**Patronage Refunds Paying Decision of Farm Credit System Associations: A Logit Model**

Tianwei Zhang

Mindy L. Mallory

Contact Information:

Tianwei Zhang

University of Illinois at Urbana-Champaign

326 Mumford Hall, MC-710

1301 West Gregory Drive

Urbana, IL 61801

Tel: (217) 840-7946

Fax: (217) 333-5538

E-mail: tzhang2@illinois.edu

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## 1. Introduction

As a financial cooperative, Farm Credit System (FCS) lending association is established and organized to provide available and reliable agricultural loans to farmers. As a cooperative enterprise, FCS association is constituted to share the profit with members and the primary means is the patronage refunds. In 2008 FCS declared $958 million patronage refunds distribution which equals 33% of its net income.[1]

For FCS lending associations, paying out patronage refunds helps entice members to do business with the cooperative, reduces members' borrowing cost, and also benefits the cooperative with tax exemptions[2]. On the other hand, paying out patronage refunds, especially in cash, lowers the capital sources which support the financial safety and growth of the cooperative. Retained patronage refunds are the major source of equity capital for financial cooperatives. Since FCS associations face such tradeoffs between maintaining sufficient capital reserves and providing reasonable returns to members, understanding how the cooperatives approach this problem is an interesting question from both a regulation and efficiency perspective.

Paying patronage refunds is a unique feature of the capital management in financial cooperatives. It is comparable to the dividends payments in the corporations in the sense of sharing profit with the shareholders. Dividends are paid based on the number of shares, i.e., the amount of capital stock. Patronage refunds are paid based on the contribution to the net interest income of the association that was made by the shareholder, i.e., the amount of loan volume. There is considerable amount of research on the dividends policy in finance journals in the past ten years (Fama and French 2001, Grullon et al. 2002, Dickens et al. 2002, Julio and Ikenberry

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[1] 2008 Farm Credit Administration Annual Report
[2] If the cash proportion of patronage refunds is at least 20%, the proportion is exempted from income tax.

2004, DeAngelo et al. 2006, Haggard and Howe 2008, maybe more), but the patronage refunds of financial cooperatives, especially FCS, have not been addressed directly. Except one paper (Briggeman and Jorgensen 2009) used survey data of one FCS association and found that the members strongly prefer patronage refunds over lower fixed interest rates, much of the literature on patronage refunds have focused on the production cooperatives who cooperate in marketing, or supplies and equipment purchasing (Beierlein and Schrader 1978, Knoeber and Baumer 1983, Royer 1987, 1993, Royer et. al. 1997, 2007). Reasons include the lack of consistent and clean dataset, and the difficulty of incorporating the regulated capital management of financial cooperatives.

The general theory of cooperatives and the outcomes of the empirical studies on production cooperatives are worthwhile in analyzing the financial cooperatives. Yet FCS as a system of cooperatives has its uniqueness, such as: FCS association serves as the financial intermediation in the farm debt market. FCS is government sponsored enterprise (GSE). FCS's operation and capital management are quite regulated for safety consideration. As for deciding if and how much patronage refunds to pay, there are multiple determinants, for example, the capital position, the financial performance, the preference of the members, and the operational philosophy of the association's manager. It is commonly recognized that the FCS association is reluctant to reverse the patronage refunds paying decision. This implies that associations that currently pay patronage refunds are more likely to continue paying while the associations that currently do not pay patronage refunds prefer continue not paying. Therefore it is important to distinguish the associations and focus on the decision of paying or not paying patronage refunds at first before further analyzing the decision of how much patronage refunds shall be paid.

This paper analyzes the evolution of paying patronage refunds of all FCS lending associations in the U.S. from 2000 to 2009. The time series pattern and regional pattern of paying patronage refunds are examined. The characteristics of the associations who pay patronage refunds are compared with those associations who do not pay.  A logistic regression model is developed to identify the important factors that influence the decision of paying patronage refunds.

This paper makes three contributions to the empirical studies on financial cooperatives. First, the paper utilizes a large panel dataset which includes all the FCS associations nationwide and over a 10 year horizon. Therefore it is feasible to statistically identify, empirically test, and generally draw conclusion of the systematic patterns in the patronage refunds paying behavior. Second, to my knowledge this is the first piece of work that investigates the determinants of patronage refunds paying decision in the agriculture financial cooperatives, especially FCS associations. Third and perhaps most importantly, the FCS is currently undergoing a risk-adjusted capital structure reform, therefore the research discussing on patronage refunds decision and capital management efficiency issues can contribute to better reform policies.

The paper is organized as follows. Section 2 explains the concept and the forms of patronage refunds of FCS associations. Section 3 reviews the relevant studies on the patronage refunds of cooperatives. Section 4 examines the time trend and regional pattern of the associations who pay patronage refunds. Section 5 explains the dataset and model specification. The characteristics of those who choose to make patronage refunds are summarized and compared to those who do not. Section 6 documents the preliminary findings and section 7 provides main conclusions based on the preliminary findings.

## 2. Understanding the Patronage Refunds

In FCS associations, the patrons are also the members, the owners, the shareholders, and the borrowers. A farmer needs to choose either paying $1,000 or 2% of the loan amount, whichever is less, to become a member and then borrows from the FCS association. For example, Farmer A needs to borrow $80,000 loan, decides to purchase $1,000 share of capital stock, and becomes a member of an FCS association. Farmer B borrows $60,000, purchases $1,000 share of capital, and also becomes a member. In the end of the year if that association declares patronage refunds, Farmer A receives more patronage refunds than Farmer B even both of them purchase the same amount of capital stock, i.e. $1,000. The patronage refunds are calculated on the base of $80,000 and $60,000 respectively. Therefore FCS's patronage refund is distributed proportional to the member's loan volume rather than member's capital contribution.

Patronage refunds can be paid in cash, in allocated equity, in capital stock or in any combination of these three in FCS associations. Cash format is self-explanatory and the primary refunding method. Allocated equity is the portion of the patronage refunds which is designated under each member's equity account and is deducted from the gross taxable income of the association. It has been "allocated to" and "belongs to" the members but not "distributed" yet. In fact the members have to pay income tax for this proportion even they haven't received that amount at current year. Besides cash and allocated equity, patronage refunds can also be returned in the format of capital stock. But none of the FCS associations in my dataset (2000-2009) chose this format. In practice, the patronage refunding procedure often works with a revolving method. The revolving account has a term structure which pays certain amount back to each member at each period over a certain time horizon and follows a first-in and first-out order.

Table1. Patronage refunds distribution in the FCS accounting-book.

| Net Income +$100 | | Unallocated | Allocated | Capital | Equity |
|---|---|---|---|---|---|
| Patronage Refunds Distributed | in Cash | -$60 | | | -$60 |
| | in Allocated Equity | -$30 | +$30 | | $0 |
| | in Capital Stock | -$10 | | +$10 | $0 |
| Earnings Retired | from Allocated Equity | | -$35 | | -$35 |
| | from Capital Stock | | | -$5 | -$5 |
| Net | | **-$100** | -$5 | +$5 | **-$100** |

Note: If patronage refund is paid in cash, both Unallocated Surplus and Equity are reduced. If patronage refund is paid in Allocated Equity, Allocated Equity is added, Unallocated Surplus is reduced, and Equity does not change. If patronage is paid in stock, Capital Stock is added, Unallocated Surplus is reduced, and Equity does not change.

Table1 shows that how the FCS accounting-book records the patronage refunds distribution in different formats. For example, $100 of net income, i.e. Unallocated Surplus, is declared as patronage refunds. $60 is paid in Cash, $30 in Allocated Equity and $10 in Capital Stock. The cash patronage refunds reduced Equity by $60 immediately. $30 paid in Allocated Equity is transferred from the Unallocated Surplus account to the Allocated Equity account and current Equity is not affected. $10 paid in Capital Stock is transferred from Unallocated Surplus account to Capital Stock account and current Equity is not affected either.

The Allocated Equity account and Capital Stock account are revolving accounts which are set up for retaining earnings, distributing patronage refunds, and retiring memberships. In Table1, $35 is retired from the Allocated Equity and $5 is retired from the Capital Stock. The revolving account performs like a tank, with $30 flowing in and $35 flowing out in Allocated Equity, $10 flowing in and $5 flowing out in Capital Stock. Of course it can be more total flow-in than total flow-out or vice versa.

Therefore in this scenario $100 of the current earned net income has been distributed but $95 is actually paid out as patronage refunds in current period. $60 is from current earnings and $35 is from the revolving account of Allocated Equity. $5 from the Capital Stock reduces the Equity level but is considered as patronage refunds since normally the Capital Stock retirement only happens at the end of the member's borrowing relationship with the associations. In the example of Farmer A and B, they pay $1,000 to purchase the associations' stock and become the members. The $1,000 will be returned to them when their borrowing relationship with the associations ends.

There are 63 out of 86 FCS associations paid patronage refunds in 2009 while only 74 out of 183 associations paid in 2000. This overall increasing trend is different from the industrial firms' "disappearing dividends" phenomenon (Fama and French 2001) and the "decline of dividend payers" in commercial banks (Haggard and Howe 2008). For FCS associations, paying out patronage refunds is a marketing tool to attract borrowers and also benefits the cooperative with tax exemptions. For the borrowers, receiving patronage refunds reduces patrons' total borrowing cost. It also gives patrons the cash to pay their income tax related to the member's earnings allocated. In fact the latter reason is a good reason for some associations to choose to have patronage refunds program.

Even though paying patronage refunds can be a non-economic decision, systematically analyzing the trend, pattern and possible determinants is still the important step to further understand the patronage refunds program and how it contributes to the efficient capital management in FCS associations. After all it is observed that more and more associations start to pay patronage refunds and start to pay more patronage refunds.

## 3. Relevant Studies

There are several articles targeting on the issue of patronage refunds in producing cooperatives who cooperate in the areas of buying supplies and equipment and of marketing (Tubbs 1971, Dahl and Dobson 1976, Beierlein and Schrader 1978, Knoeber and Baumer 1983, VanSickle and Ladd 1983, Junge and Ginder 1986, Caves and Petersen 1986, Royer 1987, 1993, Royer and Shihipar 1997, and Royer and Smith 2007). But patronage refunds payment of financial cooperatives has rarely been addressed in prior studies. Only Briggeman and Jorgensen (2009) used survey data of one FCS association in Oklahoma and concluded that members strongly prefer patronage refunds compared to lower fixed real estate interest rates.

The patronage refunds and patron valuation studies appeared in the literatures since 1970s when the financial cost of equity capital in cooperatives started to be a popular topic in agricultural economics journals. Tubbs (1971) studied the impact of coop patronage refunds on the farm operations. He argued that low cash patronage refunds amount and long revolving fund terms may hurt the farmers in the sense of discounted present value because of the immediate tax obligation Royer 2004.

Dahl and Dobson (1976) chose three Wisconsin coops with 189 members as their data sample. They assumed fixed returns and repayment period on loans, fixed rates for stock and debt, fixed tax rate, fixed rate of annual increase on stocks and debt. Therefore the cost of each capital source could be calculated recursively for a 7 year time horizon under 9 combinations of different cash patronage refunded ratio and 5/10 years revolving periods. The smallest cost scenario was picked as the optimal capital structure. The unique feature of their paper is giving an opportunity cost for the revolving funds which equals the cost of short debt of farmers. Their findings related to patronage refunds are that changing patronage cash amount has more significant impact on financial cost than shortening revolving fund term. Compared to 20%, 60%, 80% and 100% patronage refunded in cash scenario, 40% represents the optimal financial mix.

Beierlein and Schrader (1978) did similar research as Dahl and Dobson . They defined a base case capital structure of a representative farmer cooperative with 50% debt and 50% equity. They assumed fixed parameters such as tax rate, interest rate, debt repayment ratio, capital stock retirement ratio, patronage refunds growth rate, and etc. A deterministic simulator was used to generate the changes of the capital structure and the after tax present value of patron benefits over 20 years. Six capital configurations such as capitalization with only stock, capitalization with only debt, capitalization with 50% debt and 50% stock, etc. were evaluated with different annual patronage growth rates. Their illustration showed the complexity of the relationships among the capital structure of a cooperative and the generalization of particular capital plans was difficult because of the interaction with patron cash flows. Their findings on patronage refunds policy are: the total value of patron benefits decreases as the cash percentage of patronage refunds increases; shortening the revolving fund cycle has only negligible effect on patron benefits.

VanSickle and Ladd (1983) mathematically derived a model for the analyzing the economics of a cooperative's financial structure. The objective assumed by the coop is to maximize the total after-tax profits of the patrons. The total profits function is composed with the patron's net total revenues, received dividends on capital stocks, received cash patronage refunds, and discounted revolving patronage refunds. The constraint conditions include the cash patronage refunds proportion (20%-100%), dividend rate on capital stock (<8%). Other constraints are formed with the components of capital and net savings. The decision variables are the cash patronage refund ratio, revolving term length, dividend rate, qualified patronage refunds and debt. In order to get feasible and reasonable solutions, predetermined parameters were defined and a numerical searching algorithm was applied. They concluded that paying 70% of its patronage refunds in cash benefits the members more than paying 100% or 20% in cash. They showed that shortening the deferral period for patronage refunds leads to the coop using more debt and paying less patronage refunds in cash.

Knoeber and Baumer (1983) developed a model of the cooperative members in order to understand the retained patronage refunds in agricultural cooperative. They assumed no tax, no dividends, and an absolute risk-averse utility function for farmers. Each farmer had only two assets, which are the assets used in farming operation and the retained patronage refunds in the coop. Each farmer maximized the expected utility function for the optimal share of retained patronage refunds. The median level of all the farmers' preferred shares would be selected by the cooperative with a majority rule process.

The 1980's agricultural depression created tough time for agricultural cooperatives and FCS institutions. FCS institutions went through government assistance and organizational restructure. Related agricultural finance literatures focused on the loan portfolio deterioration and assets growth. Caves and Petersen (1986) showed that increasing the retention ratio of earnings accelerate coop's growth only in the short run. Junge and Ginder (1986) showed that 20% cash patronage refunds may generate negative cash flow to patrons who belongs to low tax brackets. Cooperatives have to increase the cash patronage refunds, shorten revolving periods, or use nonqualified allocation of surplus which won't be considered as taxable. Fulton et al. (1995) also concluded that need for cooperatives to redeem the equity accumulated leads to a reduction in the growth rate. This implies that distributing patronage refunds will slow the cooperatives growth.

Royer and Shihipar (1997) analyzed how the cash proportion of patronage refunds affects the cash flow of individual patrons and how the patron's preferences between cash amount and revolving period are affected by age and other factors. Diaz-Hermelo et al. (2001) incorporated member responses into the decision model of a cotton ginning cooperative. The member's production function was estimated from a survey data set. Then the member's production was incorporated into the cooperative's expected value of equity. The impacts and tradeoffs of alternative management strategies were simulated based on assumed parameters and weights. He concluded that decreasing cash patronage to increase stock redemption is a poor strategy.

Royer and Smith (2007) used adaptive expectation model on the estimation of patronage refunds expected by the member. The condition hold for equilibrium is that the marginal cost of production equal to the cash price offered by the coop plus the expected patronage refunds. They presented that maximizing coop profit yields the lowest production and highest product price while maximizing member profit yields the highest production and lowest product price.

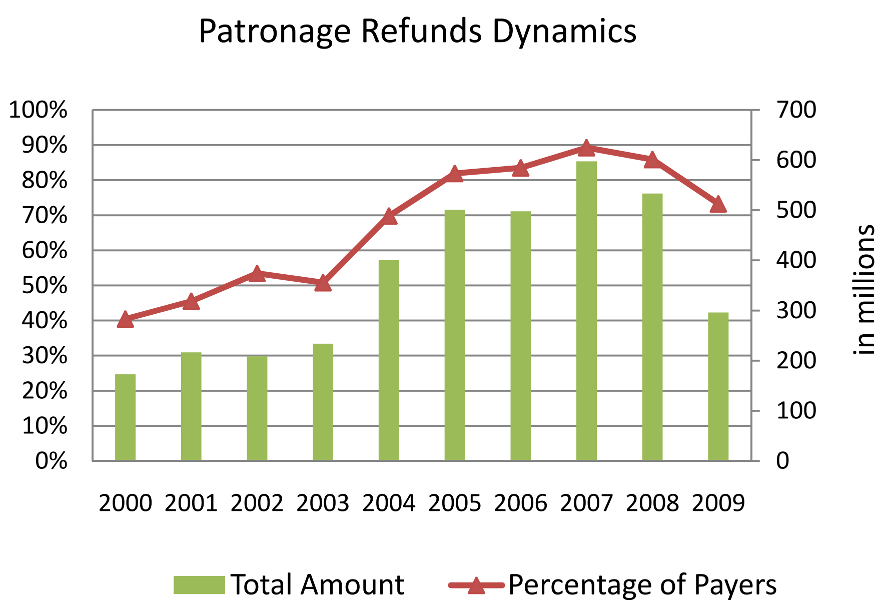
Briggeman and Jorgensen (2009)'s paper is the first paper focused on FCS associations' patronage payments. They used survey data and a conjoint analysis to identify member's preference between cash patronage refunds versus lower fixed real estate interest rates. Their results showed that the preference for cash patronage payments is so high that on average the members are willing to pay higher interest rates.

Patronage refunds problem has been an important topic in the agricultural cooperative research. In the beginning only one side, either the cooperative or the producer member side was picked up and investigated. Given fixed value of a set of parameters the impacts of changing patronage refunds ratio and changing the revolving term were evaluated either on the cooperative's capital structure or on the member's profitability. Eventually the researches have been moved towards on how to incorporate the responses of the member producers into the capital management of the cooperatives. Models also captured the relation between the member and the cooperative in a dynamic and stochastic way. Except the Briggeman and Jorgensen paper, no economic research has been done directly on FCS institutions or even on financial cooperatives. The Briggeman and Jorgensen paper used 174 observations on surveys data which is based on one FCS association. This may produce less general conclusion on the overall preference of patronage refunds. Therefore it is meaningful to conduct analysis with a rich dataset and thoroughly investigated the determinants of patronage refunds at the cooperatives side.

## 4. Time Trend and Regional Pattern

Some FCS associations pay out patronage regularly, some pay it occasionally and many just never pay. From 2000 to 2009, among the total 1141 valid observations there are 723 observations of paying patronage refunds. In other words, among the 305 associations 129 associations never pay any patronage and 106 associations pay patronage refunds regularly. Even many associations don't pay patronage refunds every year the dynamics chart in Figure1 clearly indicates the trend that more and more associations start to pay patronage refunds.

Figure1. Patronage refunds dynamics 2000-2009




In March 2000 there were 195 associations and after years of mergers there were only 88 left in 2009. Even the total number of association is decreasing the proportion of associations who pay cash patronage refunds is increasing. In Figure1, the percentage of payers equals to the number of associations who paid cash patronage refund over the total number of associations in that year. There were 40.44% associations paid patronage refunds in 2000 but 89.25% associations paid patronage refunds in 2007 which is the peak year. The columns indicate that the total amount of cash patronage refunds is also increasing over most years. It is observed that both percentage and total amount decrease slightly in 2008 and sharply in 2009 because of the financial crisis and commodity price increase.

There are currently five regional banks (CoBank, AgFirst, AgriBank, FCB Texas, and US AgBank) serving the member associations in FCS. Although associations can get involved with other associations' operation outside their own region via loan participation and loan syndications, the service that associations can provide to the farmers has bounded territory

(Figure 2). Therefore regional consistency is expected for the associations' patronage refund policies.

Figure2. FCS Regional Banks (from Farm Credit Administration web)

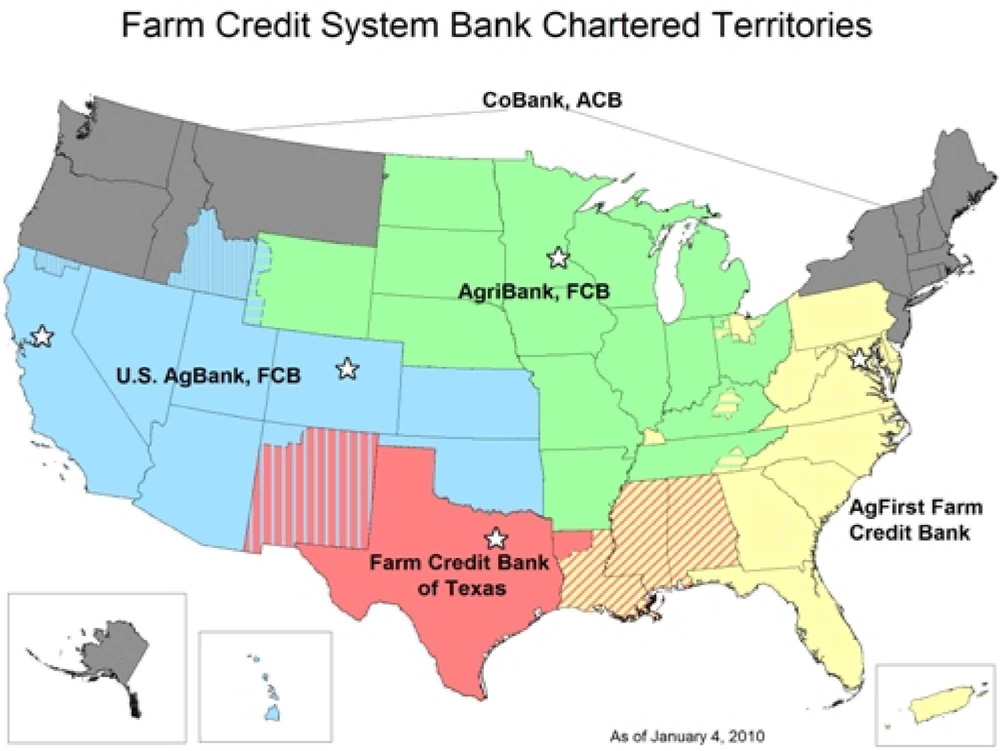
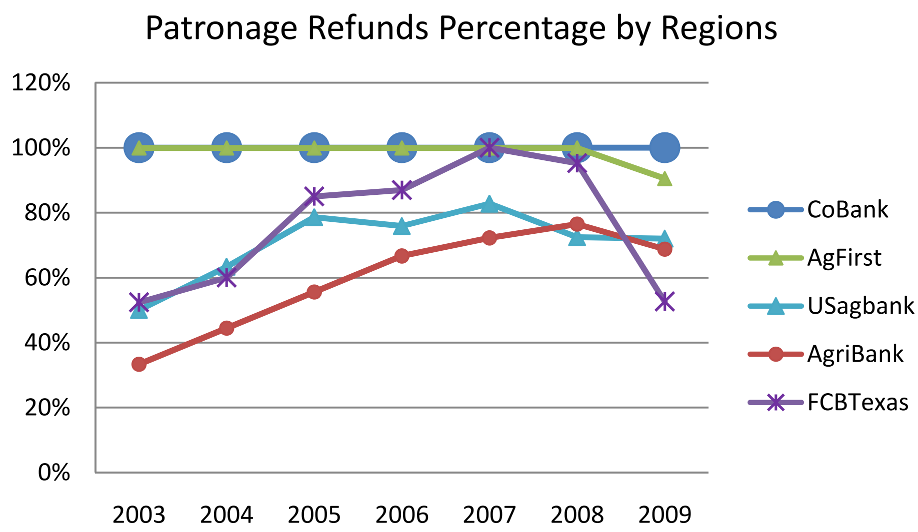


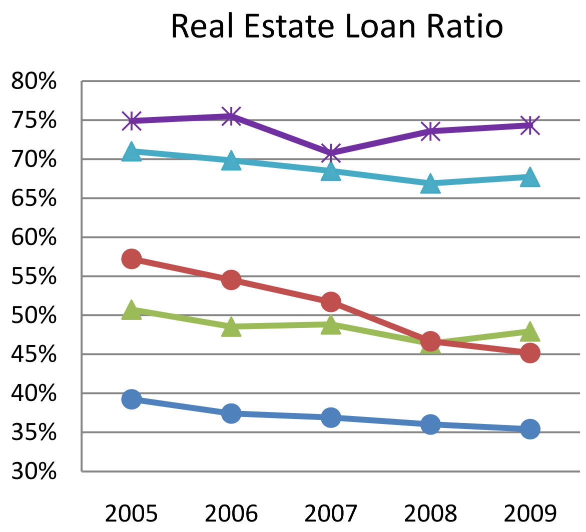

Figure3 gives the percentage of associations paid cash patronage refunds by regions. Data from 2003 are used because the current five districts were structured since then. All the five associations in the CoBank district have patronage refunds payment in each year. AgFirst associations are regular payers between 2003 and 2008. Only in 2009 two associations out of 21 do not pay patronage refunds. There is obvious trend that more associations in AgriBank and US AgBank start to pay patronage refunds over the years. FCB Texas is the one with large deviation. In 2003 about half of their association has patronage refunds, as well as in 2009. But in 2007 all associations pay patronage refunds.

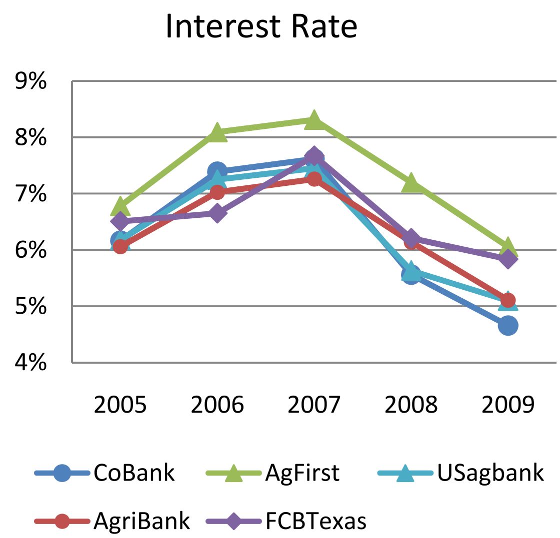
Figure3. Patronage refunds percentage by regions 2003-2009.




To further analyze the regional patronage refunds pattern, Figure4 compare the ratio of real estate loans to total loans and the implied interest rate. The ratio of an association's real estate loan over total loans is available since 2005 in the FCA reports. The higher that ratio, the less contact the association has with borrowers, and the less valuable a patronage policy becomes. Usually if the association have heavy reliance on real estate loans the borrower contact is less important. Besides paying patronage refunds, associations can also share profit with their members by lowering the interest rate on the loans. For example, Briggeman and Jorgensen (2009) analyze the preference between cash patronage refunds versus lower fixed real estate interest rates and find strong preference on patronage refunds. Therefore interest rate is a relevant factor that influences the patronage refunds policy. Actual interest rate is impossible to be traced in the lender's accounting book so I use the ratio of *total interest income from loans and leases* over *total accrual loans and leases* to represent the interest charged by the association. Lower interest rate reduces the borrowing cost of the members.

Figure4. Real estate loans ration and implied interest rate.




CoBank has the lowest ratio of real estate loans which indicates the importance of bonding with borrowers and supports the observation of 100% of patronage refunds payers. AgFirst has the second lowest ratio of real estate loans and has 100% of patronage refunds payers in most years. FCB Texas and US AgBank have the highest real estate loans ratios and their patronage refunds behavior are quite similar except 2009. As for the interest rate, it is not meaningful to compare the absolute levels between regions since the term loans portfolio are different between regions. But it is meaningful to point out the different patronage refunds policy between AgriBank and AgFirst (the red and green lines in the figure4). From the Real Estate ratio chart the AgriBank and AgFirst have similar real estate loan ratios but AgFirst obviously charge a higher interest rate than AgriBank. There is almost 1% interest gap. AgFirst pays significantly more patronage refunds than AgriBank. It shows that even the loans structures of the two regions are similar AgFirst choose to return the profit by paying patronage refunds while AgriBank choose to return the profit by charging a lower interest rate. Besides real estate loans ratio and interest rate, there are other factors that are believed to influence patronage refunds decision. More explanation on the selection of variables and a logit model are introduced in the following sections.

## 5. Data Description and Model Specification

The data used in this paper are the quarterly data downloaded from Farm Credit Administration web site.[3] Currently Call report[4] data between March 2000 and December 2009 are available. In each quarter, there are about 20 different Schedules including Balance Sheet, Income Statement, Changes in Net Worth, Reconcilement of Net Worth, Performance of Loans, and etc. Insights to create an empirical patronage refunds model come from the literature of capital management of cooperatives and the literature of bank dividends policy. I propose that the decision of paying the patronage refund is affected by the following factors: size, profitability, capital adequacy, retained earnings, investment opportunity, risk, interest rate, tax, real estate loans share. After merging schedules and generating annual variables, I have 1187 observations with approximately 300 associations over 10 years. The dataset is unbalanced because of the continuous mergers of associations and combination of regions.

In the theory of corporate finance dividends tend to be paid by mature firms who have higher profitability but lower growth rate. It is referred as Life-cycle theory in dividends literature (Fama and French 2001, Grullon, Michaely and Swaminathan 2002, DeAngelo, DeAngelo and Stulz 2006) and such relation is tested by my model. *Profit* is defined as Return

[3] http://www.fca.gov/exam/data_download.html
[4] http://www2.fdic.gov/Call_TFR_Rpts/inform.asp

on Assets which equals Current Earnings/Assets. *Grow* is defined as the current Total Loans/Assets. *Grow* also represents the investment opportunity since loans composes the majority of the investment in FCS cooperatives.[5]

Asset is used as the *Size* variable to find out if large associations pay higher patronage refunds. *Capital-adequacy (EA ratio)* is measured as the ratio of equity capital over total assets. *URE* is defined as the unallocated retained earnings over the earning surplus. It measures the proportion of earnings that is retained as unallocated. As used in Figure4, *Interest-Rate* is defined as the total loans interest income divided by the total accrual loans. *Real Estate ratio* is defined as the real estate loans over total loans. *Credit-Risk* is defined as the proportion of nonaccrual loans, i.e. the amount of bad loans in the total loans. *Tax* is defined as taxes paid over income before income taxes and extraordinary items. In order to keep the factors within a comparable magnitude, ratios are multiplied by 100 to indicate a percentage change. Log Assets is used as *Size*.

Means of the explanatory variables are summarized and compared between the associations who pay patronage and those who don't in Table2. In order to keep the observations consistent and comparable with a balanced dataset, I choose data from 2005 to 2009 since the real estate ratio is only available from 2005. And I only include the associations who appear in all the five years which end up with 75 ACAs[6] and 375 observations.

[5] In commercial banks, loans are normally as important as securities in the point of view of bank investment. But FCS cooperatives are established to provide agricultural loans to farmers, loans is absolutely the major investment.
[6] ACA: Agricultural Credit Association. An ACA can provide short, intermediate, and long term credit to borrowers. ACAs are the majority type of associations in FCS. The other type is FLCA, Federal Land Credit Association, which only make long term loans.

Table2. Means of the explanatory factor (all in percentage except Size)

| Year | N= 66 | N= 309 | **Real Estate Ratio** | | **Interest Rate** | | **Grow** | | **Profit** | |
|---|---|---|---|---|---|---|---|---|---|---|
| Payer or not | N | Y | N | Y | N | Y | N | Y | N | Y |
| 2005 | 15 | 60 | 66.16 | 56.81 | 6.12 | 6.40 | 94.65 | 93.83 | 17.49 | 17.87 |
| 2006 | 12 | 63 | 62.02 | 56.23 | 7.14 | 7.39 | 93.60 | 92.58 | 19.78 | 16.60 |
| 2007 | 8 | 67 | 65.51 | 54.81 | 6.97 | 7.62 | 94.34 | 91.92 | 19.37 | 16.36 |
| 2008 | 10 | 65 | 60.96 | 52.99 | 5.90 | 6.31 | 93.80 | 91.77 | 17.90 | 15.95 |
| 2009 | 21 | 54 | 62.27 | 50.86 | 5.53 | 5.26 | 92.85 | 92.15 | 16.10 | 16.24 |
| Year | **EA ratio** | | **URE** | | **Size** | | **Credit Risk** | | **Tax** | |
| Payer or not | N | Y | N | Y | N | Y | N | Y | N | Y |
| 2005 | 18.25 | 18.89 | 97.89 | 83.06 | 12.99 | 13.07 | 0.49 | 0.46 | 3.13 | 3.25 |
| 2006 | 20.94 | 17.34 | 99.10 | 83.76 | 12.65 | 13.27 | 0.55 | 0.38 | 3.43 | 1.37 |
| 2007 | 20.10 | 17.11 | 100.00 | 84.37 | 13.33 | 13.26 | 0.39 | 0.48 | 4.79 | 1.58 |
| 2008 | 18.41 | 16.65 | 100.00 | 83.33 | 12.95 | 13.42 | 0.88 | 1.01 | 3.06 | 1.11 |
| 2009 | 16.72 | 16.81 | 86.31 | 78.17 | 12.92 | 13.57 | 3.45 | 2.13 | 2.50 | 1.93 |

The associations who do not pay patronage refunds usually have higher percentage of real estate loans, charge lower interest rate, have more loans volume, are more profitable, have higher capital adequacy, keep significantly more earnings as unallocated, slightly smaller in size, and pay more tax. The Credit risk difference is not conclusive. The descriptive statistics are not contradictory to my anticipation in most cases. Whether or not the relations exist as expected and are significant need to be tested with statistical regression.

Logistic model is selected since the dependent variable is dichotomic. 1 indicates the paying patronage refunds decision and 0 indicates the not paying decision. Unlike OLS regression, Logistic regression has less restrictions, such as: it does not assume the linear relationship between dependent and independent, does not require normality of variables, and does not assume homoscedasticity. But Logistic model requires that the observations are independent. When this assumption is violated the estimated standard errors are incorrect and may lead wrong inferences. Since my dataset do have repeated measure on the same subject over years and the observations of same subject over years are likely to be dependent, the method of generalized estimating equations (GEE) is used to account for the correlations among the observations of same subject.

GEE first estimates the parameters with the assumption of independent observations and uses the residuals to estimate the correlations among observations of same subject. Then the correlation is used to conduct the second round of estimation of the parameters. This process is repeated until the difference between two successive estimates are very small. In SAS PROC GENMOD with the REPEATED option is implemented to fit the data.

## 6. Preliminary Results

Since the CoBank region only has five associations, the logistic model with GEE cannot generate positive definite Hessian matrix for a valid estimation with the region dummy variables. In order to evaluate the region diversity on paying patronage refunds, a regular logistic model is utilized. Then GEE is applied without region dummies. The first run includes all valid 1187 observations with 10 different regions in 10 years.[7] The second run includes only the five current regions and 603 observations (2003-2009) are used. Table3 lists the significant parameters estimates. Complete statistics results are attached by the end of the paper. The model estimated with regular logistic regression is specified as:

[7] Regions are merged and combined into five since 2003.

$$\ln(patronage = 1) = \alpha + \sum \beta_k X_k + \sum \lambda_n Z_n + \varepsilon$$
$$= \alpha + \beta_1 Interest\_rate + \beta_2 profit + \beta_3 Grow + \beta_4 EA + \beta_5 URE$$
$$+ \beta_6 Tax + \beta_7 Credit\_risk + \beta_8 Size + \sum \lambda_n region_n + \varepsilon$$

Table3. Significant parameters of the regular logistic regression model with region dummies.

| **Run 1** | 1174 Observations (2000-2009) | | | **Run 2** | 603 observations (2003-2009) | | |
|---|---|---|---|---|---|---|---|
| Parameters | Estimate | Std Err | Pr>ChiSq | Parameters | Estimate | Std Err | Pr>ChiSq |
| **Dist9** | -0.9252 | 0.2721 | 0.0007 | | | | |
| **Dist11** | -2.4301 | 0.3995 | <0.0001 | | | | |
| **Dist17** | -1.447 | 0.2919 | <0.0001 | | | | |
| **Dist18** | -1.874 | 0.7627 | 0.014 | **Dist10** | 0.9093 | 0.4096 | 0.0264 |
| **Dist20** | 3.1925 | 0.5673 | <0.0001 | **Dist20** | 2.5774 | 0.7406 | 0.0005 |
| **Dist22** | -0.7333 | 0.2513 | 0.0035 | **Dist22** | -0.666 | 0.2913 | 0.0222 |
| **Interest Rate** | 18.9509 | 4.2046 | <0.0001 | **Interest Rate** | 25.6903 | 8.8258 | 0.0036 |
| **URE** | -1.2652 | 0.5306 | 0.0171 | **URE** | -4.034 | 1.3209 | 0.0023 |
| **Credit Risk** | -32.1577 | 8.1617 | <0.0001 | **Credit Risk** | -41.2094 | 11.149 | 0.0002 |
| **Size** | 0.3453 | 0.0873 | <0.0001 | **Size** | 0.4088 | 0.1191 | 0.0006 |

The two runs basically give consistent results with the same set and signs of significant parameters. Dist20 is AgFirst and Dist22 is AgriBank. The positive sign on Dist20 and negative sign on Dist22 indicate that associations in AgFrist region more likely decide to pay patronage refunds and associations in AgriBank less likely to pay. This support the regional pattern showed in Figure2. Among all the eight defined explanatory variables, Interest Rate, URE rate, Credit Risk and Size are significant. The associations with higher interest rate, lower percentage of earnings retained as unallocated, lower credit risk, and larger size have higher probability of choosing to pay patronage refunds.

From the goodness of fit criteria, Scaled Deviance and Pearson's Chi-square statistics are very close to 1 which indicate no overdispersion or underdispersion. The Likelihood Ratio statistics in the Type 1 analysis gives information on testing the hypothesis of the significance of each additional explanatory variable and both of the two runs of model show that region dummy, interest rate, capital adequacy, credit risk and size are significant to the model fitness improvement.

In order to adjust for the repeated measurement of same association over years, GEE is applied and the working correlation between the dependent observations is assumed to be autoregressive with AR(1). Region dummies have to be removed to get the algorithm converged. Also the real estate ratio is omitted from the regular logistic model since this variable is only available after 2005. Adding this explanatory variable reduces the dataset into 375 observations with 75 ACAs in 5 years. The model estimated with GEE is specified as the following

$$\begin{aligned} \ln(patronage = 1) = \alpha + \beta_1 RE\_rate + \beta_2 Interest\_rate + \beta_3 profit + \beta_4 Grow \\ + \beta_5 EA + \beta_6 URE + \beta_7 Tax + \beta_8 Credit\_risk + \beta_9 Size + \varepsilon \end{aligned}$$

Table4 provides the parameters estimates. Among the nine explanatory variables, real estate rate, interest rate, unallocated retained earnings rate, and credit risk are significant. Therefore the model is fitted again with only the significant factors in Run4 and removing insignificant factors does not affect the model fitness because the goodness of fit statistics do not change. The GEE results also support the relationships showed in the regular logistic model in Run1 and Run2. In general, the associations with higher interest rate, lower real estate loans ratio, less unallocated retained earnings, and smaller credit risk are more likely to pay cash patronage refunds.

Table4. Parameter estimates of GEE.

| **Run3** | **375 observations** | | **Deviance=0.7671** | | **Pearson=0.823** | |
|---|---|---|---|---|---|---|
| Parameters | Estimate | Std Err | 95% Confidence Limits | | Z | Pr > \|Z\| |
| **Intercept** | 2.4486 | 5.3559 | -8.0487 | 12.9459 | 0.46 | 0.6475 |
| **RE_rate** | **-4.3702** | 1.6115 | -7.5287 | -1.2117 | -2.71 | 0.0067 |
| **Profit** | 9.0082 | 25.497 | -40.9651 | 58.9814 | 0.35 | 0.7239 |
| **Interest rate** | **28.7565** | 14.5697 | 0.2005 | 57.3126 | 1.97 | 0.0484 |
| **Grow** | -1.8551 | 3.3268 | -8.3755 | 4.6653 | -0.56 | 0.5771 |
| **Ea** | -1.6142 | 25.0817 | -50.7734 | 47.545 | -0.06 | 0.9487 |
| **URE** | **-3.5524** | 1.336 | -6.1709 | -0.9339 | -2.66 | 0.0078 |
| **Tax** | 0.0089 | 0.9684 | -1.8891 | 1.9069 | 0.01 | 0.9927 |
| **Credit risk** | **-48.4507** | 17.0935 | -81.9532 | -14.9481 | -2.83 | 0.0046 |
| **Size** | 0.3053 | 0.3093 | -0.3009 | 0.9115 | 0.99 | 0.3237 |
| **Run4** | **375 observations** | | **Deviance=0.7782** | | **Pearson=0.839** | |
| Parameters | Estimate | Std Err | 95% Confidence Limits | | Z | Pr > \|Z\| |
| **Intercept** | 6.1185 | 1.7611 | 2.6669 | 9.5702 | 3.47 | 0.0005 |
| **RE_rate** | -4.3795 | 1.4142 | -7.1513 | -1.6077 | -3.1 | 0.002 |
| **Interest rate** | 25.2269 | 13.4727 | -1.179 | 51.6328 | 1.87 | 0.0611 |
| **URE** | -3.4412 | 1.2677 | -5.9259 | -0.9565 | -2.71 | 0.0066 |
| **Credit risk** | -48.35 | 15.6927 | -79.107 | -17.593 | -3.08 | 0.0021 |

$$\ln(patronage = 1)$$
$$= 6.12 - 4.38RE\_rate + 25.23Interest\_rate - 3.44URE - 48.35Credit\_risk$$
$$\Rightarrow$$
$$prob(paying) = \frac{\exp(6.12 - 4.38RE\_rate + 25.23Interest\_rate - 3.44URE - 48.35Credit\_risk)}{1 + \exp(6.12 - 4.38RE\_rate + 25.23Interest\_rate - 3.44URE - 48.35Credit\_risk)}$$

In order to compare the influence of each significant factors, I assume a baseline scenario with real estate ratio 0.5, interest rate 0.05, URE 0.8 and credit risk 0.01. Table 5 gives the effect on the probability of paying patronage refunds with changing one factor at a time.

Table5. Demonstration of the probability change of paying patronage refunds

| coefficients | Baseline | Real estate ratio | Interest rate | URE | Credit risk |
|---|---|---|---|---|---|
| **6.12** | | | | | |
| **-4.38** | 0.5 | 0.6 | 0.5 | 0.5 | 0.5 |
| **25.23** | 0.05 | 0.05 | 0.06 | 0.05 | 0.05 |
| **-3.44** | 0.8 | 0.8 | 0.8 | 0.9 | 0.8 |
| **-48.35** | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| | **Baseline** | **Real estate ratio** | **Interest rate** | **URE** | **Credit risk** |
| $\alpha + \beta X$ | 1.956 | 1.518 | 2.2083 | 1.612 | 1.4725 |
| **exp(**$\alpha + \beta X$ **)** | 7.070986 | 4.563089883 | 9.10023284 | 5.012827 | 4.360122 |
| **Probability** | 0.876099 | 0.820243782 | 0.900992381 | 0.833689 | 0.813437 |

For example, if the real estate loans ratio increases from 0.5 to 0.6 and all other factors do not change, then the probability of paying patronage refunds drops from 0.876 to 0.82. Accordingly probability of paying increases from 0.876 to 0.9 with 1% increase of interest rate. On the other hand, the probability decreases from 0.876 to 0.834 when URE changes from 0.8 to 0.9, and decreases from 0.876 to 0.813 when bad loans ratio increases 1%.

## 7. Main Conclusions

Associations normally are reluctant to change the patronage refunds policy. Among the 1187 observations in my dataset, I only find 50 observations of switching from not paying patronage refunds to paying, 59 observations of switching from paying to not paying. In all other observations the association keeps the same policy in current year as the previous year, no matter paying or not paying. But on average, there is clearly trend of more associations paying patronage refunds over time. Associations in different bank region do show different preference on patronage refunds policy. Some choose to return the profit to members by paying patronage refunds in cash and some choose to lower the loan interest rate.

It is true that the patronage refunds policy is largely a decision made by the management team at very individual association level. Sometimes it can be triggered by quite specific reason, such as marketing tool, lump sum cash for member's tax burden, or response to bank's patronage policy change. In this paper, the good model fitness and consistent estimates over different model runs provide empirical evidence on the relationships between certain factors and the paying decision in general.

Among the proposed relevant factors: size, profitability, loans volume, capital adequacy, bad loans, interest rate, and real estate loans share, four factors are significant: real estate loans share, interest rate, unallocated retained earnings share, and bad loans ratio. When the association faces the decision of patronage refunds, a high interest rate charged, a low real estate loans reliance, a low credit risk, and a lower unallocated earnings share usually affect the association to prefer a patronage refunds paying decision.

This paper does not find evidence to support the life cycle theory of dividends policy in corporate finance. The profit level and growth of loans do not have significant effect on the decision of paying patronage refunds in FCS associations. Main reason is that FCS is a regulated cooperative system and the goal of operation is not maximizing the return of investor's investment.

Future analysis on how much patronage refund is decided among the payers will help understand the allocation and capital management of the equity in FCS associations. Enventually with more data observations, regional dummies should be added back to the GEE estimation in order to better illustrate the regional patterns on patronage refunds. Also the analysis of the term structure of revolving account is not approachable in statistical models because of the data limitation. A simulation model may be preferred in order to add the revolving account to the analysis of patronage refunds.

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## The SAS System

### The GENMOD Procedure

| Model Information | |
|---|---|
| Data Set | WORK.TEST1 |
| Distribution | Binomial |
| Link Function | Logit |
| Dependent Variable | paid_cash |
| Observations Used | 1174 |
| Probability Modeled | Pr( paid_cash = 1 ) |
| Missing Values | 13 |

**Class Level Information**

| Class | Levels | Values |
|---|---|---|
| DIST | 10 | 9 10 11 17 18 20 21 22 23 24 |

**Response Profile**

| Ordered Level | Ordered Value | Count |
|---|---|---|
| 1 | 1 | 751 |
| 2 | 0 | 423 |

**Criteria For Assessing Goodness Of Fit**

| Criterion | DF | Value | Value/DF |
|---|---|---|---|
| Deviance | 1156 | 1063.9396 | 0.9204 |
| Scaled Deviance | 1156 | 1063.9396 | 0.9204 |
| Pearson Chi-Square | 1156 | 993.0680 | 0.8591 |
| Scaled Pearson X2 | 1156 | 993.0680 | 0.8591 |
| Log Likelihood | | -531.9698 | |

Algorithm converged.

**Analysis Of Parameter Estimates**

| Parameter | | DF | Estimate | Standard Error | Wald 95% Confidence Limits | | Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|---|---|
| Intercept | | 1 | -3.8298 | 2.5062 | -8.7418 | 1.0822 | 2.34 | 0.1265 |
| DIST | 9 | 1 | -0.9252 | 0.2721 | -1.4585 | -0.3918 | 11.56 | 0.0007 |
| DIST | 10 | 1 | 0.1185 | 0.2544 | -0.3802 | 0.6171 | 0.22 | 0.6415 |
| DIST | 11 | 1 | -2.4301 | 0.3995 | -3.2131 | -1.6470 | 36.99 | <.0001 |





| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DIST | 17 | 1 | -1.4470 | 0.2919 | -2.0190 | -0.8749 | 24.58 | <.0001 |
| DIST | 18 | 1 | -1.8740 | 0.7627 | -3.3689 | -0.3791 | 6.04 | 0.0140 |
| DIST | 20 | 1 | 3.1925 | 0.5673 | 2.0807 | 4.3044 | 31.67 | <.0001 |
| DIST | 21 | 1 | 1.6821 | 1.0727 | -0.4204 | 3.7846 | 2.46 | 0.1169 |
| DIST | 22 | 1 | -0.7333 | 0.2513 | -1.2259 | -0.2408 | 8.51 | 0.0035 |
| DIST | 23 | 1 | 23.4144 | 30189.98 | -59147.9 | 59194.69 | 0.00 | 0.9994 |
| DIST | 24 | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | . | . |
| profit | | 1 | 9.0760 | 5.8225 | -2.3358 | 20.4878 | 2.43 | 0.1190 |
| interest | | 1 | 18.9509 | 4.2046 | 10.7101 | 27.1917 | 20.31 | <.0001 |
| grow | | 1 | -1.0031 | 2.2311 | -5.3760 | 3.3698 | 0.20 | 0.6530 |
| ea | | 1 | -0.7953 | 5.6417 | -11.8529 | 10.2623 | 0.02 | 0.8879 |
| URE | | 1 | -1.2652 | 0.5306 | -2.3053 | -0.2252 | 5.68 | 0.0171 |
| tax | | 1 | -0.2466 | 0.3846 | -1.0004 | 0.5073 | 0.41 | 0.5215 |
| credit | | 1 | -32.1577 | 8.1617 | -48.1543 | -16.1610 | 15.52 | <.0001 |
| size | | 1 | 0.3453 | 0.0873 | 0.1742 | 0.5164 | 15.65 | <.0001 |
| Scale | | 0 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | | |

NOTE: The scale parameter was held fixed.

**LR Statistics For Type 1 Analysis**

| Source | Deviance | DF | Chi-Square | Pr > ChiSq |
|---|---|---|---|---|
| Intercept | 1534.6397 | | | |
| DIST | 1129.7147 | 9 | 404.93 | <.0001 |
| profit | 1126.5691 | 1 | 3.15 | 0.0761 |
| interest | 1107.0238 | 1 | 19.55 | <.0001 |
| grow | 1107.0229 | 1 | 0.00 | 0.9757 |
| ea | 1102.9589 | 1 | 4.06 | 0.0438 |
| URE | 1098.5138 | 1 | 4.45 | 0.0350 |
| tax | 1096.5318 | 1 | 1.98 | 0.1592 |
| credit | 1080.1412 | 1 | 16.39 | <.0001 |
| size | 1063.9396 | 1 | 16.20 | <.0001 |





## The SAS System

### The GENMOD Procedure

| Model Information | |
|---|---|
| Data Set | WORK.TEST2 |
| Distribution | Binomial |
| Link Function | Logit |
| Dependent Variable | paid_cash |
| Observations Used | 603 |
| Probability Modeled | Pr( paid_cash = 1 ) |

**Class Level Information**

| Class | Levels | Values |
|---|---|---|
| new_dist | 5 | 10 20 22 23 24 |

**Response Profile**

| Ordered Level | Ordered Value | Count |
|---|---|---|
| 1 | 1 | 469 |
| 2 | 0 | 134 |

**Criteria For Assessing Goodness Of Fit**

| Criterion | DF | Value | Value/DF |
|---|---|---|---|
| Deviance | 590 | 476.1518 | 0.8070 |
| Scaled Deviance | 590 | 476.1518 | 0.8070 |
| Pearson Chi-Square | 590 | 444.6927 | 0.7537 |
| Scaled Pearson X2 | 590 | 444.6927 | 0.7537 |
| Log Likelihood | | -238.0759 | |

Algorithm converged.

**Analysis Of Parameter Estimates**

| Parameter | | DF | Estimate | Standard Error | Wald 95% Confidence Limits | | Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|---|---|
| Intercept | | 1 | -0.6561 | 3.9835 | -8.4635 | 7.1514 | 0.03 | 0.8692 |
| new_dist | 10 | 1 | 0.9093 | 0.4096 | 0.1065 | 1.7120 | 4.93 | 0.0264 |
| new_dist | 20 | 1 | 2.5774 | 0.7406 | 1.1258 | 4.0291 | 12.11 | 0.0005 |
| new_dist | 22 | 1 | -0.6660 | 0.2913 | -1.2370 | -0.0951 | 5.23 | 0.0222 |





| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| new_dist | 23 | 1 | 24.2554 | 53209.37 | -104264 | 104312.7 | 0.00 | 0.9996 |
| new_dist | 24 | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | . | . |
| profit | | 1 | -8.4507 | 10.6783 | -29.3799 | 12.4784 | 0.63 | 0.4287 |
| interest | | 1 | 25.6903 | 8.8258 | 8.3920 | 42.9886 | 8.47 | 0.0036 |
| grow | | 1 | -3.5874 | 3.6582 | -10.7573 | 3.5825 | 0.96 | 0.3268 |
| ea | | 1 | 19.8531 | 10.7230 | -1.1636 | 40.8698 | 3.43 | 0.0641 |
| URE | | 1 | -4.0340 | 1.3209 | -6.6229 | -1.4452 | 9.33 | 0.0023 |
| tax | | 1 | 0.1560 | 0.4449 | -0.7159 | 1.0280 | 0.12 | 0.7258 |
| credit | | 1 | -41.2094 | 11.1490 | -63.0612 | -19.3577 | 13.66 | 0.0002 |
| size | | 1 | 0.4088 | 0.1191 | 0.1753 | 0.6423 | 11.77 | 0.0006 |
| Scale | | 0 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | | |

NOTE: The scale parameter was held fixed.

**LR Statistics For Type 1 Analysis**

| Source | Deviance | DF | Chi-Square | Pr > ChiSq |
|---|---|---|---|---|
| Intercept | 638.8257 | | | |
| new_dist | 532.5285 | 4 | 106.30 | <.0001 |
| profit | 532.1116 | 1 | 0.42 | 0.5185 |
| interest | 516.8807 | 1 | 15.23 | <.0001 |
| grow | 515.4942 | 1 | 1.39 | 0.2390 |
| ea | 515.3370 | 1 | 0.16 | 0.6918 |
| URE | 504.8323 | 1 | 10.50 | 0.0012 |
| tax | 504.8290 | 1 | 0.00 | 0.9541 |
| credit | 488.6934 | 1 | 16.14 | <.0001 |
| size | 476.1518 | 1 | 12.54 | 0.0004 |

# The SAS System

## The GENMOD Procedure

| Model Information | |
|---|---|
| Data Set | WORK.TEST4 |
| Distribution | Binomial |
| Link Function | Logit |
| Dependent Variable | paid_cash |
| Observations Used | 375 |
| Probability Modeled | Pr( paid_cash = 1 ) |

**Class Level Information**

| Class | Levels | Values |
|---|---|---|
| UNINUM | 75 | 710025 710032 710056 710114 710119 710122 710150 710551 710739 710862 720033 720040 720060 720061 720105 720131 720143 720168 720181 720186 720187 720188 720189 720191 720194 720331 720335 720336 720735 720861 720899 722012 722072 722075 722077 722114 ... |

**Response Profile**

| Ordered Level | Ordered Value | Count |
|---|---|---|
| 1 | 1 | 309 |
| 2 | 0 | 66 |

**Parameter Information**

| Parameter | Effect |
|---|---|
| Prm1 | Intercept |
| Prm2 | RE_rate |
| Prm3 | profit |
| Prm4 | interest |
| Prm5 | grow |
| Prm6 | ea |
| Prm7 | URE |
| Prm8 | tax |
| Prm9 | credit |
| Prm10 | size |

**Criteria For Assessing Goodness Of Fit**

| Criterion | DF | Value | Value/DF |
|---|---|---|---|





| | | | |
|---|---|---|---|
| Deviance | 365 | 279.9977 | 0.7671 |
| Scaled Deviance | 365 | 279.9977 | 0.7671 |
| Pearson Chi-Square | 365 | 300.3867 | 0.8230 |
| Scaled Pearson X2 | 365 | 300.3867 | 0.8230 |
| Log Likelihood | | -139.9988 | |

Algorithm converged.

**Analysis Of Initial Parameter Estimates**

| Parameter | DF | Estimate | Standard Error | Wald 95% Confidence Limits | | Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|---|
| Intercept | 1 | -0.3805 | 4.5959 | -9.3883 | 8.6274 | 0.01 | 0.9340 |
| RE_rate | 1 | -4.4239 | 1.1838 | -6.7442 | -2.1036 | 13.96 | 0.0002 |
| profit | 1 | 20.6438 | 16.3404 | -11.3829 | 52.6704 | 1.60 | 0.2065 |
| interest | 1 | 50.3156 | 18.3267 | 14.3960 | 86.2351 | 7.54 | 0.0060 |
| grow | 1 | 2.4040 | 3.9515 | -5.3408 | 10.1489 | 0.37 | 0.5429 |
| ea | 1 | -13.4315 | 16.1882 | -45.1598 | 18.2969 | 0.69 | 0.4067 |
| URE | 1 | -5.7141 | 1.5220 | -8.6971 | -2.7311 | 14.10 | 0.0002 |
| tax | 1 | -1.0977 | 1.8725 | -4.7678 | 2.5724 | 0.34 | 0.5577 |
| credit | 1 | -36.5009 | 12.4879 | -60.9769 | -12.0250 | 8.54 | 0.0035 |
| size | 1 | 0.2692 | 0.1480 | -0.0208 | 0.5592 | 3.31 | 0.0689 |
| Scale | 0 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | | |

NOTE: The scale parameter was held fixed.

| GEE Model Information | |
|---|---|
| Correlation Structure | AR(1) |
| Subject Effect | UNINUM (75 levels) |
| Number of Clusters | 75 |
| Correlation Matrix Dimension | 5 |
| Maximum Cluster Size | 5 |
| Minimum Cluster Size | 5 |

**Covariance Matrix (Model-Based)**

| | Prm1 | Prm2 | Prm3 | Prm4 | Prm5 | Prm6 | Prm7 | Prm8 | Prm9 | Prm10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Prm1 | 31.15104 | -0.01071 | 14.08932 | -36.80868 | -17.80222 | -22.96910 | -0.19091 | -0.32989 | -26.41830 | -0.76230 |
| Prm2 | -0.01071 | 2.73334 | -9.98052 | -3.89541 | -1.90516 | 7.86292 | 0.13848 | 0.14369 | 1.53716 | 0.03822 |
| Prm3 | 14.08932 | -9.98052 | 596.45 | 25.61652 | 11.35093 | -578.75 | -2.73443 | 2.54503 | -13.45547 | -1.26059 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Prm4 | -36.80868 | -3.89541 | 25.61652 | 263.59 | 10.46192 | -17.19585 | 1.05854 | 0.16926 | 64.30005 | 0.80358 |
| Prm5 | -17.80222 | -1.90516 | 11.35093 | 10.46192 | 20.99932 | -9.56241 | -1.56860 | -0.06501 | 10.85241 | -0.02096 |
| Prm6 | -22.96910 | 7.86292 | -578.75 | -17.19585 | -9.56241 | 595.14 | -0.23984 | -2.15960 | 8.88119 | 1.61722 |
| Prm7 | -0.19091 | 0.13848 | -2.73443 | 1.05854 | -1.56860 | -0.23984 | 2.24108 | -0.18041 | 8.21694 | -0.008030 |
| Prm8 | -0.32989 | 0.14369 | 2.54503 | 0.16926 | -0.06501 | -2.15960 | -0.18041 | 2.01692 | -1.00979 | 0.02773 |
| Prm9 | -26.41830 | 1.53716 | -13.45547 | 64.30005 | 10.85241 | 8.88119 | 8.21694 | -1.00979 | 153.55 | 0.19462 |
| Prm10 | -0.76230 | 0.03822 | -1.26059 | 0.80358 | -0.02096 | 1.61722 | -0.008030 | 0.02773 | 0.19462 | 0.04898 |

**Covariance Matrix (Empirical)**

| | Prm1 | Prm2 | Prm3 | Prm4 | Prm5 | Prm6 | Prm7 | Prm8 | Prm9 | Prm10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Prm1 | 28.68529 | -1.01626 | 45.39661 | -30.91287 | -5.31314 | -56.53267 | -1.96937 | 0.60114 | -42.87292 | -1.28300 |
| Prm2 | -1.01626 | 2.59699 | -12.16064 | -3.35000 | -1.44945 | 7.78562 | 0.33894 | 0.04985 | 1.36849 | 0.10506 |
| Prm3 | 45.39661 | -12.16064 | 650.10 | 40.16566 | 5.57069 | -622.95 | -3.81041 | -1.57732 | -1.00632 | -3.30401 |
| Prm4 | -30.91287 | -3.35000 | 40.16566 | 212.28 | -2.16013 | -14.66539 | 1.63575 | -0.94847 | 79.00276 | 1.15085 |
| Prm5 | -5.31314 | -1.44945 | 5.57069 | -2.16013 | 11.06754 | -2.80777 | -1.16334 | -0.84856 | 16.01899 | -0.28112 |
| Prm6 | -56.53267 | 7.78562 | -622.95 | -14.66539 | -2.80777 | 629.09 | 2.97305 | 1.71945 | 22.03333 | 3.64979 |
| Prm7 | -1.96937 | 0.33894 | -3.81041 | 1.63575 | -1.16334 | 2.97305 | 1.78489 | -0.28989 | 9.44958 | 0.09436 |
| Prm8 | 0.60114 | 0.04985 | -1.57732 | -0.94847 | -0.84856 | 1.71945 | -0.28989 | 0.93778 | -7.58377 | 0.04216 |
| Prm9 | -42.87292 | 1.36849 | -1.00632 | 79.00276 | 16.01899 | 22.03333 | 9.44958 | -7.58377 | 292.19 | 0.46909 |
| Prm10 | -1.28300 | 0.10506 | -3.30401 | 1.15085 | -0.28112 | 3.64979 | 0.09436 | 0.04216 | 0.46909 | 0.09567 |

Algorithm converged.

**Working Correlation Matrix**

| | Col1 | Col2 | Col3 | Col4 | Col5 |
|---|---|---|---|---|---|
| Row1 | 1.0000 | 0.6109 | 0.3732 | 0.2280 | 0.1392 |
| Row2 | 0.6109 | 1.0000 | 0.6109 | 0.3732 | 0.2280 |
| Row3 | 0.3732 | 0.6109 | 1.0000 | 0.6109 | 0.3732 |
| Row4 | 0.2280 | 0.3732 | 0.6109 | 1.0000 | 0.6109 |
| Row5 | 0.1392 | 0.2280 | 0.3732 | 0.6109 | 1.0000 |

**Analysis Of GEE Parameter Estimates**

**Empirical Standard Error Estimates**

| Parameter | Estimate | Standard Error | 95% Confidence Limits | | Z | Pr > \|Z\| |
|---|---|---|---|---|---|---|
| Intercept | 2.4486 | 5.3559 | -8.0487 | 12.9459 | 0.46 | 0.6475 |
| RE_rate | -4.3702 | 1.6115 | -7.5287 | -1.2117 | -2.71 | 0.0067 |
| profit | 9.0082 | 25.4970 | -40.9651 | 58.9814 | 0.35 | 0.7239 |





| | | | | | | |
|---|---|---|---|---|---|---|
| interest | 28.7565 | 14.5697 | 0.2005 | 57.3126 | 1.97 | 0.0484 |
| grow | -1.8551 | 3.3268 | -8.3755 | 4.6653 | -0.56 | 0.5771 |
| ea | -1.6142 | 25.0817 | -50.7734 | 47.5450 | -0.06 | 0.9487 |
| URE | -3.5524 | 1.3360 | -6.1709 | -0.9339 | -2.66 | 0.0078 |
| tax | 0.0089 | 0.9684 | -1.8891 | 1.9069 | 0.01 | 0.9927 |
| credit | -48.4507 | 17.0935 | -81.9532 | -14.9481 | -2.83 | 0.0046 |
| size | 0.3053 | 0.3093 | -0.3009 | 0.9115 | 0.99 | 0.3237 |

**Score Statistics For Type 3 GEE Analysis**

| Source | DF | Chi-Square | Pr > ChiSq |
|---|---|---|---|
| RE_rate | 1 | 5.31 | 0.0212 |
| profit | 1 | 0.08 | 0.7841 |
| interest | 1 | 3.11 | 0.0780 |
| grow | 1 | 0.36 | 0.5472 |
| ea | 1 | 0.00 | 0.9573 |
| URE | 1 | 6.56 | 0.0105 |
| tax | 1 | 0.00 | 0.9931 |
| credit | 1 | 7.58 | 0.0059 |
| size | 1 | 1.18 | 0.2769 |

# *The SAS System*

## *The GENMOD Procedure*

| Model Information | |
|---|---|
| **Data Set** | WORK.TEST4 |
| **Distribution** | Binomial |
| **Link Function** | Logit |
| **Dependent Variable** | paid_cash |
| **Observations Used** | 375 |
| **Probability Modeled** | Pr( paid_cash = 1 ) |

**Class Level Information**

| Class | Levels | Values |
|---|---|---|
| **UNINUM** | 75 | 710025 710032 710056 710114 710119 710122 710150 710551 710739 710862 720033 720040 720060 720061 720105 720131 720143 720168 720181 720186 720187 720188 720189 720191 720194 720331 720335 720336 720735 720861 720899 722012 722072 722075 722077 722114 ... |

**Response Profile**

| Ordered Level | Ordered Value | Count |
|---|---|---|
| **1** | 1 | 309 |
| **2** | 0 | 66 |

**Parameter Information**

| Parameter | Effect |
|---|---|
| **Prm1** | Intercept |
| **Prm2** | RE_rate |
| **Prm3** | interest |
| **Prm4** | URE |
| **Prm5** | credit |

**Criteria For Assessing Goodness Of Fit**

| Criterion | DF | Value | Value/DF |
|---|---|---|---|
| **Deviance** | 370 | 287.9186 | 0.7782 |
| **Scaled Deviance** | 370 | 287.9186 | 0.7782 |
| **Pearson Chi-Square** | 370 | 310.4448 | 0.8390 |
| **Scaled Pearson X2** | 370 | 310.4448 | 0.8390 |
| **Log Likelihood** | | -143.9593 | |





Algorithm converged.

**Analysis Of Initial Parameter Estimates**

| Parameter | DF | Estimate | Standard Error | Wald 95% Confidence Limits | | Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|---|
| **Intercept** | 1 | 6.6043 | 1.8026 | 3.0712 | 10.1374 | 13.42 | 0.0002 |
| **RE_rate** | 1 | -3.6930 | 1.0596 | -5.7698 | -1.6162 | 12.15 | 0.0005 |
| **interest** | 1 | 33.7738 | 16.8718 | 0.7056 | 66.8420 | 4.01 | 0.0453 |
| **URE** | 1 | -5.0286 | 1.3155 | -7.6069 | -2.4503 | 14.61 | 0.0001 |
| **credit** | 1 | -43.5034 | 11.9748 | -66.9737 | -20.0332 | 13.20 | 0.0003 |
| **Scale** | 0 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | | |

NOTE: The scale parameter was held fixed.

| GEE Model Information | |
|---|---|
| **Correlation Structure** | AR(1) |
| **Subject Effect** | UNINUM (75 levels) |
| **Number of Clusters** | 75 |
| **Correlation Matrix Dimension** | 5 |
| **Maximum Cluster Size** | 5 |
| **Minimum Cluster Size** | 5 |

**Covariance Matrix (Model-Based)**

| | Prm1 | Prm2 | Prm3 | Prm4 | Prm5 |
|---|---|---|---|---|---|
| **Prm1** | 3.50798 | -1.00062 | -16.21762 | -1.82241 | -14.35914 |
| **Prm2** | -1.00062 | 2.19542 | -3.52611 | -0.19577 | 1.75772 |
| **Prm3** | -16.21762 | -3.52611 | 258.61 | 2.25986 | 58.68891 |
| **Prm4** | -1.82241 | -0.19577 | 2.25986 | 1.85404 | 8.36974 |
| **Prm5** | -14.35914 | 1.75772 | 58.68891 | 8.36974 | 143.66 |

**Covariance Matrix (Empirical)**

| | Prm1 | Prm2 | Prm3 | Prm4 | Prm5 |
|---|---|---|---|---|---|
| **Prm1** | 3.10141 | -1.08087 | -12.99555 | -1.48402 | -19.29813 |
| **Prm2** | -1.08087 | 2.00000 | -1.26458 | -0.16072 | 3.68712 |
| **Prm3** | -12.99555 | -1.26458 | 181.51 | 1.23881 | 70.98200 |
| **Prm4** | -1.48402 | -0.16072 | 1.23881 | 1.60717 | 10.20933 |
| **Prm5** | -19.29813 | 3.68712 | 70.98200 | 10.20933 | 246.26 |





Algorithm converged.

**Working Correlation Matrix**

| | Col1 | Col2 | Col3 | Col4 | Col5 |
|---|---|---|---|---|---|
| **Row1** | 1.0000 | 0.5624 | 0.3163 | 0.1779 | 0.1001 |
| **Row2** | 0.5624 | 1.0000 | 0.5624 | 0.3163 | 0.1779 |
| **Row3** | 0.3163 | 0.5624 | 1.0000 | 0.5624 | 0.3163 |
| **Row4** | 0.1779 | 0.3163 | 0.5624 | 1.0000 | 0.5624 |
| **Row5** | 0.1001 | 0.1779 | 0.3163 | 0.5624 | 1.0000 |

**Analysis Of GEE Parameter Estimates**

**Empirical Standard Error Estimates**

| Parameter | Estimate | Standard Error | 95% Confidence Limits | | Z | Pr > \|Z\| |
|---|---|---|---|---|---|---|
| **Intercept** | 6.1185 | 1.7611 | 2.6669 | 9.5702 | 3.47 | 0.0005 |
| **RE_rate** | -4.3795 | 1.4142 | -7.1513 | -1.6077 | -3.10 | 0.0020 |
| **interest** | 25.2269 | 13.4727 | -1.1790 | 51.6328 | 1.87 | 0.0611 |
| **URE** | -3.4412 | 1.2677 | -5.9259 | -0.9565 | -2.71 | 0.0066 |
| **credit** | -48.3500 | 15.6927 | -79.1070 | -17.5930 | -3.08 | 0.0021 |

**Score Statistics For Type 3 GEE Analysis**

| Source | DF | Chi-Square | Pr > ChiSq |
|---|---|---|---|
| **RE_rate** | 1 | 6.46 | 0.0110 |
| **interest** | 1 | 2.94 | 0.0862 |
| **URE** | 1 | 6.50 | 0.0108 |
| **credit** | 1 | 6.90 | 0.0086 |