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Credit Risk Migration Analysis of Illinois Farm Business: Possible Impacts of Farm Business Cycle

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This study uses the cohort approach to estimate the credit risk migration probability of farm business. Using data from the Farm Business and Farm Management, this study rates the credit risk into 10 risk levels plus a default level, defines a farm business cycle with peak, normal and trough periods and evaluates the effect on farm financial performance of the farm business booms and slumps. The results show that the farms with low credit risk are more likely to stay in the same risk level but the farms with high credit risk have the trend to improve their risk situation and move upwards. The results also show that the credit risk ratings are more likely to move upgrade during farm business cycle peaks.

Key words: credit risk, risk rating, farm business cycle, credit migration, credit score.

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Introduction

Credit risk migration analysis is the analysis of the changing of credit risk ratings over time. It plays the central role of modern credit risk management which helps us understand the overall portfolio quality, capital attribution, credit derivatives. There are several studies about the effects of business cycles and macroeconomic conditions on bond ratings. Nickell, Perraudin, and Varotto (2000) find that the investment grade bonds' volatility falls sharply in business cycle peak years and rises in troughs. Bangia et al. (2002) find that the contraction eigenvalue is substantially smaller than the expansion eigenvalue, which indicates a much faster decay of credit quality during contractions. Lando and Skodeberg (2002) point out that the duration in a given risk state and the direction of the migration have significant effect on migration intensity.

Credit migration analysis is a relatively new concept in the farm business. Barry, Escalante and Ellinger (2002) introduce credit risk migration probabilities matrices into farm business and identify the determining factors of farm credit risk rating. Escalante et al. (2004) claim that the macroeconomic factors have dominant effects on farm credit migration. Phillips and Katchova (2004) find that farm business exhibit a higher tendency to downgrade than upgrade during recessions and tend to upgrade than downgrade during expansions.

Based on previous agricultural finance studies this study derives annual farm credit risk migration probabilities by calculating the credit scores over time. To minimize the capital standards posted by New Basel Accord the evaluation of credit risk needs to be more precise. This study classifies the farm credit risk into 10 risk levels plus a default category, in which the debt is greater than the assets of a farm. To capture the specific farm related business cycle influence, a farm business cycle is defined and the results are compared with the macro-economy business cycle results. In order to define the farm business cycle, state level farm gross product is used as the farm business cycle indicator.

The outline of the paper is as follows. In the next section we describe the approach to rate farm credit risk and calculate credit score and extend the classification of risk levels into 10 levels. Then we introduce the cohort method to estimate the credit risk migration probabilities. After we define the farm business cycle, data and tests are illustrated. We present the empirical results and the comparisons in the following section. In the end we provide some concluding remarks and discussion of future research extension.

Farm credit risk rating

The market value of the lenders' portfolio is not observable and hence the credit risk is hard to be measured directly. The rating of credit quality is a common approach to link value change to risk assessment and management. The rating criterion can be single financial indicator, such as ROE etc. It can also be a composite index, such as credit score. Credit score modeling provide a more comprehensive evaluation of creditworthiness than a single indicator measurement. The objective criteria of score calculating are solvency, liquidity, repayment capacity, earnings and management. Splett et al. (1994) create a uniform credit-scoring model based on the set of financial ratios from the Farm Financial Standards Council. We follow the same measurement and use the same pre-determined weights for different criteria.

$$\begin{aligned} score \;&= 10\% \; liquidity + 35\% \, solvency + 10\% \; profitability + \\ &35\% \, repayment \; capacity + 10\% \; financial \; efficiency \end{aligned}$$

The measure for liquidity is the current ratio. The measure for solvency is the equity-asset ratio. The measure for profitability is the farm return on equity. The measure for repayment capacity is the capital debt-repayment margin ratio. The measure of financial efficiency is the net farm income from operations ratio. Scores are calculated by the above equation and assigned into credit risk levels using pre-determined interval ranges. In this study 10 risk levels are generated providing more detailed, accurate, reliable estimates. The comparison between 10 risk levels and 5 risk levels will be conducted in the following section. Level 1 is the lowest risk level and level 10 is the highest risk level. We also define a default category as the absorbing state where the obligator stops moving any more. The default category contains the farms with higher debt than assets. Table 1 list the distribution of the risk levels. More than 70% of farms are in the low risk levels of 1 to 5 while only about 30% of farms are in the high risk levels of 6 to 10, which results in heavy concentration in the low risk levels. Only 0.45% of farms are in the default category, which is the level 11 in our table. We define a farm in the default status when the debt falls below the assets.

Farm credit score migration matrix

Credit migration matrices, which characterize the expected changes in credit quality of obligors, are important analytical tools to many applications, including portfolio risk assessment, modeling the term structure of credit risk premium, and pricing of credit derivatives. The matrix is created by the probability that a farm of a given risk rating level moves to some other rating level over a given period of time. Cohort method is the current standard method to estimate the probabilities. It takes a specific time period, for example 1 year as the observed migration period. Given n_i obligors being in the score level i in the beginning of the year there are n_{ij} obligors migrate to score level j at the end of the year. The probability of migration from i to j over 1 year is $P_{ij} = \frac{n_i}{n_{ij}}$.

Since we have 10 risk levels plus a default category the probabilities are collected in an 11×11 matrix.

$$P = \begin{bmatrix} p_{11} & p_{12} \cdots & p_{1,11} \\ p_{21} & p_{22} \cdots & p_{2,11} \\ \vdots & \vdots & \vdots \\ p_{11,1} & p_{11,2} \cdots & p_{11,11} \end{bmatrix}$$

As long as a farm enters the default category the farm stays there and cannot migrate to other risk levels. Table 2 is the unconditional migration probabilities matrix over one year using data from 1985 to 2003. For example the first row and first column number is 55.31%, which means the estimated probability of staying in risk level 1 for next year is 55.31% if the farm is rated in level 1 for this year. The first row and second column number is 30.39%, which means the estimated probability of migrating to lower level 2 for next year is 30.39% if the farm is rated in level 1 for this year. Therefore the upper triangular indicate the probabilities of downgrade migrations. The second row and first column number is 26.48%, which means the estimated probability of migrating to higher level 1 for next year is 26.48% if the farm is rated in level 2 for this year. Therefore the lower triangular indicate the probabilities of upgrade migrations. The values along the diagonals represent the retention rates. In other words retention rates are the probabilities that farms remain in the same risk level for the next time period.

Definition of farm business cycle

Bangia et al. (2002) define the business cycle based on the definitions reported monthly by the National Bureau of Economic Research (NBER) and suggest that the underlying macroeconomic volatility, or business cycle, is important for stress testing credit portfolio. Phillips and Katchova (2004) follow the NBER definition and find that the agricultural asset performance and valuation should account for macroeconomic conditions and business cycles in addition to agricultural sector conditions. Their tests show that the year-to-year credit migration rates are different depending on national business cycles. Nickell et al. (2000) compare annual GDP across countries to the average to define the business cycle and find that the business cycle dimension is the most important in explaining variation of the transition probabilities.

These previous studies all take macroeconomic volatility into the credit risk migration analysis by using economic data of national level. This study extends the analysis in two aspects. First we use Farm Product from Gross State Product as the farm business cycle indicator to measure the agriculture related economic volatility rather than general economy volatility. Second this study uses Illinois farm data and the farm business cycle is defined by ranking several states with the highest farm product. This state specific measurement characterizes the individual performance of farm business in different states. Therefore both industrial and regional characteristics are captured better in this study than the original macroeconomic business cycle definition.

Bierlen and Featherstone (1998) define the farm boom-bust cycle into three distinct periods: the 1976-1980 boom, the 1981-1986 bust, and the 1987-1992 recovery. Led by high commodity prices agriculture had higher level of production, sales, and cash flow during 1973 to 1980. In the early 1980s lower export demand and higher interest payments cause net farm income to plummet. Falling land prices and higher interest rates led to higher D/A ratio, debt depreciation, farm foreclosures and bank failures. After that higher commodity price and government payment led a recovery. Their study provides valuable comments and pictures overall agriculture developing in the history. But the conclusion is not precise enough and is too old for our data analysis. We borrow the idea from Nickell, Perraudin, and Varotto(2000) and apply it into farm business at state level.

To investigate the dependency of credit risk migration probabilities on the state of farm business cycle, we define peak, normal, and trough periods as follows. We rank all the states by Farm Product in current million dollars and then pick up the first 15 states with the highest Farm Product for each year. Among the 15 states we group the 1st to 5th states into "upper" group, the 6th to 10th states into "middle" group, and the 11th to 15th states into "lower" group. Illinois may rank in different groups every year depending on Illinois farm business performance. If it is in the upper group we allocate that year as a "peak" year. If it is in the middle group we allocate the corresponding year as a "normal" year. If it is in the lower group we allocate that year as a "trough" year. Table 3 list the farm product for the 15 states from 1985 to 2001. We classify 2002 and 2003 as the same status as 2001 due to possible lag effects. Compared with original NBER method we have three farm business cycles rather than expansion and recession.

Data and test

The annual farm level data from the Illinois Farm Business and Farm Management (FBFM) data set are employed in this study. We only employ the farms that maintained certified usable financial records, such as FMV balance sheet certification, EMA certification, Income statement certification under FBFM system for the recorded years.

The FBFM data set has two parts. One is the old data set from 1985 to 1994. The other is the new data set from 1995 to 2003. The main difference between the two data sets is that the new data set has record for each different individual operator within the same farm. The ideal goal in our data application is to merge the old and new data sets into a seamless time series covering 18 years span that include the farm crises of the 1980s together with more stable times thereafter. Such compilation can not only reflect a through-the-cycle scope but also allow disaggregation into respective eras as needed. In order to yield the complete 1985 to 2003 time series we first sort new data set by county, farm and year. Then we assign a new identification number to the farms with more than one operator thus consider each operator as new a farm. Therefore our sample size is increased by 3%. We assume different operators are different farming units and have significantly different features in their own farm business. Totally we have 29698 observations.

In order to test if the unconditional migration probabilities are significantly different from the conditional migration probabilities we follow the previous studies by Nickell, Perraudin, and Varotto(2000), Phillips and Katchova(2004). A cell by cell t-statistics is computed for each probability in the migration matrix. p_{ij}^{C} is the conditional probability and p_{ij} is the unconditional probability. The t score is calculated by using the difference between two probabilities divided by the standard error of the conditional probability. If the t test shows significance then the farm business cycles do have different impacts on the credit risk migration probabilities and the unconditional migration matrix is not an accurate measure.

$$se(p_{ij}^c) = \sqrt{\frac{p_{ij}^c(1-p_{ij}^c)}{n_i}}\text{, and}$$

$$t = \frac{p_{ij} - p_{ij}^c}{se(p_{ij}^c)}.$$

Empirical results

We have explained the meaning of the credit risk migration probabilities matrix in Section 3. The migration probabilities matrix using the full sample is exhibited in Table 2. First, the volatility of risk rating migration increases as the credit risk quality declines. Thus, for the level 1-rated farms the probability of staying at the same rating one year later is 55.31%. But for a level 10-rated farm the retention probability is only 19.51%. This increased volatility combined with the dropping number of observations reduces the precision with which the probabilities can be estimated in the lower credit risk quality levels. Second, there is heavy probability load on the diagonal which indicate that farms are most likely to maintain their current risk rating. The diagonal-dominance characteristics are true for the 6 lower risk levels. For higher risk levels farm's retention rates keep dropping from 14.04% to 9.47% and they are more likely to move upgrades.

For instance the level 7, 8, 9 and 10 farms have higher probabilities of moving up to level 6 than any other migrating probabilities.

Migration matrices can be estimated for any desired time period and estimates over short time periods best reflect the rating migration process. The shorter the time interval the less observations are omitted. This is why we choose one year as the measuring interval. However, only Table 2 itself cannot tell the changing trend of the whole matrix over the 18 years. We plot all the biannual matrices using non-overlapping periods in Figure 1. For the sake of plot clarity we simplify the 10 credit risk levels into 5 which combine 2 original levels into one level. It is obvious that the retention rates for the low risk high credit quality farm are always the highest. The probabilities of migrating from relatively high risk low credit quality category, such as level 4 or 5, to a better level, such as level 3, are quite higher than the other migrations. This shows that the farm obligators with low credit quality do have a trend to improve their credit quality and move upward. In each biannual matrix the migration probabilities have greater tendency to move one risk level away from the current risk level in both upgrade and downgrade directions. The tendency of moving more than one risk level from current risk level is lower.

Table 4 shows the migration matrices for each farm business cycle. We use asterisk mark to indicate the statistically significant difference between the conditional probabilities and the unconditional ones. About 25% of the probability entries in peak and about 19% of the probability entries in trough are significantly different from those in Table 2. The probabilities in normal cycle period are in fact very similar to those unconditional ones.

Table 5 shows the differences of migration probabilities between the conditional farm business cycle matrices and the unconditional matrices. For example, the first row and second column number in Table 5 is -14.83%, which means that the probability of downgrading from level 1 to level 2 during peak cycle is -14.83% lower than the unconditional probability. This is not the only case during peak cycle. As one may see, the upper triangular is almost composed by negative numbers while the lower triangular contains lots of positive numbers. We have mentioned before that the upper triangular is the downgrading part and the lower triangular is the upgrading part. Therefore the results suggest that farm business performs better, or the farm credit risk is more likely to improve, during the farm business peak cycle. Unlike the original 5 risk rating levels the trend of 10 rating levels during farm trough cycle is not that obvious. In troughs low-rated farms have less ratings volatility. Another interesting point is that the retention rate of the highest risk level 10 during peak cycle is 11.18% lower than the unconditional retention rate but it is 3.36% higher than the unconditional one during trough cycle. The probabilities of falling into default category mostly are zero during peak cycle but they increase significantly during troughs. Generally the results are intuitively convincing.

Summary and conclusions

The empirical results suggest that farm business credit risk tends to upgrade during farm business peak cycles. Low rated farm business has higher risk of retaining or deteriorating during farm business troughs. There exist strong linkage between deteriorating economic conditions and higher migration to default. This supports the claim that not only the macroeconomic conditions affect the financial performance of farm business but also the agricultural business cycle and the regional farm financial performance need to be taken into consideration.

Further studies involve the test of assumption of continuous model estimation. Some studies show that the Markov Chain property holds in credit risk migration matrix. Some studies prove it wrong. If we apply the continuous approach to estimate the migration probabilities into farm business we need to prove the assumptions are satisfied. Another interesting direction is to identify the information asymmetry between the obligator the creditor, and construct reduced model for credit risk analysis based on objective assessment rather than subjective judgment.

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Table 1. Descriptive Statistics for Specialized and Diversified Farms

Credit Risk Level	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Percentage %	15.21	18.11	13.52	13.55	13.25	12.58	5.70	3.55	1.76	2.34	0.45
Cumulative %	0	33.32	46.84	60.38	73.63	86.21	91.91	95.46	97.21	99.55	100.00

[a] The credit score weights and rating interval ranges are proposed by Cesar L. Escalante.
[b] Level 1 is the lowest risk level and level 10 is the highest risk level. Category 11 indicates the default category where debt falls below assets.

Table 2. Unconditional Migration Probabilities Matrix

Last Year	Current Year											*No. of Farms*
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	
1	55.31	30.39	7.95	2.87	1.81	1.26	0.24	0.07	0.03	0.03	0.03	2929
2	26.48	43.55	14.80	7.03	3.67	2.95	1.03	0.32	0.06	0.09	0.03	3486
3	8.61	22.21	27.81	18.21	10.14	7.65	3.53	0.92	0.58	0.31	0.04	2603
4	3.41	10.47	20.21	24.73	18.67	11.23	6.21	3.26	1.23	0.54	0.04	2608
5	1.92	5.29	11.33	18.35	25.56	19.25	7.13	6.19	2.47	2.35	0.16	2551
6	1.24	4.21	6.81	12.80	20.27	27.54	10.40	6.52	3.39	6.07	0.74	2422
7	0.46	3.56	7.93	14.13	19.05	21.88	14.04	8.20	4.74	5.56	0.46	1097
8	0.15	2.20	5.12	11.57	19.47	22.11	14.20	13.47	4.98	6.15	0.59	683
9	0.00	0.00	2.96	10.65	15.38	27.81	12.43	9.47	11.83	9.47	0.00	338
10	0.00	0.00	0.22	3.99	13.53	33.92	13.30	10.64	4.43	19.51	0.44	451
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	86

Notes: The numbers in the table indicate the probability of migrating from risk level i in the last year to risk level j in the current year, expressed in a percentage. The last column lists the total number of observed farms at each risk level.

Table 3. 15 States with Largest Farm Product (in current million dollars)

rank	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
1	8087	8142	9406	9410	10076	10986	9579	10662	11055	11983	11089	12567	13490	12477	12734	13138	12768
2	3806	3460	3850	3941	3940	5022	4955	5122	5568	5522	4996	5587	5631	5024	5843	5770	5516
3	3673	3301	3386	3714	3870	3890	3815	4102	3621	4238	3425	4762	5122	3864	3789	3851	3623
4	**3300**	3071	3090	2495	3744	3537	3359	3855	3067	3588	3243	4248	3766	3494	2573	3366	3596
5	3016	2793	2851	2444	3384	3412	3115	3404	2656	3480	3197	**3860**	3756	2915	2456	2886	2831
6	2971	2740	2678	2233	**3303**	3328	2964	**3123**	**2565**	**3478**	2570	3821	**3458**	2823	2454	2607	2590
7	2662	**2599**	**2156**	2202	2948	**3104**	2731	2997	2444	3205	2322	3747	3234	2780	2343	2325	2560
8	2541	2105	2036	2022	2940	2773	2360	2709	2187	2739	2320	3726	2788	**2630**	2336	2277	2428
9	1970	1881	1776	1779	2322	2759	**2337**	2544	2122	2665	2303	2954	2746	2587	2217	2103	2407
10	1961	1756	1766	1690	2077	2307	2070	2384	2012	2477	2106	2852	2604	2498	2184	**2081**	2184
11	1946	1673	1763	1643	1960	2116	1962	2338	1886	2337	**2099**	2709	2589	2481	1914	2071	**2123**
12	1919	1668	1645	**1620**	1938	1914	1941	2093	1834	2316	1986	2642	2535	2258	1872	2005	2106
13	1890	1619	1605	1612	1915	1906	1738	2020	1743	2070	1892	2547	2367	2079	1836	1983	1799
14	1724	1608	1597	1595	1844	1886	1618	1984	1705	2064	1804	2243	2228	2000	**1721**	1779	1789
15	1713	1569	1518	1530	1806	1849	1582	1969	1673	1848	1569	2230	2173	1788	1604	1662	1775

[a] The underlined numbers are the farm products of Illinois.
[b] Farm Business Cycle Peak: 1985, 1996.
Farm Business Cycle Normal: 1986, 1987, 1989-1994, 1997, 1998, 2000.
Farm Business Cycle Trough: 1988, 1995, 1999, 2001.
[c] Data are from the Gross State Product Statistics of regional economic accounts (Bureau of Economic Analysis).

Table 4. Conditional Migration Probabilities Matrix of Farm Business Cycle

Last Year	*Current Year*											*No. of Farms*
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	
Peak												
1	78.52*	15.56*	4.07*	0.74*	0.74*	0.37*	0.00	0.00	0.00	0.00	0.00	270
2	42.04*	35.67*	14.01	3.82*	2.55	1.27	0.64	0.00	0.00	0.00	0.00	157
3	14.05*	27.03	24.32	16.76	8.65	7.03	2.16	0.00	0.00	0.00	0.00	185
4	4.17	11.81	22.92	31.25	15.97	9.72	1.39*	2.78	0.00	0.00	0.00	144
5	5.30	8.33	13.64	22.73	28.03	10.61*	6.06	3.03*	0.00	1.52	0.76	132
6	1.65	0.83*	7.44	20.66*	24.79	28.93	6.61	5.79	0.83*	1.65*	0.83	121
7	1.56	6.25	9.38	20.31	12.50	32.81	10.94	4.69	0.00	1.56*	0.00	64
8	0.00	2.27	4.55	22.73	13.64	18.18	9.09	18.18	4.55	6.82	0.00	44
9	0.00	0.00	0.00	0.00	30.00	30.00	30.00	0.00	0.00	10.00	0.00	10
10	0.00	0.00	0.00	0.00	16.67	33.33	41.67*	0.00	0.00	8.33	0.00	12
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	2
Normal												
1	53.35	30.98	8.46	3.45	2.10	1.15	0.35	0.05	0.05	0.05	0.00	1998
2	24.88	42.49	15.75	7.67	4.09	3.27	1.32	0.32	0.09	0.14	0.00	2203
3	7.07*	21.96	28.23	18.55	10.67	7.32	4.09	1.12	0.62	0.31	0.06	1612
4	3.58	9.96	19.85	23.50	19.73	11.78	5.83	3.52	1.46	0.73	0.06	1647
5	1.89	4.47	10.02	18.27	27.22	19.66	6.55	6.18	2.90	2.71	0.13	1587
6	1.49	3.54	7.07	12.52	20.65	27.72	11.10	6.01	2.62	6.44	0.85	1414
7	0.16	4.23	6.57	14.71	18.47	22.85	13.15	9.08	4.85	5.63	0.31	639
8	0.00	2.96	5.91	11.58	19.21	23.15	11.58	12.56	4.68	7.39	0.99	406
9	0.00	0.00	4.43	9.85	13.30	31.53	11.82	9.85	10.84	8.37	0.00	203
10	0.00	0.00	0.00	5.18	15.94	37.05	11.16	10.36	2.79	17.53	0.00	251
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	66
Trough												
1	51.74*	34.64*	8.02	1.97	1.36	1.97	0.00	0.15	0.00	0.00	0.15	661
2	27.44	46.71	13.06	6.22	3.02	2.58	0.53	0.36	0.00	0.00	0.09	1126
3	10.42	21.59*	27.79	17.87	9.43	8.44*	2.73	0.74	0.62	0.37	0.00	806
4	2.94	11.26	20.44*	26.07	17.01	10.40	7.83*	2.82	0.98	0.24	0.00	817
5	1.44*	6.37	13.46	17.79	22.00*	19.83	8.41*	6.73	2.04	1.80	0.12	832
6	0.79*	5.75	6.31	12.18	19.05*	27.06	9.81	7.44*	4.96	6.09	0.56	887
7	0.76	2.03*	9.90	12.18	21.07	18.53	15.99	7.36	5.33	6.09	0.76	394
8	0.43	0.86*	3.86*	9.44*	21.03	21.03	19.74*	14.16	5.58	3.86	0.00	233
9	0.00	0.00	0.80	12.80	17.60	21.60	12.00	9.60	14.40	11.20	0.00	125
10	0.00	0.00	0.53	2.66	10.11*	29.79	14.36	11.70	6.91	22.87	1.06	188
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	18

Notes: An asterisk * denotes significance at 5% confidence level of a two tailed t-test. The last columns list the number of observed farms at each risk level during different farm business cycles.

Table 5. Migration Probabilities Difference between Unconditional Matrix and Conditional Matrix of Farm Business Cycle

Last Year	*Current Year*										
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Peak											
1	(23.21)	-14.83	-3.88	-2.13	-1.07	-0.89	-0.24	-0.07	-0.03	-0.03	-0.03
2	(15.56)	-7.88	-0.79	-3.21	-1.12	-1.68	-0.40	-0.32	-0.06	-0.09	-0.03
3	(5.45)	(4.82)	-3.49	-1.45	-1.49	-0.62	-1.37	-0.92	-0.58	-0.31	-0.04
4	(0.75)	(1.34)	(2.71)	(6.52)	-2.70	-1.51	-4.82	-0.48	-1.23	-0.54	-0.04
5	(3.38)	(3.04)	(2.31)	(4.38)	(2.47)	-8.64	-1.07	-3.16	-2.47	-0.84	(0.60)
6	(0.41)	-3.38	(0.63)	(7.86)	(4.52)	(1.39)	-3.79	-0.74	-2.56	-4.42	(0.08)
7	(1.11)	(2.69)	(1.44)	(6.18)	-6.55	(10.93)	-3.10	-3.52	-4.74	-4.00	-0.46
8	-0.15	(0.08)	-0.58	(11.16)	-5.84	-3.93	-5.11	(4.71)	-0.43	(0.67)	-0.59
9	0.00	0.00	-2.96	-10.65	(14.62)	(2.19)	(17.57)	-9.47	-11.83	(0.53)	0.00
10	0.00	0.00	-0.22	-3.99	(3.14)	-0.59	(28.36)	-10.64	-4.43	-11.18	-0.44
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Normal											
1	-1.96	(0.60)	(0.50)	(0.59)	(0.29)	-0.11	(0.11)	-0.02	(0.02)	(0.02)	-0.03
2	-1.60	-1.06	(0.95)	(0.64)	(0.41)	(0.31)	(0.28)	0.00	(0.03)	(0.05)	-0.03
3	-1.53	-0.24	(0.41)	(0.34)	(0.53)	-0.32	(0.56)	(0.19)	(0.04)	0.00	(0.02)
4	(0.17)	-0.51	-0.35	-1.23	(1.06)	(0.54)	-0.38	(0.26)	(0.23)	(0.19)	(0.02)
5	-0.03	-0.82	-1.31	-0.07	(1.66)	(0.41)	-0.58	-0.02	(0.43)	(0.36)	-0.03
6	(0.25)	-0.68	(0.26)	-0.28	(0.38)	(0.18)	(0.70)	-0.51	-0.77	(0.37)	(0.11)
7	-0.30	(0.67)	-1.36	(0.58)	-0.59	(0.97)	-0.89	(0.87)	(0.11)	(0.07)	-0.14
8	-0.15	(0.76)	(0.79)	(0.01)	-0.26	(1.04)	-2.63	-0.91	-0.30	(1.24)	(0.40)
9	0.00	0.00	(1.47)	-0.80	-2.08	(3.72)	-0.60	(0.38)	-1.00	-1.09	0.00
10	0.00	0.00	-0.22	(1.19)	(2.41)	(3.13)	-2.15	-0.28	-1.65	-1.98	-0.44
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trough											
1	-3.57	(4.26)	(0.06)	-0.90	-0.45	(0.70)	-0.24	(0.08)	-0.03	-0.03	(0.12)
2	(0.96)	(3.17)	-1.75	-0.81	-0.65	-0.38	-0.50	(0.04)	-0.06	-0.09	(0.06)
3	(1.82)	-0.62	-0.02	-0.34	-0.71	(0.79)	-0.80	-0.18	(0.04)	(0.06)	-0.04
4	-0.48	(0.79)	(0.23)	(1.34)	-1.66	-0.83	(1.62)	-0.44	-0.25	-0.29	-0.04
5	-0.48	(1.08)	(2.13)	-0.56	-3.56	(0.58)	(1.28)	(0.54)	-0.43	-0.55	-0.04
6	-0.45	(1.54)	-0.50	-0.62	-1.22	-0.48	-0.60	(0.92)	(1.57)	(0.02)	-0.18
7	(0.31)	-1.52	1.97	-1.95	(2.01)	-3.35	(1.95)	-0.84	(0.59)	(0.53)	(0.31)
8	(0.28)	-1.34	-1.26	-2.12	(1.56)	-1.08	(5.54)	(0.69)	(0.60)	-2.29	-0.59
9	0.00	0.00	-2.16	(2.15)	(2.22)	-6.21	-0.43	(0.13)	(2.57)	(1.73)	0.00
10	0.00	0.00	(0.31)	-1.33	-3.42	-4.14	(1.06)	(1.06)	(2.48)	(3.36)	(0.62)
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

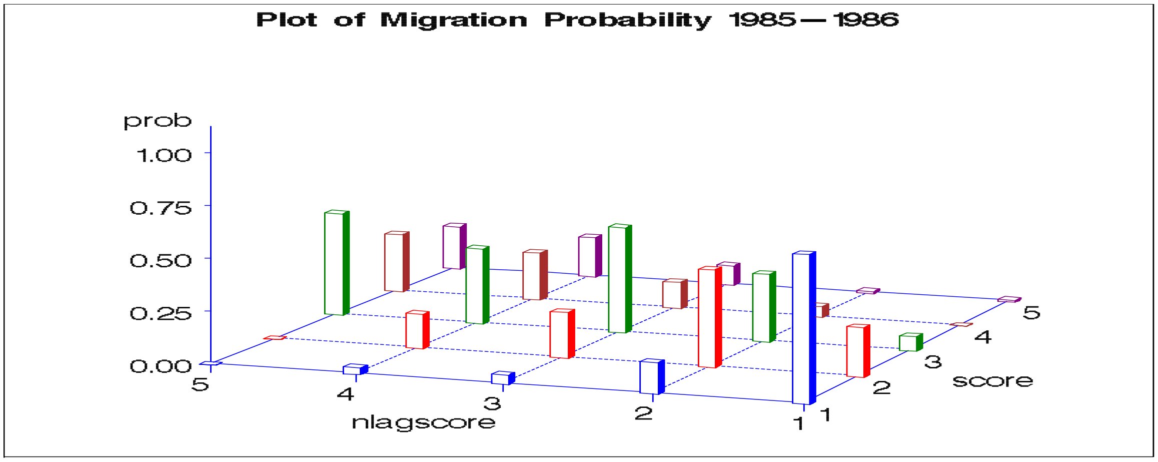
Notes: The numbers indicate the difference between unconditional migration probabilities and conditional migration probabilities during different farm business cycle. Positive numbers in parentheses means the conditional probability is larger than the unconditional one.

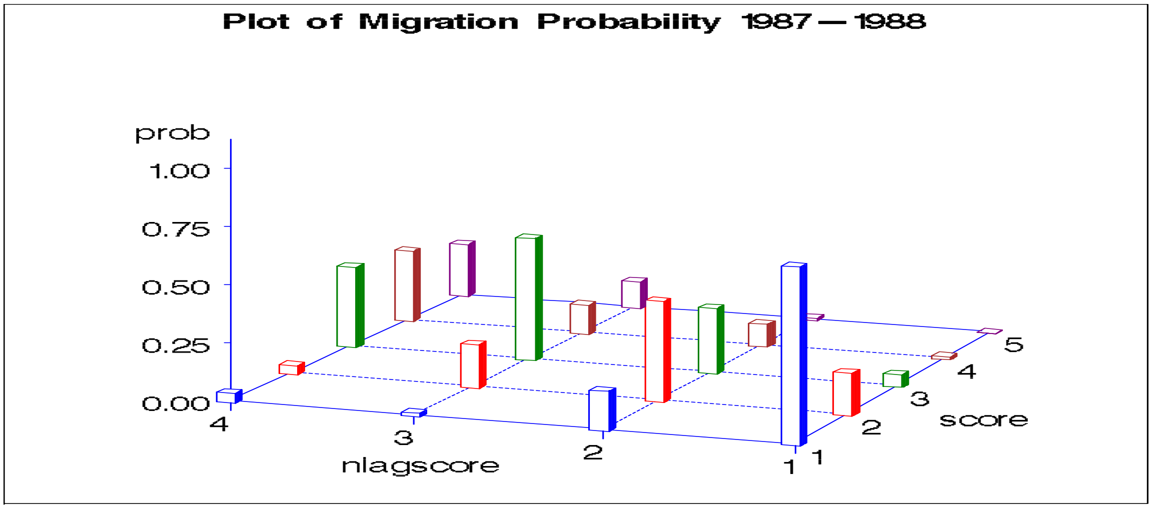
Table 6. Conditional Migration Probabilities Matrix of NBER Business Cycle and Migration Probabilities Difference between Unconditional Matrix and Conditional Matrix of NBER Business Cycle

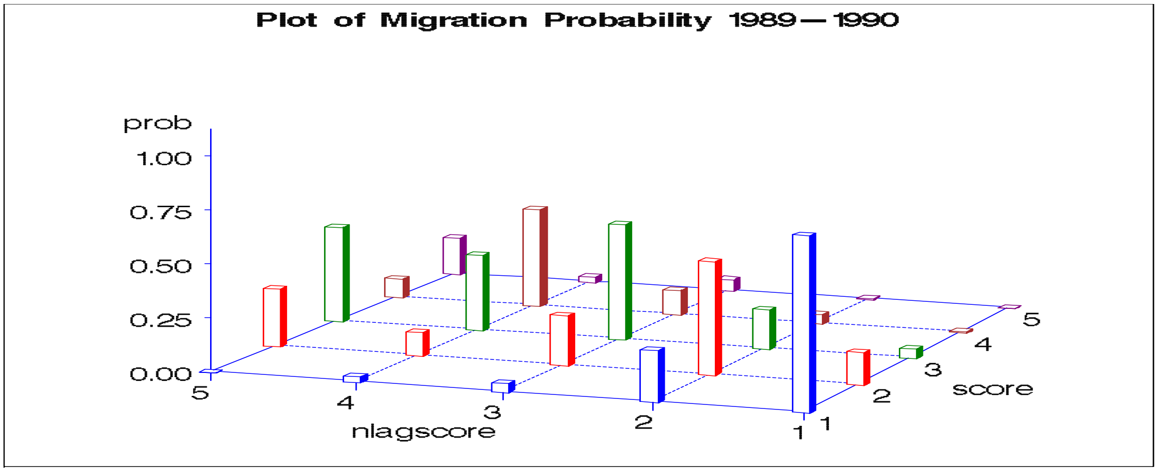
Last Year	*Current Year* 1	2	3	4	5	6	7	8	9	10	11	*No. of Farms*
Expansion												
1	57.47*	28.66	7.83	2.75	1.55	1.35	0.24	0.05	0.05	0.05	0.00	2069
	(2.16)	-1.72	-0.13	-0.11	-0.26	(0.09)	0.00	-0.02	(0.01)	(0.01)	-0.03	
2	29.54*	40.93*	14.83	7.01	3.35	2.84	0.95	0.34	0.09	0.13	0.00	2326
	(3.06)	-2.62	(0.03)	-0.02	-0.32	-0.12	-0.09	(0.03)	(0.03)	(0.04)	-0.03	
3	9.45	23.42	28.05	17.65	9.67	7.07	3.28	0.68	0.45	0.23	0.06	1768
	(0.84)	(1.21)	(0.24)	-0.56	-0.47	-0.57	-0.25	-0.24	-0.12	-0.08	(0.02)	
4	3.95	11.03	20.47	24.13	19.44	11.15	5.60	3.20	0.69*	0.34	0.00	1749
	(0.53)	(0.57)	(0.26)	-0.60	(0.77)	-0.09	-0.61	-0.06	-0.54	-0.19	-0.04	
5	1.94	5.28	12.20	19.59	26.16	18.06	6.39	5.22	2.70	2.29	0.18	1705
	(0.01)	-0.01	(0.87)	(1.24)	(0.60)	-1.18	-0.74	-0.97	(0.23)	-0.06	(0.02)	
6	1.59	4.59	7.52	13.32	20.84	25.69	10.20	6.69	3.06	5.61	0.89	1569
	(0.35)	(0.38)	(0.71)	(0.52)	(0.57)	-1.85	-0.21	(0.17)	-0.33	-0.46	(0.15)	
7	0.58	4.17	8.49	16.40	19.42	21.29	12.23	7.91	3.60	5.61	0.29	695
	(0.12)	(0.62)	(0.56)	(2.27)	(0.37)	-0.58	-1.81	-0.29	-1.14	(0.05)	-0.17	
8	0.23	3.24	6.71	11.81	17.82	22.92	13.66	12.04	3.94	6.94	0.69	432
	(0.09)	(1.04)	(1.59)	(0.24)	-1.65	(0.81)	-0.54	-1.43	-1.04	(0.80)	(0.11)	
9	0.00	0.00	5.13	12.82	15.90	29.74	12.82	5.64*	9.74	8.21	0.00	195
	0.00	0.00	(2.17)	(2.17)	(0.51)	(1.93)	(0.39)	-3.83	-2.09	-1.26	0.00	
10	0.00	0.00	0.39	5.02	17.76	35.14	15.44	11.58	3.86	10.04*	0.77	259
	0.00	0.00	(0.16)	(1.03)	(4.24)	(1.21)	(2.14)	(0.94)	-0.57	-9.47	(0.33)	
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	57
Recession	1	2	3	4	5	6	7	8	9	10	11	
1	47.14*	36.12*	8.76	3.59	2.79	1.20	0.27	0.13	0.00	0.00	0.00	753
	-8.16	(5.74)	(0.81)	(0.72)	(0.98)	-0.07	(0.03)	(0.06)	-0.03	-0.03	-0.03	
2	14.93*	49.02*	16.42	8.61	5.17*	3.90	1.49	0.34	0.00	0.00	0.11	871
	-11.55	(5.48)	(1.62)	(1.58)	(1.49)	(0.95)	(0.46)	(0.03)	-0.06	-0.09	(0.09)	
3	4.51*	16.17*	27.53	21.15	11.66	10.58*	4.98	1.87	1.09	0.47	0.00	643
	-4.10	-6.03	-0.29	(2.94)	(1.52)	(2.93)	(1.44)	(0.94)	(0.51)	(0.16)	-0.04	
4	1.51*	7.25*	16.16*	26.13	19.03	13.29	8.16	4.23	2.87*	1.21	0.15	662
	-1.90	-3.22	-4.04	(1.40)	(0.36)	(2.06)	(1.95)	(0.97)	(1.64)	(0.67)	(0.11)	
5	1.08*	3.71*	7.26*	14.37*	25.04	24.42*	9.89*	8.66*	2.47	3.09	0.00	647
	-0.84	-1.58	-4.06	-3.97	-0.52	(5.17)	(2.76)	(2.46)	0.00	(0.74)	-0.16	
6	0.17*	2.43*	5.55	10.05*	16.64*	34.84*	11.61	7.45	3.29	7.28	0.69	577
	-1.07	-1.79	-1.27	-2.75	-3.63	(7.30)	(1.21)	(0.93)	-0.09	(1.21)	-0.05	
7	0.35	2.12	3.89*	8.83*	16.25	24.73	18.37	9.54	8.48*	7.07	0.35	283
	-0.10	-1.44	-4.04	-5.30	-2.80	(2.86)	(4.34)	(1.34)	(3.74)	(1.51)	-0.10	
8	0.00	0.00	0.57*	9.14	19.43	20.57	16.57	17.71	9.14	6.29	0.57	175
	-0.15	-2.20	-4.55	-2.42	-0.04	-1.54	(2.37)	(4.24)	(4.16)	(0.14)	-0.01	
9	0.00	0.00	0.00	4.00*	10.00	27.00	11.00	16.00	18.00	14.00	0.00	100
	0.00	0.00	-2.96	-6.65	-5.38	-0.81	-1.43	(6.53)	(6.17)	(4.53)	0.00	
10	0.00	0.00	0.00	0.87*	2.61*	36.52	6.96*	6.09*	5.22	41.74*	0.00	115
	0.00	0.00	-0.22	-3.12	-10.92	(2.60)	-6.35	-4.56	(0.78)	(22.23)	-0.44	
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	21

Notes: An asterisk * denotes significance at 5% confidence level of a two tailed t-test. The last columns list the number of observed farms at each risk level during different farm business cycles.
[a] The first row of numbers of each risk level indicate the conditional migration probabilities. The second row of numbers of each risk level indicates the difference between unconditional migration probabilities and conditional migration probabilities during different farm business cycle.
[b] Positive numbers in parentheses means the conditional probability is larger than the unconditional one.

Figure 1. The 3-D Unconditional Migration Probabilities Matrix Plot over Time Trend






Plot of Migration Probability 1989—1990
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0.25
0.00
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4
3
2
1
nlagscore
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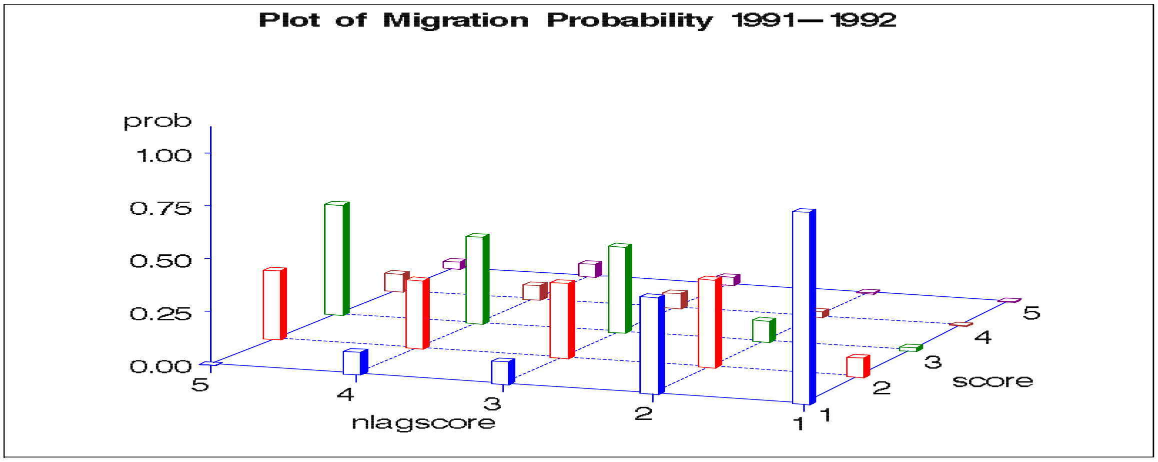
2
3
4
5
score


Plot of Migration Probability 1991—1992
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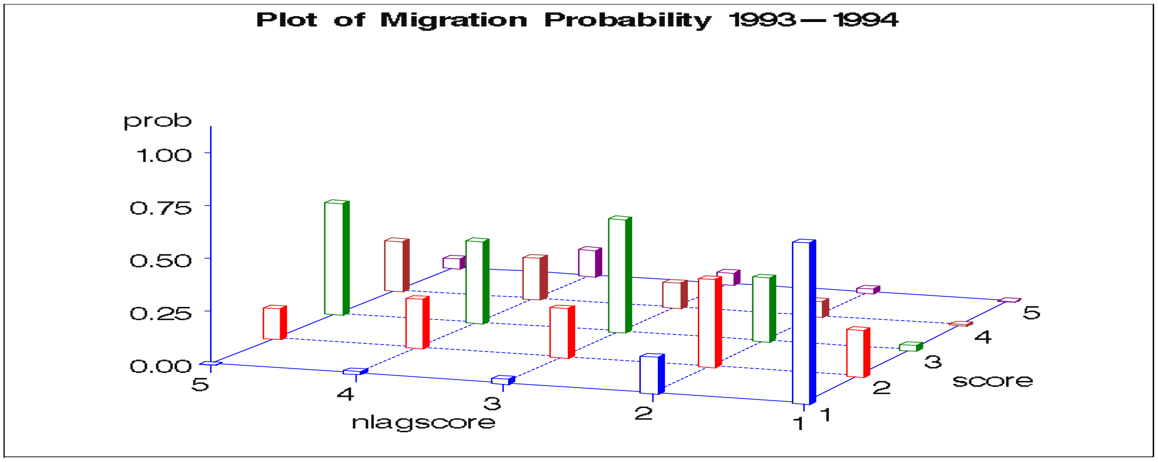
3
4
5
score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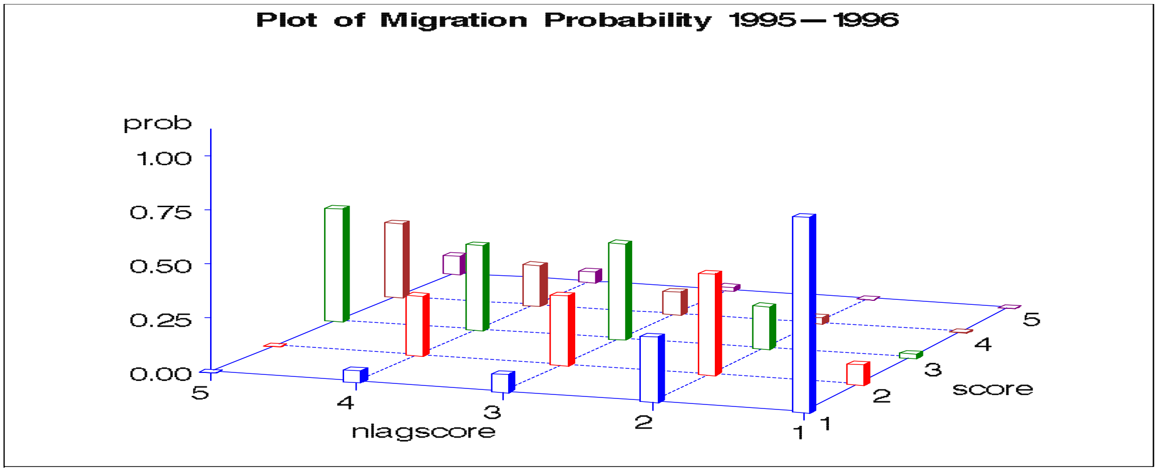
3
4
5
score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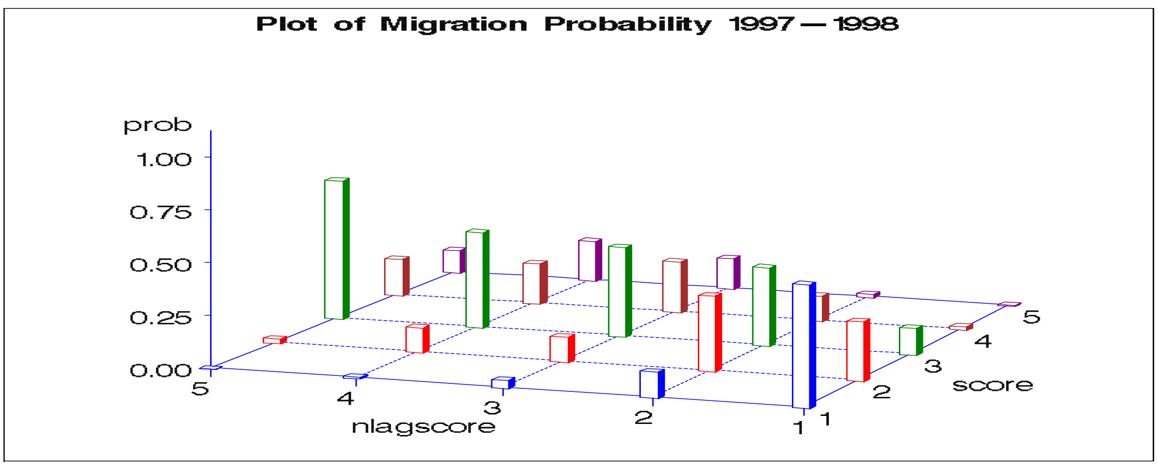
2
3
4
5
score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0.00
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4
3
2
1
nlagscore
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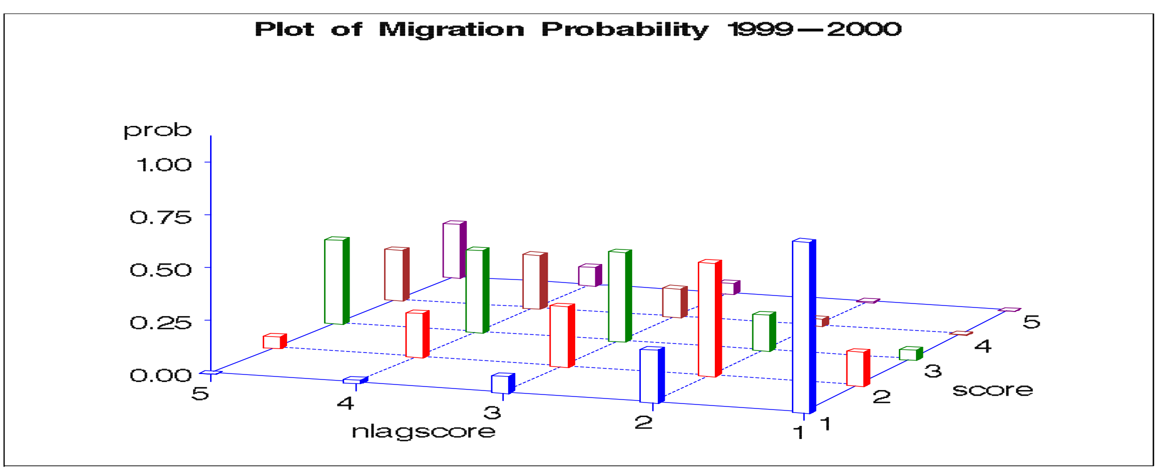
2
3
4
5
score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nlagscore
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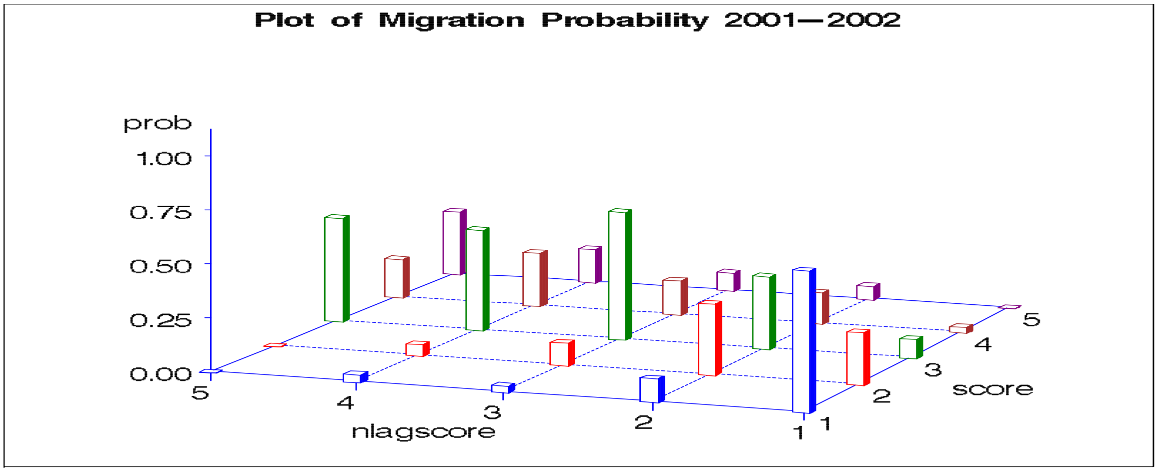
2
3
4
5
score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4
3
2
1
nlagscore
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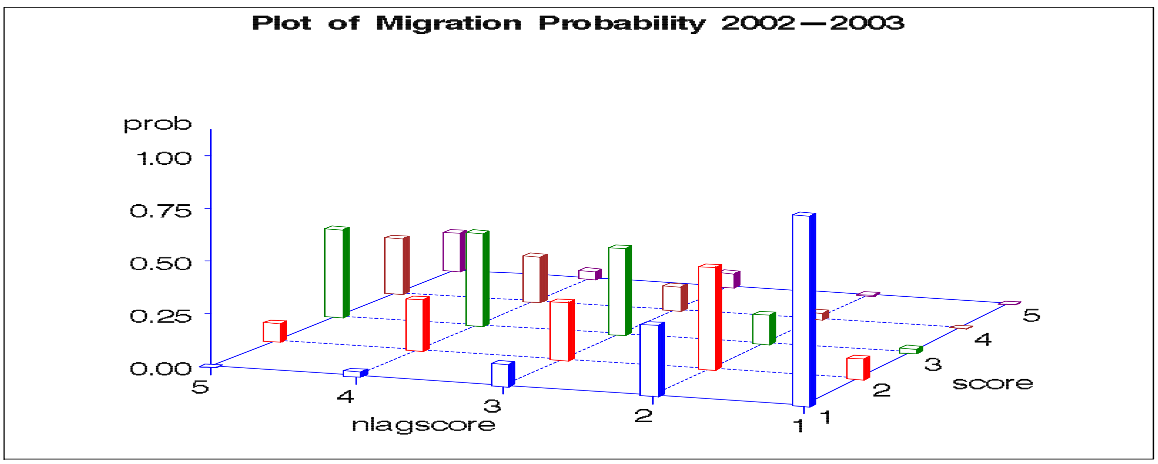
2
3
4
5
score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0.50
0.25
0.00
5
4
3
2
1
nlagscore
1
2
3
4
5
score