A Credit Migration Analysis of the Financial Vitality of Female and Racial Minority Borrowers of the Farm Service Agency under Recessionary Conditions

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ABSTRACT

This paper compares the credit migration transition of female and racial minority farmers of the Farm Service Agency's lending program using both time-discrete method and time-homogeneous Markov chain method. The estimated results indicates that racial and gender minority farms have higher financial vulnerability.

Keywords: Farm Loan, Credit Migration, Transition matrix, Markov chain, Cohort method, Time homogeneous

INTRODUCTION

- USDA's Farm Service Agency (FSA) is considered as a lender of last resort since it makes direct loans to those farmers who are unable to obtain credit from regular commercial lenders.
- FSA's loan program is even more crucial for farmers during economic downturns. During the recent economic recession from 2007 to 2009, farmers claimed that it has been harder for them to obtain loans and that they have faced unique credit and debt burdens[1].
- This study is designed to analyze the credit migration transition rates of racial and gender minority farmers that are existing FSA borrowers.
- The major contention of this study is that economic shocks, such as a recession, can affect different gender and different racial minority farmer groups differently given the inherent differences in structural attributes, infrastructural support, resource endowments, and varying levels of opportunities and access to sources of assistance and resources that may be results of longitudinal, historical events that created such inequities.

[1] National survey of farm credit counselors and farm advocacy organizations: http://www.farmaid.org/atf/cf/%7B6ef41923-f003-4e0f-a4a6-ae0031db12fb%7D/FARMER_CREDIT_REPORT-MARCH_2011.PDF

DATA

This study utilizes the Farm Business Plan data from the FSA national office spanning from year 2004 to year 2013. The FSA normally calculates a credit score when a farm applies for a new loan, receives the proceeds of the approved loan, or receives servicing action. In this analysis, the credit risk classification variable [2] from FSA's Borrower Account Classification System will be used as levels for credit scores (Table 1):

Table 1. Farm Credit Classification

Total Overall Score	Classification	Classification Category
1 to 1.59	1	Commercial
1.6 to 2.19	2	Standard
2.2 to 2.79	3	Acceptable
2.8 to 4	4	Marginal

Source: FSA Handbook, General Program Administration, 1-FLP

A fifth category (NR) is added to capture observations that have been dropped from the dataset before the end of the sample time period. These loan accounts may have been fully settled or re-classified as delinquent loan accounts.

[2] Classification score= weighted current ratio score + weighted debt to asset ratio score + weighted return on assets ratio score + weighted term debt and capital lease coverage ratio (TDCLC) score

METHODOLOGY

Credit risk migration analyzes the likelihood that a borrower will remain in the same risk rating category from one period to the next. These migration rates are used to project the credit quality of lenders' loan portfolios according to class upgrades versus downgrades, and derive estimates of probability of loan default or stress rates.

Major rating companies such as Moody's and Standard and Poor's use discrete time (cohort) approach (Lando and Skodeberg, 2002; Schuermann and Jafry, 2003):

$$P_{ij}^{\Delta t} = \frac{N_{ij}}{N_i}$$

where N_{ij} farms has migrated from rating category i to j, over a specific time horizon Δt, given N_i farms that belong to rating category i at the start of the time horizon.

However, this discrete approach ignores any rating change within sub-periods of a give time frame and focuses only on migration observed at the beginning and the end of a time period, therefore, reduces its reliability in consistently producing accurate and efficient rates of migration rates.

First introduced by Lando and Skodeberg (2002) and supported by other literatures (Schuermann and Jafry, 2003; Deng et al, 2003), a Markov Chain time-homogeneous model was proposed to address the deficiency of cohort method.

Consider a K-state Markov chain where state 1 is the highest rating category and state K is the default rate. Following Lando and Skodeberg (2002), we collect the transition probabilities of the Markov chain for a given time horizon through a K×K matrix $P(t)$ whose $ijth$'s element is the probability of migrating from state i to state j in a time period of t. This continuous-time chain generator matrix Λ can be present as a K×K matrix for which:

$$P(t) = \exp(\Lambda t) \cong \sum_{k=0}^{\infty} \frac{\Lambda^k t^k}{k!}, \quad t \geq 0.$$

where Λt is the matrix Λ multiplied by t on every entry and the exponential function is a matrix exponential. Hence, one can obtain the maximum likelihood estimators of the transition probability matrices by obtaining the maximum likelihood estimator of this generator first and then applying the matrix exponential function on this estimate, scaled by time horizon. The entries of the generator Λ satisfy:

$$\lambda_{ij} \geq 0 \quad for \quad i \neq j$$

$$\lambda_{ii} = -\sum_{i \neq j} \lambda_{ij}$$

which guarantees that sum of the rows of the matrix is equal to one. The parameter λ_i is defined as the probabilistic behavior of the holding time in state i ,where $\lambda_i = -\lambda_{ii}$, and the probability of jumping from state i to j given a jumping occurs is defined by λ_{ij}/λ_i .

To estimate the generator matrix Λ we need to obtain the estimates of its entries. The maximum likelihood estimator of λ_{ij} is given by:

$$\lambda_{ij} = \frac{N_{ij}(T)}{\int_0^T Y_i(s)\,ds}$$

where $N_{ij}(T)$ is the total number of transitions over the period from i to j, and $Y_i(s)$ is the number of farms assigned credit category i at time s.

The interpretation of this equation is: numerator counts the number of observed transition from i to j over the entire period of observation, and the denominator effectively collects all observations assigned with category i over period T. Thus, any period spent in a particular rating class will be picked up in the denominator.

RESULTS

Table 2. Summary Matrices for Female Farmers Under the Cohort Method and Markov Chain Method, 2004-2013 (percent)

Period 1	Period 2 Farm Credit Risk Classes				
Farm Credit Risk Classes	1	2	3	4	NR
Time Discrete Cohort Method					
1	17.42†	13.33	9.89	3.87	55.48
2	8.58	17.95	15.40	7.95	50.11
3	3.72	11.25	24.67	12.52	47.83
4	3.15	9.24	16.88	21.64	49.09
NR	4.69	9.95	11.26	7.14	66.96
Time-Homogeneous Markov Chain Method					
1	17.97	11.96	13.13	7.63	49.31
2	5.63	25.76	13.66	8.06	46.89
3	4.04	10.54	30.69	9.50	45.23
4	4.15	9.67	13.94	26.22	46.01
NR	5.53	12.21	15.14	9.66	57.46

† The matrices are derived based on biannual transition, which means instead of using one-year horizon in any two-year period, we used a two-year horizon.

Table 3. Summary Matrices for Male Farmers Under the Cohort Method and Markov Chain Method, 2004-2013 (percent)

Period 1	Period 2 Farm Credit Risk Classes				
Farm Credit Risk Classes	1	2	3	4	NR
Time Discrete Cohort Method					
1	23.97	16.03	10.29	3.79	45.91
2	11.56	25.03	15.83	7.35	40.24
3	6.14	16.14	25.29	11.03	41.39
4	3.87	12.63	18.92	20.44	44.13
NR	5.65	11.94	12.68	6.83	62.91
Time-Homogeneous Markov Chain Method					
1	25.27	14.46	13.11	6.61	40.55
2	8.02	30.84	14.22	7.56	39.37
3	6.50	13.66	31.74	8.58	39.52
4	5.92	12.59	14.57	26.85	40.06
NR	7.68	15.50	16.38	9.26	51.18

Table 4. Summary Matrices for White Farmers Under the Cohort Method and Markov Chain Method, 2004-2013 (percent)

Period 1	Period 2 Farm Credit Risk Classes				
Farm Credit Risk Classes	1	2	3	4	NR
Time Discrete Cohort Method					
1	23.79	15.67	10.05	3.71	46.77
2	11.77	24.56	15.76	7.22	40.69
3	6.22	16.13	24.80	10.91	41.94
4	4.01	12.71	18.80	20.11	44.37
NR	5.75	11.95	12.39	6.69	63.22
Time-Homogeneous Markov Chain Method					
1	25.39	14.29	12.87	6.46	41.00
2	8.13	30.90	13.96	7.36	39.64
3	6.60	13.64	31.64	8.36	39.76
4	6.04	12.59	14.43	26.71	40.23
NR	7.83	15.51	16.10	9.06	51.50

Table 5. Summary Matrices for Racial Minority Farmers[a] Under the Cohort Method and Markov Chain Method, 2004-2013 (percent)

Period 1	Period 2 Farm Credit Risk Classes				
Farm Credit Risk Classes	1	2	3	4	NR
Time Discrete Cohort Method					
1	18.11	14.33	10.24	5.35	51.97
2	6.27	21.35	13.88	9.41	49.10
3	3.00	10.65	25.68	12.68	47.99
4	2.37	7.26	15.79	22.26	52.33
NR	4.34	10.05	12.33	7.23	66.06
Time-Homogeneous Markov Chain Method					
1	17.39	12.02	13.56	8.68	48.35
2	4.84	24.28	14.25	9.71	46.92
3	3.60	10.30	30.05	10.36	45.68
4	3.70	9.20	13.87	26.30	46.93
NR	4.89	11.89	15.82	10.29	57.11

[a] Racial Minority Farms include African American, Asian/Pacific Islander, American Indian, and Hispanic

RESULTS

- Consistent with the findings of previous empirical studies on credit migration (Lando and Skodeberg, 2002; Deng et al, 2003), the cohort method tends to produce lower, seemingly underestimated rates of migration, especially among migrations to and from the extreme credit classes (from the top rating category to the lowest rating category, excluding the exit category, NR). This trend is reflected in the matrices developed for all four gender and race categories of farm borrowers (Table 2 - 5).
- Disregarding the NR class, the transition probabilities (migration rates) calculated for male farm borrowers seem to dominate those estimated for female farm borrowers, especially in terms of retentions (diagonal terms) and upgrades (rates below the diagonal terms). This is especially true when the time homogeneous estimates (Markov chain) are considered.
- Comparing the time homogeneous (Markov chain) migration matrices of white and non-white farm borrowers for all ratings except the NR rating, the white borrowers' matrix reflect higher retention rates while the non-white borrowers' matrix tend to have higher downgrade (rates above the diagonal terms).

CONCLUSION

The transition probability estimates establish that among the gender and racial classes of FSA loan clientele, female and non-white farm borrowers tend to display a greater need for financial assistance given their higher financial vulnerability (as may be reflected by higher rates of credit downgrade).

These classes of borrowers are accommodated under the lending program for Socially Disadvantaged farmers that ensure that these classes of farmers are allocated some funds even if their financial conditions may be less competitive in their respective borrower categories.

(Source: oneworld365.org)

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