Farm Diversification as an Adaptive Capability: Examining the Resilience of Kansas Farms

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1. Introduction

Risk and uncertainty are inexorable facts of life for agricultural producers. Although conventional risk management techniques have helped to moderate the impacts of specific sources of risk, they lack the ability to comprehensively cope with uncertainty in general. Subsequently, the concept of system resilience has emerged as a potential alternative to conventional risk management options. System resilience, a theory originating from socio-ecological research (Holling, 1973), is the ability of a system to structurally withstand any disturbance, predicted or unpredicted. Considering that a farm is essentially a socio-ecological system, resilience methodologies can help farmers prepare for unexpected shocks (Lin, 2011). A vital component of any resilient system is the development of adaptive capabilities that allow the system to structurally withstand disturbance (Milestad et al 2012). Researchers have posited that farm diversification is an adaptive capability that can enhance resilience (Lin, 2011, Kremen & Miles 2012).

System resilience is broadly defined as "…the capability of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks" (Walker et al, 2004). The concept of resilience embraces the fact that every productive system will always be subject to some level of unpreventable vulnerability (Juttner & Maklan, 2011), thereby demanding that the system either endure or adapt for survival. In regards to agricultural systems, one could generally define a resilient farm as one which has developed adaptive capabilities that allow it to return to normal (or improved) operations after having experienced an unexpected economic or ecological shock. From this perspective, agricultural producers have already implemented resilience techniques into their risk management strategies for many years. Yet, in terms of formal risk management practices, applications of system resilience in agriculture are still evolving. As a part of this evolution, researchers have acknowledged that diversification is a management practice that can potentially lead to higher levels of farm resilience. A diversified farm can potentially withstand simultaneous disturbances to several crops on a regular basis, as well as promote and maintain viability and productivity.

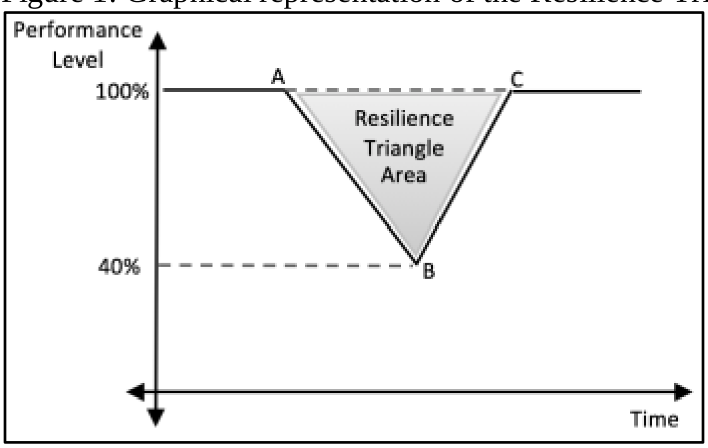
Previous studies have shown that the diversification of farm production can enhance the ability to respond to changes in consumer preferences and weather financial shocks (Lin, 2011, Kremen and Miles, 2012, Featherstone and Moss 1990). However, the literature on farm resilience in general and on the effect of diversification on farm resilience is still relatively underdeveloped. This study attempts to fill this gap by presenting an empirical examination of the role that farm diversification can play in enhancing resilience of agricultural production systems. Specifically, it utilizes 40 years of farm-level data from the Kansas Farm Management Association (KFMA) database to conduct an empirical examination of the effect of diversification on farm resilience. The contribution of this paper to the literature is twofold. First, the application of the resilience triangle framework in the agricultural production context introduces the system resilience perspective to existing risk management literature in this field. Second, the results of empirical analysis provide useful insights for informing policy and farm-level decision making in the face of increasingly volatile macroeconomic and agro-ecological conditions. The rest of the paper is organized as follows: Section 2 presents methods including conceptual framework, data, and the analysis, followed by the results in Section 3 and conclusions in Section 4.

2. Methods

Conceptual Framework

The conceptual framework is based on the resilience triangle approach adopted from the system resilience literature. The resilience triangle framework has been used to dynamically assess and compare the resilience of different socioeconomic systems such as automotive industry supply chains and critical urban infrastructure systems (Sheffi, 2006, Tierney and Bruneau, 2007, A.P. Barroso, 2015, Carvalho et al., 2011, Zobel, 2011, Guller et al., 2015, Pant et al., 2013). A resilience triangle is a graphical representation of the impact of a shock (vertical axis) and the time required to recover from the shock (horizontal axis). The extent of a system's resilience is defined by the area of the triangle resulted from connecting three points on the graph: (a) pre-shock performance level, (b) post-shock performance level, and (c) performance level after recovery (Figure 1). For example, systems with large resilience triangles (which can result from either greater impact of a shock, longer recovery time, or both) indicate lower levels of resilience and vice versa.

Figure 1: Graphical representation of the Resilience Triangle framework



To examine the resilience of agricultural production systems this study considers three distinct shocks during 40 year period between 1973 and 2013: i) the early1980s farm crisis, ii) the poor crop years in 2005, and iii) the global economic recession in 2008.

Data

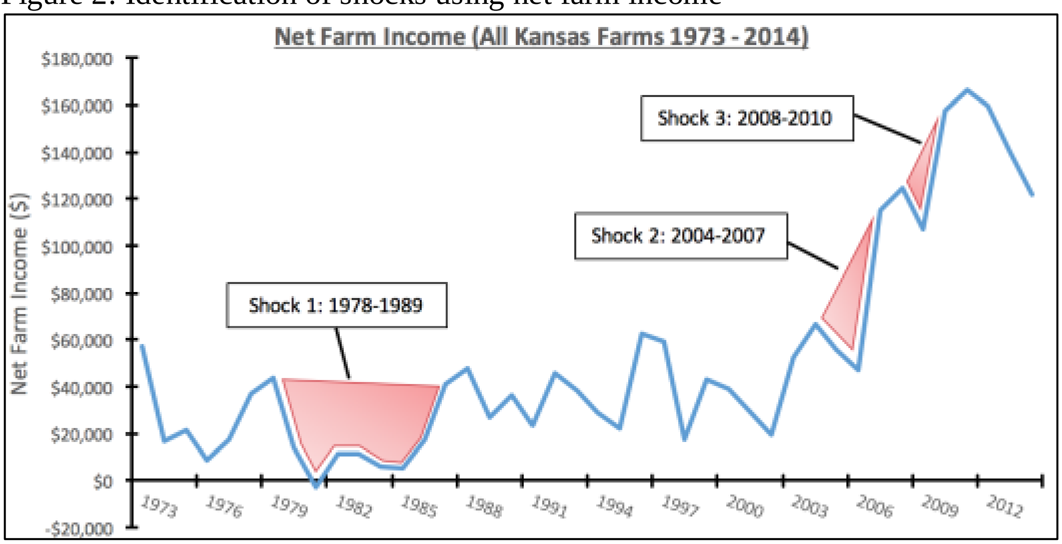
The analysis is based on a unique panel dataset obtained from the KFMA database which includes detailed farm-level financial and production data for more than 3000 farms in Kansas between 1973 and 2014. The data for this study was compiled by pooling information on each farm across three shock periods. This produced total of 1,444 observations. Table 1 provides summary statistics for these observations for the total sample as well as for observations in each respective shock period.

Table 1: Summary Statistics

	All Shock Periods	1978-1989 Shock	2004-2007 Shock	2008-2010 Shock
Observations	1,444	434	474	536
Avg. Acres Managed	1892.99	1414.65	1951.02	2228.98
	1439.95	932.14	1399.54	1689.94
Avg. Value Farm Prod.	$374,110.23	$157,872.84	$352,569.95	$568,246.66
	388,910.13	120,173.58	346,760.63	462,445.18
Avg. Age of Producer	54.18	50.98	55.57	55.55
	11.25	9.55	11.31	11.95
Avg. Net Farm Income	$94,711.68	$31,417.28	$86,954	$152,845.00
	119,040.43	24,078.30	105,625.19	145,591.11

The average annual net farm income for the period from 1973 to 2014 was examined for all Kansas farmers in the sample in order to identify potential periods of shock and subsequent recovery for the resilience analysis (Figure 2). As a result, three periods of economic and/or ecological shocks were identified. First, between 1979 – 1981, average net farm income declined by 106% and remained at that low level until about 1985. Between 1985 – 1988, average net farm income increased dramatically to surpass its 1979 levels. Thus, the period between 1979 – 1988 was identified as a strong candidate for the resilience analysis. Second, two additional time periods for resilience analysis emerge in the early and late 2000s. On average moving into the year 2002, average net farm income was on a downward trend. However, after 2002, values for average net farm income increased dramatically, denoting a structural upward shift in farm incomes in Kansas. The two time periods of shock and recovery emerge between 2004-2007 and 2008-2010. Although these are just 1- or 2-year periods of decreased net farm income (as compared to the major shock in the 1979-1989 period), they are interesting for this particular study because they provide an opportunity to analyze farm resilience across a range of shocks varying by underlying cause, magnitude, and duration.

Figure 2: Identification of shocks using net farm income



In order to get a better understanding of the shock periods selected for this study, 6 different geographic regions of Kansas are analyzed as denoted by the KFMA. Figure 4 shows the fluctuations in average net farm income for these six regions starting in 1978, which can be compared to the state-level aggregate data in Figure 3. At first glance the regional data does not seem to fluctuate quite as much as the state-level data, so Figure 5 examines 1978-1988 specifically. Here one can more clearly see that average net farm income for each of the six geographic regions does seem to align with the pattern exhibited in Figure 3, with some additional areas of significance. First, note that the shock appears to begin in all regions in 1979, except for North Central Kansas, which appears to enter the shock in 1978. Also, when using the strict definition of the start and end points of the shock period (i.e. the shock ends when net farm income is at or above pre-shock levels), there are differences between the regions' ending periods. For example, Northwest Kansas appears to end their shock in 1987, whereas Southwest Kansas does not end their shock until 1988. This will be important to consider when computing both regional resilience levels and farm-level resilience index values.

Figure 4: Regional Net Farm Income (1978-2014)

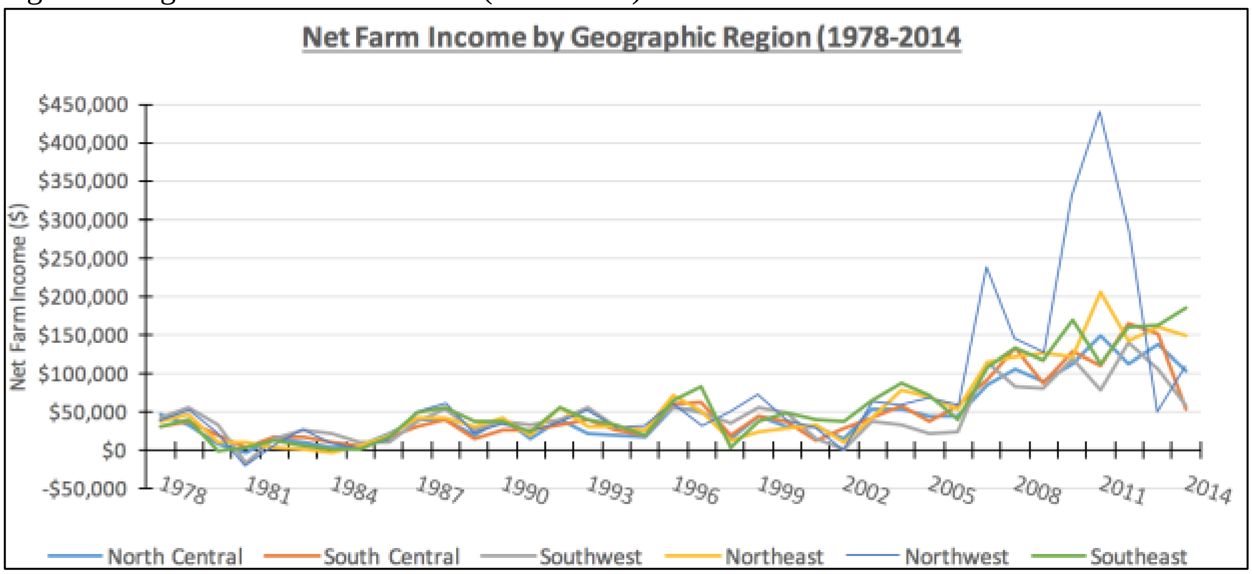
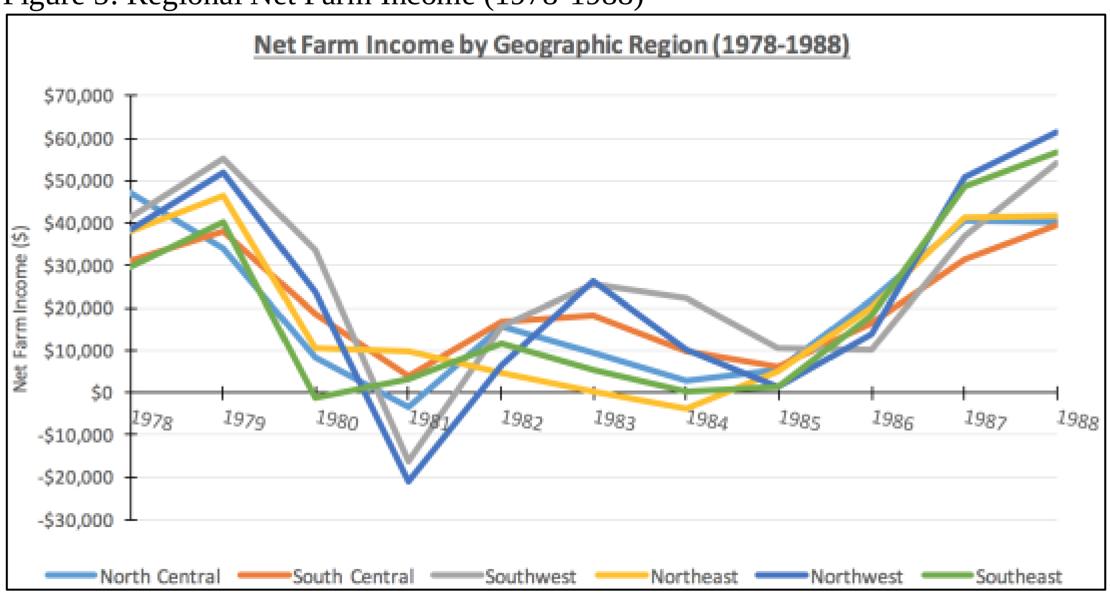
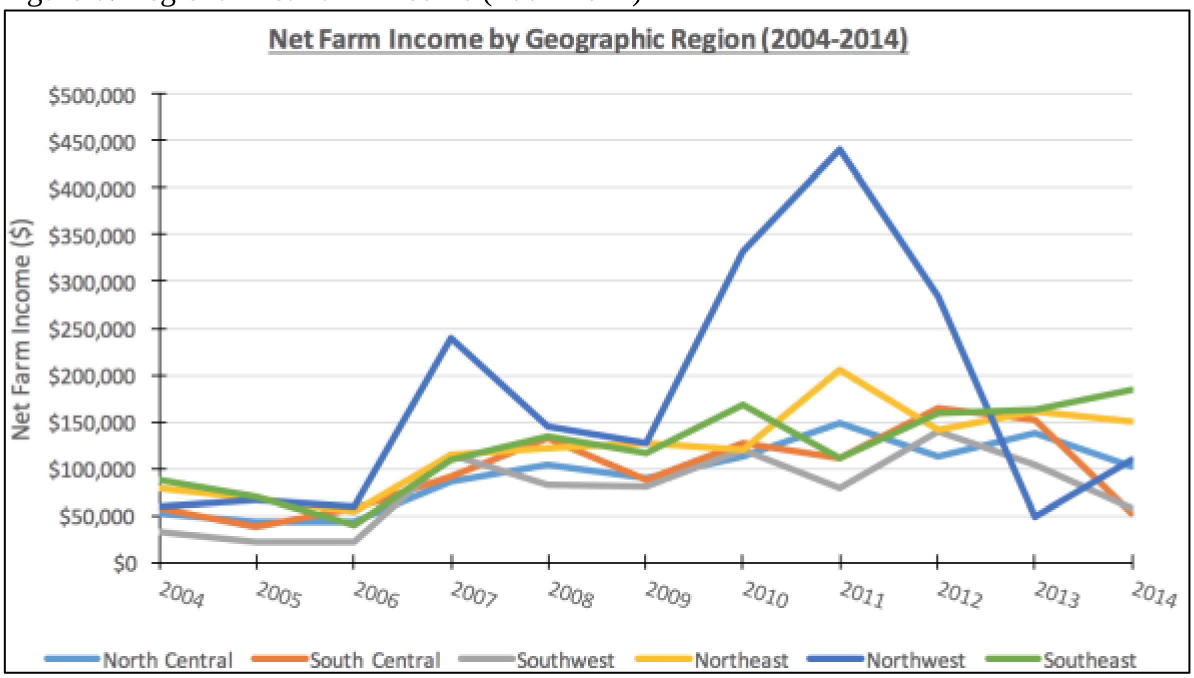


Figure 5: Regional Net Farm Income (1978-1988)



The other two aggregately-defined shock periods for Kansas farms are examined more closely in Figure 6. The graph reveals that the shapes of the curves are not as closely related to the aggregate levels as compared to the first shock period. Although Figure 6 does display an upward trend in the 2000's for all regions, there is much more discrepancy at the individual regional level. The most glaring observation is the enormous fluctuations exhibited by the Northwest region. Average Net Farm Income in this region tops out in 2011 at $440,406, which is almost twice as much as the next highest regional-level net farm income level (Northeast Kansas at $206,247). In regards to the specific shock periods (2004-2007 and 2008-2010), the regions do generally follow the trends of Figure 2, but of course with some exceptions. For example, South Central Kansas appears to end their shock period in 2006 vs 2007. Also, Northwest Kansas appears to enter the shock period in 2005 instead of 2004. In the second shock period, we see that Northeast Kansas enters the shock in 2009, and Southwest seems to enter the shock immediately in 2007 (following the previous shock).

Figure 6: Regional Net Farm Income (2004-2014)



Analysis

Resilience Index

First, an index reflecting resilience level of a for all Kansas farms, during time period t, is calculated following Barroso 2015 approach:

$$R = 1 - \frac{\sum_{t_0}^{t_N}\left(1 - \left(\frac{ANFI_{t_n}}{ANFI_{t_0}}\right)\right)}{(t_n - t_0)} \quad (1)$$

Where R is the resilience index value assigned to all Kansas farms on average during the time period under consideration, $ANFI_{t_0}$ is the level of fully operational net income of at time t_0 (the start of the shock), and $ANFI_{t_n}$ is the average net farm income for all Kansas farms during each subsequent time period, t_n. For example, for the resilience analysis over the first shock period, the t_0 is 1979 and t_N is 1987, resulting in 0.297 as an average resilience index for all Kansas farms during that shock period.

Next the average resilience indexes are calculated for each of six major geographic regions in Kansas. This is done to account for the variation in agro-ecological conditions across the different regions of the state of Kansas. For example, it is likely to observe farms in the southwest of Kansas suffering from an ecological shock, whereas farms in the northeast of Kansas having a strong harvest during the same time period. The average resilience index values for each region during the first shock are shown in Table 2.

Table 2: R_i values by geographic region

Region	North Central	South Central	Southwest	Northeast	Northwest	Southeast
R_i	0.376	0.396	0.396	0.346	0.268	0.137

The data shows that farms in South Central and Southwest Kansas were most resilient during this shock period and farms that were in the Southeast of Kansas were the least resilient. Additionally, we find that farms in the central part of the state are more resilient during this shock (averaging 0.386) than farms in the east and west (averaging 0.241 and 0.332, respectively). Also, farms in the North are slightly more resilient than farms in the South.

The resilience index values at the individual farm level are calculated next. To accomplish this task, we first identified farms that had continuous data from 1978 to 1989. This resulted in 434 observations. This 11-year period was selected to analyze the resilience over the first shock because for some regions the shock appears to begin in 1978, and for others the shock does not begin until 1979. Likewise, for some regions the shock appears to end sooner than others. As to be expected then, there is also a fair amount of variability in the start and end years of the shock for individual farms. Some farms do not appear to be impacted by the shock until 1981 (perhaps relying on previous years' successes to weather the first years of the state-wide shock), and others seem to be impacted immediately in 1978. Farms were therefore separated into their respective years of initial shock dates, using four options: 1978, 1979, 1980, and 1981. More specifically, the following criteria was used to identify the shock start date at the farm level. Net farm income at the start of the shock must first fall within one of the four years listed. This level of net farm income must be greater than the previous year's net farm income, and also greater than or equal to the following year's net farm income. In other words, these restrictions identify the year that has the highest net farm income out of the possible four choices, but is also followed by a decline in net farm income during the subsequent year.

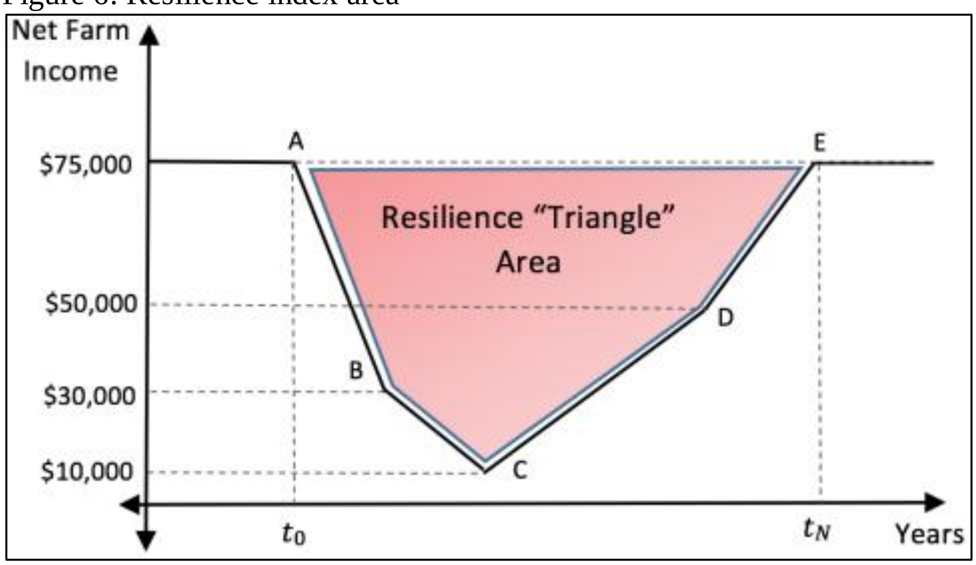
Next, to define the end date of the shock at the farm level the following criteria are enforced. When some year after the start of the shock has a net farm income level equal to or greater than the net farm income level at the start of the shock, the shock is over for that farm. In other words, this will be the year when the performance recovered or surpassed the pre-shock performance level. For some farms this occurs in as little as 1 year later (indicating perfect resilience), in contrast some other farms take the entire 11-year period to recover. The variable net farm income is rather volatile at the individual farm level, and it may be true that farms with small recovery times may initially post a recovery and then subsequently perform poorly. So even though the farm is assigned a relatively high resilience index value, when examined closer it may not necessarily appear to be very resilient. This is one potential problem with the chosen method, indicating that further studies may identify a better variable to use when computing resilience index values. However, the previously outlined definition of farm resilience is that the farm experiences a shock and then returns to pre-shock levels.

Having identified the starting and ending times, equation (1) is modified slightly to calculate resilience index for each individual farm in the sample:

$$R_i = 1 - \frac{\sum_{t_0}^{t_N}\left(1-\left(\frac{NFI_{t_n}^{i}}{NFI_{t_0}^{i}}\right)\right)}{(t_n - t_0)} \qquad (2)$$

Where R_i is the resilience index value for farm i. On the right hand side, $NFI_{t_n}^{i}$ is the net farm income for Farm i at time t_n, where t_n is a particular time period following the start of the shock. Note that $NFI_{t_n}^{i}$ is divided by $NFI_{t_0}^{i}$, which is net farm income for farm i at the start of the shock, t_0. Figure 6 shows that this index is essentially quantifying the area of the shaded region, so although it is not a perfect triangle (due to the nature of net farm income), it creates a measure that includes both the magnitude of the impact of the shock as well as the length of time to recovery.

Figure 6: Resilience index area



Next, the individual farm resilience indexes are calculated for shocks two and three using the same approach. Although these apparent shocks were experienced over much shorter time spans, they are nevertheless noteworthy. Starting in 2002, ANFI began an upward trend. This resulted in ANFI in 2011 being over 700% higher than it was in 2002 (going from $19,245.66 in 2002 to $166,374.6 in 2011). However, during the two aforementioned shock periods there were distinct drops in ANFI, each lasting 1-2 years. The resilience index for all Kansas farms during the 2004-2007 shock was 0.584, and for 2008-2010 was 0.644. On the surface these are interesting results because starting from the original 1978 shock, which had an average resilience index value of 0.391, the resilience index values for Kansas farms on average increased. This could potentially indicate that resilience-enhancing adaptive capabilities were increasingly implemented over the past 4 decades, better enabling farmers to weather shocks. Table 3 presents summary statistics for R_i values at the individual farm level for all shock periods.

Table 3: Farm Level R_i Results

	All Shock Periods	1978-1989 Shock	2004-2007 Shock	2008-2010 Shock
Mean	0.548	0.391	0.584	0.644
Standard Deviation	0.268	0.212	0.255	0.263
Range	0.997	0.963	0.997	0.990
Minimum	0.001	0.002	0.001	0.008
Maximum	0.998	0.965	0.998	0.998

Diversification Index

The diversification index for each farm is calculated using the following method:

$$D_i = \sum (PAP_n)^2 \tag{3}$$

where D_i is the diversification level of farm i and PAP_n refers to the percentage of total acres planted for crop n. For example, if a farm has dedicated 100% of acres to a single crop then $D_i = 1$, alternatively if a farm has dedicated 40%, 30%, 20%, and 10% of acres to different crops then the concentration ratio is 0.3. Consequently, farms with *less* diversification (i.e. higher concentration) will have higher D_i values and farms with higher diversification (i.e. lower concentration) will have D_i values closer to zero.

This diversification index is computed using two different methods. The first method is to compute a diversification index for each individual year, for each individual farm, and then compute an average diversification index level for all years.

$$D_i = \frac{\sum_{Year\ 1}^{Year\ N}\left(\sum\left(\frac{Acres\ planted\ to\ crop\ n\ in\ year\ t}{Total\ acres\ planted\ in\ year\ t}\right)^2\right)}{Number\ of\ shock\ years\ for\ farm\ i} \tag{4}$$

The second method used is an attempt to account for the notion that diversification on the farm does not have to happen each year in isolation (i.e. one farmer planting many crops), but could happen over time as farmers follow crop rotation schedules. Thus, one may not see diversification across crops within individual years, but the farmer may diversify across crops over time. To compute a diversification index more indicative of this process crop acres across all years are summed and then converted to a percentage. The specification is thus:

$$D_i = \sum\left(\frac{Sum\ of\ acres\ planted\ to\ crop\ n\ for\ all\ years}{Sum\ of\ total\ crop\ acres\ for\ all\ years}\right)^2 \tag{5}$$

Summary statistics for the computed diversification index values using both methods are provided in Tables 4 and 5. The results indicate that diversification index values do increase over time, under both methods. This means that over time farms have become more specialized and less diversified. Also, diversification index values using method two are smaller than using method one. This could potentially indicate that one method is better than the other. Recall that with this index specification, smaller values indicate greater levels of diversification. Theoretically then this should make sense because using method two we are allowing farms to diversify across crops and years, rather than just across crops within years. Hence, greater levels of diversification might appear due to farmers following crop rotations or adjusting crops based on other factors like prices or weather conditions.

Table 4: Diversification Index Method 1

	All Shock Periods	1978-1989 Shock	2004-2007 Shock	2008-2010 Shock
Mean	0.409	0.403	0.413	0.408
Standard Deviation	0.171	0.164	0.180	0.166
Range	0.881	0.853	0.881	0.878
Minimum	0.119	0.147	0.119	0.122
Maximum	1	1	1	1

Table 5: Diversification Index Method 2

	All Shock Periods	1978-1989 Shock	2004-2007 Shock	2008-2010 Shock
Mean	0.384	0.366	0.385	0.399
Standard Deviation	0.179	0.169	0.189	0.175
Range	0.891	0.864	0.891	0.877
Minimum	0.108	0.136	0.109	0.123
Maximum	1	1	1	1

The results indicate general trends consistent to those outlined in the existing body of literature. More specifically, the results indicate that farms are becoming less diversified over time, farms are becoming on average larger, and average value of farm production is increasing over time. Additionally, the resilience of farms is increasing over time (reference Table 3) as computed by our resilience triangle method. It is important to also note some potential structural shifts and control variables when running the models. For example, between shock period 1 and shock periods 2 &3, major changes were made in terms of agricultural legislation. In the 1990's major changes happened in the way that the government subsidized and insured farmers' incomes and crop production. The 2002 farm bill instituted heavy grain subsidies and the 2008 farm bill saw further adjustments to crop insurance programs as well as legislation on bio-energy crop production. Outside of government, the late 1990's and early 2000's marked a surge in bio-fuel crop production which had ramifications throughout the agricultural producers of Kansas. Thus there were major changes in both government intervention and market forces between the first shock period and the subsequent two. Keep in mind, however, that this is an attempt at a new method of assessing the ability of farms to cope with change. Whether this change is ecological, economic, or legislative, the fundamental idea of resilience, and the adaptive capabilities that promote resilience, is the ability to withstand and type of shock. As the analysis continues then, the major changes that happened in the 15-20 year period across three shocks are considered while also attempting to stay true to the tenants of system resilience analysis.

Model Specification

After computing both resilience and diversification indexes for individual farms in the sample, an econometric model is specified to estimate the effect of diversification on farm resilience. In this specification, R_i is resilience index of farm i, and Div_i^n is diversification index value for farm i using method n (where n = 1 or 2 as previously outlined).

$$R_i = \alpha + \beta_1 D_i^n + \beta_j X_{ij} + \varepsilon_i \qquad (6)$$

Note that from this point on, the analysis proceeds using only the second diversification index method. Both methods are highly correlated, magnitudes are very similar, and model results are also very similar. As better methods of measuring diversification and resilience are developed, the analysis can be adjusted accordingly. For now, though, the analysis proceeds with the method that allows for greater flexibility with how diversification can be defined (i.e. across crops and across years). Results from this model are show in Table 6, along with the results from the subsequent models. First, notice that diversification is statistically significant and negative. This indicates that lower levels of the diversification index correspond to higher levels of resilience. Recall that the nature of the diversification index is such that lower levels indicate greater diversification, so this result could indicate that more diversified farms are more resilient.

To account for factors that influence farm productivity and profitability additional control variables are included in the model. These control variables include the following: age of the producer, size of the farm, square of the farm size, geographic location of the farm, and time period of the shock. After computing regressions using all control variables, geographic regions and the age of the farmer were found to be statistically insignificant and were therefore eliminated. Thus, the following model is specified:

$$R_i = \alpha + \beta_1 Div_i^2 + \beta_2 Acres_i + \beta_3 Acres_i^2 + \beta_4 D_{1989} + \beta_5 D_{2010} + \varepsilon_i \qquad (7)$$

3. Results

The results in Table 6 show that all estimated parameters are statistically significant at the 95% level. The coefficient on the size of the farm is positive, indicating that larger farms are more resilient. Moreover, the coefficient on the squared value of farm size is also statistically significant and negative. This indicates that once farms reach a particular size the impact on resilience is negative. Intuitively we might describe this as "the bigger they are, the harder they fall." In other words, while increasing the number of acres farmed could help with diversification and resilience efforts, having too large of a farm could mean financial ruin if a major shock impacts the enterprise. The coefficients therefore indicate that farms over 5100 acres will start to become less resilient than farms under 5100 acres. Controlling for time periods, the coefficient on D_{1989} is negative indicating that farms were less resilient in 1989 than 2007. The coefficient on D_{2010} is positive which means that farms were more resilient in 2010 than in 2007. Most importantly, with these controls in place the coefficient on diversification is still statistically significant and negative.

Now, although net farm income is a measure of profitability, and therefore farm resilience, insight could also be gained from analyzing the revenue-generating abilities of farms. Recalling that in the discussion of how farm resilience is defined, what is most important is the ability to initiate production in subsequent seasons. While profitability is very much an important criterion, there will be no profit without revenue generation first. Thus, the impact of the diversification index and all of the control variables on the average value of farm production is assessed across all shock years. The results of exploratory analysis posit that the following specification yields important results:

$$AvgVFP_i = \alpha + \beta_1 Div_i^2 + \beta_2 Age_i + \beta_3 Acres_i + \beta_4 Acres_i^2 + \beta_5 D_{1989} + \beta_6 D_{2010} + \beta_7 D_{SW} + \varepsilon_i \qquad (8)$$

In this model $AvgVFP_i$ is the average value of farm production for farm i, Div_i^2 is diversification index values for farm i, Age_i is the average age of the farmer during the shock period, $Acres_i$ is the average number of acres managed for farm i during the shock period, $Acres_i^2$ is the square of the acres managed and the last three variables are dummies to represent structural time shifts in 1989 & 2010, as well as the statistically different value of farm production for farms in Southwest Kansas. The results show that all seven coefficients are statistically significant at the 95% level and the signs are all worth discussing.

Table 6: Modelling Results

	Equation 6	**Equation 7**	**Equation 8**
LHS Variables:	Resilience Index	Resilience Index	Value Farm Prod.
<u>RHS Variables</u>			
Intercept	0.582	0.579	284,174.72
	34.94*	25.395	6.52
Diversification Index	-0.088	-0.128	-339,514.35
	-2.249	-3.550	-8.278
Age	-	-	-2072.178
	-	-	-3.134
Farm size	-	3.93E-05	172.916
	-	2.116	15.489
1989	-	-0.186	-122,544.2
	-	-11.268	-6.441
2010	-	0.058	179,126.03
	-	3.788	10.256
Southwest	-	-	-75,111.14
	-	-	-2.576
(Farm size)^2	-	-3.82E-09	-0.003
	-	3.989	-2.662

*t-statistic listed below coefficient values

First, notice that the sign on the diversification index coefficient, β_1, is negative which indicates that more diversified farms have higher farm production values. Next, it appears that younger farmers are able to achieve higher farm production values (we can of course speculate as to causes here), and larger farms generate more production dollars (which makes intuitive sense given that Avg_VFP is revenue and not profit, so more acres should mean more production, meaning more revenue). Regarding the squared value of the farm size, although it is statistically significant it is not quite binding. Solving for the effect yields the result that farms above 25,000 acres begin to negatively impact revenue. It is important to note that farm size and value of farm production are moderately correlated (correlation coefficient of 0.61), and intuitively they should be. However, similar to the resilience index impact, it may be that very large farms find it difficult to extract full production values from all acres. Hence the variables were included in this specification. In terms of the time period dummy variables, compared to 2007, 1989 farm production values were lower and 2010 values were higher. Finally, farms in Southwest Kansas had statistically lower farm production values than farms in other regions of Kansas.

4. Conclusions

The purpose of this study was to empirically measure the impact of particular adaptive capability, diversification, on farm resilience. This was achieved by implementing an innovative system resilience approach utilizing the resilience triangle in combination with a large, unique, and detailed panel database of Kansas farms. In order to utilize the resilience triangle approach, methods from system resilience literature (Barroso, et al. 2015) were adapted and applied using farm level data on net farm income. From these efforts, resilience index values were computed for more than 1400 farms during three distinct shock periods. Additionally, a unique diversification index was also computed at the individual farm level that accounted for variation in crop selections across acres and across years.

The results indicated that after controlling for farm size and time period variations, there is indeed a positive relationship between diversification across crops and farm resilience. Moreover, although farm size is positively correlated with resilience, this relationship holds only to a certain level. Thus we find that farms limiting their acres to a specified level and implementing diversification techniques will be better able to encounter and recover from economic and ecological shocks. To strengthen the analysis, the relationship between revenue generation and diversification was also assessed. Indeed, the results mirrored those of the resilience analysis in that larger and more diversified farms were able to generate higher levels of revenue from production efforts.

The world is entering a time that is estimated to be tremendously more volatile for agricultural producers than ever before experienced. As a part of the effort to secure economic viability for farmers during the tumultuous years ahead, the concept of system resilience has emerged as a developing strategy in agricultural risk management options. Undeniably, full resilience is quite a lofty status for any system to attain, and until a crystal ball is discovered farmers could never fully prepare for every disturbance, predicted or unpredicted. Understanding this ultimate constraint, resilience research is less concerned with getting systems to a state of *perfect* resilience, and more interested in understanding how systems adapt over time to develop resilience capabilities. Producers, policy makers, and researchers will nonetheless benefit from the results of this research when making decisions concerning how agricultural systems can adapt and remain viable through the uncertain times ahead.

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