Risk Rationing in China Rural Credit Markets

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Abstract

The purpose of this paper is to provide a specific test of Boucher, Carter et al. (2008) framework on risk rationing. The data were collected through a survey of 730 farm households in Shaanxi province conducted in November 2010. We compare factor associated with risk rationed, quantity rationed and price rationed farmers. Seemingly unrelated regressions are performed using risk rationing, quantity rationing and price rationing measure as the dependent variable and measures of demography, wealth, income, year of farming and risk aversion as independent variables. We apply seemingly unrelated regression, cluster analysis and cross tabulation in the study. According to a seemingly unrelated regression, we find existing risk rationing is due to risk-based behavior by borrowers. A cross tabulation results support the proposition by Boucher, Carter et al showing the financial wealthy is risk rationed and relatively land-poor is risk rationed. This paper is believed to be among the first empirical validation of the risk rationing theory.

1. Introduction

Previous literature has shown the existence of risk rationing and its significance as the borrower voluntarily withdraws from the credit market even she has the collateral wealth needed to qualify for a loan contract. Recent literature by Boucher, Carter et al. (2008) presents theory of risk rationing and identify the necessary and sufficient condition of risk rationing incidence. The goal of this paper is to provide a specific test of Boucher, Carter et al. (2008) framework on risk rationing. This paper uses a unique survey form to collect land use rights and risk rationing data. Survey questions were designed so that risk rationing could easily be extracted.

The rest of this paper proceeds as follows. In the next section, we briefly review the model structure on risk rationing. In Section 3, several hypotheses are derived. Next, we describe credit rationing status and the household survey data that are used in the analysis. The seemingly unrelated regression, cluster analysis and cross tabulation are formulated in the following section. The empirical results are presented and discussed.

2. Model

The model structure is based on Boucher, Carter et al. (2008). A farmer chooses activity choice between a safe, subsistence reservation activity and a risky commercial activity where the latter must be financed by an optimally designed credit contract offered by a competitive sector of lenders.

Agent's endowments are consist of financial wealth,W, and land, T. Financial wealth is liquid and can be used as collateral to secure production loans. Land can also be used as collateral and sold at price p_T.

Agents allocate their land between two activities; reservation or subsistence activity which is safe and commercial activity which is risky but gives higher return. A reservation activity does not require capital and yields a certain return ω per unit land. A risky commercial activity requires a fixed investment k per unit land and yields an uncertain return with gross revenues x_g per unit land if good state is realized and gross revenues x_b per unit land if bad state is realized.

Assume an agent has additively separable utility function

$$U(C_j, e) = u(C_j) - d(e) \qquad (1)$$

where C_j is consumable wealth in state *j* and *e* is the effort exerted in production which can be either high ($e = H$) or low ($e = L$). The disutility of effort, $d(e)$, is increasing in effort so that $d(H) > d(L)$. Let ϕ^e be the probability of the state of nature under effort *e*, so that $\phi^H > \phi^L$.

Assume $W < Tk$ so that an agent must borrow to utilize the commercial activity.

The optimal contract maximizes the agent's expected utility subject to the principal's (lender's) participation constraint and the agent's incentive compatibility constraint (ICC). We solve for optimal loan contract (s_g, s_b) where s_g and s_b are the borrower's payoff per unit area financed under the good and bad states of nature.

$$Max_{s_g,s_b}\ Eu\big(W+(p_T+s_j)T\,\big|e=H\big) \tag{2}$$

$$subject\ to:$$

$$\pi(s_j|H)\equiv\ \phi^H(x_g-s_g) \tag{3}$$
$$+(1-\phi^H)(x_b-s_b)$$
$$-rk\geq 0$$

$$\big[u\big(W+(p_T+s_g)T\big)-u(W+(p_T+s_b)T)\big] \quad (4)\ \text{ICC}$$
$$\times(\phi^H-\phi^L)\geq d(H)-d(L)$$

$$-s_j\leq\frac{W}{T}+p_T;\quad j=g,b \tag{5}$$

Quantity rationing occurs when

(a) the agent would be offered and demand a credit contract in the symmetric information world; but,

(b) the agent lacks sufficient wealth to collateralize the contract (i.e.,$W+p_TT<-Ts_b^*(W,T)$).

Risk rationing occurs when

(a) the agent would be offered and demand a credit contract in the symmetric information world;

(b) the agent is offered a financially feasible contract in the asymmetric information world (i.e., $W+p_TT\geq -Ts_b^*(W,T)$) but,

(c) the agent chooses not to accept the offered contract, preferring the reservation subsistence activity.

3. Hypotheses and Regressors

Based on the theory and implication reported by Boucher, Carter et al. (2008), a number of hypotheses that describe the most important factors explaining credit rationing were formulated.

1) Wealth-biased quantity rationing

Quantity rationing is decreasing in financial wealth and productive wealth.

2) Risk rationing and financial wealth

2.1) The financial wealthy is risk rationed. Thiele and Wambach (1999) and Boucher, Carter et al. (2008) demonstrate that the occurrence of risk rationing may depend on the type of wealth considered.

Let A and P denote the coefficient of absolute risk aversion and predence respectively.

2.2) If $P > 3A$, then an agent with financial wealthy (rich) will prefer commercial activity and poor will prefer subsistence activity and be risk rationed.

2.3) If $P < 3A$, poor will prefer commercial activity and rich will prefer subsistence activity and be risk rationed.

3) Risk rationing and productive wealth

The relatively land-poor is risk rationed. The land-wealthy choose to participate in the credit market and fully exploit their productive asset (land).

The seemingly unrelated regression and two-step cluster analysis are employed to test the above hypotheses. The dependent variables, risk rationing, quantity rationing and price rationing are identified based on credit rationing status.

The independent variables in a model consist of sex, education, year of farming, farm size, household income, asset value, farm profit and Binswanger risk aversion measure which can be drawn from the survey data. We also conduct a simple field experiment to estimate the partial risk aversion coefficient of the farmers based on Binswanger (1981). The Binswanger risk aversion measure is obtained from the question “"Imagine an honest stranger comes up to you and offers a gamble with the payout depending on the flip of a coin. If the coin lands heads you get the amount in the first column of Table 1 and if it lands tails you get the amount in the second column. Each has a 50% chance of occurring. If the gamble was repeated by many flips of the coin you would expect to receive the amount in the third column. While the odds of receiving the amount in the first column are the same as the odds in the second column the high and low values are different. Study the six gambles in the table and select the **one** gamble that you would prefer".

Table 1: Measurement of Risk Aversion Coefficient (Binswanger, 1981)

Choice	Gain in Good luck: (RMB): 50% chance	Gain in Bad luck: (RMB): 50% chance	Expected value (RMB)	Risk Aversion Class	Coefficient of partial risk aversion at all levels
1	500	500	500	Extreme	7.5
2	950	450	700	Severe	3.615
3	1200	400	800	Intermediate	1.189
4	1500	300	900	Moderate	0.506
5	1900	100	1000	Slight to neutral	0.168
6	2000	0	1000	Neutral to preferred	≤ 0

4. Credit Rationing Status

The survey asked questions that made it possible to infer respondents' credit rationing status based on Boucher, Guirkinger et al. (2006). Price rationed farmer is the one who borrowed and were happy with the amount they received. An applicant who was rejected a loan is quantity rationed. A non-applicant is the most difficult to classify. He might not have applied because of three reasons; first, he knew that he would be rejected (quantity rationed); second, he was afraid to lose collateral (risk rationed); or third, he had enough money and no need to borrow (price rationed). Three types of credit rationed farmers namely risk rationed, quantity rationed and price rationed farmers have been identified and used as dependent variables.

5. Survey and Data

The farm household survey was conducted in Shaanxi province, Yangling district in November 2010. Seven hundred thirty households were surveyed. Each household was interviewed by either one or two graduate students from Northwest Agriculture and Forestry University. The students recorded interviewee responses on a paper survey form which was later entered into a database. The survey itself dealt exclusively with farm finance, risk perception and management, and transaction of land use rights.

The characteristics of these communities are as follows. On average there are about five people living in each household. The average number of years farming is 28 years, and the average farm size is 5mu (about 5/6th of an acre). Household income average is $23,796 RMB/year with approximately 41 percent of household income coming from farm activities. The average profit per year earned from cropped land is 953 RMB/mu. The average asset per household is 218,208 RMB while the average debt per household is 20,531 RMB.

In order to identify who is risk rationed farmer from the survey response, we separate Chinese farmers into two groups. The first is a group of 52 farmers who did not request a loan but a local RCC or bank evaluates their creditworthiness and offers them a loan. The proportion of risk rationed farmers in the first group is 23.1 percent who indicated that they did not use the total amount of credit made available to them because they are afraid of losing collateral. The second group is farmers who must formally request a loan from their local RCC or bank. There are 121 farmers who have applied for a loan within the past two years but 568 farmers have not. Among 121

farmers who have applied for a loan, no risk rationed farmer is found in this group. Among 568 farmers who have not applied for a loan, approximately 7.6 percent of these farmers are risk rationed. They responded that they have not applied from RCC or bank in the last two years because they are afraid of losing collateral. Among all 730 respondents, the total proportion of risk rationed farmers is approximately 6 percent. When we generalize this percentage to 350 million farm households in China, there are 21 million farm households who are risk rationed.

To compare characteristics among credit rationed farmers, quantity rationed and price rationed farmers were also identified. Approximately 2.2 percent of all respondents are quantity rationed who indicated that they must formally request a loan from RCC or bank and have applied for a loan within the past two years but RCC or bank did not offer them any loan. The proportion of price rationed farmers is approximately 17.4 percent who indicated either they actually used a loan that RCC or bank offered to them without requesting a loan or they have applied for a loan and accepted the offered loan.

6. Seemingly Unrelated Regression Results

In this section the results of the hypotheses testing are reported. To investigate the determinants of the credit rationing farmers, seemingly unrelated regression analysis is performed explaining the type of wealth associated with risk rationing, quantity rationing and price rationing. Corresponding to the formulated hypotheses above, 8 independent variables are included in the regression. The results are presented in Table 2.

1) Wealth-biased quantity rationing

In order to test wealth-biased quantity rationing hypothesis, a financial wealth is represented by household income and asset value; a productive wealth is represented by land size. We find quantity rationing is decreasing in financial wealth but not in productive wealth. However, all variables representing financial wealth and productive wealth are not statistically significant. An increasing in financial wealth tends to relax quantity rationing, but an increasing in land endowment will not relax quantity rationing.

2) Risk rationing and financial wealth:

The financial wealthy is risk rationed. Household income variable on risk rationing is positive but not statistically significant.

3) Risk rationing and productive wealth

Land size variable on risk rationing is not statistically significant but the sign is correct and negative. A result shows that the relatively land-poor is risk rationed.

In addition, we find Binswanger risk aversion coefficient is significantly associated with risk rationing. However, the sign of Binswanger is negative meaning that the more risk averse farmers are, the lower the probability of being risk rationed. This result is counter-intuitive. However, this confirms that risk rationed farmers are risk averse and the existing risk rationing is mainly due to risk-based behavior by borrowers.

Moreover, a farm profit is associated with price rationing and statistically significant at 1 percent level. Farmers with higher profit are more likely to be price rationed.

7. Cluster Analysis

The goal of this cluster analysis is to form similar groups of farmers and test hypothesis 2.2) if $P > 3A$, then an agent with financial wealthy (rich) will prefer commercial activity and poor will prefer subsistence activity and be risk rationed; and hypothesis 2.3) if $P < 3A$, poor will prefer commercial activity and rich will prefer subsistence activity and be risk rationed. Let *RRA* denote the coefficient of relative risk aversion, we apply $RRA < ½$ to represent $P > 3A$ and $RRA > ½$ to represent $P < 3A$ (see Boucher, Carter et al. 2008, page 417).

We apply the two-step cluster procedure. The categorical variables are 1) coefficient of relative risk aversion greater than ½; 2) whether farmer is risk rationed and 3) whether farmer is rich or poor. According to the data, the average asset value of Shaanxi farmers is 218,208.47 RMB. A farmer who has an asset value greater than 218,208.47 RMB is considered rich, otherwise is poor. A model summary and results of the two-step cluster analysis are shown in Figure 1-6.

Cluster 1 is not consistent with hypothesis 2.3. We find 23.4 percent of farmers are rich and have $RRA > ½$ ($P < 3A$), but they are not risk rationed. Similarly, cluster 2 is not consistent with hypothesis 2.2. Approximately 12.1 percent of farmers have $RRA < ½$ ($P > 3A$). The majority of farmers in this cluster are poor. All farmers in cluster 2 are not risk rationed. Also, cluster 3 with the size of 5.7 percent is not consistent with hypothesis 2.3. The majority of farmers are poor and have $RRA > ½$ ($P < 3A$). All of them are risk rationed. However, only cluster 4 is consistent with hypothesis 2.3. We find 58.8 percent of farmers are poor and have $RRA > ½$ ($P < 3A$),

and they are not risk rationed. Therefore, the proposition proposed by Boucher, Carter et al. is consistent with 58.8 percent in one cluster that are non-risk rationed.

8. Cross Tabulation Analysis

With the regression and cluster analysis, we do not find any significant variables on the hypotheses. We try to apply a cross tabulation analysis to examine the partial effect of risk rationing.

1) Wealth-biased quantity rationing

Table 3 shows the ambiguity of relationship between quantity rationing and asset value as well as a relationship between quantity rationing and farm size. Therefore, we are not able to conclude that quantity rationing is decreasing in financial wealth and productive wealth by using cross tabulation analysis.

2) Risk rationing and financial wealth

Results from Table 4 support that the financial wealthy is risk rationed. We cross tabulate asset value with risk rationed farmers. The proportion of risk rationed farmers is increasing in asset value. As asset value increases, the proportion of risk rationed farmers is greater than the proportion of non-risk rationed farmers.

3) Risk rationing and productive wealth

We find that relatively land-poor is risk rationed. A cross tabulation results in Table 5 show that a proportion of risk rationed farmers tends to increase as land size decreases.

9. Conclusion

The purpose of this paper is to provide a specific test of risk rationing theory proposed by Boucher, Carter et al. (2008). The farm household survey was conducted in Shaanxi province in November 2010 and 730 households were surveyed. Survey questions were designed so that credit rationing could easily be extracted. This paper has an important empirical contribution, since it is among the first analyzing the rural sample that consists of households who are risk rationed, quantity rationed and price rationed. We apply seemingly unrelated regression, cluster analysis and cross tabulation in the study.

Among all 730 respondents, the total proportion of risk rationed farmers is approximately 6 percent. When we generalize this percentage to 350 million farm households in China, there are 21 million farm households who are risk rationed. The main result of the paper is that the cross tabulation analysis supports the hypothesis that financial wealthy is risk rationed and relatively land-poor is risk rationed. However, results based on the seemingly unrelated regression and cluster analysis are not significant and consistent with propositions by Boucher, Carter et al. The incidence of risk rationing is important to policy implication. Land use rights in China will be only partially effective as it does not increase farmers' willingness to offer up the collateral needed to obtain loans.

Table 2: Seemingly Unrelated Regression Results

	Risk Rationed (1)	Quantity Rationed (2)	Price Rationed (3)
Sex	0.0088432	0.0065058	0.023043
	(0.0198357)	(0.0125393)	(0.0304527)
Education	0.0048159	0.0083313**	0.0096751
	(0.0058787)	(0.0037162)	(0.0090252)
Years of Farming	-0.00036	0.0007149	7.17E-05
	(0.0008195)	(0.0005181)	(0.0012582)
Farm Size	-2.12E-03	1.07E-04	-3.82E-03
	(0.0038225)	(0.0024164)	(0.0058685)
Household Income	4.11E-07	-2.88E-07	-8.85E-08
	(0.000000468)	(0.000000296)	(0.000000718)
Asset Value	-3.79E-08	-2.11E-08	8.43E-08
	(0.0000000465)	(0.0000000294)	(0.0000000714)
Farm Profit	2.46E-06	-2.19E-06	0.0000542***
	(0.00000476)	(0.00000301)	(0.0000073)
Binswanger	-0.0052731*	-1.38E-03	-1.61E-03
	(0.0028338)	(0.0017914)	(0.0043506)
Observations	648	648	648

Note: Each observation is a household. Standard errors are in parentheses.
The dependent variable for each column is listed in the column heading.
***Significant at the 1 percent level, ** 5 percent level, *10 percent level

Table 3: Cross Tabulation Analysis: Wealth-biased quantity rationing

Asset Value (RMB) (Binned) * Quantity Rationed Farmer Cross tabulation

% within Quantity Rationed Farmer

		Quantity Rationed Farmer		
		0	1	Total
Asset Value (RMB) (Binned)	<= 50000	11.6%		11.4%
	50001 - 92500	8.7%	6.7%	8.6%
	92501 - 100000	13.0%	26.7%	13.3%
	100001 - 130000	8.5%	6.7%	8.5%
	130001 - 150000	11.6%	26.7%	12.0%
	150001 - 200000	17.6%	6.7%	17.4%
	200001 - 300000	12.8%	20.0%	13.0%
	300001 - 500000	8.7%	6.7%	8.6%
	500001+	7.5%		7.3%
Total		100.0%	100.0%	100.0%

Farm size excluding rented (Binned) * Quantity Rationed Farmer Cross tabulation

% within Quantity Rationed Farmer

		Quantity Rationed Farmer		
		0	1	Total
Farm size excluding rented (Binned)	<= 2.00	11.7%	12.5%	11.7%
	2.01 - 3.00	12.1%	18.8%	12.2%
	3.01 - 4.00	17.1%	6.3%	16.9%
	4.01 - 5.00	20.2%	18.8%	20.2%
	5.01 - 6.00	16.2%	12.5%	16.1%
	6.01 - 6.60	3.2%	12.5%	3.4%
	6.61 - 7.50	11.1%		10.9%
	7.51+	8.4%	18.8%	8.7%
Total		100.0%	100.0%	100.0%

Table 4: Cross Tabulation Analysis: Risk rationing and financial wealth

Asset Value (RMB) (Binned) * Risk Rationed Farmer Cross tabulation

% within Risk Rationed Farmer

		Risk Rationed Farmer		
		0	1	Total
Asset Value (RMB) (Binned)	<= 50000	11.6%	7.5%	11.4%
	50001 - 92500	8.7%	7.5%	8.6%
	92501 - 100000	13.5%	10.0%	13.3%
	100001 - 130000	8.7%	5.0%	8.5%
	130001 - 150000	12.1%	10.0%	12.0%
	150001 - 200000	16.7%	27.5%	17.4%
	200001 - 300000	12.4%	22.5%	13.0%
	300001 - 500000	8.5%	10.0%	8.6%
	500001+	7.8%		7.3%
Total		100.0%	100.0%	100.0%

Table 5: Cross Tabulation Analysis: Risk rationing and productive wealth

Farm size excluding rented (Binned) * Risk Rationed Farmer Cross tabulation

% within Risk Rationed Farmer

		Risk Rationed Farmer		
		0	1	Total
Farm size excluding rented (Binned)	<= 2.00	11.5%	14.0%	11.7%
	2.01 - 3.00	12.3%	11.6%	12.2%
	3.01 - 4.00	16.6%	20.9%	16.9%
	4.01 - 5.00	20.6%	14.0%	20.2%
	5.01 - 6.00	15.9%	18.6%	16.1%
	6.01 - 6.60	3.4%	4.7%	3.4%
	6.61 - 7.50	10.8%	11.6%	10.9%
	7.51+	8.9%	4.7%	8.7%
Total		100.0%	100.0%	100.0%

Figure 1: Two-Step Cluster Analysis Model Summary

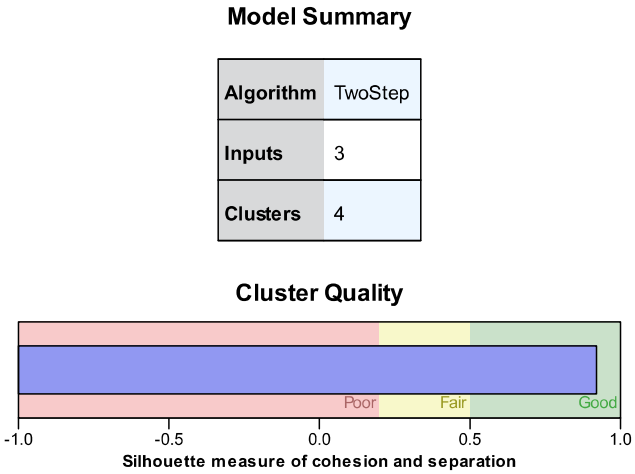


Figure 2: Cluster Solutions

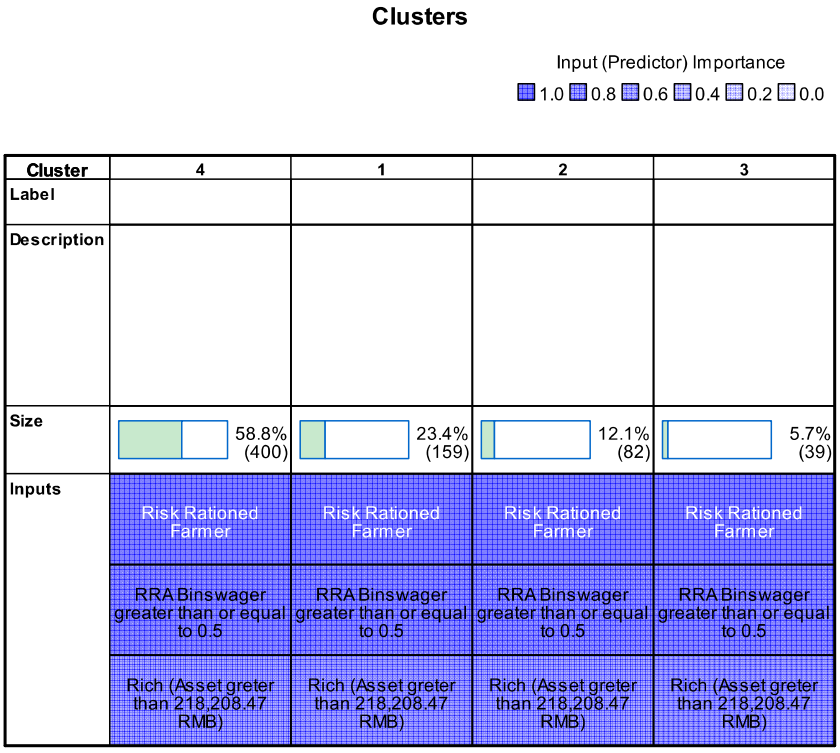
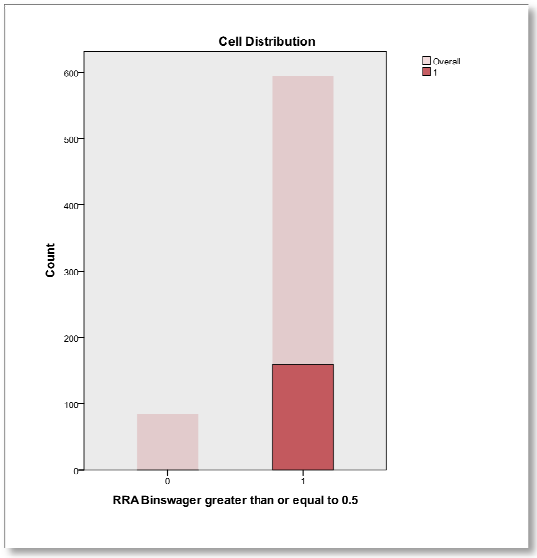
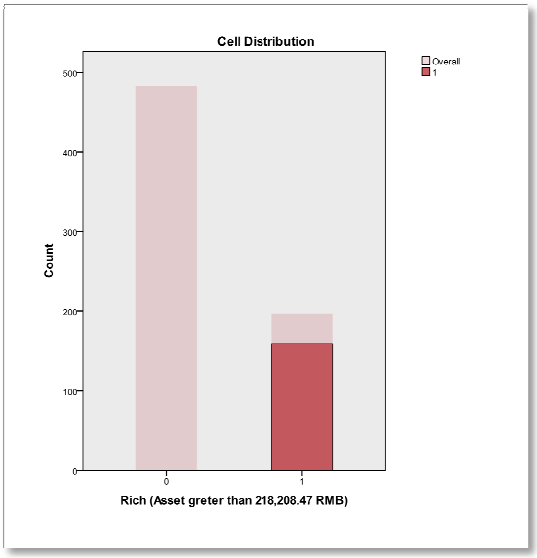


Figure 3: Cluster 1





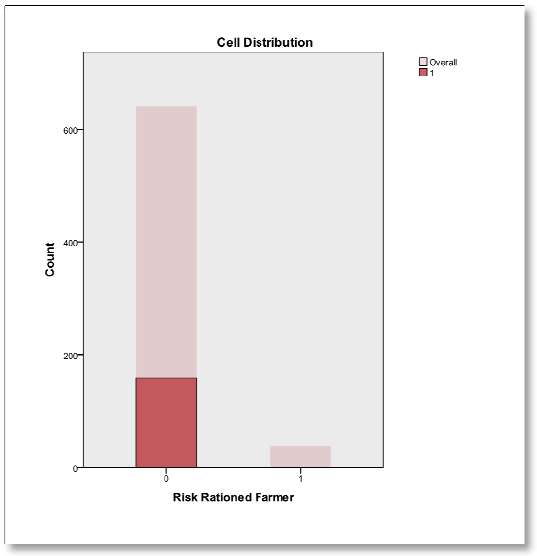
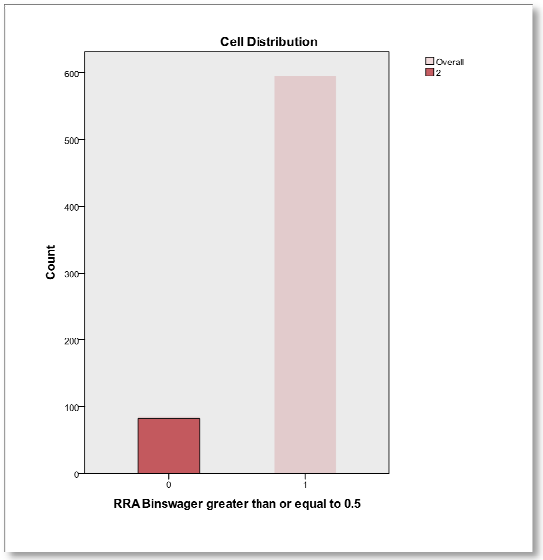
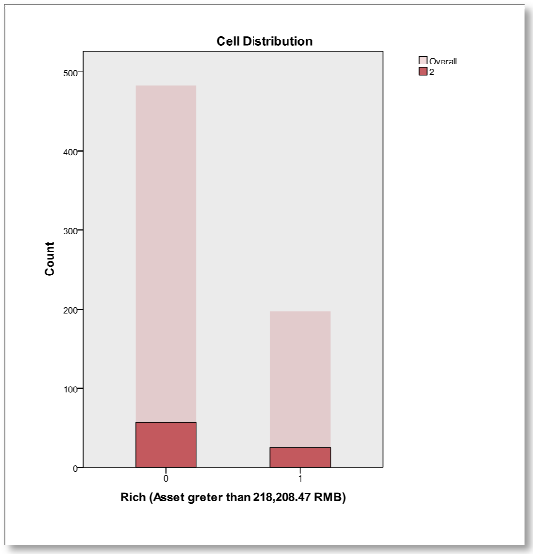


Figure 4: Cluster 2





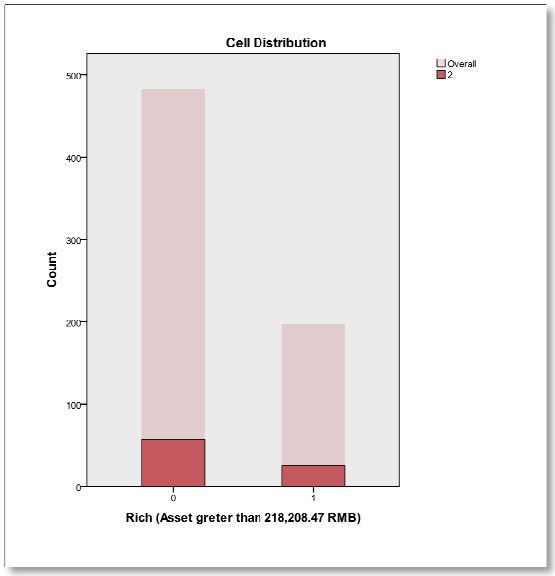
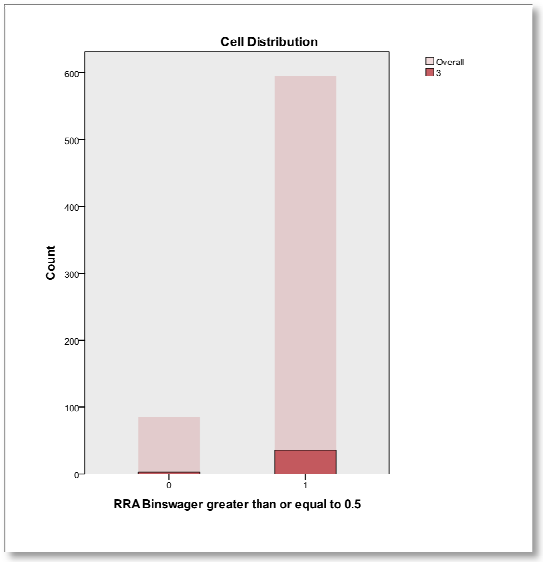
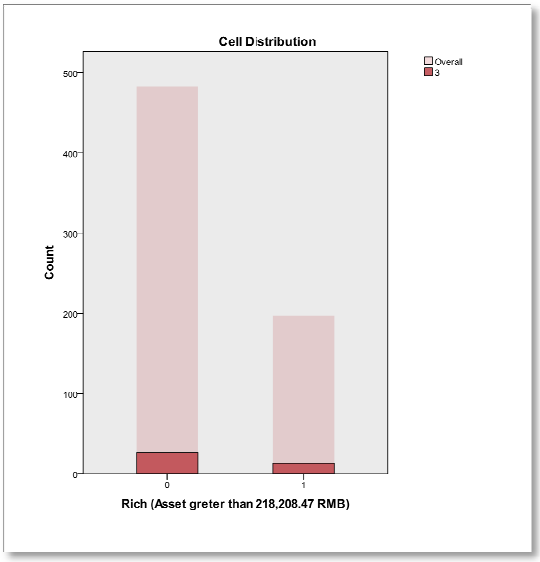


Figure 5: Cluster 3





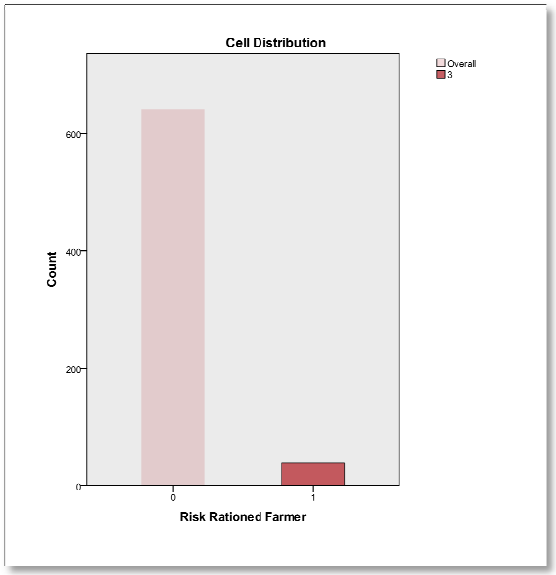
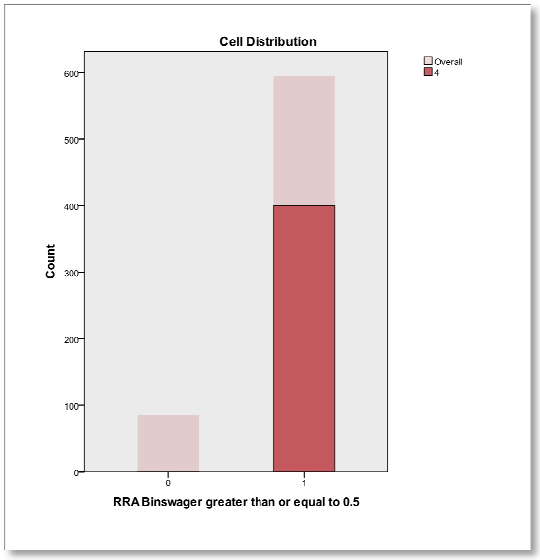
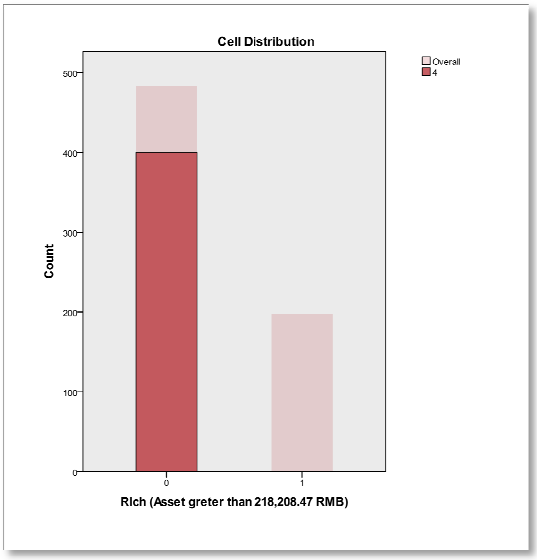
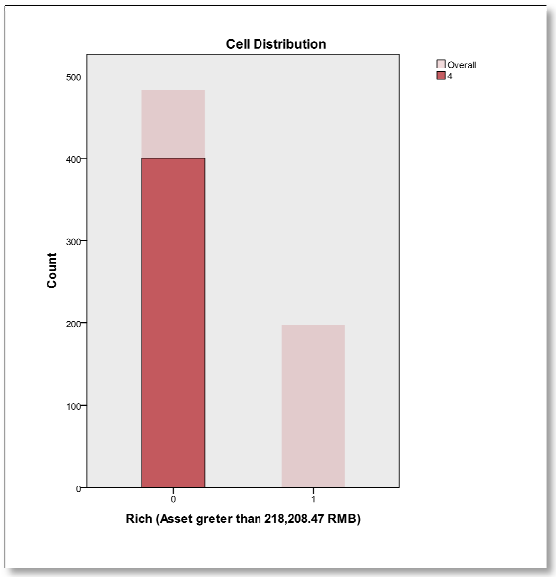


Figure 6: Cluster 4







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