THE CHANGING DEBT MATURITY STRUCTURE OF U.S. FARMS

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Introduction

Despite the recent global recession and continuing U.S. economy wide credit problems, the financial health of the farm sector has been excellent in recent years. The farm sector's financial stability has been largely unaffected by the global financial crisis despite unstable input prices and variable output prices. However, given the widespread impacts of the global economic crisis, there have been concerns raised about the debt repayment ability of farmers and the future stability of asset values—especially for livestock farmers, whose net farm incomes declined in 2009 due to higher feed costs and weakened domestic and international demand.

In the current economic environment, the prospects for an increase in interest rates at some point in the near future are rising, if for no other reason than they are currently at historically low levels. The farm enterprises under greatest short-term risk are those holding variable rate loans. Data from the ARMS survey suggests that some farms may reduce risk by shifting to fixed rate loans. Thirty percent of all loans originated before 2007 were found to be variable rate compared to 26.9 percent for loans obtained during 2007-2009.

Debt maturity is also an important element in financial contracting that affects borrower's financial flexibility and financing cost – especially if short-term liabilities and concentrated debt maturity render farm businesses more susceptible to default. In the farm sector, changing options for organizing and financing a business have evolved over time to meet the needs of farm businesses (Boehlje and Lins, 1995). However, internally generated equity has traditionally been used to finance the growth of farm businesses along with debt if internal equity was not

sufficient. Farm business financing depends upon a combination of equity, short term debt, and long term debt. When using debt financing, a mixture of short–term and long-term debt allows flexibility and a means of managing financing costs. To better understand finance dynamics, we need to better understand this relationship. Assuming that there is an optimal debt maturity structure for farms, and some farms use debt, some combination of short- and long-term debt will be used.

Figure 1 shows that the long-term to total debt ratio for farm businesses has fallen modestly since earlier in the decade (from 70 to 64 percent). The analysis in this paper looks at the determinants of debt structure and examines some reasons why this is occurring.

The objectives of this paper are (1) to examine changes in the maturity structure of farm business debt, and, (2) to investigate the determinants of farm business' choice of the maturity structure of their debt. We use tobit analysis to examine the relationship between farm business debt maturity and farm financial measures, characteristics, and risk. Calendar year data for 2008was used to examine changes in the determinants of the maturity structure.

Background Literature

When firms seek external financing, they must make a decision on debt maturity. According to Modigliani and Miller's (1958) framework, there is no advantage gained from switching between short- and long term debt (Bougatef, 2010). However, with the existence of market imperfections such as financial distress and information asymmetry, the literature suggests that firms have a target optimal debt maturity structure. Previous theories suggest that optimal debt maturity is

susceptible to minimizing the overall cost of capital and it is determined by firm characteristics. In fact, several studies (Stohs and Meyer, 1996; Scherr and Hurlburt, 2001; Morris, 1996; Korner, 2007; and others) have examined debt maturity structure and found that optimal debt maturity structure is determined by firm-specific factors and macroeconomic variables.

Maturity matching principle

The maturity matching principle states that liabilities employed to finance assets should be repayable at the time those items can generate sufficient cash flows to pay off the debt service. If you violate the matching principle, you create a problem either of too little equity or low profitability. Myers (1977) suggests that the correspondence between debt and asset maturity serves to take care of the problem of underinvestment and shows that debt maturity depends on the asset economic life cycle. Stohs and Myer (1996), find that firms with longer asset maturities use longer term debt. In essence, firms want to align asset and debt duration to attenuate the impact of interest fluctuations. The maturity matching principle leads to a hypothesis about debt maturity and asset maturity.

Testable Hypothesis 1: Debt maturity is an increasing function of the asset economic life cycle.

Debt maturity and signal theory

Short term debt issuance is viewed by the market as a sign of firm quality, (Flannery, 1986). Investors believe that shortening debt maturity is a sign of a firm with good investment. Diamond (1991) developed a model which addresses asymmetric information between insiders and outsiders about firms' default risk. Firms with low risk and abnormal returns should shorten maturity. Only higher profit firms should choose short-term loans because they believe in their

ability to refinance at an opportune time. Scherr and Hurlbert (2001) found a positive relationship between debt maturity and profitability.

Testable Hypothesis 2: Debt maturity is a decreasing function of a firm's performance.

Debt maturity and firm size

Larger firms face a low degree of asymmetric information and for that reason they are generally considered lower risk. For this reason, Heyman, Deloot, and Ooghe (2003) and Scherr and Hurlbert (2001) found that debt maturity is negatively related to firm size. Morris (1976) finds the contrary, that larger firms use more long term debt since they have superior access to capital markets.

Testable Hypothesis 3: Size is negatively related to debt maturity.

Debt maturity and leverage

Higher leveraged firms may tend to lengthen debt maturities to postpone their exposure to bankruptcy risk (Morris, 1996). In support of this finding, Korner (2007) found that leverage has a positive impact on debt maturity structures. In essence, firms with higher debt to asset ratios tend to use more long term debt.

Testable Hypothesis 4: Leverage contributes to extending debt maturity.

Model Specification

In this section, we specify the model to be estimated, and develop both the dependent and independent variables based on the previous section outlining theories of debt maturity and

testable hypotheses. Control variables have also been included to account for other factors such as region, farm type, and off-farm income. The list of variables can be found in table 1.

We use the proportion of long term debt[1] divided by total debt to depict debt maturity. Empirical studies have provided different measures of debt maturity including the number of years (or months) until the debt is repaid. In this preliminary analysis, we follow Barclay and Smith (1996) and Antoniou et al (2008) who used the ratio of long term debt to total debt. The specification of the independent variables is detailed in the following paragraphs.

Farm size can be measured in several ways, gross sales, total assets, or market value. In this study, we use the natural logarithm of gross sales (lngvsales) based on testing the different measures in estimation. We use this measure to test the hypothesis that size is negatively related to debt maturity. The debt to asset ratio (daratio) is used to measure the relevance of leverage to the choice of the farm's debt maturity structure. We also include a proxy variable to measure the impact of net working capital[2] (wc). This variable is measure of risk in the short term and is expected to have a positive impact on the debt maturity ratio since it is a measure of credit risk at loan origination.

The fixed asset ratio (faratio) variable is included to measure asset maturity. Several proxies can be used to measure asset maturity. In our case, we use the ratio of fixed assets[3] to total assets to measure the impact of asset maturity on debt maturity structure. We were motivated to use this

[1] Long term is defined as term debt with a maturity of more than one year.
[2] Net working capital = current assets – current liabilities

[3] Fixed assets, also known as a non-current asset or as property, plant, and equipment (PP&E), is a term used in accounting for assets and property which cannot easily be converted into cash. This can be compared with current assets such as cash or bank accounts, which are described as liquid assets. In most cases, only tangible assets are referred to as fixed.

particular ratio since it takes into account the maturity of long-lived assets as a whole. This proxy is used to test the hypothesis that debt maturity is an increasing function of the asset life cycle (the economic life of an asset).

We have also included a proxy variable (solvency1) for risk into our analysis. ERS uses a four level solvency measure which looks at the debt-to- asset ratio and farm income. The dummy variable we use reflects (favorable) farms which do not have net farm income problems and have low debt-to-asset ratios[4]. This variable is used to test the hypothesis that debt maturity is a decreasing function of a firm's performance.

Other variables are also included to control for farm characteristics that influence debt maturity. Region variables (Lake States, Corn Belt, Northern Plains, and Southern Plains) have been included to control for geographical differences in financial structures and policies in different U.S. markets. Total off-farm income (totofi) is included to control for farm's ability to service larger quantities of debt and we expect the variable to have a positive effect on long-term debt.

Data

Data for the analysis are taken from the Agricultural Resource Management Study (ARMS) which is conducted annually by the Economic Research Service and the National Agricultural Statistics Service. Descriptive statistics are shown in table 2. The survey collects data to measure the financial condition (farm income, expenses, assets, and debts) and operating characteristics

[4] Farms are classified according to solvency measures (favorable; marginal income; marginal solvency; and vulnerable). Favorable farms have net farm incomes greater than zero and debt-to-asset ratios less than or equal to 40 percent. Marginal income farms have net farm incomes less than zero. Marginal solvency farms have debt-to-asset ratios greater than 40 percent. Vulnerable farm have net farm incomes less than zero and debt-to-asset ratios greater than 40 percent.

of farm businesses, the cost of producing agricultural commodities, and characteristics of farm operators and associated households.

The target population in the survey is operators that are associated with farm businesses representing agricultural production across the United States. A farm is defined as an establishment that sold or normally would have sold at least $1,000 of agricultural products during a given year. Farms can be organized as sole proprietorships, partnerships, family corporations, non-family corporations, or cooperatives. Data are collected from one operator per farm, the senior farm operator. A senior farm operator is defined as the one who makes most of the day-to-day management decisions. For the purpose of this study, we only include commercial farms[5].

The Tobit Model

We use the tobit model to estimate the relationships and test the hypotheses we have listed earlier in the paper. Tobit is used since censoring or selectivity problems exist in the data. The tobit or censored normal regression model is used for situations in which *y* is observed for values greater than zero but is not observed for values of zero or less. The standard tobit model is defined as:

$$y_i^* = x_i\beta + \varepsilon_i$$

$$y_i = y_i^* \quad \text{if} \quad y_i^* > 0$$

$$y_i = 0 \quad \text{if } y_i^* <= 0$$

where yi* is the latent dependent variable, *yi* is the observed dependent variable, **x***i* is the vector of the independent variables, β is the vector of coefficients, and the Єi's are assumed

[5] Commercial farms are farms with $250,000 sales per year and farms with professional managers.

to be independently normally distributed; $\epsilon i \sim N(0,\sigma)$ (and therefore $yi \sim N(0,\beta,\sigma)$.

Note that observed zero's on the dependent variable can mean either a "true" 0 or censored data. At least some of the observations must be censored data, or *yi* would always equal *yi** and the true model would be linear regression, not tobit.

Maximum-likelihood estimation of the tobit model is straightforward. Let *f* (.) and *F*(.) denote the density function and the cumulative density function for *y**. Then the model implies that the probabilities of observing a non-zero *y* and a zero *y* are *f* (*y*) and $p(y^* < 0) = F(0)$, respectively. The log-likelihood function for the model is therefore

$$\ln L = \ln(\Pi_{yi>0} f(y_i)\ \Pi_{yi=0} F(0)$$

$$= \Sigma_{yi>0} \ln f(y_i) + \Sigma_{yi=0} \ln F(0)$$

Because *y** is normally distributed (as the ϵ's are normally distributed), f(.) and F(.), and therefore the log–likelihood function, can be re-expressed in terms of the density function and the cumulative density function of the standard normal distribution, (.) and Φ(.), and the log-likelihood function can be written in the familiar form:

$$\ln L = \Sigma_{yi>0}\left(-\ln\sigma + \ln \text{Ø}\left(\frac{y_i - x_i\beta}{\sigma}\right)\right) + \Sigma_{yi=0} \ln\left(1-\Phi\left(\frac{x_i\beta}{\sigma}\right)\right)$$

Maximum likelihood estimation can then proceed in the usual fashion. We use appropriate procedures for complex survey design data -- weighting and jackknife procedures to estimate variances. Formulas for calculating the probability, conditional effects, and unconditional effects are available from the authors.

Results

In this paper, we only discuss the conditional results for our estimation. That is, the estimates for farms where the debt maturity ratio is greater than zero ($yi^{*}>0$) and farms use a positive amount of long term debt.

Table 3 presents the tobit results of our analysis. In 2008, the size variable (lngvsales) is positive and significant. This finding confirms the hypothesis that farm size negatively related debt maturity.

The coefficient on leverage (daratio) was positive, but insignificant. This finding does not support the hypothesis that the debt-to-asset ratio is positively related to debt maturity.

The net working capital (wc) was negative and insignificant. This variable is a proxy for credit risk. However, the variable is insignificant and does not support with our hypothesis that debt maturity is a positive function of risk.

The result for the variable that measures asset maturity (fasset) is negative and significant. This finding supports the hypothesis that debt maturity is an increasing function of the asset life cycle.

The solvency variable (solvency1) is negative and significant in 2008. The result is consistent with the hypothesis that debt maturity is a decreasing function of a firm's performance.

The regional variables have mixed effects. However, the livestock variable is significant and positive in both years. Livestock operations tend to be more capital-intensive, this reflects a need for longer term debt to finance capital requirements.

Our findings indicate that size, asset maturity, financial risk, region, and type of farm operation influenced debt maturity in 2008. Future studies will continue to refine model specification,

incorporate market conditions, and better examine market timing strategies in order to reduce the overall cost of capital.

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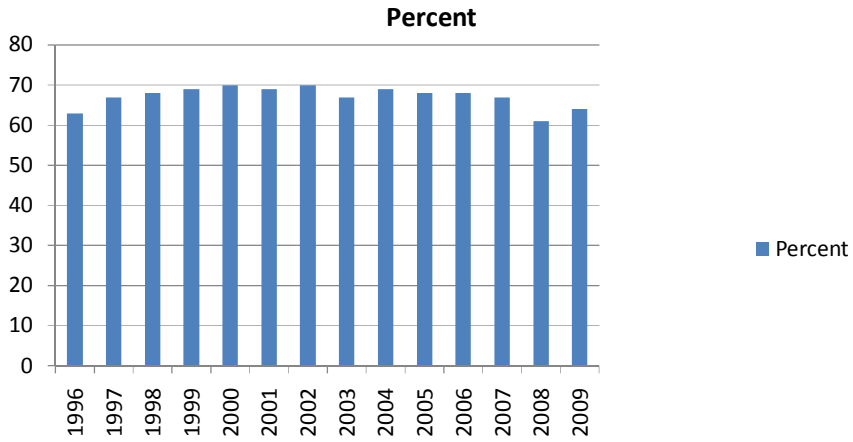
Figure 1. Ratio of long term debt to total debt, farm businesses



Source: Agricultural Resource Management Survey, NASS and ERS

Table 1. Analysis variables

Variable	Units	Description
Ltdratio	Proportion	Proportion of long term debt compared to total debt – long term debt, as defined here, refers to term debt or debt repaid in a period greater than one year.
Lnsales	Log of gross sales	Log of gross value of farm sales
Daratio	Proportion	Ratio of total debt to total assets
Wc	Proportion	Proportion of current liabilities compared to current farm assets – commonly known as net working capital
Lstates	Dummy variable	Equals 1 if farm is located in the Lake States
Cornbelt	Dummy variable	Equals 1 if farm is located in the Corn Belt
Nplains	Dummy variable	Equals 1 if farm is located in the Northern Plains
Splains	Dummy variable	Equals 1 if farm ids located in the Southern Plains
Totofi	$10,000's of dollars	Income earned off the farm
Livestock	Dummy variable	Equals 1 if it is a livestock farm and 0 if it is a crop farm
Fasset	Proportion	Proportion of fixed assets compared to total assets –fixed assets is a term used in accounting for assets and property which cannot be easily converted into cash.
Solvency1	Dummy variable	Equals 1 if the farm has adequate net income and a low debt to asset ratio; equals 0 for farms with net incomes less than zero or a high debt-to-asset ratio or both

Table 2. Descriptive statistics for commercial farm businesses, 2008

	2008	2008
Variable	Mean	Standard error
Ltdratio	0.51	0.0009
Lnsales	13.37	0.0002
Daratio	0.17	0.0004
Wc	2.90	0.134
Lstates	0.12	0.0007
Cornbelt	0.27	0.0009
Nplains	0.16	0.0008
Splains	0.07	0.066
Totofi	48.52	0.029
Livestock	0.35	0.001
Fasset	0.78	0.0004
Solvency1	0.70	0.001

Note: The mean value is adjusted for the complex survey design and the standard errors are for the estimated mean.

Table 3. Marginal effects for commercial farm businesses, 2008

Variable	Probability	Conditional level
Lnsales	0.018**	0.017***
	(0.009)	(0.008)
Daratio	0.075	0.070
	(0.066)	(0.062)
Wc	-0.00007	0.00006
	(0.00006)	(0.00005)
Lstates	0.137***	0.160***
	(0.015)	(0.020)
Cornbelt	0.094***	0.095***
	(0.016)	(0.017)
Nplains	0.091***	0.097***
	(0.018)	(0.021)
Splains	-0.010	-0.010
	(0.034)	(0.031)
Totofi	-0.017***	-0.016***
	(0.001)	(0.001)
Livestock	0.065***	0.063***
	(0.014)	(0.015)
Fasset	0.140***	0.132***
	(0.035)	(0.033)
Solvency1	-0.073***	-0.072***
	(0.019)	(0.019)

Standard errors in parentheses. ***significant at the 1% level; **5% level; *10% level

The estimates are adjusted for the complex survey design.