Transition Probability Approach in the Evaluation of Relative Financial Strength and Endurance of Farm Service Borrowers under Recessionary Conditions

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Abstract

This paper examines the relative financial strength and endurance of several paired classes of farmers according to business maturity (beginning versus mature farm businesses), farm operators' age and experience (young versus older, more experienced farm operators), and farm size (small versus large farm businesses) by utilizing transition probability approach. Results show that the financial stress resulting from the late 2000s recession did not significantly influence the financial vitality of farms in general, regardless of the farm types. The financial strength of small farms, young farm operators, and beginning farms during the recessionary period remained at favorable levels, although their performances were lower to their counterparts.

Keywords: credit risk migration, recession, macroeconomic variables, agricultural lending, credit scoring, cohort method, transition probability

JEL codes: Q10, Q14

BACKGROUND

Small farms have been a vital part of the agricultural sector in the United States. Small farms, per se, constitute 92 percent of the total number of the farms in 2013. Beginning farms, on the other hand, have been the focus of government assistance efforts as there is a declining rate of business start-ups in the farm sector in recent years. The survival and growth of such farms is an important priority for the farm sector that confronts the prospect of accelerated aging of farm operators and the increasing consolidation of farm businesses.

One explanation of small farms' steady growth and eventual increase in more recent years is the change in the preference of consumers in favor of fresh quality goods (Low and Vogel, 2011). It has been observed that the organic farming alternative is popular among smaller farms, especially those operated by full-time farmers. Consumers consider organic foods as healthier, fresher, and produced sustainably on small farms (O'Donoghue, 2011), that increases demand for organic products.

The economic climate in recent years is also a contributing factor to the steady growth of smaller farms. As there is high volatility in the prices of agricultural inputs and farm products, farmers are more cautious when they consider expansion plans for their farms.

While the portion of small farms has increased in more recent years, the proportion of the beginning farms to total farms in the U.S. has been decreasing for the past decades. According to the Farm Service Agency, a farm can be considered as beginning if it has been in the business for 10 years or below. Based on the Census of Agriculture from 1997 to 2002, 30 percent of principal operators had less than 10 years of experience farming in 1997; by 2012, only 22 percent had such experience which translates to 469,098 farms. In addition, beginning farms account for only a minimal portion of total production of the agricultural sector. In 2012,

beginning farms constitute only 6.7 percent of the total agriculture production, which was expected as beginning farms normally hold fewer assets vis-à-vis the more established farms (Williamson, 2014). The average size of a beginning farm is smaller compared with mature farms. In 2013, the average size of a beginning farm is 135 acres, while the size of a mature farm is 436 acres. Beginning farms account for only about 6 percent of the total farmland acres operated. This is attributed to the fact that established farms usually obtain their land from relatives or by inheritance. The declining number of farm business start-ups has been an issue in the sector and support for the sector has been a priority of the government in recent years.

It has also been observed that the share of young operators is getting smaller. The average age of the principal operators has increased by 2 percent between 2007 and 2012. Among the principal operators, only 6 percent of the operators are 35 years old and below in 2012, down from 16 percent in 1982.

The downward trend in the number of young farmers reflects farm consolidation, the presence of multiple generations of operators on some farms, and the capital-intensive nature of farming. For example, land prices and startup capital requirements can make it difficult for beginning farmers to purchase or rent land (O'Donoghue, 2011). In addition, the equipment being used by farms can last more than a decade. That lowers operational costs over time and could encourage old farmers to work longer on their farms. The increased proportion of old farmers is also associated with improved health technology that enables farmers to work in their farm businesses for a longer period of time (Mishra et al., 2005).

The increasing number of old farmers becomes a growing concern in the farm sector as the future of agriculture is considered. In 2012, only 33 percent of U.S. farmers were at least 65 years old. The impending retirement of these older farm operators from the sector and the small number of

younger farmers are among the government's concerns about the sector. Even though this is the trend in the agricultural sector, Hoppe and Banker (2010) argued that this is not as bad as it appears to be. Older operators' output only comprises 2 percent of the U.S. total farm output. In addition, most of the land owned by older operators are enrolled in land retirement programs or being rented out. Furthermore, some large farms with older operators are multiple-generation farms, with at least 20 years separating the oldest and youngest operators (O'Donoghue, 2011).

Access to credit is one of the factors that enable these farm businesses to take advantage of growth opportunities. Without credit, a business may opt to stay in their current level production, or worse, decide to opt out of the sector because of financial constraint. These credit issues will result to widespread declines in production and employment (Nash, 2011).

Even though smaller businesses usually borrow small amounts of money from lending institutions, these farms have higher rates of failure compared to larger businesses and are usually susceptible to business shocks (Nash, 2011). In addition, lending institutions usually employ the same scoring model regardless of the business sizes of their farm borrowers. This is a disadvantage to small farms given that they have extrinsic characteristics that the scoring model cannot take into account. For example, some institutions do not consider assigning some premium to farmers' soil enhancement investments that organic farms are practicing.

Young beginning farmers also pose greater risks to lending institution because of their usual lower farm equity infusions and the fewer assets they maintain compared with old mature farms. The lack of assets of these farms is a hindrance to meet loan requirements. Even when the loan has approved, lending institutions set higher collateral requirements to secure the loan. This is considered as one of the barriers to entry to agricultural land-ownership, as this scenario leads to higher fixed costs and cash outlays for young and beginning farmers trying to purchase land. As such, high level of land ownership is not considered a feasible model for young beginning farmers (Kauffman, 2013).

Debt is also not evenly distributed among farm operators. The share of farmers using debt is inversely related to both operator age and years on the farm (Harris, 2009). Operators that use their farm businesses as their primary source of income mostly use loans to fund and operate their businesses. Nearly three of every five farm operators who used debt used only one lender and incurred one loan to finance their business. Loans are heavily concentrated among three lender groups-- commercial banks, the Farm Credit System (FCS), and Farm Service Agency (FSA) & individuals. Commercial banks and the Farm Credit System accounted 45 and 36 percent, respectively, of the total agricultural loans in 2007. The share of farm debt of these two financial entities has been increasing while the share of loans extended by the FSA has declined in previous years. For the entire U.S. farm sector (which accounts for all stakeholders engaged in farming), these lenders accounted for 92 percent of debt owed in 2007. The other sources of loans are insurance companies and captive finance companies.

The financial crisis in 2008 affected the agricultural credit markets. Prices of agricultural products fell by 26 percent from 2008 to 2009. This led to lower farm incomes that created cash flow difficulties for some agricultural institutions, causing loan repayment rates to fall. The economic condition and regulatory concerns during this period made lenders impose stringent standards by raising collateral requirements. This resulted in falling incomes that drove down the repayment rates during the recession (Kauffman, 2013).

Even though the overall credit markets have been affected by the late 2000s recession, the agricultural credit markets were in better shape compared to the overall bank situation. Ellinger and Sherick (2010) associate this with the structural characteristics of farm businesses. Most agricultural banks did not put money in structured securities that lost considerable value. Agricultural institutions did not heavily lend money to the real estate industry, which was a major industry affected by the recession. In addition, a study by Li, Escalante, Epperson, and Gunter (2013) shows that during the

recessionary period, delinquency rates on agricultural loans were lower compared with the overall delinquency rates in the banking industry, which confirms the relatively stronger financial health of agricultural lenders.

There are several studies that focus on how changes in economic conditions affect the credit scores of farms. The analyses of agricultural loan credit rating movement have not been fully explored yet in literature compared to the extensive applications made on bond transactions. Most of these studies were employed using state-level agricultural data that tend to have shorter duration and many risk-rating systems were relatively new. These risk-rating systems may not represent differences in credit qualities, with the tendency of producing high concentrations of ratings in a specific class of institution (Brady, English, and Nelson, 2008).

The transition probability approach has been employed for most research about this topic in the sector. In the study by Barry, Escalante, and Ellinger (2002), farm-level data from Illinois were used to estimate migration rates for a farmer's credit score and other performance measures under different time-averaging approaches. The credit scoring model used in that study was obtained from a joint statistical and experiential model developed from a workshop of farm lenders in the MidWest and summarized in Splett et al. (1994). Transition rates for credit scores, return on investment (ROE), and repayment capacity were derived. The results suggest greater stability in migration ratings for longer time-averaging periods, although less stable than bond migrations, and for the credit score criterion versus ROE and repayment capacity.

Research by Phillips and Kachova (2004) focused on credit score migration rates of farm businesses, testing whether migration probabilities differ across business cycles. The analysis utilized farm-level data for 1985-2002 from the Illinois Farm Business Farm Management Association. The results suggest that agricultural credit ratings are more likely to improve during expansions and deteriorate during recessions. The analysis also tests whether agricultural credit ratings depend on the

previous period migration trends. The findings show that credit score ratings exhibit trend reversal where upgrades (downgrades) are more likely to be followed by downgrades (upgrades).

The study of Deng, Escalante, Barry, Yu (2007) introduces the application of two Markov chain time approaches, both time-homogeneous and non-homogeneous models, for analyzing farm credit risk migration as alternatives to the traditional discrete-time (cohort) method. The Markov chain models are found to produce more accurate, reliable transition probability rates using the 3x1 migration measurement method used by farm lenders. They found that substantial mean differences in singular value decomposition (SVD) are produced between farm credit risk migration matrices developed under the cohort and Markov chain models than when similar comparisons are made in corporate finance literature using bond ratings migration.

This research will examine the relative financial strength and endurance of several classes of farmers paired according to business maturity (beginning versus mature farm businesses), farm operators' age/experience (young versus older, more experienced farm operators), and farm size (small versus large farm businesses). This study's time period (2005 to 2012) will allow for the comparative analyses of changes in the financial performance quality of these classes of farms before, during and after the 2008 recession. Using transition probability approach, this study will determine whether there are significant differences in migration rates for different types of farmers – from beginning and small farms, to mature and large farms – that translate to differences in credit quality and financial performance, especially during periods of economic shocks. From the lenders' viewpoint, the goal is to be able to determine whether specific classes of borrowers will require more attention in credit appraisal and loan monitoring. From the borrowers' perspective, this study will clarify the relative financial strength of those easily suspected as more vulnerable to economic adversities.

METHODOLOGY

Transition Probability Matrices

This study will employ transition probability approach to examine credit movements over two consecutive periods. Transition probability rates are calculated by tracking the changes or movements of credit ratings from one class to another.

Figure 1. Transition Probability Matrix

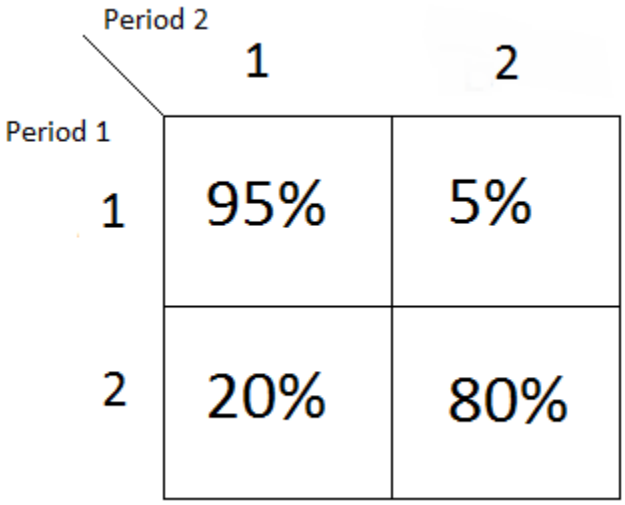

Figure 1 illustrates the derivation of transition probability. Migration rates will be measured using the historical movement of credit risk classifications of farm observations. The example in figure 1 illustrates several migration possibilities for the farms' credit risk classes. As figure 1 indicates, historical rates of movements among farms might indicate class one farms could remain in class one 95 percent of the time OR migrate to class two 5 percent of the time. Class two farms, on the other hand, could remain in class two 80 percent of the time and migrate to class one 20 percent of the time.

In this analysis transition probabilities will be estimated using annual credit scores from 2005 to 2012. An average one-period transition matrix (1x1) will be created on order to analyze the overall credit

score movements. The values along diagonals represent retention rate, while the off- diagonal values represent upgrades and downgrades in credit score classification.

The data will also be split in order to compare farms by farm type and period. First, farms will be divided in terms of three criteria – by farm size (small versus large), by business maturity (beginning versus mature), and by operator's age (young versus old). These categories will be useful in understanding comparative changes in credit quality among pairs of farm types.

Transition matrices will also be developed for each type farms for every period. Migration matrices will be created for pre-recession period (2005 – 2007), during the recession (2008 – 2009), and post-recession (2010 – 2012). With this, analysis on how migration rates are conditioned by economic conditions for each farm type will be employed.

Comparing Matrices

There are several ways to compare matrices to determine whether there is any significant difference between them. In this paper, L^1 distance metrics will be utilized to compare transition matrices as demonstrated by Jafry and Schuermann (2003).

L^1 distance metrics is a simple but effective way to compare distance between two matrices. Specifically, this metric is being computed as:

$$M_{L1} = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}\left|P_{A,i,j} - P_{B,i,j}\right|}{N^2} \qquad (1)$$

where P_A and P_B denote matrices being compared with *N x N* dimensions, where the average absolute difference between corresponding elements of the matrices are being computed. Using this metric, matrices that represent credit movements for different periods will be compared. This will also be employed to compare matrices of farm types based on farm size, business maturity, and operator's age,

for each period and for the whole time span of this study. Lastly, transition matrices of different farm type farms for a certain period will be compared to other periods. This way, distance metrics can be used to compare how large each farm's migration behavior in a specific period differs to others.

Data Sources and Variable Specifications

This analysis will use data from the Farm Service Agency (FSA) compiled for its borrowers from 2005 to 2012. The FSA data set was collected as part of the loan covenants with borrowers that require the provision of periodic financial reports to monitor the borrowers' business and financial progress until their loan obligations have been paid. This study's data set covers a national scope of farm level data on financial characteristics and past borrowing records of existing FSA clients. The analysis only includes farms that consistently maintained records over the 8-year period, which results in a sample size of 1,432 farms originating from all states (except Hawaii, Alaska, and Washington DC).

This study will extend the credit-scoring model and classification intervals used by Splett, et al. (1994) for 5 credit class classification classes to a 10-class rating model, with the intervals redefined between the lowest and highest possible ratings, to see if additional volatility in the transition probability ratings will be obtained. The 10-class rating class boundaries are based on the original five-class rating model where, for example, class 1 in the latter model was broken down into classes 1 and 2 of the ten-class rating model. The same trend applies to the subsequent classes in the rating models.

RESULTS

Transition Matrices by Period

Credit scores of 1,432 farms have been divided to three economic periods or episodes (pre-recession, recession, and post-recession) in order to compare credit score movements of these farms for each period. Table 1 shows credits score movement for these each economic period.

Table 1. Average One-Period Transition Matrices of Periods (Pre-Recession, Recession, Post Recession) for Credit Scores, Ten Credit Classes, (Percent)

	Period 2 Classes									
Period 1 Classes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pre-Recession										
1	19.64	7.14	3.57	12.50	19.64	26.79	7.14	3.57	0.00	0.00
2	11.54	7.69	11.54	17.31	21.15	11.54	11.54	3.85	3.85	0.00
3	4.76	7.14	15.48	19.05	23.81	19.05	5.95	2.38	2.38	0.00
4	0.99	3.45	5.91	18.23	22.17	20.69	16.26	7.88	2.46	1.97
5	0.62	1.25	4.37	10.19	30.77	21.62	17.67	8.52	3.74	1.25
6	0.18	0.88	2.46	7.04	16.55	32.04	23.77	12.15	3.17	1.76
7	0.00	0.16	1.28	3.67	8.31	22.20	37.22	22.52	2.24	2.40
8	0.00	0.19	0.96	2.68	10.15	12.84	19.92	40.04	9.39	3.83
9	0.53	0.00	0.53	3.17	5.82	11.11	15.34	25.93	29.10	8.47
10	0.00	0.00	0.00	0.00	7.23	12.05	13.25	28.92	19.28	19.28
Recession										
1	35.29	11.76	5.88	5.88	29.41	5.88	5.88	0.00	0.00	0.00
2	5.26	28.95	15.79	18.42	10.53	15.79	0.00	2.63	0.00	2.63
3	1.72	1.72	24.14	20.69	13.79	17.24	13.79	6.90	0.00	0.00
4	2.16	2.16	10.07	18.71	20.86	15.11	12.95	14.39	1.44	2.16
5	0.38	2.66	5.70	13.31	30.42	18.25	14.45	11.03	2.28	1.52
6	0.00	1.59	2.23	7.01	16.56	34.39	16.88	15.29	2.55	3.50
7	0.00	1.82	1.45	3.27	14.55	19.64	36.73	17.82	2.91	1.82
8	0.00	0.84	1.26	4.18	8.37	14.64	18.83	37.66	9.21	5.02
9	0.00	0.00	1.49	2.99	5.97	8.96	14.93	31.34	22.39	11.94
10	0.00	0.00	0.00	13.64	4.55	9.09	13.64	40.91	9.09	9.09
Post Recession										
1	44.23	19.23	3.85	11.54	15.38	3.85	1.92	0.00	0.00	0.00
2	18.18	28.28	10.10	14.14	17.17	8.08	1.01	3.03	0.00	0.00
3	7.98	19.02	32.52	14.11	11.04	8.59	5.52	0.61	0.61	0.00
4	3.00	6.01	14.16	26.18	22.32	14.59	9.44	3.43	0.43	0.43
5	0.93	5.22	7.09	11.94	33.77	18.66	11.38	8.02	1.87	1.12
6	0.53	3.54	6.02	5.66	21.24	35.93	16.46	7.26	2.12	1.24
7	0.37	1.12	2.99	4.48	13.99	24.25	33.96	14.55	3.17	1.12
8	0.00	1.97	1.75	3.73	9.43	18.42	21.49	33.77	6.80	2.63
9	0.00	0.00	2.68	2.68	9.40	10.07	10.07	23.49	34.23	7.38
10	0.00	0.00	0.00	4.00	12.00	12.00	18.67	17.33	16.00	20.00

During the pre-recession, the highest retention rate has been observed in class 8 borrowers, which reports 40.04 percent class retention rate. This is also the case with the recession period, where class 8 also has the highest retention rate of 37.66 percent. Unlike the pre-recession, the recession period, has shown high retention rates for high classes. In the post-recession period, meanwhile, class 1 has the highest retention rate of 44.23 percent. It has also been observed that the retention rates for higher classes are even higher compared to recession. This is an indication that overall, farms have improved after the recessionary period. This is in line with the results of Philips and Kachova (2004) study that observed improved financial status of farms after recession.

Table 2. Summary Transition Rates by Period

	Pre-Recession	**Recession**	**Post-Recession**
Migration Trends: Year-to-Year			
Upgrade	32.19	32.05	39.07
Retention	31.70	31.63	33.21
Downgrade	36.10	36.31	27.72

Comparing the total transitions for each period (Table 2), pre-recession and recession periods have almost the same percentage of migration movements. Downgrades are the highest for pre-recession and recession, which translate to 36.10 percent and 36.31 percent, respectively. This is followed by upgrades that account for 32.19 percent and 32.05 percent for pre-recession and recession. The results for these two periods suggest farms' resiliency during recession as the economic change has minimal effect in their credit score.

In the post-recession period, upgrades account for the highest percentage (39.07 percent) of movements during the period. Upgrades were followed by retentions that account for 33.21 percent, and then downgrade, which tallies 27.72 percent. Both upgrades and retentions are higher, while portion of downgrades is lower, when these migration trends are compared to the two previous periods. The higher

percentage of upgrades during this period represents better financial capacity of farms in general after recession.

Table 3. L^1 Distance metrics Between Periods

	L^1
Comparing Periods	
Pre-recession and recession	0.034
Pre-recession and post-recession	0.039
Recession and post-recession	0.036

Table 3 shows that the differences between transition matrices between the three periods are small. The L^1 for the difference between the pre-recession and recession is 0.034, while the L^1 between pre-recession and post-recession is 0.039. The distance metric for recession and post-recession and post-recession meanwhile is 0.036.

Transition Matrices by Farm Type

Farms were also classified into different farm types. To compare the relative financial strength and endurance of several paired classes of farmers, tables have been made according to farm operators' age/experience (young versus older, more experienced farm operators), business maturity (beginning versus mature farm businesses), and farm size (small versus large farm businesses).

Young versus Old Farm Operators

Young farm operators have the highest retention rate in class 8, which translates to 36.81 percent. The retention rate for these operators ranges from 36.81 percent to 18.56 percent. Older farm operators, meanwhile, have the highest retention rate of 50.00 percent for class 1 borrowers. There is a relatively higher retention rates between classes 4 and 8, which would an implication of what kind of farm the

agency caters. Old farmers' transition matrix, however, observed of having no value for some cells that would indicate less disperse credit score these farmer being categorized.

Table 4. Average One-Period Transition Matrices of Young and Old Farms for Credit Scores, Ten Credit Classes, 2005-2012 (Percent)

	Period 2 Classes									
Period 1 Classes	1	2	3	4	5	6	7	8	9	10
Young										
1	32.12	11.68	5.84	11.68	16.79	15.33	5.11	1.46	0.00	0.00
2	12.61	25.23	12.61	13.51	17.12	10.36	4.50	3.15	0.45	0.45
3	6.05	11.59	24.69	17.88	15.11	13.85	6.55	3.02	1.26	0.00
4	1.79	3.85	9.62	21.28	24.87	17.31	11.79	7.18	1.28	1.03
5	0.89	2.66	5.92	12.08	32.45	19.78	13.97	8.47	2.55	1.24
6	0.30	1.93	3.70	6.80	18.21	33.89	19.08	11.87	2.54	1.67
7	0.25	0.85	1.86	4.42	12.61	21.95	35.86	17.83	2.81	1.56
8	0.00	0.76	1.16	3.90	10.25	14.21	20.85	36.81	8.39	3.67
9	0.19	0.38	1.35	2.69	7.12	10.58	13.27	26.54	28.85	9.04
10	0.00	0.38	0.00	2.27	10.61	12.88	13.26	25.38	16.67	18.56
Old										
1	50.00	25.00	8.33	0.00	16.67	0.00	0.00	0.00	0.00	0.00
2	31.25	18.75	12.50	18.75	0.00	12.50	0.00	0.00	6.25	0.00
3	5.26	10.53	15.79	15.79	21.05	21.05	5.26	5.26	0.00	0.00
4	12.50	9.38	9.38	28.13	15.63	9.38	15.63	0.00	0.00	0.00
5	0.00	7.02	5.26	17.54	33.33	21.05	8.77	3.51	1.75	1.75
6	0.00	2.74	6.85	4.11	19.18	31.51	17.81	10.96	6.85	0.00
7	0.00	1.82	3.64	1.82	12.73	30.91	29.09	18.18	1.82	0.00
8	0.00	0.00	2.44	12.20	4.88	34.15	14.63	21.95	7.32	2.44
9	0.00	0.00	4.17	4.17	8.33	20.83	12.50	16.67	29.17	4.17
10	0.00	0.00	0.00	0.00	0.00	0.00	14.29	28.57	28.57	28.57

Table 5. Summary Transition Rates of Young and Old Farms, 2005-2012

	Young	Old
Migration Trends: Year-to-Year		
Upgrade	35.53	40.48
Retention	32.26	28.87
Downgrade	32.22	30.65

Comparing these two farm classes within the time line of the study, older farm operators are in a better credit position relative to younger farm operators. Upgrades account for 40.48 percent, while downgrades share 30.65 percent for old farm operators. Young farm operators have upgrades of 35.53 percent of total class transition compared to downgrades that have 32.22 percent. This means that regardless of the period, old farm operators are in better position in getting loans, which would reflect their financial stability and probable risk aversion (Patrick, Whitaker, and Blake, 1980).

Table 6. L^1 Distance metrics Between Farm Types

	L^1
Comparing Farm Types	
Young and old farm operators	0.043
Beginning and mature farms	0.022
Small and large farms	0.032

Looking at L^1 distance metrics (Table 6), difference between the young and old farm operators is 0.043, which is the higher value obtained among the three paired comparisons. One possible explanation for this is the concentration of old farm operators on only few credit classes in the scope of the study.

Beginning versus Mature Farms

Table 7 shows the transition rates of beginning and mature farms. The retention rates of beginning farms range from a high of 38.07 percent for class 7 borrowers to a low of 20.60 percent for class 4 borrowers. Retention rates of mature farms, on the other hand, range from 37.65 percent for class 1 borrowers to a low of 14.77 percent for class 10 borrowers. Looking at the retention rate for each farm class for these farm types, mature farms have a higher rate for higher classes compared to the beginning farms. Transition matrix for mature farms behaves quite similarly with the results of the studies by Barry, Escalante, and Ellinger (2002) and Escalante, Barry, Park, and Demir (2004).

Table 7. Average One-Period Transition Matrices of Beginning and Mature Farms for Credit Scores, Ten Credit Classes, 2005-2012 (Percent)

	Period 2 Classes									
Period 1 Classes	1	2	3	4	5	6	7	8	9	10
Beginning Farms										
1	28.13	4.69	6.25	7.81	23.44	20.31	9.38	0.00	0.00	0.00
2	17.24	27.59	10.34	5.17	17.24	8.62	6.90	6.90	0.00	0.00
3	4.96	11.57	22.31	17.36	17.36	13.22	5.79	4.96	2.48	0.00
4	1.87	3.00	7.49	20.60	22.10	19.48	12.73	10.11	0.75	1.87
5	0.88	1.94	4.42	10.95	32.86	21.38	14.13	9.54	2.83	1.06
6	0.29	1.29	3.86	7.43	16.57	35.29	19.29	11.71	3.14	1.14
7	0.28	0.28	1.52	4.28	12.97	21.52	38.07	16.97	2.90	1.24
8	0.00	0.52	0.86	2.94	10.02	15.37	23.32	35.06	8.98	2.94
9	0.00	0.00	0.00	2.81	8.99	9.55	12.92	24.72	30.34	10.67
10	0.00	0.00	0.00	2.11	6.32	14.74	10.53	25.26	14.74	26.32
Mature Farms										
1	37.65	18.82	5.88	12.94	11.76	9.41	1.18	2.35	0.00	0.00
2	12.78	23.89	13.33	16.67	15.56	11.11	3.33	1.67	1.11	0.56
3	6.44	11.53	25.08	17.97	14.58	14.58	6.78	2.37	0.68	0.00
4	2.39	4.59	10.64	22.02	25.69	15.78	11.56	5.32	1.47	0.55
5	0.85	3.22	6.61	12.88	32.29	19.07	13.64	7.71	2.37	1.36
6	0.30	2.31	3.79	6.32	19.12	33.04	18.90	11.90	2.46	1.86
7	0.23	1.21	2.12	4.39	12.41	22.56	34.37	18.32	2.73	1.67
8	0.00	0.85	1.36	4.66	10.18	14.33	19.42	37.15	8.06	3.99
9	0.27	0.55	2.19	2.73	6.28	11.75	13.39	26.78	28.14	7.92
10	0.00	0.57	0.00	2.27	12.50	11.36	14.77	25.57	18.18	14.77

Table 8. Summary Transition Rates of Beginning and Mature Farms, 2005-2012

	Beginning	Mature
Migration Trends: Year-to-Year		
Upgrade	34.30	36.40
Retention	33.02	31.70
Downgrade	32.69	31.90

Examining Table 8, results show that beginning farms fare well during the scope of the study. Both beginning and mature farms have highest average transitions in upgrades that translate to 34.30 percent and 36.40 percent, respectively. Downgrades comprise the lowest for two classes of farms, which translates 32.69 percent and 31.90 percent for young and mature farms, respectively. Meanwhile, L^1 distance metrics between these two types of farm is 0.22, which is lower than the distance metrics between young and old farm operators (Table 6).

Small versus Large Farms

Looking at Table 9, the average retention rates for small farms range from 36.78 percent for class 7 borrowers to a low of 19.37 percent for class 10 borrowers. The retention rate for class 1 borrowers is relatively high, tallying 34.48 percent. For large farms, the average retention rates range from 37.14 percent for class 8 borrowers to a low of 16.33 percent for class 10 borrowers.

As both types has lowest retention rates in class 10 borrowers, this translates that for both small and large farms, majority of class 10 borrowers tend to increase their credit score for the succeeding year and few farms tend to stay in that class. The peculiar results from large farm transition matrix are that none of these farms got class 1 classification. This would be associated with the kind of sample for this type.

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Table 9. Average One-Period Transition Matrices of Small and Large Farms for Credit Scores, Ten Credit Classes, 2005-2012 (Percent)

	Period 2 Classes									
Period 1 Classes	1	2	3	4	5	6	7	8	9	10
Small Farms										
1	34.48	12.41	5.52	10.34	16.55	14.48	4.83	1.38	0.00	0.00
2	14.00	25.50	13.00	11.50	16.00	11.00	4.00	3.50	1.00	0.50
3	6.85	11.61	23.21	18.45	14.58	13.99	6.85	3.27	1.19	0.00
4	2.70	3.97	9.22	22.89	24.17	16.38	11.92	6.68	1.43	0.64
5	1.01	3.18	6.60	11.72	31.21	20.89	13.59	8.15	2.56	1.09
6	0.31	1.95	3.97	6.35	16.97	35.16	18.80	12.03	2.87	1.59
7	0.30	0.91	1.64	4.38	11.81	22.78	36.78	17.05	2.86	1.46
8	0.00	0.66	1.17	4.01	9.25	14.64	21.12	36.27	9.25	3.64
9	0.21	0.42	1.27	2.54	6.14	11.65	12.71	25.21	29.87	9.96
10	0.00	0.45	0.00	2.25	9.01	11.26	13.51	25.23	18.92	19.37
Large Farms										
1	0.00	25.00	25.00	25.00	25.00	0.00	0.00	0.00	0.00	0.00
2	13.16	21.05	10.53	26.32	15.79	7.89	5.26	0.00	0.00	0.00
3	2.50	11.25	28.75	15.00	18.75	15.00	5.00	2.50	1.25	0.00
4	0.55	4.37	10.93	16.94	25.68	19.13	12.02	7.65	0.55	2.19
5	0.44	1.75	3.93	13.76	36.03	16.81	14.41	8.73	2.40	1.75
6	0.25	1.97	3.20	8.13	23.40	28.33	19.95	11.08	1.97	1.72
7	0.00	0.74	2.97	4.21	15.84	19.80	31.19	21.04	2.48	1.73
8	0.00	1.04	1.30	4.42	13.25	14.81	19.22	37.14	5.19	3.64
9	0.00	0.00	2.78	4.17	13.89	6.94	16.67	31.94	22.22	1.39
10	0.00	0.00	0.00	2.04	16.33	18.37	12.24	26.53	8.16	16.33

Table 10. Summary Transition Rates of Small and Large Farms, 2005-2012

	Small	Large
Migration Trends: Year-to-Year		
Upgrade	35.39	36.84
Retention	32.56	30.54
Downgrade	32.05	32.61

Comparing the migration trends of these two farm classes, large farms have higher rate of upgrades compared to small farms, tallying 36.84 percent compared to 35.39 percent. Looking at the retention and downgrade migration trends, meanwhile, small farms showed higher values, registering 32.56 percent and 32.05 percent, respectively. This would be the case as large farms have significantly higher upgrade rates that lower the proportion of two other migration trends, which is positive for this type of farm.

Looking at L^1 distance metrics (Table 6), the difference between small and large farms is 0.032, a figure that is in between the two other paired classes.

Transition Rates of Each Farm Type for Each Period

Table 11. Summary Transition Rates of Paired Classes of Farmers for Each Period

Young versus Old Farm Operators						
	Upgrade		**Retention**		**Downgrade**	
	Young	Old	Young	Old	Young	Old
Pre-Recession	31.86	41.67	31.97	23.96	36.16	34.38
Recession	31.79	39.58	31.79	27.08	36.42	33.33
Post-Recession	39.16	36.46	33.09	36.46	27.75	27.08
Beginning versus Mature Farms						
	Beginning	Mature	Beginning	Mature	Beginning	Mature
Pre-Recession	30.58	33.00	31.32	31.90	38.10	35.10
Recession	30.27	32.95	32.78	31.06	36.95	35.99
Post-Recession	38.94	39.14	34.03	32.79	27.04	28.07
Small versus Large Farms						
	Small	Large	Small	Large	Small	Large
Pre-Recession	32.60	30.64	31.81	31.31	35.59	38.05
Recession	32.07	31.99	31.72	31.31	36.21	36.70
Post-Recession	38.06	42.93	34.19	29.46	27.75	27.61

This section will examine whether there are significant differences in migration rates for different types of farms that translate to differences in credit quality especially during periods of economic shocks.

Table 11 shows how average migration rates for each type of farm have been affected by different economic periods.

Looking at the young and old farm operators, results suggest that young operators were quick to recover from economic recession. Old farm operators, meanwhile, were relatively stable during on this period. During pre-recession, old farm operators had higher percentage of upgrades of 41.67 percent, compared with 31.86 percent of young farm operators. Also in this period, 31.97 percent of total transitions of young farm operators were retentions, compared with average retention rates of old farms of 23.96 percent.

During the recession period, the percentage of each migration trends for young operators was almost the same with pre-recession. There were only a decrease for upgrades and retentions of 0.07 percent and 0.18 percent, respectively and increase for downgrades of 0.26 percent. This only shows flexibility of these farms during weak economy. After the recession, young farm operators showed improvement as it increased it upgrade percentage to 39.16 percent, which is way higher compared to its upgrade rates during recession. Curiously, upgrade percentage of old farm operators is lower during post-recession, tallying 36.46 percent, which would be the effect of the increased percentage of retention to 36.46 percent, which translates to 9.38 percent difference with the retention rates during recession.

Looking at L^1 distance metrics (Table 12) of these two farms for different periods, recession tallied the highest distance, registering 0.105. Pre-recession and post-recession periods, meanwhile, show lower L^1, tallying 0.087 and 0.067, respectively. One possible explanation of these values is the higher activity or credit movements of these farms during recession period.

Table 12. L^1 Distance metrics of Paired Farm Types for Each Period

Farm Types for Each Period	
	L^1
Pre-Recession	
Young and old farm operators	0.087
Beginning and mature farms	0.036
Small and large farms	0.055
Recession	
Young and old farm operators	0.105
Beginning and mature farms	0.054
Small and large farms	0.081
Post-Recession	
Young and old farm operators	0.067
Beginning and mature farms	0.037
Small and large farms	0.047

Comparing the beginning and mature farms, results imply that beginning farms managed to survive the recession, while mature farms also show resiliency during the time period. During the recession period, 36.95 percent of total transitions were downgrades for beginning farms, but it decreased to 27.04 percent during the post-recession period. Upgrades for beginning farms, meanwhile, had increased from 30.27 percent during the recession period to 38.94 percent during the post-recession period. Mature farms, on the other hand, also increased the portion of upgrades from 32.95 percent during recession to 39.14 percent during post-recession. Retention rates had almost the same portion during three periods for mature farms, as it only range from 31.90 percent to 32.79 percent.

L^1 distance metrics between beginning and mature farms show that the recession period had the highest distance of 0.054. These two farms' L^1 for pre-recession and post-recession are pretty much the same, recording 0.036 and 0.037, respectively. Results behave the same with young and old farm operators have.

Results from small and large farms suggest that these types adapt well to changing economic environment. Many of these farm classes upgraded their class ratings after recession. Upgrades of large farms comprised 42.93 percent of total transition during post-recession compared to 31.99 percent during recession. Small farms, meanwhile had 38.06 percent, which is 5.99 percent higher compared to upgrades during recession.

Retention rates were also stable during economic recession. Large farms retained the 31.31 percent retention rate during recession, but decreased its rate to 29.46 percent during post-recession. Small farms only decrease by 0.09 percent from 31.81 percent during pre-recession to 31.72 percent during recession. Retention rates for small farms had further increased during post-recession to 34.19 percent. The results suggest that small farms were a bit more stable throughout the three periods, although more large farms have better credit scores after recession.

Same with the results of the other two paired classes, recession period also tallies the highest L^1 distance metrics between small and large farms. Distance between small and large from during this period is 0.081, compared to 0.055 during pre-recession and to 0.047 of post-recession.

CONCLUSIONS

The results show that the late 2000s recession has minimal effect on farms in terms of credit rating movement, regardless of farm type. This is in line with the previous studies that show farms had relatively better financial health during economic shocks. All of the farms showed better credit scores after the recession, which shows resiliency of farm sector in general.

While the farm sector shows resiliency during the economic recession, there's no wonder that sector was affected by the changing economic conditions as reflected by higher distance metrics of each farm type during recession compared to other periods. This means that in general, there was high level of credit movements compared to pre- and post – recessionary period. As such the government should consider the nature and magnitude of their support for the sector especially for beginning small young farms in order for them to withstand volatile, more challenging economic conditions.

The results suggest that financial strength of small farms, young farm operators, and beginning farms during the recessionary period remained at favorable level. Although their counterpart classes were in better credit classes during and post-recession period, these farms show resiliency with a higher upgrade rate, and better or almost the same retention rates for the higher classes. This suggests that lenders should still cater to these kinds of farms during recession as they can still manage to withstand changing economic conditions.

Further studies can focus on the uniqueness of migration rates for agricultural loans for farm borrower from different regional affiliations. Employing different credit migration approach for each farm type can also be done in order to test what approach is the best indicator of farm loan portfolio quality.

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APPENDIX A

Credit Scoring Classification Intervals (Source: Splett et al.)

Variables (Measures/Classes	Interval Ranges	Weights
LIQUIDITY (Current Ratio)		
Class 1	> 2.00	
Class 2	1.60-2.00	
Class 3	1.25-1.60	
Class 4	1.00-1.25	
Class 5	< 1.00	___x 0.10 =____
SOLVENCY (Equity-Asset Ratio)		
Class 1	> 0.80	
Class 2	0.70-0.80	
Class 3	0.60-0.70	
Class 4	0.50-0.60	
Class 5	< 0.50	___x 0.35 =____
PROFITABILITY (Farm Return on Equity)		
Class 1	> 0.10	
Class 2	0.06-0.10	
Class 3	0.04-0.06	
Class 4	0.01-0.04	
Class 5	< 0.01	___x 0.10 =____
REPAYMENT CAPACITY (Capital Debt-Repayment Margin Ratio)[a]		
Class 1	> 0.75	
Class 2	0.50-0.75	
Class 3	0.25-0.50	
Class 4	0.05-0.25	
Class 5	< 0.05	___x 0.35 =____
FINANCIAL EFFICIENCY (Net Farm Income from Operations Ratio)		
Class 1	> 0.40	
Class 2	0.30-0.40	
Class 3	0.20-0.30	
Class 4	0.10-0.20	
Class 5	< 0.10	___x 0.10 =____
	Total Score (Numeric)	

[a] Term debt coverage ratios were used to measure repayment capacity in this study.

APPENDIX B

Ten Credit Classes [a]

Credit Score Classes	Interval Ranges
Class 1	1.00 - 1.40
Class 2	1.41 - 1.80
Class 3	1.81 - 2.25
Class 4	2.26 - 2.70
Class 5	2.71 - 3.15
Class 6	3.16 - 3.60
Class 7	3.61 - 4.05
Class 8	4.06 - 4.50
Class 9	4.51 - 4.75
Class 10	4.76 - 5.00

[a] The ten credit classes were derived from the original five credit classes defined by Splett, et al. (1994) where class 1 in the latter classification was split into classes 1 and 2 of the new ten-class approach, and so forth.