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Following beginning farm income and wealth over time

A cohort analysis using ARMS

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Abstract

Purpose – The paper examines the evolution of beginning farms' income statement and balance sheet items over a 15-year period. The purpose of this paper is to gain insight into the diversity of beginning farms from a financial point of view.

Design/methodology/approach – Using the USDA's Agricultural Resource Management Survey (ARMS), the author constructs a synthetic panel of data consisting of age cohorts of beginning farmers and follow them over time. Baseline financial information for the farm income statement and balance sheet is examined in 1999 and again in 2014 for each cohort.

Findings – Overall, there is a marked contrast in the evolution in the income statement between beginning farmers who are under 45 years old and those over 45. The gross cash income of the youngest cohorts grows tremendously, as do their expenses, indicating rapid expansion in production on the part of the youngest cohorts. The change in the balance sheets of the cohorts also provides a glimpse into the changing roles of beginning famers over time. The youngest cohort of beginning farmers increase the current and non-current assets on their balance sheets by a substantial amount, more than doubling both. Furthermore, the youngest cohort is the only group to take on more current liabilities, indicating increased financing of the production expenses.

Practical implications – Differences in the evolution of financial profiles of beginning farms may predict differences in future output, and it could be a predictor of the farm's operational goals or intentions, as well as predictor of future financial needs and challenges.

Originality/value – Knowing and understanding likely trajectories of beginning farmers may provide an opportunity to better tailor farm programs, outreach, and support to beginning farmers.

Keywords Agricultural Resource Management Survey, Beginning farmers, Cohort study, Farm income and wealth

Paper type Research paper

Introduction

There is a great diversity among beginning farmers. Beginning farmers establish operations at different ages, operate farms of different sizes, and specialize in different commodities, all across the USA. As I will show, the differences among beginning farmers extend beyond the physical and geographical characteristics of the new farmers and their farms at the startup phase of the operation. Using the Agricultural Resource Management Survey (ARMS) data, I conduct a cohort analysis that examines the financial evolution of beginning farms from the early beginning phase (the baseline) through the transition phase of the farm, when farms have between 15 and 25 years of farming experience. The differences in how beginning farms' income statements and balance sheets evolve are useful for understanding the roles today's beginning farmers will play in the future of agriculture, and may help understand how farm policies may differentially affect beginning farmers. The implications for policy are many: differences in financial growth profiles between beginning farm cohorts may predict differences in future output, and it could be an indication of the farm's operational goals or intentions. Ultimately, knowing and understanding these differences may provide an opportunity to better tailor farm programs, outreach, and support to beginning farmers.

Beginning famers may take divergent paths after establishing their operations and one way to examine their evolution is by following them over time. Ideally, a panel of data where each farmer is measured periodically – annually, for example – would be used.

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However, because ARMS is an annual cross-section of famers, we are unable to observe the same farms every year over time in the data[1]. Fortunately, in the absence of panel data, alternative methods are available and one such well-known method is to construct groups of farms or farmers, also known as cohorts, with similar characteristics. A cohort analysis of beginning farms allows us to follow groups of similar farms over time when I am unable to follow the same individual farms over time. In this study, the cohorts are constructed by grouping beginning farmers by age class in ten-year intervals[2]. Therefore the individual units in the data are created with the cohorts' averages of the variables of interest (in this case, the selected items in the income statement and balance sheets) in order to observe changes in beginning farms income and wealth positions. The age of the beginning farmer is used to construct cohorts, because age is immutable, and there is no chance a beginning farmer will move to a different cohort over time – providing stable groups that may be compared over time, a critical component of a cohort analysis. Creating cohorts by age is also a natural construction for meaningful analysis of the future of agriculture. Although the cohorts are created by grouping beginning farmers by age (or age range), all beginning farmers at the baseline in 1999, no matter their age, have no more than ten years of experience. Hence, although they are of different ages, they have identical years of farming experience and the differences in the outcome of beginning farms cannot be attributed to experience.

Financial information in the ARMS

The US Department of Agriculture's ARMS is administered annually to farm households across the USA and is designed to solicit information about production practices, costs of production, business finances, and operator and household characteristics. The ARMS is nationally representative and has the advantage over other sources, such as the Census of Agriculture, because of its breadth and depth of information[3]. As well, the national coverage of ARMS data gives it an advantage over state-level surveys by allowing us to represent the diversity of commodity production. If we were to focus on just a few states, or a specific region, the inference based on the sample would be limited. Further, a practical consideration of ARMS is it allows us a large sample, which will prove necessary as we create cohorts.

The remarkable level of detail in ARMS data allows researchers to fully account for the farm business income and expenses, as well as its assets and liabilities. Cash sales for crops are reported by type of crop; total livestock sales are reported by type, numbers sold or removed, and held in inventory at the beginning of the year, as well as on December 31st of the survey year. The ARMS separately records income from marketing and production contracts for all commodities delivered during the year, including the quantity and final price. As well, income owed to the operation in accounts receivable or through deferred payments are reported. Researchers are able examine government payments, such as direct payments, conservation program payments, and other farm-related income such as agricultural disaster payments are recorded and itemized. ARMS also records Federal and private crop insurance indemnity payments, and other income associated with the sale of farm assets, and even income from royalties and leases received from energy production on the farm.

The information gathered by ARMS for operating and capital expenses are just detailed as for income. Total production expenses paid for by the operators or partners of the farm are collected, as are those paid for by landlords and contractors. The expenses include, among other things, seed and plants, nutrients, biocontrols, feed, fuel, medical supplies, and energy and utilities. Annual capital investments are also recorded – purchases that include improvements to land such as irrigation, wells, and feedlots; new construction or remodeling of existing farm dwellings such as barns, buildings, silos, and sheds; cars, trucks, tractors and other self-propelled equipment used by the operation; non-self-propelled such as pumps and capital equipment for livestock and crop production; and farm office equipment placed on a depreciation schedule.

ARMS treats the farm's balance sheet items with equal diligence, collecting information on the value of farm assets and farm debt. The values of dwelling and structures owned by the operation are recorded, as are values for machinery and equipment. Researchers are able to discern current assets held by the farm include items such as livestock and crop inventory, purchased inputs such as chemicals and fuels, and paid insurance and other items such as accounts receivable and liquid assets.

Finally, offsetting farm debt is collected, including detailed loan information, by type (whether it was a short-term operating loan, real estate, or longer-term non-real estate loan), purpose, term, amount and source, which includes traditional private commercial lending sources, state and Federal sources. Together with assets, this information allows researchers to accurately estimate the financial position of farms and their ability to service debt.

Use of cohorts in the ARMS to study beginning farms

At a basic level, researchers may wish to observe the behavior of an individual farm at two or more points in time, because this provides more information than observing only a single instance in time. Because ARMS data are an annual cross-section of farms, I construct groups of farms, or cohorts, with the repeated cross-sectional samples. Using cohorts allows us to control for cohort-specific factors that could influence the phenomenon that I am examining. This means that cohorts must be constructed of homogenous individuals, but there must enough heterogeneity in individuals across cohorts for meaningful inference based on the estimates. Furthermore, the cohorts must be stable over time with respect to the characteristics of the individuals who populate them. This is a particularly difficult condition given that in repeated cross-sections there are ample opportunities for individuals to move between cohorts along many dimensions, such as operated acreage, or some measure of production level, such as sales or value of production. One way to ensure stability in cohorts over time is through a relatively stationary cohort grouping categories.

The use of synthetic cohorts with ARMS data has recently appeared in work evaluating agricultural policies by Whitaker (2009) and O'Donoghue and Whitaker (2010). Whitaker (2009) used a synthetic panel to test for the effects of agricultural supports on farm household consumption. He used data from ARMS for years 1998-2004 to create a synthetic panel of data using 48 states and nine production specialty categories. O'Donoghue and Whitaker (2010) studied the decoupling of farm program payments, also using state-commodity groupings to create cohorts. They group cohorts by two-year periods to increase the number of observations. Morrison *et al.* (2004) used farm type (retirement and residential, family, and corporate farms) and farm size (sales) to create cohorts with ARMS data to study the impact of use of production contracts on risk management, profitability, and farm structure.

Following the previous econometric literature on synthetic panel models, namely that of Deaton (1985), Verbeek and Nijman (1992), Moffitt (1993), and McKenzie (2004), our individual units are created with cohorts means of the variables of interest (the selected items in the income statement and balance sheets) in order to observe changes in beginning farms production, profitability, and efficiency. For our purposes, I use the age of the principal operator of the beginning farm to create cohorts, because age is immutable and insures the cohorts will consist of the same "like" individuals over time. Creating cohorts by age is also a natural construction for conducting meaningful analysis of the future of agriculture.

Table I presents the construction of the beginning farmer cohorts. I begin constructing five age cohorts of beginning farmers using the 1999 ARMS data, what is termed the baseline year. Our youngest cohort is comprised of beginning farmers who were age 24-34 in 1999; the other cohorts follow in ten-year increments.

After observing the cohorts at the baseline, I follow or "age" them over 15 years and then observe the cohorts again in 2014. It should be noted the individual farms in the age cohorts in 2014 will consist of different individual farms than those of the 1999 cohorts.

This is because ARMS is a cross-sectional sample. For example, the beginning farmers who were between the ages of 24-34 in 1999 are now 39-49 years of age in 2014, but these are not the same individual farmers that were in the 1999 baseline data (Table I). Likewise, the oldest cohort of beginning farmers, those who were 65 years or older in 1999, are now at least 80 years old.

All of the cohorts at the 1999 baseline are beginning farmers with no more than ten years of farming of experience. As the years increase, not only do the cohorts age, but so do their years of experience (following the direction of the arrow in Table I). After "aging" the cohorts 15 years, the cohorts now all have at least 15 years of farming experience and as much as 25 years (Table II).

Table III shows the actual average ages and years of experience for the cohorts of beginning farmers in the 1999 and 2014 ARMS data samples. Given the construction of the

Cohort	Age of cohort in 1999	Year	Age of cohort in 2014
Age 24-34 in 1999	24-34	Aging 15 years	39-49
Age 35-44 in 1999	35-44		50-59
Age 45-54 in 1999	45-54		60-69
Age 55-64 in 1999	55-64		70-79
Age 65+in 1999	65+		80+

Note: The unweighted cell sizes become very small as cohort 5 ages

Table I. Beginning farmer cohorts: aging over time

Cohort	Experience in 1999	Experience in 2014
Age 24-34 in 1999	Less than or equal to 10	15-25
Age 35-44 in 1999	Less than or equal to 10	15-25
Age 45-54 in 1999	Less than or equal to 10	15-25
Age 55-64 in 1999	Less than or equal to 10	15-25
Age 65+ in 1999	Less than or equal to 10	15-25

Notes: Data consist of farms with at least $1,000 of gross annual sales. Beginning farms are farms headed by an operator who has no more than ten years of experience
Sources: USDA (1999, 2014)

Table II. Beginning farmer cohorts: ranges of years of experience

	Cohort				
	Age 24-34 in 1999	Age 35-44 in 1999	Age 45-54 in 1999	Age 55-64 in 1999	Age 65+ in 1999
Year			1999		
Average years of experience	4.3	5.1	5.7	5.8	5.9
Average age	30.3	39.6	49.4	58.8	71.6
Year			2014		
Average years of experience	19.7	19.9	19.8	19.8	20.2
Average age	44.4	54.7	63.9	73.2	83.9

Notes: Data consist of farms with at least $1,000 of gross annual sales. Beginning farms are farms headed by an operator who has no more than ten years of experience
Sources: USDA (1999, 2014)

Table III. Actual average years of experience and average ages of beginning farmer

cohorts by years of farming experience, I do not expect the average experience of the cohorts to be significantly different. In 1999, the youngest cohort of beginning farmers has 4.3 years of experience, while the oldest cohort of beginning farmers has 5.9 years of experience. On the other hand, the average age will be different, and this is by design. The average age of the beginning farmer in the youngest cohort was 30.3 years; for the oldest cohort it was over 70. When the cohorts are sampled again in 2014, the average years of experience and ages have increased across all cohorts by about 15 years[4].

The evolution of the beginning farmer's Income statement

To examine the change in the beginning farmers' income statements, I track the evolution of the beginning farmer's gross cash income and its major components, cash expenses, and net farm income over 15 years using the constructed age cohorts, beginning in 1999 The income statement presents the flows of revenues and expenses that are a direct result of the farm's operations over a period of time, in this case, one year, and these flows can illustrate differences in the enterprise's objectives and provide insight into their roles in the future of agriculture.

Gross cash farm income

Table IV provides the baseline for major elements of the income statement for each cohort of beginning farmers in 1999, as well as for the same cohorts 15 years later in 2014. Again, in 1999 each cohort consists only of beginning farmers; in 2014, the snapshot of the income statements will be for the same cohorts, except now these cohorts all have roughly 20 years of experience – they are no longer beginning farmer. Gross cash farm income is composed of cash receipts from crop and livestock production, income from government farm programs payments, and cash income from other farm-related activities. To begin with, in general the older the cohort, the lower their baseline level of gross cash farm income. The youngest cohort has an average annual GCI of over $188,000 in 1999, while the oldest cohort, those 55-64 in 1999 have an annual average GCI of almost $60,000. As a component of GCI, livestock receipts account for the largest share across all cohorts, with crop receipts making up the second largest source. At the baseline in 1999, the differences in the magnitudes of the subcomponents of GCI maybe attributed to differences in the size of the operations, but may also reflect differences in commodity specializations, which are displayed in Table V. From the table, it is evident that the younger cohorts are more likely to specialize in cash grain crops than their older counterparts.

Following the cohorts over 15 years yields insights into their roles in the sector. Figure 1 presents the change in the major elements of the income statement for each cohort over a 15 years period from the 1999 baseline. In 2014, the youngest cohort, now consisting of farmers between the ages of 39 and 49 years old, had on average close to $366,000 in GCI, or nearly double the level of their 1999 baseline. The new level of GCI for the youngest cohort is almost twice the amount the next highest grossing cohort, the 35-44 age group (Figure 1).

The growth in the cash income of younger cohorts is driven by growth in crop and livestock income. Crop receipts for the cohort of 24-34 year olds increases by 217 percent; livestock income is up by 27 percent. These changes are in contrast to the changes in crop and livestock income received by the oldest cohort, beginning farmers who were 55-64 in 1999. Crop sales for the oldest cohort was almost 15 percent; livestock income increased by 28 percent.

Also telling of the different trajectories of beginning farms is the divergence of income received from other "farm-related" activities. These activities include performing custom work, hiring-out machinery, renting out land, and engaging in production contracts. In 1999, the baseline average annual income from farm-related activities for beginning farmers 24-34 years old were $25,897, while they were only $8,838 for the oldest cohort, 55-64 year olds. By 2014, the amount of income received by the youngest cohort more than doubled to $52,102.

Table IV. Beginning farmers' income and wealth positions: change in levels, by cohorts over a 15 year period: 1999 to 2014[a]

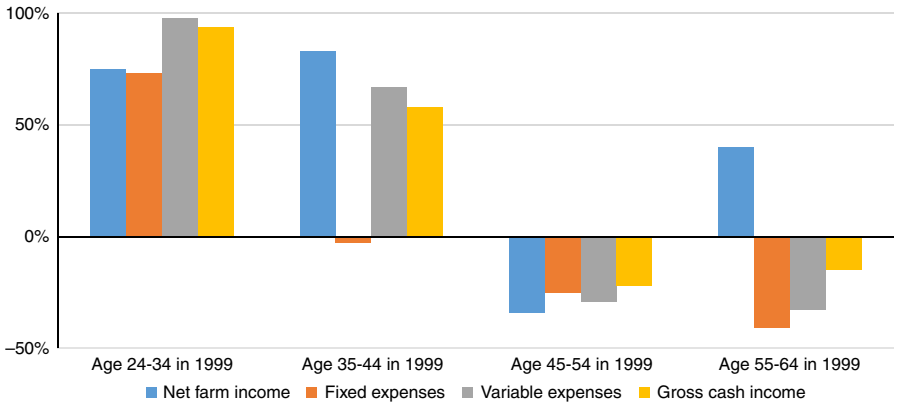
	Year							
	1999				2014			
	Age 24-34 in 1999	Age 35-44 in 1999	Age 45-54 in 1999	Age 55-64 in 1999	Age 24-34 in 1999	Age 35-44 in 1999	Age 45-54 in 1999	Age 55-64 in 1999
Income statement								
Gross cash income	$188,631	125,662	107,952	59,619	$365,900	198,901	84,431	50,784
Livestock income	79,627	48,147	29,235	20,034	101,360	90,632	31,392	14,386
Crop sales, including CCC loans	65,207	45,544	55,486	26,057	206,480	81,599	38,710	24,307
Government payments	17,901	10,446	7,263	4,990	5,958	3,393	2,677	2,285
Other farm-related income[b]	25,897	21,525	15,967	8,538	52,102	23,278	11,652	9,806
Total cash expenses	139,451	97,555	95,508	52,586	267,933	145,124	68,960	34,018
Variable expenses	105,000	72,490	78,310	39,946	208,185	120,705	55,843	26,602
Fixed expenses	34,451	25,065	17,198	12,641	59,747	24,419	12,847	7,416
Net farm income	46,120	28,196	19,108	13,719	80,562	51,712	12,670	19,180
Balance sheet								
Total assets	$657,632	707,534	740,635	731,683	$1,531,695	1,062,051	1,041,789	769,128
Current assets	92,837	69,122	51,739	32,845	221,042	115,182	86,429	28,278
Non-current assets	564,795	638,412	688,896	698,838	1,310,653	946,870	955,360	740,849
Total liabilities	139,002	127,325	80,035	67,674	263,817	127,092	63,356	27,985
Current liabilities	46,508	27,193	18,317	13,018	96,856	41,363	22,094	10,177
Non-current liabilities	92,494	100,132	61,718	54,655	166,961	85,729	41,263	17,808
Net worth	518,630	580,209	660,600	664,009	1,267,878	934,959	978,433	741,143

Notes: Data are for farms with at least $1,000 of annual gross sales. [a]Dollar figures are adjusted to 2014 dollars; [b]other farm-related income includes performing custom work, hiring-out machinery, renting out land, and engaging in production contracts. The cohort age 65 years or greater of beginning farms is not included because the sample size was too small
Sources: USDA (1999, 2014)

	Cohort				
	Age 24-34 in 1999	Age 35-44 in 1999	Age 45-54 in 1999	Age 55-64 in 1999	Age 65+ in 1999
Specialization of operation					
Grains, wheat, corn, soy, rice	26.7	15.9	6.7	5.8	2.7
Tobacco, cotton, peanuts	4.7	3.3	2.7	2.8	0.7
Fruit, nut, vegies	4.1	3.7	6.8	9.0	9.5
Nursey and greenhouse	0.2	3.5	0.9	1.9	2.3
Beef cattle	30.6	41.1	47.0	51.3	49.3
Dairy	2.1	0.9	1.9	0.1	0.4
Hogs	2.3	4.8	3.7	1.0	0.0
Poultry	8.1	6.1	1.7	4.7	1.0
Other crops or livestock	21.2	20.6	28.5	23.4	34.1

Note: Data are for farms with at least $1,000 of annual gross sales
Sources: USDA (1999, 2014)

Table V.
Commodity specialization of beginning farmers in 1999, by cohort



Note: Dollar figures are in 2014 dollars
Source: USDA (1999, 2014)

Figure 1.
Selected income statement items: percentage change between 1999 and 2014

Cash expenses

Cash expenses can be broken into two components: variable expenses and fixed expenses. Variable expenses are outlays for livestock and feed purchases, seed, fertilizer and chemicals, labor, the cost of custom work, and other common periodic expenses such as repairs and maintenance. Fixed expenses include expenses that are structured, recurring costs to the farm such as real estate and property taxes, interest, insurance premiums, and rent and lease payments. Like gross cash farm income, total cash expenses are highest for the youngest cohort of beginning farmers, while lowest for the oldest cohort. For each cohorts at the baseline in 1999, variable expenses are larger than fixed expenses (Table I). The difference between the annual average cash expenses of the youngest cohort and the oldest is $86,865. The difference with regard to fixed expenses is only $21,810.

The largest growth in expenses occurs for the youngest cohort. Their variable expenses have nearly doubled over the 15-year period, while their fixed expenses have increased by 73 percent. The older cohorts, those over 45 years of age in 1999, saw their average annual

expenses fall over the 15-year period. Also notable is the difference between the average annual fixed expenses of the youngest cohort vs the oldest. By 2014, the youngest cohort's fixed expenses were eight times those of the oldest cohort, reflecting the greater use of debt and leasing by the younger cohorts.

Net farm income

Net farm income is a bottom line measure of the farm's profitability and it is calculated as the farm's gross cash income minus cash expenses, depreciation expenses, and non-cash benefits paid to labor, adjusted for the farm's inventory change and farm's capital consumption. The distribution of net farm income across of the beginning farm cohorts at the 1999 baseline reflects the distribution of gross cash income at that time. In 1999, the youngest cohort had the highest net farm income, $46,120; while the older cohort had the lowest net farm income. Over the 15-year period, net farm income increased for all cohorts except the cohort of 45-54 year old, with the greatest growth occurring in the cohort of beginning farmers who were 35-44 years old in 1999.

The evolution of the beginning farmer's balance sheet

The farm's balance is point-in-time snapshot of the farm's assets holdings and liabilities. Movements over time in assets and liabilities reflect the growth or contraction of the operation, as well as changes in the reliance on debt. Total assets and liabilities can each be broken into two components: a current portion and a non-current portion.

Assets

Current assets held by the farm include items such as livestock and crop inventory, purchased inputs – chemicals and fuels, for example – prepaid insurance and other items such as accounts receivable and liquid assets. Non-current assets are long-lived assets such as investments in cooperatives, farm machinery and equipment, animals held for breeding, and importantly, land and buildings, which make up the majority of the value of non-current assets.

At the baseline in 1999, the youngest cohort of beginning farmers start with the lowest level of total assets, about $83,000 lower than the cohort of beginning farmers with the highest level of assets baseline (Table IV)[5]. Despite this, beginning farmers between the ages of 24 and 34 had an average of $657,632 in total assets, and it should be noted that the youngest cohort had more current assets than the others. On average, in 1999, they had $92,837 – almost three times the amount held by the oldest cohort. This reflects greater holdings of livestock and crop inventory, as well as accounts receivable and other farm assets. Generally, the value of non-current assets holding are higher for older beginning farmer cohorts. The value of non-current is driven primarily by land and buildings and the difference is due to the lower land and building holding by the youngest cohort.

Over the 15 years, the current assets of the youngest cohort has grown 138 percent, or nearly double the growth of the two other cohorts that experience growth in their currents assets. On the hand, the oldest cohort showed a decline in current assets. This reflects differences in changes in the intensity of production among the cohorts. All of the cohorts experience growth in non-current assets, and this is largely attributed to changes in the amount of land held and its value. While the youngest cohort had the lowest baseline level of non-current assets – for example, farm machinery, land and buildings, and breeding livestock – they experience the greatest growth over the 15 years, and have an average of $1.3 million in non-current assets in 2014, the highest of all the cohorts (Figure 2).

Liabilities

Offsetting the assets on the balance sheet are the farm's liabilities. Current liabilities include debts payable within one year, the current portion of term debt, and accrued interest and accounts payable. Non-current liabilities are real estate debt and other long-term debt for non-real estate items. At the baseline in 1999, non-current liabilities represent the larger of the two liabilities – ranging from 67 percent of total liabilities for the youngest cohort to 81 percent for the oldest cohort – and generally, for successively older cohorts, the level of total liabilities fall. The youngest cohort of beginning farmers has the most debt due to holding relatively high levels of current and non-current debt, though at the 1999 baseline, the cohort of beginning farmers 35-44 had the highest level of non-current assets.

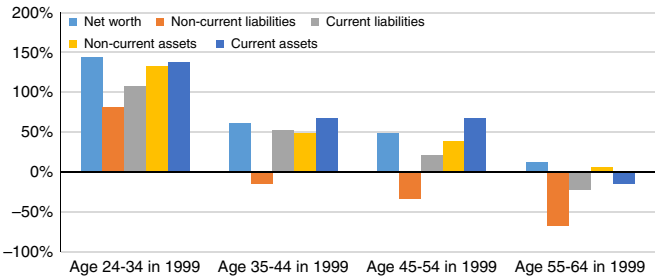
After 15 years, total liabilities decline for all but the youngest cohort, and in that case, they nearly increase to twice their baseline level 1999. This is the results of growth in both current liabilities and non-current liabilities. For the others cohorts, short-term debt contracts, and the change grows more negative for older cohorts. Again, this indicates that the youngest cohort is expanding production, while the other cohorts are reducing production or focusing on other types of production that do not involve production loans.

Net worth

Farm net worth or equity is farm assets over farm liabilities. On average at the 1999 baseline, all of the cohorts have over half of a million dollars in net worth, with the oldest cohort holding the highest net worth, $664,009. As well, over the 15 years, all of the beginning famers cohorts experience a growth in net worth, ranging from 12 percent to 144 percent. At the end of 15 years, the cohort of beginning farmers who are between 24 and 34 years old in 1999 have on average almost $1.3 million in farm net worth, $289,445 more than the next highest group, the cohort of 45-54 year olds.

Understanding the age paradox across cohorts

The question remains: why do we observe such a striking divergence in farm income and wealth across cohorts of beginning farmers? Keeping in mind that farmers in each of the cohorts begin farming at the 1999 baseline with roughly the same number of years of experience (see Table III), the operator's age does not reflect the level of experience, as has been suggested by Katchova and Miranda (2004), for example. Therefore, the divergence may be attributed to something beyond the normal business life-cycle (Boehlje, 1973). In this section, I will explore characteristics that could be contributing to this age paradox – the divergence in income and wealth among the cohorts shown in Table IV. As I will show, the characteristics are inter-related.



Note: Dollar figures are in 2014 dollars

Source: USDA (1999, 2014)

Figure 2.
Selected balance sheet items: percentage change between 1999 and 2014

Real estate represents the largest single asset a farm holds on average, and at the sector level accounts for the greatest single source of wealth; therefore it is a prime candidate for understanding why we observe an age paradox. Table VI shows the average number of acres leased, owned, and total acres operated for the cohorts in 1999 and 2014. Over these 15 years, all cohorts of beginning farmers increase the total number of acres owned on average, as well as the total number of acres operated. After 15 years, the youngest cohort owns 332 acres on average, but this is not materially different from the levels of acres owned by the other cohorts. In fact, the cohort of beginning farmers who were 45-54 years old in 1999 own more land on average. On the other hand, while the level of acres owned may not be materially different from across cohorts, the value of the land does vary across cohorts. Over the study period, the youngest cohort sees their average value of real estate increase while the others experience a decline on average. In 2014, the youngest cohort owns land that is on average $655 to $1,030 more valuable per acre than the land owned by the older two cohorts.

The land value of the younger cohorts can in turn be explain by regional distributions (Table VII). In 1999, 27.8 percent of beginning farmers in the youngest cohort were located in the Corn Belt (Iowa, Missouri, Ohio, Indiana, and Illinois); the highest concentration of any cohort, but also the highest concentration of any region. In fact, among all cohorts except those age 45-54, the Corn Belt contains the highest percent of beginning farms. The youngest cohort is least likely to be located in the Southeast region, while the oldest cohort is least likely to be found in the Northeast. And the Corn Belt experienced the greatest

	Year							
	1999				2014			
Item	Age 24-34 in 1999	Age 35-44 in 1999	Age 45-54 in 1999	Age 55-64 in 1999	Age 24-34 in 1999	Age 35-44 in 1999	Age 45-54 in 1999	Age 55-64 in 1999
Acres leased	231	186	106	100	361	196	104	50
Acres owned	146	141	140	173	332	234	356	324
$/acre owned	$2,791	3,610	4,182	3,447	$3,073	3,338	2,418	2,042
Total acres operated	364	320	237	252	665	409	417	342

Sources: USDA (1999, 2014)

Table VI. Average land leasing, ownership, and total acres operated by cohort

	Cohort			
Region	Age 24-34 in 1999	Age 35-44 in 1999	Age 45-54 in 1999	Age 55-64 in 1999
Northeast	7.3	6.6	7.4	2.5
Lake states	10.0	11.3	7.1	5.9
Corn Belt	27.8	20.4	16.0	23.7
Northern plains	9.8	8.0	5.3	7.9
Appalachia	11.4	16.4	13.1	11.2
Southeast	2.4	8.0	10.3	8.9
Delta	10.7	4.9	8.8	9.5
Southern plains	11.7	12.0	19.8	13.9
Mountain	6.2	6.7	5.0	5.3
Pacific	2.8	5.6	7.3	11.3

Sources: USDA (1999, 2014)

Table VII. Regional distribution of beginning farms by cohorts in 1999

per acre growth in value, as well having the highest overall per acre land values (USDA, 2014). So, while the youngest cohort does not own significantly more land, they predominantly locate in a region characterized by high-land values.

Table VI also illustrates a significant divergence among cohorts in the number of acres leased. The two youngest cohorts increase their average number of acres leased, and the youngest cohort, those who were age 24-34 in 1999, experience the largest increase (57 percent). On the other hand, the oldest cohort reduces the number of acres it leased by 50 percent. It is also notable that the youngest cohort is the only cohort that leases more acres, on average, than is owns, both in 1999 and in 2014. Ultimately, the youngest cohort operates a significantly larger number of acres on average after 15 years, a nearly 80 percent change over the baseline.

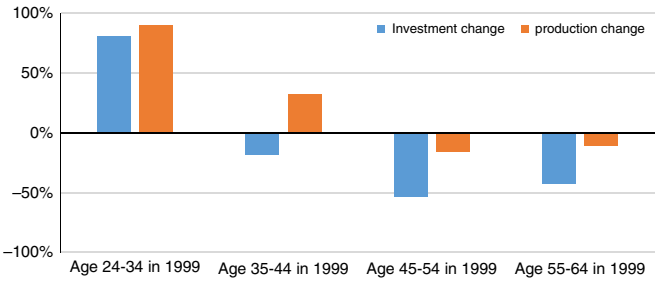
While the number of acres owned and their value could be partly responsible for the paradox, the total number of acres operated indicates that the youngest cohort is operating larger farms, or between 249 and 323 acres on average more than the other cohorts. And the larger number of total acres operated has implications for other characteristics that we observe about the cohort, namely capital use and output.

Figure 3 shows the percent change in capital investment and value of production. Capital investment for the youngest cohort of beginning farmers increases by over 80 percent, while that of the other cohorts declines[6]. Further, the youngest cohort begins the study period with an average annual capital investment figure of $24,582, just $2,341 lower than the cohort of beginning farmers age 35-44, the cohort that had the higher average capital investment at the baseline in 1999.

In terms of assets, the difference in capital investment growth means that the youngest cohort holds far more farm equipment ($218,458 on average) – more than twice as much as the next greatest level, which is held by the cohort of 35-44 year olds. In contrast, the oldest cohort holds $49,432 in farm equipment.

The dramatic growth in production is also driving the purchase of current assets – livestock and crop inventories, purchased inputs, and cash invested in growing crops. Together with the land and capital equipment, non-current assets contribute to the divergence that we see among cohorts.

The differences in commodity specialization, acres operated, capital investment, and ultimately production affect the evolution of the income statement and balance sheet. Namely, the cohorts that specialize in large-scale production, in particular grains, are on average more efficient with capital and are more profitable. This is illustrated by the net income figures shown earlier in Table IV, but it is also illustrated by the differences in



Note: Investment per acre is calculated as investment in depreciable property (machinery and equipment, vehicles, and single-purpose structures) over total acres operated

Source: USDA (1999, 2014)

Figure 3.
Annual production and capital investment by cohort: percent change between 1999 and 2014

financial ratios across cohorts (Table VIII). While the younger cohorts have higher overall debt to asset ratios, they are more efficient with capital, shown by the asset turnover ratios[7]. As well, they are generally operating more efficiently than the other cohorts with respect to expenses, and clearly they are more profitable. It is notable that the youngest cohort is the only cohort to have a positive return on equity at the baseline in 1999.

On a per acre basis, all cohorts experience a decline in investment (Table IX); however, the youngest cohort's investment declines by a much smaller amount than the other cohorts; declining by only 1.3 percent per acre after 15 years, and in 2014 the figure is still nearly $70/acre, the largest amount in 2014. In contrast the oldest cohort is investing $23/acre in 2014, down about 60 percent from their 1999 investment rate.

Revenue per acre is also highest for the youngest cohort. In 1999, the cohort of beginning farmers between the ages of 24 and 34 have per acre revenue of about $518. In contrast, the older cohort has per acre revenue of $237. As well, over time the younger cohorts increase their revenue per acre, while the older two cohorts experience a decline.

In sum, we observe this age paradox among beginning farmers with respect to the differences in income and wealth for several reasons, and they are all inter-related. The younger beginning farmers are more likely to specialize in cash grain production (Table V), to locate in the Midwest (Table VII), and to operate larger farms – including owning more land.

Financial ratio	Cohort Age 24-34 in 1999	Age 35-44 in 1999	Age 45-54 in 1999	Age 55-64 in 1999
Debt to asset				
1999	0.21	0.18	0.011	0.09
2014	0.17	0.12	0.06	0.04
Asset turnover ratio				
1999	0.29	0.18	0.15	0.08
2014	0.24	0.19	0.08	0.07
Operating expense ratio				
1999	0.74	0.78	0.88	0.88
2014	0.73	0.73	0.81	0.67
Return on equity				
1999	1.27	−1.60	−0.97	−2.21
2014	2.40	2.15	−1.18	−0.48

Sources: USDA (1999, 2014)

Table VIII. Select financial ratios by cohort and year

Measure	Cohort Age 24-34 in 1999	Age 35-44 in 1999	Age 45-54 in 1999	Age 55-64 in 1999
Investment/acre, 1999	$67.5	84.2	106.5	54.6
Investment/acre, 2014	$66.9	53.4	27.8	23.0
% change	−1.3	−34.2	−73.9	−57.9
Revenue/acre, 1999	$518.1	392.9	455.8	236.9
Revenue/acre, 2014	$550.2	486.1	202.6	148.7
% change	6.2	23.7	−55.6	−37.2

Notes: Dollar figures are in 2014 dollars. Revenue per acre is calculated using gross cash farm income over total acres operated. Investment per acre is calculated as investment in depreciable property (machinery and equipment, vehicles, and single-purpose structures) over total acres operated

Sources: USDA (1999, 2014)

Table IX. Investment and output per acre by cohort and year

The specialization by the young cohorts of beginning farmers drives two characteristics that account for the difference: higher investment in capital equipment and more total land operated. And rates of financial return have been shown to increase with harvested acres, driving the profitability of these young cohorts of beginning farmers.

While land ownership is a factor in the change in wealth, it does not account fully for the age paradox in wealth. All cohorts in the study increased ownership over the 15 years, and the average number of acres owned across the cohorts does not vary by much. In 2014, the oldest cohort owns only eight more acres on average than the youngest. Where we do see a large divergence is in acres leased. Again, this is a signature feature of commercial operations – operating high acreage – a majority of it leased – and holding higher amounts of current assets, like livestock and crop inventories, and purchased inputs.

And as the youngest cohort specializes in cash grains, cash grain farms (corn, soybeans, and wheat in particular) and grow larger, they exhibit more efficient use of capital as they increase their acreage as is suggested by MacDonald *et al.* (2013). The youngest cohort are able to make more "turns" with their assets, earning $24 dollars for every $100 of assets, or 20 percent more than the next most efficient cohort (Table VIII). As well, average total production increases for the younger cohorts rather dramatically, and they are also able to be more productive farms on a per acre basis. They have the highest per acre revenue in 2014, and they also have the highest asset turnover ratio. Ultimately, they are the most profitable cohort.

Summary

The detailed financial data in ARMS allows researchers to examine the financial components of the farm operation on a national scale. The incredible breadth and depth of the survey lends itself to re-creating farm income statements and balance sheets, and examining them for different subsets of farmers, in this case beginning farmers. Studying cohorts of beginning farmers' income and wealth statistics reveals beginning farmers take divergent paths over time, and the differences may be the results of many factors[8]. Past research presents evidence that beginning farmers enter the sector for a variety of stated reasons, and these reasons point to different outcomes in terms of production, farm income and farm wealth. Mishra and El-Osta (2016) examined farmers' stated reasons for entering farming. Given the choice of three stated reasons: whether the farm was stared for the purpose of being the primary source of income; started as a secondary source of income, or had taken over the operation. They found that there are differences in outcomes as measured by farm sales by stated reason. Those who stated the purpose of entering farming was to be a primary source of income had annual farms sales $86,000; those who stated it was for secondary source had farm sales of $38,590. This is particularly true of individuals who enter farming later in life: as a group they are likely to report entering farming as a primary source of income or to take over an operation, but may instead have other goals related to retirement or preferences for a lifestyle.

In 2014, the median age of a beginning farmer was 52 years old, and while only about 17 percent are under the age of 35, young beginning farmers represent the cohort of beginning farmers who will go on to produce much of the value of product in the sector. Among the beginning farmers in 1999, those who began in the youngest cohort will go on to produce almost 60 percent of total production by all cohorts in 2014. Consequently, in this analysis, I find a marked contrast in the evolution in the income statement between beginning farmers who are under 45 and those over 45 years old. The gross cash income of the youngest cohorts grows tremendously, as do their expenses, indicating strong growth in production. The change in the balance sheets of the cohorts also provides a glimpse into the changing roles of beginning famers over time. The youngest cohort of beginning farmers increase the current and non-current assets on their balance sheets by a substantial amount, more than doubling the both. Furthermore, the youngest cohort

is the only group to take on more current liabilities, indicating increased financing of the production expenses.

Based on the outcomes of this cohort analysis, the significant differences in financial trajectories of cohorts of beginning farms taken together with the differences in the likelihood of specialization provides an opportunity for policy makers and stakeholder groups to tailor outreach and support to reach different groups of beginning farmers, because beginning farmers are not a homogenous group. They have different needs when it comes to government policy depending on the policy makers' intentions. The younger cohorts operate larger farms, specialize in cash grains, and use capital equipment intensively. While they own nearly as much land as their older counterparts, they rely heavily on leased acres. They also accrue more debt, though they use their assets more efficiently. This knowledge helps distinguished who among the beginning farmers, for example, would be helped by policies that encourage capital investment, such as increasing the expensing deduction on their taxes, or providing tax credits to land owners who lease land to beginning farmers (Williamson and Stutzman, 2016). It is though the cohort analysis of detailed financial and physical characteristics of the beginning farms that insight into the implications for policy can be found.

Notes

1. A small subset of farms in ARMS is sampled in multiple years, but these are mostly larger (over $1 million of annual gross sales) operations.
2. Many beginning farms have multiple operators, therefore the cohort assignment is based on the age of the principal operator.
3. The ARMS documentation, including survey manuals and questionnaires can be found here: www.ers.usda.gov/data-products/arms-farm-financial-and-crop-production-practices/questionnaires-and-manuals.aspx
4. I test for compositional bias due to differential survival among beginning farm cohorts. To do so, I adjusted the average age in 2014 by 15 years, and then took the difference in averages between 1999 and 2014. The differences range from 0.1 to −2.7 years (the largest differences coming from the oldest cohort, which we do not include in the study because the sample size in 2014 is too small). The *t*-tests shows only the youngest and older cohorts had statistically significant differences. The average age of principal operators in the youngest cohort was 0.9 years younger (after the adjustment) in 2014 than in 1999. It is statistically significant at the 1 percent level, and this is due in part to very lower variances. I would also attribute part of the difference to a much larger sample size in 2014 due to TOTAL, thus increasing the chance of picking up more farms in those cohorts. For the other cohorts we include in our study, the differences are also less than a year, ranging from −0.6 to 0.1, but they are not statistically significant. In this regard, the compositional economically changes are small, and only statistically different from zero in one cohort. The youngest cohort is comprised of slightly younger principal operators on average. Therefore, in terms of economic significance, its hard to argue the bias is large, and to the degree there is bias, is would bias the 2014 results downward and the results would be underestimating the changes for the youngest cohort.
5. Not a statistically significant difference.
6. Capital investment is investment in depreciable property, for example, machinery and equipment, vehicles, and single-purpose structures.
7. All cohorts have average debt-asset-ratios well below the 0.4 threshold level for being considered highly leveraged (see Harris *et al.* (2009) for more information about categorizing farm businesses by leverage levels).
8. This cohort analysis is not a study of the beginning operator's managerial skill or performance, and differences in the outcomes of the cohorts after 15 years should not be interpreted as measures of such.

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Further reading

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