Organic Agriculture: An Agrarian or Industrial Revolution?

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The notion of industrialized agriculture has been a dominant theme in the applied economics literature. More recently, the debate has entered the realm of organic agriculture, with some suggesting that the organic sector has strayed from its agrarian roots. The terms "industrial" and "agrarian" are widely used, yet few have given precise definitions of what the terms mean. This paper puts forth testable hypotheses for agrarian and industrial agriculture. Then, using census data from the 2008 Organic Production Survey, we examine the evidence to assess whether the organic farm sector fits an agrarian or industrial model. Overall the evidence is mixed, yet suggests that the organic sector is less agrarian than expected.

Key Words: industrial agriculture, organic agriculture, agrarianism, Organic Production Survey

One way of viewing the production agriculture segment of the U.S. food system is as a continuum of operations (farms) that use a range of different production practices, with "organic" and "industrial" claiming opposite ends of the spectrum. Beyond the most obvious differences, such as those regarding use of pesticides and other chemicals, the production systems vary in other meaningful ways, including pasture access for livestock and use of genetically modified organisms. These differing practices arise from the underlying beliefs about farming, which separate the two systems. Organic producers raise crops by working in harmony, as much as possible, with the land and local conditions. The holistic attitude extends to organic livestock production as well, which has practices that accommodate animals' natural behavior. According to the International Federation of Organic Agriculture Movements (IFOAM), an organic system is "a production system that sustains the health of soil, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects" (IFOAM 2009). Industrial agriculture production, on the other hand, focuses on efficiency (Heady 1983). In order to minimize costs, industrial agriculture relies heavily on technology, and production is "capital intensive, substituting machinery and purchased inputs such as processed fertilizers for human or animal labor" (Barlett 1989, p. 253).

On both sides of the debate are advocates, journalists, and academics who have adopted normative stances on the question of organic versus industrial farming, suggesting that one food production technology is superior to the other. This tension between organic and industrial agriculture has existed much longer than most of us imagine. While precise dating is difficult, Europe in 1926 has been suggested as a starting location and point in time for the organic movement—decades before the widespread adoption of modern intensive farming methods (Conford 2001). The focus of the early organic movement was on soil quality—more specifically, on how the use of humus (compost) amends the soil, increasing its fertility (Conford 2001). Around the same time, concern about soil quality was on the minds of those involved in conventional agriculture as well, as the

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Soil Conservation and Domestic Allotment Act of 1936 linking soil conservation and farm policy in the United States illustrates.[1] Even at this early time, fundamental differences are evident: the focus of the early pioneers of organic farming was on enhancing soil fertility, while the conventional sector was concerned with addressing soil erosion brought on by farming techniques (Conford 2001, Benedict 1953). These early views regarding soil quality are another clear signal of differences between the two approaches to farming. Over the course of the eight decades since 1926, these two perspectives on farming and soil sent organic and conventional agriculture in different directions.

Organic agriculture in the United States has grown in size since the early 1920s and has gained recognition as a legitimate sector, ultimately receiving its own place within the U.S. Department of Agriculture (USDA), where the National Organic Program regulates the definition, certification, and enforcement of the "organic" label (USDA 2010a). Increased policy attention to the industry has resulted in an expansion of funds for research into organic agriculture; for example, USDA sponsors the Organic Research and Extension Initiative, a grant program specifically targeting organic agriculture.[2] Along with the industry growth, regulatory attention, and additional funds for research, economic research on organic agriculture has increased. That said, many unanswered questions remain, such as: what is it that consumers believe they are purchasing when they buy organic food? Little, if any, economic research has examined the factors that influence consumer tastes and preferences for organic food. Surveys conducted by the organic industry indicate that consumers state their reasons for purchasing organic food as: the environment, health, food quality, and support for small and local farmers (Whole Foods 2004). This last factor—support for small and local farmers—is also widely used by companies when marketing their organic products:

> "Family farms supply 90 percent of our milk." *Horizon Organic*
> "Organic brings economic opportunity to many small, family farms." *Stonyfield Organic*
> "Buying organic supports small, independent family farms." *Whole Foods*
> "Organic agriculture can be a lifeline for small farms …." *Amy's Organic*

The perception that purchasing organic food products supports an agrarian ideal that agriculture should consist of small-scale family farms may be a residual from the earliest days of the organic movement, when organic farming took place on small, diversified farms, and organic food was sold in independent natural food stores (Anderson 1994, Dimitri and Greene 2002). Since that time, the U.S. organic sector has grown in size, with retail sales increasing by more than a factor of 6 since 1997, and certified organic farmland tripling between 1997 and 2005[3] (USDA 2010b). Some have even suggested that organic food has moved from being a niche product to the mainstream (Dimitri and Greene 2002). While the nomenclature "mainstream" may be overstating gains the organic sector has achieved, organic food products have indeed claimed a position in our food markets: they are available in nearly all food stores, private label organic products are ubiquitous, and even the "big-box" stores such as Costco and Wal-Mart boast a wide variety of organic food products (Dimitri and Oberholtzer 2009).

Some observers have suggested that today's organic food sector has strayed from its agrarian roots, and is more aptly described as corporate organic or an "organic-industrial complex" (Pollan 2001, Fromartz 2006). DeLind (2000) suggests that the pivotal point in the transformation from an agrarian to an industrial character was the implementation of the National Organic Standards. Further, she raises the question as to whether agrarian ideals can be maintained in a large organic sector or whether the end result will be only a slightly greener version of the current industrialized food system. Yet growth after the

[1] There is some debate as to whether this Act was intended to address environmental issues or whether including soil conservation in the 1936 Act was merely a way to work around the Supreme Court's ruling that the processing tax that funded farm payments, via the 1933 Agricultural Adjustment Act, was not legal (Benedict 1953, Effland and Dimitri 2006).

[2] See http://www.csrees.usda.gov/fo/organicagricultureresearchandextensioninitiative.cfm for information on the specifics of this grant program.

[3] 1997 is the year that collection of two critical data series began: farmland (by USDA's Economic Research Service) and retail sales (*Nutrition Business Journal*). See www.ers.usda.gov/organic/briefing for additional information.

implementation of the organic standards is not unexpected, given that the economic rationale for organic standards includes increasing consumer confidence in the label as well as reducing the transaction costs associated with trading organic products (Lohr 1998). As a consequence, a legitimate organic standard should facilitate market expansion.

Framework for Assessing "Agrarian" or "Industrial"

Despite the debate in organic circles, it is unclear whether the weight of the evidence suggests that the organic sector is "agrarian" or "industrial." Despite the "industrial" label placed on the organic sector by popular writers such as Pollan and Fromartz, and the musings of interested researchers and other organic pundits, the question has not yet been systematically examined. To the best of my knowledge, this research presentation is the first serious attempt to do so. That said, addressing the question of whether organic farming in the United States is an agrarian or industrial movement is not straightforward. The first obstacle is that the profession has not agreed upon clear, concise definitions of the terms "agrarian" and "industrial." Thus, it is difficult to find and estimate appropriate measures of the degree of agrarianism and industrialization of the organic sector. At best, the literature suggests a stylized description of how different factors, such as farm size or farm specialization, would vary according to whether the farm sector is considered agrarian or industrialized (see box). The factors included in the box below are not the definitive word on how to differentiate between agrarian and industrial systems, but they provide a reasonable framework for this discussion.

STYLIZED KEY ELEMENTS OF FARM SECTOR

Factor	*Agrarian Family*	*Industrialized Corporate*
Farm size	Small	Large
Farm ownership	Family	Family or corporate
Farm labor	Mostly family labor	Mostly hired labor
Farm specialization	Diversified	Monoculture
Decision making	Independent	Specified via contract

Agrarianism is most often associated with Jeffersonian ideals suggesting that agriculture and rural life provide a superior lifestyle (Danbom 1999). More recent depictions of agrarian values can be found in the writings of Wendell Berry. According to his vision, the family farm represents good farming, defined as "farming that does not destroy either farmland or farm people" (Berry 1987). The Small Farm Commission report provides a definition of a "small farm" based on measurable characteristics, specified as having annual sales less than $250K, and with labor provided by the farmer and family[4] (USDA 1998). On the other hand, industrialization has been called "…the application of modern industrial manufacturing, production, procurement, distribution and coordination concepts to the food and industrial product chain" (Boehlje 1996). Other phrases frequently used in reference to industrialization include: large, increased use of science and technology, contract farming, efficient, concentrated, vertically integrated, vertically coordinated, more profitable, corporate farming, and so on (Hamilton 1994, Welsh 1996, Drabenstott 1994, Boehlje 1996). Hamilton (1994) points out that whether a person views industrialization of agriculture as positive or negative depends on a person's attitude as well as her familiarity with agriculture.

Ex ante expectations about whether organic agriculture is industrial or agrarian are mixed. Two compelling factors suggest that the organic market will likely follow the industrial path of the conventional sector. The first one is that U.S. consumer demand for organic products largely parallels that for conventional products. For example, consumers are accustomed to purchasing out-of-season produce, such as lettuce, year-round, and so expect to be able to do the same for organic fruits and vegetables. The available data suggest that the pattern of organic imports into the United States largely follows that of the conventional sector, and that out-of-season produce comprises a large portion of organic imports (Oberholtzer, Dimitri, and Jaenicke 2010). The second factor is that the majority of intermediaries (i.e., wholesalers, processors, manufacturers, brokers, and distributors) in the sector began as conventional businesses, and either fully con-

[4] The $250K figure was established for the conventional sector.

verted to organic or added an organic component to their business (Dimitri and Oberholtzer 2009). These firms provide the critical link between "raw" commodities produced on the farm and food products sold by retailers, and are responsible for the manufacture and distribution of organic products along the supply chain. Thus, firms new to the organic sector most likely adapted their existing (conventional) practices to the new (organic) parts of their businesses.

However, factors that focus on the farm level are less suggestive of an industrialized sector. Because organic farming is more labor-intensive than conventional farming, organic farms are more likely to be small, which supports the agrarian model. On the other hand, labor intensiveness also suggests that farms are more likely to require hired labor, which lends support to the industrial paradigm. Organic farms rely on crop rotation to improve soil fertility and increase pest resistance, and thus are necessarily diversified (at least temporally), which lends support to the agrarian notion of diversified farms.

In the absence of established concrete measures of industrialization and agrarianism, I suggest the following six hypotheses, which follow from the stylized factors regarding the terms "agrarian" and "industrial." Each describes the status of a key factor that prevails in an agrarian organic sector, and has a commensurate opposite version that would describe industrialized agriculture:

HYPOTHESIS 1. *Production takes place on small (acres) farms.*

HYPOTHESIS 2. *Production takes place on a farm with sales less than $250K.*

HYPOTHESIS 3. *Farms are family-owned.*

HYPOTHESIS 4. *Most farm labor is family-provided.*

HYPOTHESIS 5. *Farm production is not specialized in a small number of crops.*

HYPOTHESIS 6. *Farmers are independent operators who make their own production and marketing decisions.*

The posed hypotheses are examined using data from the 2008 Organic Production Survey (OPS), a special study of the Agricultural Census. The OPS is USDA's first attempt to obtain a comprehensive set of data describing the organic farm sector, and the survey responses make possible a statistically reliable analysis of the organic farm sector (USDA 2010d). The OPS data are compared to those represented in the Agricultural Census, which covers all farms (organic and conventional). Since organic farms comprise a tiny share of the entire sector (less than 3 percent), the comparison is equivalent to an evaluation of the organic farm sector versus the conventional farm sector.

Before directly tackling the agrarian versus industrial questions, it is useful to step back and take a brief look at some basic comparisons between the organic sector and the rest of agriculture. Some fundamental differences emerge quite quickly. Produce and milk, for example, account for a higher share of farm-level sales than they do for the entire sector, while grains and livestock account for a smaller share (Table 1). This result is consistent with retail sales data, which indicate that fresh produce and dairy comprised 53 percent of total organic retail sales in 2008 (Nutrition Business Journal 2009). OPS results reveal that organic commodities likely follow a different path through the market channels upon leaving the farm. In 2008, approximately 7 percent of organic farm sales were sold directly to consumers, 10 percent were sold directly to retailers, and approximately 83 percent moved through wholesale markets (USDA 2010d). For the entire agricultural sector, in 2007 only 0.4 percent of the value of agricultural commodities was sold directly to consumers (USDA 2009). Comparable statistics for sales made through the wholesale channels and direct to retail sales are not available for the entire sector.

Table 1. Farm-Level Sales by Category

Category	Organic (2008)	All of Agriculture (2007)
	percent	
Vegetables and melons	22	5
Fruit and tree nuts	13	6
Grains, oilseeds, dry beans, and peas	16	26
Livestock	3	27
Poultry and eggs	12	12
Milk from cows	24	11
Other	10	12

Sources: USDA (2010d), USDA (2009).

Table 2 shows the top organic states, either in terms of the number of farms or the value of sales, as well as the comparable statistics for the entire agricultural sector. California is the leader in both total sales and number of farms, for organic and the entire agricultural sector. Wisconsin has the second largest number of farms, while Washington State has the second highest level of sales. These six states account for 64 percent of the market value of organic sales and 48 percent of organic farms in the United States. In comparison, the same six states produce 22 percent of market value of agricultural products, and 15 percent of all farms in the United States. In other words, organic and conventional production and farms are not concentrated in the same locations. When applicable, these six states will be used in the following discussion of the hypotheses.

Data Meet the Hypotheses

HYPOTHESIS 1: Production takes place on small (acres) farm. While farm acreage is one measure for assessing whether a farm is small, the literature does not specify a standard number of acres that defines a "small" farm. Thus, it is useful to examine farm size from several angles, such as in aggregate, by region, and for specific products. For crops and pasture, the average number of acres per farm provides an indication of whether a farm is relatively "large" or "small." For livestock and poultry, the number of animals per farm is a more appropriate measure of size.

The average number of acres per farm in the organic sector for all farms in the United States reveals that organic farms are smaller (Table 3). This result holds for all farmland, cropland, and pasture; however, the difference for cropland is less than 80 acres. An average organic pasture farm is much smaller, by approximately a factor of three, than the typical pasture farm. Organic vegetable farms are smaller, while apple farms are roughly the same size. The average organic broiler farm has fewer birds, while the average organic layer farm has more. Organic dairies have fewer organic cows, while organic egg facilities produce, on average, fewer eggs per farm.

Comparing the average farm size in the main producing regions yields a different perspective of the organic sector. The average organic vegetable farm in California is larger than the national average for organic vegetable farms, at 151 acres, although still half the size of all vegetable farms in the United States. The same is true of carrot and lettuce farms. Organic apple orchards in Washington are not much smaller than all apple farms in the state. The average number of organic milk cows per farm in Texas is quite large (Texas is home to farms that supply the largest processor of private-label milk in the nation), and exceeds the average number of cows per farm in California and Texas. The average number of organic birds per farm[5] in California greatly exceeds the average number of chickens per farm in Georgia, the state with the largest share of national broiler production.

Thus, the statistics on average acres per farm yield mixed results: on average, organic farms are smaller than their conventional counterparts. But this doesn't hold for every organic product in every part of the country.

HYPOTHESIS 2: Production takes place on a farm with sales less than $250K. A $250K sales threshold is the generally accepted definition for a small farm in the United States. Several factors suggest that the level $250K may not be the correct value to use when assessing whether an organic farm is small. The conundrum is readily apparent when examining the components of total farm revenue separately: quantity produced and prices received. Turning first to quantity, organic farms tend to be smaller than conventional farms and thus have fewer acres available for planting. Yields between organic and conventional farms may differ, although comprehensive studies of relative yields for the U.S. organic farm sector do not exist. Some long-term cropping system trials indicate that once a farm is completely transitioned to organic, yields for organic and conventional are the same (Pimental et al. 2005). However, European research conducted on working farms suggests that yields may be lower (Offermann and Nieburg 2000). Thus, a typical organic farm is likely to have lower output than a typical conventional farm. However, organic products receive higher prices than do their conventional counterparts. The net effect on farm sales, in comparison

[5] Based on the National Agricultural Statistics Service's report of inventory at year end (USDA 2009, 2010d), for both organic and the entire sector. This is not the same measure as the number of broilers sent to market during the year.

Table 2. Organic and Sector-Wide Production and Farms for Main Organic States

	Organic sector		All of Agriculture	
State	Sales (in $1,000s)	No. of farms	Sales (in $1,000s)	No. of farms
California	1,148,650	2,580	33,885,064	81,033
New York	105,133	788	4,418,634	36,352
Oregon	155,613	637	4,386,143	38,553
Pennsylvania	212,739	551	5,808,803	63,163
Washington	281,970	862	6,792,856	39,284
Wisconsin	132,764	1,152	8,967,358	78,463
Total U.S.	3,164,995	13,766	297,220,491	2,204,792

Sources: USDA (2010d), USDA (2009).

to a conventional farm, is ambiguous. This line of reasoning suggests that the definition of a small farm, in terms of sales, in the organic sector might require further scrutiny. That said, it is still useful to ascertain how the farms in the sector line up in regard to total sales, using the standard benchmark. The average farm size, in terms of sales, is slightly less than the $250K threshold. The typical organic farm has sales averaging about $100K more than the average farm in the United States. The two states with the greatest dollar value of organic sales, California and Washington, have larger farms; together, these states produce 45 percent of the farm value of organic products.

The statistics indicate that California has a strong presence in the organic farm sector, and that Washington is the main presence in organic fruit production. California has the largest farms, with revenues averaging $445K per farm, which is approximately 80 percent larger than the national average. Washington's average sales per farm are approximately $327K, and the state has the largest fruit farms in the country, with sales averaging $369K per farm. Pennsylvania has the second highest sales per farm, at $386K. Removing the top six states and recalculating sales indicates that the average farm size for all other states is about $157K. So, using the accepted definition of "small," the average farm in every state except for California, Pennsylvania, and Washington is small (see Table 4).

The average farm in California exceeds the $250K threshold for "small" for nearly all organic products, with the exception of fruit farms. Some products, for example broilers, are high value, thus average sales per farm is high (over $9 million per farm in California). In terms of quantities, California broiler sales averaged 1.5 million birds per farm, and the average sales revenue per bird in the state was $6. Organic vegetable farms in California are more than four times larger than the average organic vegetable farm, across the nation. The average lettuce farm in California earns revenues of $920K per year; the farms raising lettuce in the rest of the country earn an average of $9K per farm. While dairy farms in California are large, Texas organic dairy farms are larger, with average sales exceeding $8 million per farm.

When examining the size of farms, again there are mixed findings. Farms in three states—California, Washington, and Pennsylvania—are large. The typical farm in all other states is small. On a product level, for the nation, organic milk and broiler farms exceed the $250K threshold, while fruit, lettuce, and egg farms are small.

HYPOTHESIS 3: Farms are family-owned. Currently, data needed to discuss this hypothesis are not available.

HYPOTHESIS 4: Most farm labor is family-provided. Reliance on farm family labor may need to be considered differently for organic farms: because conventional farms replace human labor with chemicals, such as herbicides, the labor requirements for an organic farm are likely higher. One study indicates that the labor needs for an organic farm exceed those for a conventional

Table 3. Select Statistics on Average Number of Acres per Farm, Organic and the Entire Sector

Product	Nationwide		Specific Production Regions	
	Organic	Entire sector	Organic	Entire sector
	Acres per farm		Acres per farm	
ALL FARMLAND	284	418	na	na
cropland	164	241	na	na
pastureland	344	993	na	na
ALL VEGETABLES	34	68	151 (CA)	302 (CA)
carrots	9	36	65 (CA)	173 (CA)
lettuce	25	82	176 (CA)	302 (CA)
APPLES	17	16	43 (WA)	54 (WA)
	Birds per farm		Birds per farm	
BROILERS	16,163	49,056	164,450 (CA)	6,372 (CA)
			23,357 (PA)	108,479 (GA)
			22,408 (IA)	65,672 (DE)
LAYERS	3,429	2,402	na	na
	Cows per farm		Cows per farm	
MILK COWS	98	133	368 (CA)	850 (CA)
			1885 (TX)	313 (TX)
	Eggs per farm		Eggs per farm	
EGGS (chickens, dozen)	82,174	547,396	197,695 (CA)	1,157,292 (CA)
		(contract)	288,526 (PA)	2,702,535 (OH)

Notes: Organic data are for 2008; data for the entire sector are for 2007. Pasture for all agriculture was calculated by subtracting cropland (number of farms) from total acres (total number of farms). Inventory numbers for broilers, layers, eggs, and milk cows for organic farms are as of December 31, 2008; for conventional farms, the numbers are as of December 31, 2007.

Sources: USDA (2010d), USDA (2009).

farm by about 35 percent (Pimental et al. 2005). Thus, an organic farm may hire more labor than a conventional farm and still be an agrarian farm in spirit. Complicating the conceptual issues are measurement problems. Assessing the extent to which labor is provided by the farm family is challenged by the type of data collected, which is the percentage of farms using hired labor. Thus, there is no way to determine the division of work between family and hired labor for organic and conventional farms. The OPS reports that more than half of organic farms rely on hired labor (including contract labor) (see Table 5). Farms located in California and Washington are the most likely to hire labor, with 74 and 68 percent of the farms, respectively, using hired labor. In every state, and nationally, organic farms hire labor at a greater rate than do their conventional counterparts.

Table 4. Average Sales per Farm, by Select Product and Region

Product/region	Organic (2008)	Entire Sector (2007)	Product/Region	Organic (2008)	Entire Sector (2007)
ALL PRODUCTS	$ per farm (1,000s)		BROILERS [a]	$ per farm (1,000s)	
national	230	134	national	826	329
California	445	418	California	9,227	1,225
Washington	327	173	Iowa	883	17
Pennsylvania	386	92	Pennsylvania	685	132
Wisconsin	115	114	rest of U.S.	224	337
Oregon	244	113			
New York	133	122	MILK		
rest of U.S.	154	125	national	373	457
			California	1,451	1,914
VEGETABLES [b]			Texas	8,093	982
national	175	212	rest of U.S.	280	404
California	839	1,373			
rest of U.S.	69	142	CHICKEN EGGS		
LETTUCE			national	158	*
national	134	*	California	379	*
California	921	*	Pennsylvania	494	*
rest of U.S.	10	*			
FRUIT [c]					
national	127	165			
California	142	291			
Washington	369	348			
rest of U.S.	32	80			

[a] Entire sector sales for broilers was calculated by inferring sales (multiplying number of broilers sold per farm by the average annual price); organic sector sales were directly reported in the Organic Production Survey.
[b] "Vegetables" reflects vegetables, melons, potatoes, and sweet potatoes.
[c] Average fruit sales per farm reflect fruit and tree nuts; for organic, the average fruit sales represent just fruit.

Note: Asterisk means that a comparable statistic is not available.
Sources: Author calculations of *Organic Production Survey (2008)* (USDA 2010d), *2007 Census of Agriculture* (USDA 2009), and "Quick Stats" (USDA 2010e).

Organic farmers reported the cost of labor and total cost of organic production expenses, from which labor's share of organic production expenses was calculated. Across the United States, labor costs comprise about 23 percent of organic production expenses. Farm income and cost of production data, collected by the Agricultural Resource Management Survey, suggest that, in 2008, labor costs made up an average of 14 percent of total farm expenses (USDA 2010c). These two measures are not directly comparable because organic farmers reported share of organic (and not total) production expenses, while the ARMS data refer to labor costs as a percentage of total production expenses. However, the data are suggestive, and it is reasonable to surmise that organic farms (i) rely on hired labor more often, and (ii) have higher labor costs on a percentage basis.

HYPOTHESIS 5: Farm production is not specialized in a small number of crops. Gardner (2002) developed a methodology for estimating what he called a "crude measure" of farm specialization,

Table 5. Farm Use of Hired Labor (2008)

State	Farms Hiring Labor (organic)	Hired Labor Share of Organic Production Expense	Farms Hiring Labor (entire sector)
	percentage		
National	53	23	22
California	74	28	37
Washington	68	34	28
Pennsylvania	40	26	19
Wisconsin	44	13	23
Oregon	57	22	27
New York	40	17	26

Note: Hired labor share of production expense is not available for the entire sector.

Source: Author calculations of *Organic Production Survey (2008)* (USDA 2010d) and *2007 Census of Agriculture* (USDA 2009).

which is the average number of commodities produced on a farm. The beauty of his measure is its simplicity: using census data, he sums up the number of farms producing each commodity, and then divides that figure by the total number of farms in the country. Gardner confined the analysis to 17 commodities; because he was interested in observing how farm specialization changed over the twentieth century, he selected commodities that were tracked over the century.[6] In 1900, farms produced an average of 5.1 commodities; in 1950, farms produced 4.2 products; in 1969, farms produced an average of 2.7 products; and in 2000, farms produced 1.3 products (Gardner 2002, Dimitri, Effland, and Conklin 2005).

Following this methodology for the organic sector will likely understate farm specialization: first, Gardner's list is weighted towards field crops, and the organic sector is weighted towards specialty crops. Second, because organic farmers practice crop rotation, specialization in the organic sector contains a temporal component that is not captured in one year's worth of census data. While it might make more sense to estimate the sector's specialization over time, this is not currently possible. Both of these factors impose biases in the same direction, and thus will understate the actual degree of farm specialization. Using Gardner's technique for the entire United States, each farm produced an average of 1.43 products, which suggests that the sector is fairly specialized.

HYPOTHESIS 6: Farmers are independent operators who make their own production and marketing decisions. Farmers who make marketing and production decisions independently are likely not bound by the confines of a contract, which will often specify production and other practices in fairly great detail. In practice, the degree of control exerted by a contract varies by the product, region, and the firm writing the contract (MacDonald et al. 2004). Reading the actual contract or understanding the clauses in a contract would be necessary in order to understand how much decision making remains with a farmer. In absence of such information, the best, albeit indirect, measure available is the frequency with which contracts are used and how much production is under contract. Knowing which products were under contract would make our analysis stronger, but the aggregate data reported does not identify products under contract. An additional shortcoming is that the OPS collects data only on production contracts, thus the independence of marketing practices is not reflected.

Approximately 10 percent of organic farms use contracts; of these farms, 56 percent produce all of their output under contract (Table 6). The state with the greatest number of farms using contracts is California, where 20 percent of the farms use contracts. Across all states, the greatest share of

[6] The products Gardner (2002) included are: corn, sorghum, wheat, oats, barley, rice, soybeans, peanuts, alfalfa, cotton, tobacco, sugar beets, potatoes, cattle, sheep, pigs, and chickens.

Table 6. Use of Production Contracts by Organic Farms (2008, in number of farms)

State	Farms using production contracts	Percentage of Production Under Contract				
		< 25%	25–49%	50– 74%	75–99%	100%
National	1,473	140	131	167	206	829
California	281	25	12	23	19	202
Washington	19	6	2	5	3	3
Pennsylvania	88	4	4	2	13	65
Wisconsin	113	9	11	5	18	70
Oregon	50	7	8	4	11	20
New York	78	8	4	2	7	57

Source: Author calculations of *Organic Production Survey (2008)* (USDA 2010d).

farms using contracts is in Pennsylvania (Table 7). Nearly all of the output of the California and Pennsylvania farms is produced under contract. Compared to the entire sector, a greater percentage of organic firms use contracts (Table 7).

Table 7. Percentage of Farms Using Production Contracts

State	Organic	Entire Sector
	percentage of farms using contracts	
National	11	1
California	11	0
Washington	2	0
Pennsylvania	16	3
Wisconsin	10	2
Oregon	8	0
New York	10	0

Source: Author calculations of *Organic Production Survey (2008)* (USDA 2010d) and *2007 Census of Agriculture* (USDA 2009).

Based on the relatively small percentage of farms using contracts, it appears that the majority of farmers in the organic sector are not subject to the controls of contracts and instead are independent decision makers. However, other research yields potentially conflicting information. In 2007, 67 percent of organic intermediaries—the firms that purchase the products of farmers—reported using verbal or written contracts for procurement. These firms purchased an average of 44 percent of the volume of organic products via written, negotiated contracts, procured 27 percent through verbal agreements or ongoing implicit relationships, and acquired the remaining 29 percent of organic products through spot markets (Dimitri, Oberholtzer, and Da Pra 2010).

Conclusion: Agrarian or Industrial?

Tallying the findings for each hypothesis suggests the following:

HYPOTHESIS 1. *Production takes place on small (acres) farms.*	agrarian
HYPOTHESIS 2. *Production takes place on a farm with sales less than $250K.*	agrarian
HYPOTHESIS 3. *Farms are family-owned.*	unknown
HYPOTHESIS 4. *Most farm labor is family-provided.*	industrial
HYPOTHESIS 5. *Farm production is not specialized in a small number of crops.*	industrial
HYPOTHESIS 6. *Farmers are independent operators who make their own production and marketing decisions.*	a draw

Two factors are suggestive of an agrarian organic sector, and both are related to farm size. In terms of acreage and the number of animals per farm, most farms are small, particularly in comparison to conventional farms. The average organic farm also has sales below the $250K threshold that delineates small and large farms. However, the bulk of organic production takes place on large farms, in terms of sales and size, so the evidence is not overwhelmingly supportive of an agrarian sector. The factors leaning towards an industrial agriculture are equally ambiguous. Hired labor is used more often in the organic sector. However, because organic farms substitute labor for chemical usage, their labor requirements are necessarily greater. In terms of specialization, the available data suggest that the organic sector is slightly less specialized than the conventional sector; however, given that there is likely a temporal aspect to specialization, further investigation is required. An indirect examination of the final factor, independent decision making, yields inconclusive results, and a closer look at contract terms and product coverage would sharpen our understanding of the independence of organic farmers. Some have suggested that the sector may actually be bifurcated into industrial and agrarian components, marketing to different consumers.

In many ways, this exercise demonstrates that the state of knowledge of the organic sector is incomplete. A basic understanding of yields, labor requirements, and farm ownership structure would enhance our understanding of many important economic issues, in addition to providing insight into the sector's degree of industrialization or agrarianism. Refining the definition of a small farm, with an eye towards the unique character of the organic farm, would also be useful. However, despite the ambiguities of the analysis due to data shortcomings, based on these six hypotheses and the available data, the organic sector appears less agrarian than I had previously imagined.

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