deviation of conventional profits is less than that of transitional organic producers. As with the comparison of expected profits across production methods, a formal proof to demonstrate this relationship is not possible but the assumptions inherent in the model imply that transitional organic profits are at least as variable as conventional profits. The key factor in determining this inequality is the uncertainty related to marketing and technical infrastructure, as stressed by Greene and Kremen (2003) and captured by σ_s^2.

(12) $\quad \sigma_o^T \geq \sigma_c$

From (11) and (12), we have that the CV of profits is higher for transitional producers than for conventional producers. Therefore, for risk adverse farmers, it must hold that:

(13) $\quad U_t[\Pi_c, CV_c] > U_t[\Pi_o^T, CV_o^T]$

Further, for highly risk adverse producers who wish to seek organic certification, expected utility over this three-year transitional period may be lower than $\overline{U}$, thus precluding the possibility of switching to organics despite utility that could eventually be garnered from higher long term profits or creating less of an impact on the environment.

Producers who value the option to switch to organic production but are precluded from making the switch due to the costs and risks associated with the three-year transitional period may also consider the option of production contracting. Profits associated with production contracting are given by:

(14) $$\Pi_p = p_p \overline{q_p} - w\bar{l} - S_p(u_p)$$

Following the findings of MacDonald, et. al (2004) as well as Key (2005), it is assumed that $p_p < \overline{p}$, implying that producers receive lower average prices under production contracts relative to conventional farmers but that there is no uncertainty in farmgate price. A notable absence from this profit formulation is input costs, which are typically absorbed by contractors. S_p is a function only of producers' general understanding of the market and given that contractors serve as the outlets for commodities produced, $S_p < S_c$.

The model, in conjunction with research on contracting income, argues that producers under production contract have expected profits at least as great as their independent counterparts. However, somewhat more relevant to this study is the fact that uncertainty is absent from the formulation of income under production contracting. Formally:

(15) $$\sigma_p = 0$$

The absence of variability from the profit equation reflects the fact that risk and uncertainty is considered to be the greatest motivating factor among producers who choose contracting. Given that the choice of production contracting provides indisputable reductions in the standard deviation of profits and no discernible reduction in expected profits relative to conventional farming, it must be that:

(16) $$U_t[\Pi_o^{T,P}, CV_o^{T,P}] > U_t[\Pi_o^{T}, CV_o^{T}]$$

Therefore, the model demonstrates that producers interested in switching to organic production can improve their expected utility during the three-year transitional period by exchanging independence for production contracting. Improving utility relative to $\overline{U}$ increases to chances of the interested producer making the switch to organic and seeking certification.

IV. Concluding Remarks

Virtually no data are available on the incidence of contracting among organic producers. The Economic Research Service of the USDA now maintains data on organic acreage by state and commodity throughout the U.S. but at this point in time statistical analyses are precluded. However, the analytical research compiled by Dimitri and Greene (2003) demonstrates that a variety of contractual arrangements are already in place in organic markets such as wheat, corn, and soybeans. Interestingly, the conventional markets corresponding to these commodities are among the lowest in terms of contracting proliferation.

The model constructed in this paper illustrates that contracting, and production contracting in particular, presents incentives to organic farmers seeking certification. As the organic market grows and attains greater amounts of recognition, federal assistance is expected to increase for organic producers. Looking towards the future, the most pertinent question regarding federal assistance programs is whether or not they can keep pace with consumer demand for organics and therefore producers' desires to capture higher profit margins through organic production.

Numerous producer survey results, as well as the existence of contracts in the organic wheat, corn, and soybeans markets suggest that at the present time obstacles to organic production still remain that are not being assuaged by federal aid. Agricultural contracting remains a somewhat controversial topic in the literature, and therefore a close monitoring of the growth and industrial organization of the organic sector is warranted for policy considerations.

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