

Testing the Pecking Order Theory and the Signaling Theory for Farm Businesses

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Abstract

Numerous empirical studies in the finance field have tested many theories for firms' capital structure. Under the assumption of asymmetric information, the pecking order theory proposes the financing order for farm businesses, which implies a negative relationship between their cash flow and leverage. Meanwhile, the signaling theory suggests a farms' financing strategy, meaning high quality farms prefer to facilitate their capital rising by sending diverse signals to potential lenders. Could these capital structure theories be applied for farm businesses?

This paper tests the applicability of the pecking order theory and the signaling theory for farm businesses. The results show that farm businesses not only follow the pecking order theory but also the signaling theory. In addition, unlike corporate firms who can choose high leverage as financing signals, farm businesses mainly depend on their large size and good historical operation records to facilitate investment financing.

Key Words: Farm Businesses, Pecking Order Theory, Signaling Theory

JEL classification: Q14

Testing the Pecking Order Theory and the Signaling Theory for Farm Businesses

Extensive empirical work has been completed in finance field on the theories of firms' capital structure. Application of these theories to farm businesses, however, is limited. Hubbard and Kashyap (1992) test for the presence of financial constraints on U.S. farms and found that the sensitivity of investments to changes in net worth is greater during financial stress periods. Bierlen and Featherstone (1998) find that credit constraints were more important during the 1980s farm crisis and for farms with weaker internal finance positions. Jensen, Lawson, and Langemeier (1996) similarly observe the significant effects of internal funds on farm investments. Barry, Bierlen and Sotomayor (2000), test the applicability of the pecking order and partial adjustment theories for farm businesses. They found that farms adjust to long-run financial targets for equity, debt, and leasing, but that additional financing needs follow a pecking order that is stronger for farms with greater asymmetric information problems. Following Barry, Bierlen and Sotomayor, our study expands the theory content by considering the potential effects of the pecking order and signaling theory on the capital structure for farm businesses.

In finance, the signaling theory and the pecking order theory both concern the relationship between a firm's financial leverage and cash flow under asymmetric information. Signaling theory suggests a positive relationship, while pecking order behavior implies a negative relationship. These contradictory theoretical implications are both supported in the empirical. Baskin (1989) and Wilbricht (1989), Jensen, Solberg, and Zorn (1992), Claggett (1991) find evidence supporting the pecking order

hypothesis. Sunder and Myers (1999) test a panel of 157 firms from 1971 to 1989 and find statistically significant support for the pecking order theory. Considering the capital structure in the signaling setting, Ravid and Sarig (1991) find firms signal their quality by the optimal combination of dividends and leverage. They predict that “better firms to be highly leveraged and to pay higher dividends than lower quality firms.” This assertion is supported by many empirical studies (e.g. Aharony and Swary (1980), Masulis (1980) that document positive abnormal returns follow either a dividend increase or an increase in leverage). Shenoy and Koch (1995) reconciled signaling theory and pecking order theory by proposing that signaling theory acts intertemporally while pecking order theory focuses on the contemporaneous relationship between cash flow and leverage. Is this distinction applicable for farm businesses? According to signaling theory, farmers and lenders have asymmetric information regarding farm's investment prospects. Farm owners then attempt to convey to lenders their good expectations of future performance through diverse signals, which can be higher leverage or rich accumulated assets. Lenders judge the truth of these signals and then issue loans. If high leverage can also work as a financing signal for farm businesses, financed farms should have a higher leverage level which is connected with contemporaneous investments. Since the payoffs from the investments cannot be realized immediately due to the long production cycle in agriculture, the relevant signaling should imply a positive relationship between farms' current leverage and future cash. Pecking order financing suggests that farms with given investment opportunities in any given period will first rely on available cash

flow to meet financing needs. After cash is depleted, farmers prefer to utilize debt financing compare to issuing equity, which implies cash flow and leverage should be negatively related and simultaneously determined.

The purposes of our study are to econometrically test whether the farm businesses follow the pecking order theory as well as the signaling theory. First, we test whether leverage and cash flow are negatively related during the same time period, which is implied by pecking order theory. Then we test whether farm businesses follow the signaling theory and whether the high leverage is used by farm businesses as well as other signals (such as good historical income and profitability) to facilitate their investment financing.

Relevant Literature

Numerous theories on capital structure in finance have evaluated Modigliani and Miller (1958)'s landmark suggesting condition under which capital-structure is irrelevant to the value of firm. Agency theory, market timing theory, inertia theory all developed to reflect characteristics of firm's capital structure. Our paper mainly concerns financing strategy and decisions, so the signaling theory and the pecking order theory will be focus on.

The Pecking Order Theory

The pecking order theory of capital structure is among the most influential theories of corporate leverage. Originally developed by Myers-Majluf (1984), it considers the role of information asymmetries (with regard to presently held assets and investment opportunities) between firms and capital markets. According to Myers-Majluf, firms use internal funds that are less costly than external funds. When outside funds are necessary, firms prefer debt to equity because of lower information costs associated with debt issues, while equity is rarely issued. Later, these ideas were refined into testable predictions and confirmed by Vogt (1994) who finds that internal funds have an important influence in firm's investment decisions; pecking order behavior is most pronounced in firms that have low long-run dividend payout policies.

The Signaling Theory

The concept of signaling was first studied in the context of job and product markets by Akerlof and Arrow and was developed into signal equilibrium theory by

Spence (1973), which says a good firm can distinguish itself from a bad firm by sending a credible signal about its quality to capital markets. The signal will be credible only if the bad firm is unable to mimic the good firm by sending the same signal. If the cost of the signal is higher for the bad type than that of the good type firm, the bad type may not find it worthwhile to mimic, and so the signal could be credible. Ross (1977) shows how debt could be used as a costly signal to separate the good from the bad firms. Under the asymmetric information between management and investors, signals from firms are crucial to obtain financial resources. Ross assumes that managers (the insiders) know the true distribution of firm returns, but investors do not. Signaling of higher debt by managers then suggests an optimistic future and high quality firms would use more debt while low quality firms have lower debt levels. In this way, a good firm can separate itself by attracting scrutiny while the bad firm will not mimic because the bad firm will not want to be discovered.

Two types of signaling inside information have been suggested: one is the costly signaling equilibrium discussed by Spence (1973), Leland and Pyle (1977), Ross (1977) and Talmor (1981) etc., the other is the costless signaling equilibrium as proposed by Bhattacharya and Heinkel (1982), Rennan and Kraus (1984). A signal is costly if the production of the signal consumes resource or if the signal is associated with a loss in welfare generated by deviations from allocation or distribution of claims in perfect markets. The signaling paradigm is multivariate for financial instruments. Poitevin (1989) demonstrates that debt could be used as a signal to differentiate the potential competition of new entrant firms. Low cost entrants signal this fact by

issuing debt while the incumbent or high cost entrants issue only equity; Harris and Raviv (1985) argue that calling firm's convertibles can be a kind of signal and Bhattacharya and Dittmar (1991) show stock repurchase is another kind of signal to represent firm value.

Finance Theory and Farm Businesses

Although the pecking order theory has influential effects on finance capital structure, it is also criticized for its simplifying assumptions, where the firm's only financing choice is debt vs. equity. The pecking order theory does not hold in more complicating settings in corporate finance, for example when the firm chooses between straight and convertible debts and there is an agency problem between shareholder and manager etc. However, farm businesses are immune to the complications discussed above. Farm businesses work with very simple external financing, debt and equity, farm operator is equity owner as well as manager. Farm businesses are exact background for testing the pecking order theory.

The signaling theory talks about financing tactics, where good firms try to distinguish themselves from bad quality firms by using different financing device. Farm owners also have incentives to get external financing by adopting such financing strategies. Unlike corporate firms who offer signals (dividend or repurchase shares from stock market) to stock market, farm owners send signals to all potential lenders in agricultural capital market. The signal instruments for farm business can be its profitability, farm income, the historical good performance record (return on assets) farm leverage, risk management documentation, operating products etc.

Based on above theory implications, this paper tests pecking order theory as well as the signaling theory. We explore whether the pecking order theory and the signaling theory can be applied for farm businesses.

Model

Under asymmetric financial markets, the pecking order theory and the signaling theory could be tested through combined relationships among a farm's cash flow, financial leverage and investments contemporaneously and intertemporally. We develop a simultaneous dynamic equation system, which is composed of three equations to integrate the two theories into empirical testing work.

Cash Flow Equation

An important econometric issue that needs to be addressed is that pecking order theory considers the financing deficit to be exogenous. Farms' cash flow and leverage simultaneously affect each other and both are influenced by farms' investments. When farms face a good investment opportunity, they first use cash, followed by debt, and last they will issue equity. Testing the contemporaneous relationship between cash flow and leverage will help to validate the pecking order theory. Meanwhile, the dynamic interaction between the previous investment, leverage and future cash flow would support the signaling theory. More promising farms can attain financial support by signaling their historical leverage and consequent positive cash flow record to lenders. The above spirit of the pecking order theory and signaling theory is in the cash flow equation.

$$\text{Equal (1) } CF_t = \alpha_1 CF_{t-1} + \alpha_2 L_t + \alpha_3 L_{t-1} + \alpha_4 INV_t + \alpha_5 INV_{t-1} + \alpha_6 ROA_t + \alpha_7 ROA_{t-1} + u_t$$

CF_t represents cash flow at time period t. CF_{t-1} is lagged one period cash flow variable.

L_t is farm total leverage (debt) at time t, while L_{t-1} is the lagged leverage variable.

ROA is farm's return on assets, representing farm's profitability. INV_t and INV_{t-1} are

investment variables standing for current and lagged one period. u_t is the error term. To test whether farm businesses follow the pecking order theory, we need to look at α_2 . Negative sign of the coefficient, at the same time period, demonstrates pecking order behavior holds for farm businesses. The signaling theory can be tested by considering relationships between previous investment (α_5) and current cash flow as well as lagged debt variables (α_3) and current cash flow. α_3 , α_5 will appear to be positive according to the signaling idea.

Leverage Equation

Titman and Wessels (1988) suggests a positive relationship between size and leverage in the pecking order theory, by arguing that larger firms tended to be more diversified and failed less often, farm size is considered a proxy for information asymmetry between farms and capital markets. Since larger farms are more closely observed by lenders, they should convey more accurate credit risk information. Titman and Wessels measure firm size with the natural logarithm of net sales where the logarithmic transformation accounts for the conjecture that small firms are particularly affected by a size effect. To develop this specification, we measure the effect of farm size on farm leverage; we also consider the simultaneous relationship of leverage and cash flow suggested by the pecking order theory.

The signaling application contained in leverage equation is that farms with sound management practices, indicated by their lagged cash flow to expanded debt capacity at lower costs. Based on inside information, good operating farms could signal a higher leverage or rich accumulated assets, which can not be sustained or reached by

low liquidity and low profitability farms. High quality farms are measured by lagged positive cash flow and high return on assets.

$$\text{Equal (2)} \quad L_t = \beta_1 CF_t + \beta_2 CF_{t-1} + \beta_3 ROA_{t-1} + \beta_4 INV_t + \beta_5 INV_{t-1} + \beta_6 LSIZE_t + v_t$$

Following Titman and Wessels, our measure of size is the natural logarithm of farm's total assets, $LSIZE^1$. L_t is the farm's total leverage. Pecking order relationship, in this equation, is reflected by contemporaneous interaction of farm's leverage and cash flow (β_1 should be negative). From the view of asymmetric information, pecking order theory also predicts a positive sign of $Lsize$ (β_6), showing larger farms are less information constrained and could be easily observed in capital market. Meanwhile, signaling theory suggests good performing farms use previous ample cash flow (β_2) and profitability (return on assets ROA_{t-1} , β_3) as signals to attract capital institution and attain funds for their profitable projects. One character of farm business is that, for the same type business, larger farm size implies a more equity farm, which enables the scale of economy, thus could bear more endurance in depressive business circle. So, to some degree, size could also be used as financing signal. The positive sign of farm size ($Lsize$, β_6) will co-represent the pecking order and the signaling theory.

Investment Equation

Hubbard and Kashyap (1992) reinterpret the accelerator mechanism by emphasizing the asymmetric information in capital market. "Costs of external finance vary inversely with the level of "inside finance", and there is a direct channel for

¹ The logarithmic transformation serves to compress the magnitude of the size variable for the largest firms, with the goal of reducing possible heteroskedasticity and skewness resulting from such outliers.

internal funds to affect investment: when borrower's net worth improves, lenders become more willing to lend, and additional investment can be financed." Benefit from their study, we test the pecking order principle by considering the relationship among investment, internal cash flow and leverage. In addition, in a more complex view of pecking order theory offered by Myers (1984), firms are concerned with future as well as current financing costs. Balancing current and future cost, it is possible that firms with large expected investment maintain low-risk debt capacity to avoid either foregoing future investments or financing them with new risky securities. It is thus possible that, controlling for other effects, firms with larger expected investments have less current leverage. We synthesize their ideas into an investment equation.

$$\text{Equal (3)} \quad INV_t = \gamma_1 CF_t + \gamma_2 CF_{t-1} + \gamma_3 L_t + \gamma_4 L_{t-1} + \gamma_5 ROA + \gamma_6 ROA_{t-1} + \varepsilon_t$$

Equal (3) mainly tests the dynamic relationship between investment and lagged leverage for the pecking order theory. A negative sign for lagged leverage ($\gamma_4 < 0$) is anticipated, which implies farmers keep a lower current debt level in order to accumulate financing capacity for future investments. At the same time, farm's investment would devour current cash flow; γ_1 should show a negative sign here. Similar logic holds in this equation for signaling theory. Farm owners depend on historical good cash flow (γ_2) and return on asset (γ_6) performance to reveal their quality priority, farm investment soon successfully financed by lenders in capital market. In this vein, γ_2, γ_6 should display positive sign to show well performing farms continually expand by making new investments.

Testing Hypothesis

To summarize, the theoretical signification of pecking order theory is embodied by the contemporaneous relationship in the cash flow, leverage, and investment equations, while the implications of signaling are observed from the inter-temporal relationship between investment and lagged cash, cash flow and lagged leverage, and vice versa. To investigate the information signaling hypothesis and pecking order behavior, we make the null and alternative assumptions in Table 1.

Data and Method

Data

The empirical analysis utilizes data from the Illinois Farm Business Farm Management (FBFM) system for farms that received continuous annual balance sheet certification during the 1995-2002 time periods. Our study focuses on sample farms with at least 2 years of continuous operation. A total of 1419 farms meet the criteria. Summary statistics for variables and other farm characteristics are reported in table 2.

The variables discussed in table 2 are reflected in the following measures: Cash flow (CF) is the farm's total net cash provided by operating activities and investing activities. Net cash provided by operating activities is calculated as the sum of farm operating receipts (excluding breeding livestock) and net non-farm income less cash paid for operating expenses and paid for interest, operating market livestock and feed, family living, income and self-employment tax. Net cash from investing activities is the cash sale of breeding livestock, cash sale of machinery and equipment, and cash sale of buildings, securities, real estate, and investments/fund transfers less cash paid for breeding livestock, machinery and equipment, buildings, and cash paid for securities, real estate, and investments/fund transfers. Total leverage (L) is the sum of short term liabilities, intermediate liabilities and long term liabilities. Short-term debt is current liabilities plus intermediate liabilities. Current liabilities include short term operating notes, commodity credit Corp. loans, feed accounts payable/ASC, lease payment and accounts payable with merchants & dealers, estimated accrued tax liability accrued interest, due principle within twelve months of intermediate and long

term notes. Intermediate liabilities are the capital lease/deferred portion of intermediate notes and life insurance policy loans etc. Long term liabilities contains the real estate mortgages and contracts. Investment (INV) is mainly comprised of two parts, one is machinery and building purchases, the other is land purchase and improvements. Return on assets (ROA) is measured by the return on market value assets.

Method

Equals are estimated through a dynamic simultaneous equation system, which is composed of cash flow equation, leverage equation and investment equation:

$$Eq. (1) CF_t = \alpha_1 CF_{t-1} + \alpha_2 L_t + \alpha_3 L_{t-1} + \alpha_4 INV_t + \alpha_5 INV_{t-1} + \alpha_6 ROA_t + \alpha_7 ROA_{t-1} + u_t$$

$$Eq. (2) L_t = \beta_1 CF_t + \beta_2 CF_{t-1} + \beta_3 ROA_{t-1} + \beta_4 INV_t + \beta_5 INV_{t-1} + \beta_6 LSIZE_t + v_t$$

$$Eq. (3) INV_t = \gamma_1 CF_t + \gamma_2 CF_{t-1} + \gamma_3 L_t + \gamma_4 L_{t-1} + \gamma_5 ROA + \gamma_6 ROA_{t-1} + \varepsilon_t$$

Each equation is jointly determined by other two equations. Endogenous variables in this simultaneous system are cash flow (CF_t), leverage (L_t) and investment (INV_t). Preceding estimation, we need to make sure that these variables are identifiable. In our dynamic model, (each equation contains a lagged one period variable) we have sets of predetermined variables. Such as lagged cash flow variable (CF_{t-1}), lagged leverage (L_{t-1}), lagged investment variable (INV_{t-1}) and return on assets variable (ROA_{t-1}). These variables are obviously not exogenous, but with regard to current values of the endogenous variables, they can be regarded as having been determined. In this study, we also assume that farm's return on asset is determined by industry characteristic exogenously and farm size has been determined at study time

period. So, the endogenous variables can be identified within the system. We use GMM approach to estimate our simultaneous equation system, which those lagged variable are used as instrumental variables. Furthermore, GMM approach will allow us to generalize the covariance structure for the disturbance.

Empirical Results

Full Sample Results

Our testing approach first estimates the model for the full sample farms that maintained at least 2 years of certified data. The model is then re-estimated based on a classification of the farms into different size and age groups. The 1995-2002 full sample coefficient estimates are reported in Table 3.

For the cash flow equation, the negative significant coefficient of leverage shows cash flow and leverage are inversely related to each other ($\alpha_2 = -0.786^{***}$), which are consistent with the pecking order principle: farm operators first deplete cash, when they seek further development, they will issue debt as financial resource. The coefficient on the lagged leverage variable displays an insignificant relationship with cash flow ($\alpha_3 = -0.0003$), suggesting we cannot come to the conclusion, in this equation, that leverage is used as signal for farms to get financing.

Debt demonstrates the strongest and most robust relationship with cash flow. Thus, leverage equation offers obvious phenomena for pecking order behavior and signaling idea. We find a significant negative sign between cash flow and leverage ($\beta_1 = -0.829^{***}$), meaning if farm operators have more cash flow, they will borrow less money. This finding supports the contemporaneous pecking order hypothesis. Signaling theory is embodied in the relationship between leverage and the lagged cash flow ($\beta_2 = 0.021^{**}$) and lagged return on assets ($\beta_3 = 0.0003^{**}$). This result is similar to the study by Ravid and Sarig (1991), who demonstrate firms use dividend and leverage as signal, our result shows farm businesses adopt cash flow and profitability

(ROA_{t-1}) as a signal. The second equation also yields a positive relationship between leverage and farm size (measured by the natural logarithm of total farm assets $\beta_6=0.003^{**}$), which is consistent with the findings of Titman and Wessels (1988) who indicates that larger farms are less information constrained and perhaps survive economic depression. Consequently, they hold a dominant position for funding compared to small farms in pecking order theory. At the same time, it also implies the signaling idea, well performed farms tend to improve size (which can be another signal for farm businesses demonstrate their business strength), the accumulate equity can act as signal to attract lenders.

In investment equation, we find farm investment decision is affected by its profitability (ROA_{t-1} , $\gamma_6= 0.0009^{***}$) of last period. Even if farm face a negative cash flow of last period (CF_{t-1} , $\gamma_2 = - 0.043^{***}$), the good investment opportunity (ROA_{t-1} $\gamma_6= 0.0009^{***}$) still promotes farms make further investments. This also illustrates, from another perspective, that investments for farm businesses mainly depend on leverage. A negative contemporaneous relationship between investment and cash flow not necessarily means that farms invest more when cash flow are small, rather, this is because we calculate the net cash flow from operating activity plus investment activity. It is normal for farms' investments to be greater than cash flow in hand, so the total net cash flow should be negative after farms make investments. This contemporaneously negative relation between farm's investment and cash flow follows the pecking order principle. Although our testing supports the complex view

of pecking order hypothesis proposed by Myers (1984) who report a negative relationship between lagged leverage ($\gamma_4 = -0.014$), it is not significant.

Grouping Comparison

Grouping criteria in corporate studies have included payment versus nonpayment of dividends and membership versus non-membership in the New York Stock Exchange. Hubbard also cited the use of distinct business periods (e.g., boom versus bust) as a potential criterion. Our grouping methods are determined in two ways. One is following Barry, Bierlen, and Sotomayor, we group farm operators under 45 and over 50 years of age based on level of difference in the degree of information constraint. The other grouping approach borrows the idea from Titman and Wessels (1988), regarding farm size as a proxy for information asymmetry. Models for the upper and lower one-third of the farms are estimated. The middle one third is omitted to obtain greater differences between different groups.

According to theory, firms with greater asymmetric information problems should adhere more closely to the pecking order. To test what kind farms are more following the signaling theory is based on the assumption that well performed farms could like to send diverse signals to attract potential lenders in capital market, thus facilitate their financing. Comparison results are reported in Table 4 and Table 5.

Comparing the old farmer and young farmer group in the cash flow equation of table 4, the absolute value of the leverage coefficient for young operators ($\alpha_{2-young} = -0.825^{***}$, $\alpha_{2-old} = -0.701^{***}$) are larger than that of old operators, suggesting young farmers are more information constrained as they more closely follow the pecking

order theory. The lagged leverage and future cash flow have a insignificant relationship for old farmers and young farmers, this shows that there is no clear pattern of signaling implication for both old and young farmers for choosing leverage as a signal for financing ($\alpha_{3-young} = 0.01016$, $\alpha_{3-old} = - 0.00331$). Comparison between small and large farms in cash flow equation demonstrates that smaller farms are, at the same degree, following the pecking order theory as large farms, while larger farms tend to more closely follow the signaling theory. The leverage coefficients for small farms have almost equal impact on cash flow as larger farms ($\alpha_{2-small} = - 0.796^{***}$, $\alpha_{2-large} = - 0.806^{***}$), but larger farms prefer to adopt positive profitability from previous period as a signal to convince lenders, attaining financial support, and realize future income ($\alpha_{7-small} = - 0.0002$, $\alpha_{7-large} = - 0.00047^{**}$).

In the leverage equation of table 5, larger farms' previous cash flow and profitability have greater impacts on their leverage (the coefficients of lagged cash flow and return on assets $\beta_{2-large} = 0.05369^{***}$, $\beta_{3-large} = 0.00064^{***}$, for larger farm and $\beta_{2-small} = 0.01692$, $\beta_{3-small} = 0.00023^*$ for smaller farms). As the signaling theory predicted, the leverage level for smaller farms is especially affected by their size compare to larger farms ($\beta_{6-small} = 0.00749^{**}$, $\beta_{6-large} = 0.00537^{**}$) and old farmers also tend to depend on size as well as higher profitability as signals to seek for financing ($\beta_{3-young} = 0.0002889^*$, $\beta_{3-old} = 0.0002938^*$, $\beta_{6-young} = 0.00199$, $\beta_{6-old} = 0.00698^{***}$). This finding is consistent with Poitevin's study (1989) that the incumbent business has advantage to get financial support depending on longer well developed relationship with financial institutions. This mechanism works same way for old farmers, the long

run cooperative relationship between old farmers and their lenders enable them more easily access loan and finance their farm business. Table 5 also obviously demonstrates that small farms and young farmers are more following the pecking theory compare to large farms and old farm operators ($\beta_{I-small}=-0.847^{***}$, $\beta_{I-large}=-0.777^{***}$, $\beta_{I-young}=-0.833^{***}$, $\beta_{I-old}=-0.768^{***}$) which is reflected through the relationship between simultaneous relationship of cash flow and leverage.

Conclusions and suggestions

Our study results demonstrate significant support for the applicability of both the pecking order theory and signaling theory for farm businesses. However, unlike corporate firms which can use leverage as signal to facilitate their financing, potential lenders for farm businesses more prefer to issue loans to farms with larger size, good historical record of income as well as high profitability.

Our comparison results from age group show those young farm operators apt to more track the pecking order theory while old farmers are more following the signaling theory. Grouping by farm size suggests that smaller farms are more closely following the pecking order and that their leverage position is sensitive to a change in size. Larger farms with greater total assets also flow the financing order suggested by the pecking order theory, in addition, they also have incentives to adopt signal financial strategies during their development.

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Table1. Null and Alternative Hypotheses for Testing the Pecking Order versus Signaling Theory

Pecking Order Theory	Signaling Theory
$CF_t = \alpha_1 CF_{t-1} + \alpha_2 L_t + \alpha_3 L_{t-1} + \alpha_4 INV_t + \alpha_5 INV_{t-1} + \alpha_6 ROA_t + \alpha_7 ROA_{t-1} + u_t$	
Hpo: $\alpha_2 = 0$ Hpa: $\alpha_2 \neq 0$	Hso: $\alpha_3 = 0$ $\alpha_5 = 0$ and $\alpha_7 = 0$ Hsa: $\alpha_3 \neq 0$ $\alpha_5 \neq 0$ and $\alpha_7 \neq 0$
The negative sign of α_2 suggests farms following the pecking order theory; otherwise, there is no pecking order behavior.	The signaling theory is expressed dynamically in cash flow and lagged term of leverage term. If α_3 α_5 and α_7 all show a positive sign, farms' signaling behavior is confirmed.
$L_t = \beta_1 CF_t + \beta_2 CF_{t-1} + \beta_3 ROA_{t-1} + \beta_4 INV_t + \beta_5 INV_{t-1} + \beta_6 LSIZE_t + v_t$	
Hpo: $\beta_1 = 0$ $\beta_6 = 0$ Hpa: $\beta_1 \neq 0$ $\beta_6 \neq 0$	Hso: $\beta_2 = 0$ $\beta_3 = 0$ $\beta_6 = 0$ Hsa: $\beta_2 \neq 0$ $\beta_3 \neq 0$ $\beta_6 \neq 0$
If farms follow the pecking order theory, we should get $\beta_1 < 0$, which means cash flow and leverage at the same term have a negative relationship. Because of asymmetric information, $\beta_6 > 0$ shows larger farms are less information constrained and they are easier to attain financial support.	Generally, farms with good cash flow performance could undertake higher financial leverage. Otherwise, continuously issuing debt probably leads farms to bankruptcy. We expect β_2 β_3 β_6 showing positive signs.
$INV_t = \gamma_1 CF_t + \gamma_2 CF_{t-1} + \gamma_3 L_t + \gamma_4 L_{t-1} + \gamma_5 ROA_t + \gamma_6 ROA_{t-1} + \varepsilon_t$	
Hpo: $\gamma_1 = 0$ $\gamma_4 = 0$ Hpa: $\gamma_1 \neq 0$ $\gamma_4 \neq 0$	Hso: $\gamma_2 = 0$ $\gamma_6 = 0$ Hsa: $\gamma_2 \neq 0$ $\gamma_6 \neq 0$
If Hpo is rejected, the significant negative coefficients $\gamma_1 < 0$, $\gamma_4 < 0$, would be consistent with pecking order behavior.	The significant positive coefficients here (γ_2 , γ_6) would be consistent with the implications of the signaling theory.

Table 2. Summary statistics for sample farm characteristics

Variable	Mean	Std Dev	Minimum	Maximum
Total Net cash flow (\$)	-17,048	90,066	-1,639,186	569,761
Net short term debt (\$)	7,532	59,197	-651,344	647,483
Net long term debt (\$)	7,408	69,196	-513,155	1,737,866
Debt/Asset ratio	0.34	0.21	0.00	2.41
Total Investment (\$)	26,892	40,438	0.00	984,509
Total Assets (\$)	1,114, 283	835,561	59,738	9,988,631
Return on Assets (%)	4.89	7.56	-47.53	81.08
Age of Operator	48.73	10.54	19	97

Note: Dollar amounts are in current dollars.

Table 3. Estimation Results for the Simultaneous Equation System

$$CF_t = \alpha_1 CF_{t-1} + \alpha_2 L_t + \alpha_3 L_{t-1} + \alpha_4 INV_t + \alpha_5 INV_{t-1} + \alpha_6 ROA_t + \alpha_7 ROA_{t-1} + u_t$$

$$L_t = \beta_1 CF_t + \beta_2 CF_{t-1} + \beta_3 ROA_{t-1} + \beta_4 INV_t + \beta_5 INV_{t-1} + \beta_6 LSIZE_t + v_t$$

$$INV_t = \gamma_1 CF_t + \gamma_2 CF_{t-1} + \gamma_3 L_t + \gamma_4 L_{t-1} + \gamma_5 ROA_t + \gamma_6 ROA_{t-1} + \varepsilon_t$$

Equal (1)	Coef.	St.D.	Equal (2)	Coef.	St.D.	Equal (3)	Coef.	St.D.
CF_{t-1}	0.0225	0.0159	CF_t	-0.829***	0.010	CF_t	-0.153***	0.013
L_t	-0.786***	0.0096	CF_{t-1}	0.021**	0.010	CF_{t-1}	-0.043***	0.012
L_{t-1}	-0.0003	0.0145	ROA_{t-1}	0.0003***	0.00009	L_t	0.037**	0.013
INV_t	-0.233***	0.0208	INV_t	0.059**	0.022	L_{t-1}	-0.014	0.012
INV_{t-1}	-0.0031	0.0197	INV_{t-1}	0.009	0.021	ROA	-0.0004***	0.00009
ROA_t	0.00084***	0.0001	$LSIZE_t$	0.003**	0.001	ROA_{t-1}	0.0009***	0.00008
ROA_{t-1}	-0.00008	0.0001						
Adj. R-Square = 0.7136			Adj. R-Square = 0.6985			Adj. R-Square = 0.1965		
No. of farms = 1419			No. of farms = 1419			No. of farms = 1419		

*, **, *** statistical significance at the 10% 5% and 1% level based on two tailed tests

Table 4. Estimated Coefficients of Cash Flow Equation between Two Group Farms

$$CF_t = \alpha_1 CF_{t-1} + \alpha_2 L_t + \alpha_3 L_{t-1} + \alpha_4 INV_t + \alpha_5 INV_{t-1} + \alpha_6 ROA_t + \alpha_7 ROA_{t-1} + u_t$$

Variables	Small Farms	Large Farms	Young Operator	Old Operator
CF_{t-1}	0.03446 (0.02513)	-0.00478 (0.0268)	0.0283 (0.02638)	0.04046 (0.02715)
L_t	-0.796*** (0.0148)	-0.8064*** (0.0177)	-0.8247*** (0.0158)	-0.7014*** (0.01701)
L_{t-1}	0.00596 (0.02218)	-0.02197 (0.02624)	0.01016 (0.02438)	-0.00331 (0.02432)
INV_t	-0.199*** (0.03041)	-0.3239*** (0.04686)	-0.2391*** (0.03646)	-0.2719*** (0.04073)
INV_{t-1}	-0.01561 (0.02868)	0.00377 (0.04462)	-0.00039 (0.034)	-0.04272 (0.03899)
ROA_t	0.0009*** (0.00015)	0.0004* (0.000247)	0.00088*** (0.000186)	0.0006*** (0.0002)
ROA_{t-1}	-0.0002 (0.00014)	0.00047** (0.00023)	-0.00009 (0.00017)	-0.00006 (0.00018)
No of farms	801	562	699	670
Adj R-Square	73.66%	67.96%	74.42%	59.14%

*, **, *** statistical significance at the 10% 5% and 1% level based on two tailed tests.

Table 5. Estimated Coefficients of Leverage Equation between Two Group Farms

$$L_t = \beta_1 CF_t + \beta_2 CF_{t-1} + \beta_3 ROA_{t-1} + \beta_4 INV_t + \beta_5 INV_{t-1} + \beta_6 LSIZE_t + v_t$$

L_t Eq.	Small Farms	Large Farms	Young Operator	Old Operator
CF_t	-0.84659*** (0.01589)	-0.77717*** (0.01711)	-0.8327*** (0.01606)	-0.76756*** (0.01854)
CF_{t-1}	0.01692 (0.01564)	0.05369*** (0.01804)	-0.01913 (0.01534)	0.05987*** (0.01954)
ROA_{t-1}	0.00023* (0.00013)	0.00064*** (0.0002)	0.000289* (0.000158)	0.000294* (0.000167)
INV_t	0.06704** (0.032)	0.03872 (0.04692)	0.03283 (0.0375)	0.06109 (0.04308)
INV_{t-1}	-0.01458 (0.02981)	0.03834 (0.04391)	0.01444 (0.03441)	-0.00712 (0.04083)
$LSIZE_t$	0.00749** (0.0033)	0.00537** (0.00272)	0.00199 (0.00223)	0.00698*** (0.00147)
No of farms	801	562	699	670
Adj R-Sq	72.20%	67.01%	72.90%	57.93%

*, **, *** statistical significance at the 10% 5% and 1% level based on two tailed tests.