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The Illinois Institute for Rural Affairs (IIRA) works to improve the quality of life for rural residents by partnering with public and private agencies on local development and enhancement efforts.

Western Illinois University

Young Illinoisans' Interests in Farming

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Abstract

This paper explores young persons' interests in farming using published data from the Census of Agriculture and related sources. One of the salient findings of the research is that the head of the farming household provides positive reinforcement for young persons in the household to engage in farming; the strength of the reinforcement is the largest for biological sons or daughters and least for adopted children. In spite of this parental influence, 92% of young persons from farming families look for employment elsewhere. The consequence is reflected in the median growth rate of young producers in Illinois, -2.7%.

Introduction

The 2017 US Census of Agriculture defines a young agricultural producer as 35 years of age or younger[2]. Illinoisans in this age group are predominantly White (73%), female (50.19%), and have been to college (64%). Professionally, slightly more than one-in-five holds a job in the information sector and a mere one-in-one-hundred is engaged in the agricultural sector (Table 1).

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[2] 2017 US Census of Agriculture, Appendix B: *General Explanation and Census of Agriculture Report Form*.

Table 1: Profile of Illinoisans ≤ 35 Years of Age, as at January 2022

Characteristic	%		%	Characteristic	%
Gender		**Race**		**Main Job, by Industry**	
(N=3,370,215)		(N=3,370,215)		(N = 1,439,084)	
Female	50.19	White	73	Information	22
Male	49.81	Black	15	Public Admin.	16
				Leisure	11
Education				Agriculture	1
High School	23				
Some College +	64				

Source: CPS, 2022

Conceptually, one's interest in a vocation is one's perceptions of the 'value' of the vocation[3]. Table 1 suggests that only a miniscule portion of young Illinoisans believe that work in agriculture is of value.

How could we explain young Illinoisans' interests in farming? This paper addresses this and other related questions using the framework of the stimulus sampling theory[4].

Theoretical Model, Stimulus Sampling Theory (SST)

The basic idea of SST is that one learns or acquires interest in an act by associating three elements in a sequence: a stimulus (S), a response (R), and a reinforcing outcome (O). Specifically, one experiencing an S-R-O sequence will learn associations for three pairs of elements: S-R, R-O, and S-O[5]. The S-O connection provides "good" or "bad" feedback that either facilitates or inhibits a S-R connection. For example, for S = agricultural land, R = farming the land, and O = income including government assistance for farming, the perception of O as good will strengthen the S-R link.

Model Workings

The stimulus situation includes all variable components of the environment; both environmental (for example, weather) and individual stimuli (for example, knowledge about agricultural science) are studied. Each stimulus is related to one response; for example, one's knowledge about agricultural science may be conditioned to farming. Thus, it is possible to characterize one's disposition to farming by listing stimulus elements and their responses. Such a listing is the theoretical state of the system, an indicator of which at the macro level would be the proportion of the people with primary jobs in the farming sector.

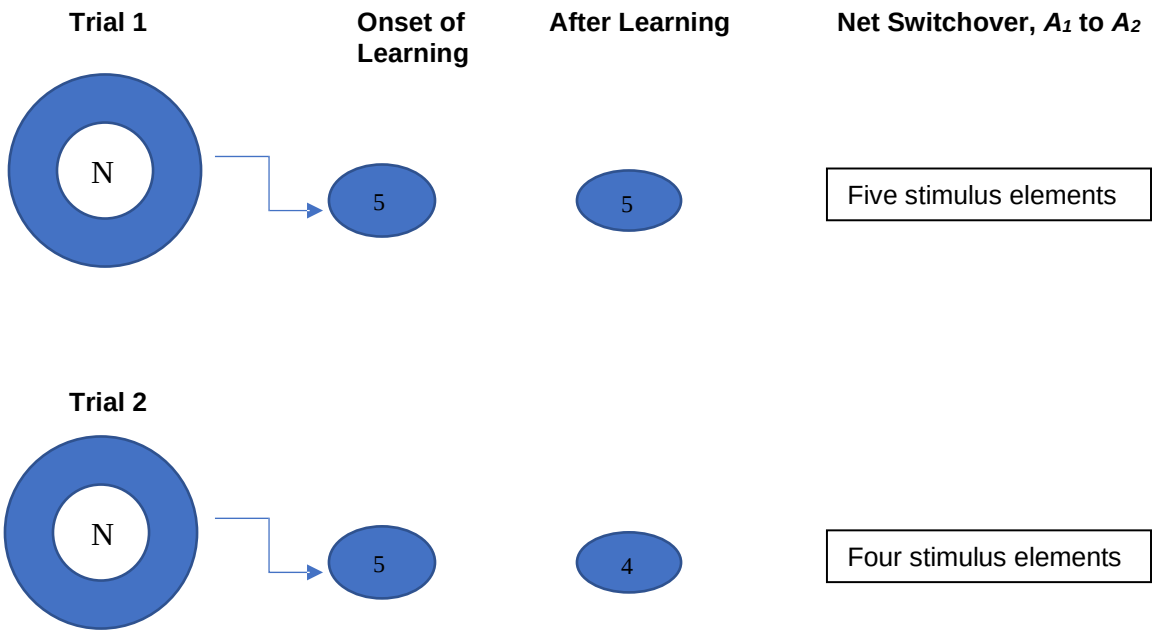
[3] Value is utility, defined as benefits less costs; see Athiyaman, A. (2022). Labor mobility in Illinois: Industry by Occupation Analysis. *Research Brief*, 4(8), April 18, 1-16. See, http://www.iira.org/wp-content/uploads/2022/04/RB48_local-mobility-in-illinois-industry-by-occupation.pdf.

[4] Thibaut, J. W., & Kelley, H. H. (2017). *The social psychology of groups*. Routledge.

[5] Technically, $nPr = \left(\frac{3!}{2!}\right) = S-R; R-O; S-O$.

The reinforcing outcome "O" could be economic (for example, money income) and / or noneconomic (for example, respect). For example, consider a young person (subject) from an intergenerational family farm[6] who has been farming with her family for some years; symbolically, A_1 = engage in farming, and A_2 = engage in some other alternative, a free operant. The population of potential stimulus elements, N, corresponding to A_1 and A_2 is represented in Figure 1. In the beginning year, trial 1, a sample of five stimulus elements occur and no response is made by the subject; then, the family receives income from the sale of agricultural products (farm income), a portion of which is allocated to the subject stimulating subject's interests in farming and connecting the five stimuli to the response A_1. On the second trial, the probability of response A_1 is fixed at 0.2 since only one of the 5 conditioned stimuli is present. Again, if farming is economically successful, then the subject is reinforced with a portion of the income, and now a total of 9 stimuli is connected to A_1.

Figure 1: Conditioning of the Stimulus Elements to the Act of Farming



[6] Farm owned by family or individual, a sole proprietorship.

Figure 1 can be summarized using probabilities. Let p and $1\text{-}p$ denote the proportion of stimuli connected to responses A_1 and A_2. Since the proportions change over trials, p_i will denote the proportion of A_1-linked stimuli at the i^{th} trial. Predictions of p_{i+1} are made with the formulation:

$$p_{i+1} = (1 - \theta)p_i + \theta$$

where, θ is the probability that a stimulus element is sampled on any given trial.

In words, $1 - \theta$ is the probability that the element is not sampled; its probability of connected to response A_1 remains the same as before at time i, p_i. The other possibility is the stimulus element gets chosen and reinforced in trial $i+1$, with probability θ.

This simplified SST offers many propositions about S-R, R-O, and S-O connections in the domain of young persons' interests in farming (Table 2)[7]. For example, the 2017 US Census of Agriculture provides a listing of farms by economic class, that is, classification of farms by the sum of market value of agricultural products sold and Federal farm program payments. This economic, reinforcing, outcome indicator takes on seven values: less than $1,000, $1,000-$2,499, $2,500-$4,999, $5,000-$9,999, $10,000-$24,999, $25,000-$49,999, $50,000 or more. An R-O proposition that could be assessed empirically is:

> **R-O$_i$**: The number of young Illinoisans working in the agricultural sector will covary positively with the economic class of the farms; the higher the economic outcome for agriculture, the larger would be the workforce in agriculture.

[7] SST framework offers opportunities for research into each of the S, R, and O concepts; for example, exploration of salient stimuli or deterministic attribute (*N*) for young versus mature farmers, class of responses for uncontrollable stimuli such as weather, and non-economic outcome variables such as family bonding, teamwork, etc.

Table 2: Testable Propositions: Deduced from the Application of SST to Young Persons' Interests in Farming

Conceptual Links		Proposition
S-R	S-R_1:	Young persons' farming behavior is correlated positively with family connections in farming.
	S-R_2:	Young persons' farming behavior is negatively associated with level of education.
R-O	R-O_1:	The number of young farmers in Illinois will covary positively with the economic class of the farms.
	R-O_2:	The lower the family distance between the head of family who is engaged in farming and the young person in the family, the higher will be the probability of the young person engaging in the target behavior, farming.
S-O	S-O_1:	Family farms will attract a larger number of young persons to farming than any other type of farming business.
	S-O_2:	Full-owner farms will attract young farmers in larger proportion than part-owner and tenant farms.

Methodology

Data from the 2017 US Census of Agriculture[8], Current Population Survey (CPS)[9], and American Community Survey (ACS)[10] were used to profile young Illinoisans with interest and occupation in farming and to test the hypotheses given in Table 2.

The Agricultural census data are aggregate, frequency data. They can be used to highlight the proportion of family farms and corporate farms, but they cannot be combined with a variable such as young farmers; cross-classification of variables is difficult, mostly impossible at the state level. In this paper, the census data are mostly used to describe young persons' interests in farming at the macro level.

In contrast, the ACS and CPS data are micro, individual-level data; they can be used to test hypotheses. For example, the ACS, 2015-2019, PUMS, persons file for Illinois contained 630,922 records. The records were screened for the presence of the following class of workers: self-employed incorporated,

[8] https://www.nass.usda.gov/Publications/AgCensus/2017/index.php.

[9] https://www.census.gov/programs-surveys/cps.html.

[10] https://www.census.gov/programs-surveys/acs/data.html.

self-employed unincorporated, and without pay; the focus was on the agricultural sector. The screening resulted in 2,592 records. These were matched with the PUMS housing file to address the hypotheses given in Table 2.

Table 3 shows the variables extracted from ACS and CPS, operational definitions of the variables, and associated hypotheses. Measures of central tendency and dispersion, tests of independence in contingency tables, and rank-correlation coefficients were the statistical models employed to summarize data and test hypotheses.

Table 3: Operational Definitions

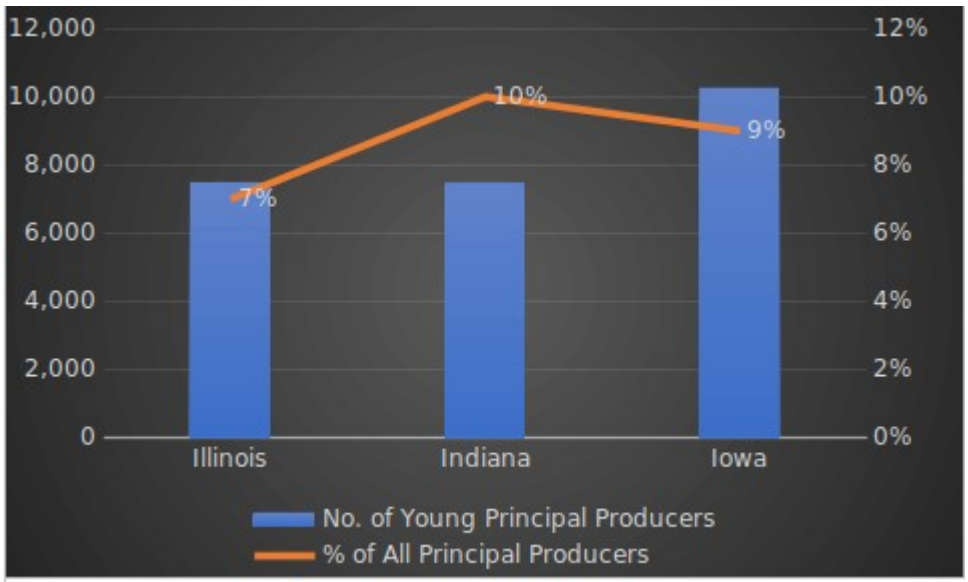
Hypothesis (see Table 2)	Variable Definitions	Data Source
$S\text{-}R_1$	Main occupation of person 1, the householder: farming = 1; Other = 0; Main occupation of young persons, persons 2-5: farming = 1; Other = 0.	ACS, 2019 Questionnaire; Q4 and Q.42, e.
$S\text{-}R_2$	PRTAGE: Persons age; 0-79 (ratio scale), 80 = 80-84, 85 = ≥85. PRMJIND1: Major industry; Agriculture = 1; else = 0. PEEDUCA: Highest level of school completed; Value labels: 31 = <1st grade … 46 = Doctorate.	CPS; 2022 January data.
$R\text{-}O_1$	HEFAMINC: Family income; value labels: 1 = <$5,000 … 16 = ≥$150,000. Sum of PRMJIND1.	CPS; 2022 January data.
$R\text{-}O_2$	Persons 2 to 5; relations to person 1 (householder). Distance = 1 for biological / adopted son or daughter; 2 = grandchild; else = 3. Main occupation of young persons, persons 2-5: farming = 1; Other = 0.	ACS, 2019 Questionnaire; Q2 and Q.42, e.
$S\text{-}O_1$	PEIO1COW: Class of worker; value label 7 = Self-employed, unincorporated business; Else = 0. PRMJIND1: Major industry; Agriculture = 1; else = 0.	CPS; 2022 January data.
$S\text{-}O_2$	Person 1: self-employment income from own farm business. Main occupation of young persons, persons 2-5: farming = 1; Other = 0.	ACS, 2019 Questionnaire; Q.42e and Q43b.

Findings

Profile Analysis

Seven percent of agricultural producers in Illinois, that is, persons involved in making decisions about the farm operation, are young, 35 years of age or younger. The neighboring states, Indiana and Iowa, have greater proportion of young producers, 10% and 9%, respectively (Figure 2). However, in terms of acres farmed, young producers in Illinois farm the most: 334 acres on average, compared to 170 acres for Indiana residents and 241 acres for Iowans.

Figure 2: Young Principal Producers: Illinois, Indiana, and Iowa



Source: 2017 Census of Agriculture – State Data.

A typical young producer's household is a four-person household. A majority of the young producers, 51%, operate less than 100 acres and have been the principal operators of the farm for less than six years[11]. Most of them are single operators (64%) of their family farm (81%) and grow oilseed and/or grain crops in their primary farming business (64%). Slightly more than one-in-four operators earn between $1,000 to $9,999; a similar proportion (25%) earn between $100,000 to $499,999. One in ten reports earning more than $500,000 in agricultural product sales and Federal farm program payments (Table 4).

[11] The profile is based on both 2012 and 2017 census data; 2012 census had more variable levels.

Table 4: Profile of Young Principal Producers

Profile Variable	Definition	Frequency; Central Tendency is in Bold	
Area Operated	Land area of the farm.	**Less than 100 acres**	**52%**
		100 to 499 acres	33%
		500 + acres	15%
		N	5,067
Business Organization	Operations ownership.	**Family and individual business**	**83%**
		Partnership	5%
		Other	12%
		N	5,505
Tenure	Farms classified by tenure of producers.	**Full owner**	**35%**
		Part owner	33%
		Tenant	31%
		N	5,067
Principal on Present Operation	Primary producer.	**< 6 years**	**45%**
		6 – 10 years	31%
		11+ years	24%
		N	5,067
Number of Operators	Producers, operators of the farm	**One**	**65%**
		Two or more	35%
		N	5,067
Economic Class	Sum of farm's market value of agricultural products sold and Federal farm program payments.	Less than $1,000	7%
		$1,000 - $9,999	**27%**
		$10,000 - $49,999	20%
		$50,000 - $99,999	12%
		$100,000 - $249,999	15%
		$250,000 - $499,999	10%
		≥ $500,000	10%
		N	5,067
NAICS	Industry	**Oilseed and Grain Production**	**64%**
		Beef Cattle Ranching & Farming	12%
		Other	24%
		N	5,067

Source: 2012 and 2017 Census of Agriculture.

Results of Hypothesis Testing

Hypothesis S-R_1 is predicated on the notion that family connections in farming will influence young persons in the family to take up farming. Table 5 provides evidence in this direction; of the 13,923 head of households who reported farming as their primary self-employment, 8% of the young members of their household had farming as their primary occupation. This number reduces to 1% for young persons in households with non-farming interests.

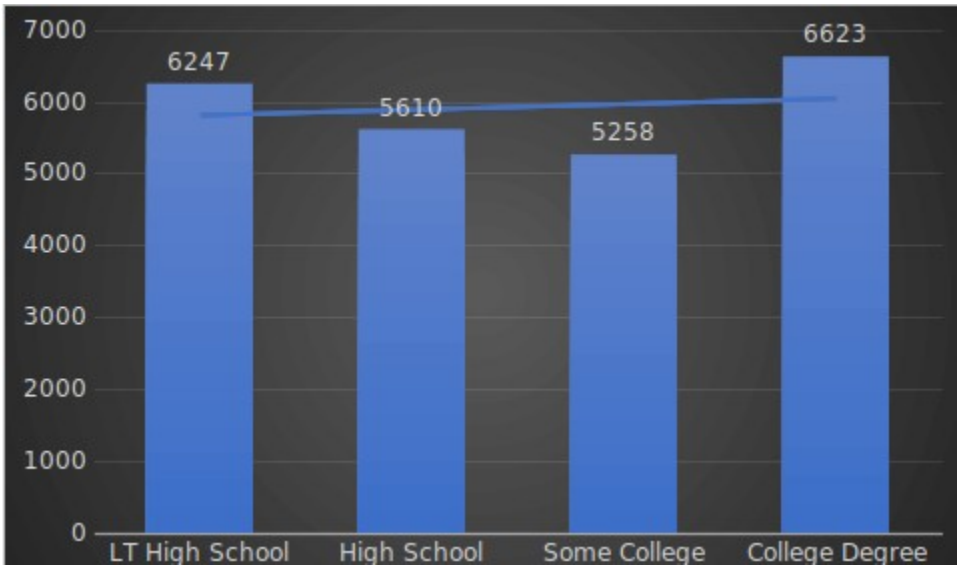
Table 5: Young Persons' Interests in Farming: Intergenerational Influences

Occupation of Head of Household	Occupation of Young Person in the Household	
	Farming	Other Occupation
Farming (N = 13,923)	8%	92%
Other Occupation (N = 29,780)	1%	99%

Note: χ^2 = 1602.95; p <0.05. *Phi* = 0.192, t = 44.54, p < 0.05.

Hypothesis 2, S-R_2, predicts a negative relationship between young persons' farming behavior and level of education. This was disconfirmed; as shown in Figure 3, the correlation between the variables is 0.16, p <0.05.

Figure 3: Level of Education by Number of Young Farmers



The expectation that "higher the farm revenue the more will be the number of young persons engaged in farming", R-O_1, was confirmed (Table 6); almost 50% of the young farmers are associated with farms that earn $100,000 or more. A simple, power model of the form: $y = 3216.9x^{0.6592}$ best explains the relationship between number of young farmers and the impact of farm income; $r^2 = 0.49$.

Table 6: Number of Young Farmers by Economic Class; Mode is Highlighted

Economic Class of Farm	No. of Young Farmers
$30,000 - $34,999	8%
$35,000 - $39,999	8%
$50,000 - $59,999	26%
$60,000 - $74,999	9%
$100,000 - $149,999	18%
$150,000 and more	**31%**
All	100% (N = 46,699)

Note: $r = 0.7$; $t = 210.42$, $p < 0.05$.

The head of the farming household provides positive reinforcement for young persons in the household to engage in farming; the strength of the reinforcement is the largest for biological son or daughter (Table 7). The statistical validity of the statement, hypothesis R-O_2, was tested using the expected frequency of young farmers given in Table 5, 8%. The resultant test statistic, $\chi^2 = 107.93$, was significant at the $p < 0.01$ level.

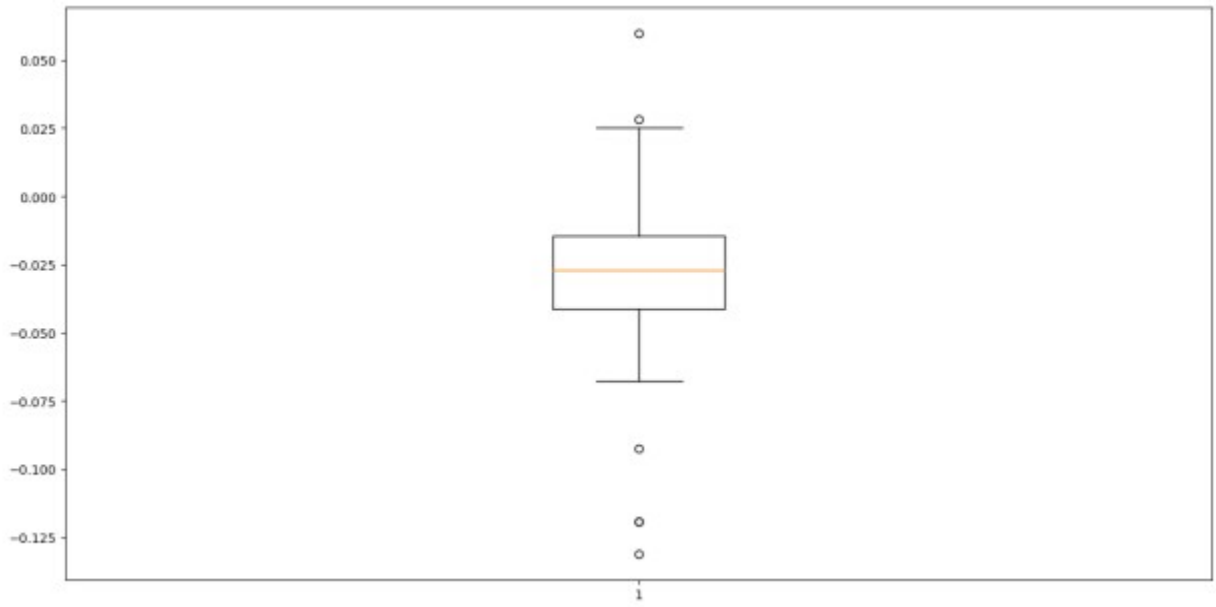
Table 7: Probability of Farming

Relationship to the Head of Household, Farmer	Percent in Farming	N
Biological son/daughter	10%	10124
Adopted son/daughter	4%	263
Step son/daughter	8%	567
Spouse	7%	1505
Other relatives	0%	830

The hypothesis about family farms attracting a large number of young farmers ($S\text{-}O_1$) was tested by correlating two change scores: county-level growth in young farmers and increases in farming-family businesses in the counties.

Figure 4 is the five-number summary of the annual compound growth rates (ACGRs) of young farmers in Illinois counties. The median annual growth rate is -0.027 per year. The interquartile range is 0.026; the 95% confidence interval for the median is -0.054 to 0.0135 which suggests that most of the observations lie between -0.054 to 0.0135 ACGRs. Marshall County is an outlier with a -13% annual decline in young farmer population. Lawrence, Moultrie, and Champaign are examples of counties that have positive growth rates in the segment (Appendix 1).

Figure 4: Box Plot of Young Farmer Growth Rates in Illinois Counties



Note: ACGR data shown in Appendix 1 were used to construct the figure. Summary statistics are: Min = -0.13; Q1 = -0.04; Median = -0.027; Q3 = -0.014, and Max = 0.059.

The ACGRs for family farming businesses in the counties range from -6% to 5% (Appendix 1). The correlation between the change scores, ACGRS for young farmers and family businesses, was negative: $r = -.22$, $t = -2.13$, $p < 0.05$, thus disconfirming the hypothesis that family businesses attract a large number of young farmers.

Figure 5 highlights CPS data on young farmers in full-owner farms. Of the 13,830 young, agricultural workers, 36% work for local governments and 33% are employed by private firms in the industry. The remaining 31% are self-employed and work in farms.

In general, majority of young, self-employed function in the service sectors. Production and manufacturing sectors do not attract young entrepreneurs in large numbers, for example, the agriculture sector has 7% of young entrepreneurs and manufacturing, 6% (Table 7).

Figure 5: Young Agricultural Industry Workers

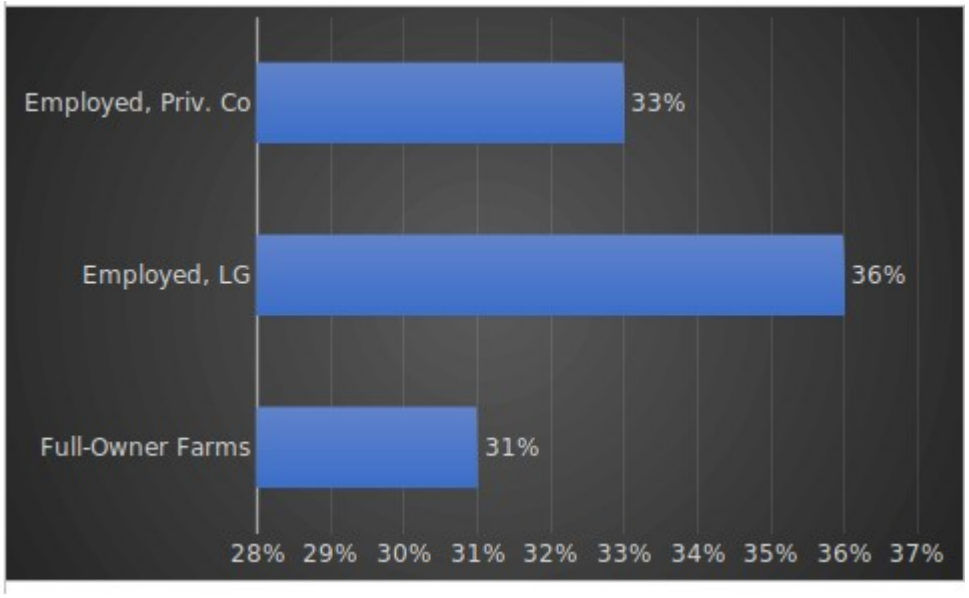


Table 7: Young Persons by Class of Worker by Industry

Industry	No. of Young Persons; Self-Employed, Un-Inc. Business
Agriculture	7%
Manufacturing	6%
Information	9%
Professional Services	28%
Education	27%
Arts& Entertainment	8%
Other Services	15%
All	100% (N = 66,411)

Summary and Conclusion

This paper explores young Illinoisans interests in farming using the conceptual framework of stimulus sampling theory. Multiple data sources are used to gain insights into the topic, for example, Census of Agriculture, ACS, and CPS.

Results of data analysis suggest:

1. Young producers in Illinois constitute 7% of the farm-operator population; neighboring states, Indiana and Iowa, have greater proportion of young producers, 10% and 9%, respectively.
2. A large number of young producers (50%) earn more than $100,000 a year from farming.
3. Family connections in farming influence young persons in the family to take up farming; for example, of the 13,923 head of households who reported farming as their primary self-employment, 8% had young members of their household engaged in farming as their primary occupation. This number reduces to 1% for young persons in household with non-farming interests.
4. The head of the farming household provides positive reinforcement for young persons in the household to engage in farming; the strength of the reinforcement is the largest for biological sons or daughters.
5. The median growth rate of young producers in Illinois counties is -2.7%.

Point 5 above, the negative ACGR of young farmers, could be a concern if family farms are being replaced by corporations, but they are not[12]. The truth is that most young persons from farming families are looking elsewhere for jobs. Their motivation in doing so would be the topic for a future *Research Brief*.

[12] See, Athiyaman, A. (2022). Foreign Businesses in the Agricultural Sector in Illinois. *Research Brief*, 4(12), June 28, 1-14. Available: http://www.iira.org/wp-content/uploads/2022/06/Foreign-Businesses-in-the-Agricultural-Sector-In-Illinois_RB4_12.pdf.

Appendix 1: Annual Compound Growth Rates (ACGRs)

County	Family Farms, ACGR	Young Farmers, ACGR
Adams	0.00%	-2.23%
Alexander	-3.00%	-9.24%
Bond	-1.00%	-1.57%
Boone	-1.00%	-6.06%
Brown	-1.00%	-5.23%
Bureau	-1.00%	-4.20%
Calhoun	0.00%	-6.48%
Carroll	-2.00%	-3.01%
Cass	-1.00%	-3.48%
Champaign	-2.00%	2.40%
Christian	-1.00%	-2.54%
Clark	1.00%	0.81%
Clay	-1.00%	-1.47%
Clinton	-3.00%	-2.97%
Coles	-1.00%	-4.21%
Cook	5.00%	-11.95%
Crawford	-2.00%	-1.42%
Cumberland	-1.00%	0.39%
De Kalb	-4.00%	-4.83%
De Witt	-1.00%	-1.61%
Douglas	-4.00%	-1.17%
Edgar	-2.00%	-2.39%
Edwards	-5.00%	0.20%
Effingham	-2.00%	-2.48%
Fayette	0.00%	-3.49%
Ford	1.00%	-3.01%
Franklin	-3.00%	-2.46%
Fulton	0.00%	-2.80%
Gallatin	-2.00%	-5.77%
Greene	1.00%	-1.51%
Grundy	-1.00%	-4.52%
Hamilton	-6.00%	-6.77%
Hancock	-1.00%	-0.55%
Hardin	0.00%	-4.62%
Henderson	2.00%	-0.85%
Henry	-1.00%	-3.08%
Iroquois	0.00%	-1.50%
Jackson	-1.00%	-4.40%
Jasper	0.00%	-1.30%
Jefferson	1.00%	-5.07%
Jersey	0.00%	-0.93%
Jo Daviess	0.00%	-5.73%
Johnson	3.00%	-3.11%
Kane	-1.00%	-4.62%

Appendix 1: Annual Compound Growth Rates (ACGRs), Cont'd

County	Family Farms, ACGR	Young Farmers, ACGR
Kankakee	-2.00%	-1.71%
Kendall	-4.00%	-1.99%
Knox	-1.00%	-3.85%
La Salle	-2.00%	-2.68%
Lake	-3.00%	5.96%
Lawrence	3.00%	2.81%
Lee	-1.00%	-3.79%
Livingston	-1.00%	-0.79%
Logan	-4.00%	1.03%
Macon	-2.00%	-0.77%
Macoupin	-1.00%	-2.91%
Madison	-1.00%	-6.03%
Marion	-3.00%	-1.81%
Marshall	2.00%	-13.11%
Mason	2.00%	-1.83%
Massac	0.00%	-5.03%
Mcdonough	-1.00%	-2.13%
Mchenry	0.00%	-3.11%
Mclean	-1.00%	-2.03%
Menard	-1.00%	-3.47%
Mercer	1.00%	-1.89%
Monroe	0.00%	-3.00%
Montgomery	0.00%	-2.23%
Morgan	-3.00%	-1.92%
Moultrie	-2.00%	2.52%
Ogle	-3.00%	-1.50%
Peoria	-1.00%	-4.15%
Perry	0.00%	-4.01%
Piatt	-2.00%	-1.43%
Pike	-1.00%	-1.00%
Pope	0.00%	-11.95%
Pulaski	-2.00%	-3.41%
Putnam	-3.00%	1.68%
Randolph	1.00%	-5.88%
Richland	1.00%	-5.19%
Rock Island	-2.00%	-1.28%
Saline	-1.00%	-3.32%
Sangamon	-1.00%	-2.83%
Schuyler	-1.00%	-2.70%
Scott	-5.00%	-4.22%
Shelby	-2.00%	-1.23%
St Clair	1.00%	-3.49%
Stark	1.00%	-0.15%
Stephenson	-3.00%	-3.51%

Appendix 1: Annual Compound Growth Rates (ACGRs), Cont'd

County	Family Farms, ACGR	Young Farmers, ACGR
Tazewell	-2.00%	-2.85%
Union	-2.00%	-1.86%
Vermilion	2.00%	-4.11%
Wabash	-4.00%	-0.74%
Warren	3.00%	-0.57%
Washington	-2.00%	-4.62%
Wayne	-4.00%	0.27%
White	-4.00%	-2.16%
Whiteside	-3.00%	-2.20%
Will	-3.00%	-2.86%
Williamson	-3.00%	-5.15%
Winnebago	-3.00%	-3.55%
Woodford	-1.00%	-1.82%