Target Capital Structure: Dynamics, Determinants and Speed of Adjustment

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Abstract

The corporate finance literature has focused on explaining the determinants of firms target capital structure and speed of adjustment using the well-established theories such as pecking order, signaling and trade-off theories. However, less attention has been paid to understanding the financing behavior of farm businesses using these theories.

Unlike corporate firms with professional management, farm businesses are different in a way that family members participate in management, the owner is often the manager, the decision-making unit is small, and farms heavily depend on government subsidies to stabilize income. These distinctive setting in farm business may result in different patterns of capital structure decision-making. Hence, we evaluate the application of corporate finance theories in the context of understanding the relationship between target capital structure and profit in the farm business.

We use a dynamic partial adjustment model to examine the determinants of capital structure and speed of adjustment, and detect capital structure theories with which the leverage ratio of farm business would comply. Our sample comprises a panel of 1500 Dutch farms over the years 2001 to 2015.

We find strong evidence that farms prefer internal funds to external funds. Profit is negatively related to leverage, supporting the pecking order theory, which has often been rejected for large firms. Consistent with the signaling theory, we find that size is positively related to leverage. Farm asset structure, growth, investment, and earnings volatility significantly determine the target capital structure. An interesting finding is that farm leverage is highly persistent and that lagged leverage is the best predictor of subsequent leverage ratios. Also, farms appear to have target leverage ratio and are reported to adjust their leverage towards the optimal level. The speed of adjustment to the target capital ranges from 8.6% to 63%, and varies by farm size and farm. This evidence further confirms the existence of dynamics in the farm capital structure decision. This article provides insights to understanding the dynamic nature of farm capital structure and the applicability of capital structure theories in the farm business.

Keywords: *Farm business, dynamic partial adjustment model, target capital structure, adjustment speed*

Introduction

A question often asked is do firms set target capital and adjust to it regularly? The corporate finance literature has focused on explaining the determinants of firms target capital structure and speed of adjustment using the well-established theories such as pecking order, signaling and trade-off theories. However, less attention has been paid to understanding the financing behavior of farm businesses using these theories.

Unlike corporate firms with professional management, farm businesses are different in a way that family members participate in management, the owner is often the manager, the decision making unit is small in size, and farms heavily dependent on government subsidies to stabilize income (Zhengfei, and Lansink, 2006). In addition, the seasonal nature of the production (leading to mismatches in cash inflow and outflow), legal forms, and limited access to equity markets, provides an interesting distinctive setting.

These distinctive setting in farm business may result in different patterns of capital structure decision-making. Hence, we evaluate the application of corporate finance theories in the context of understanding the relationship between target capital structure and profit in the farm business.

How farm businesses manage their capital structure has important implications for their performance (in terms of profit, financial risk, and survival), as well as the return and stability of lenders and financial institutions. Measuring the speed of adjustment helps to understand the overall responsiveness and flexibility of farms in adapting to changes in the farm financial and production structure.

Examining whether the pecking order and signaling theories explain the financial decision-making and capital structure of the farm business is also relevant. These theories have been criticized for being complicated to apply in corporate finance setting as it relies on the simplified assumption that a company has only two financing choices: debt and equity, the choice and ratio decision between equity vs debt gets complicated due to the agency problem, and the pecking order theory assumes that managers act in the interest of shareholders and the latter are passive. Farm businesses seem immune to these criticisms (Barry, Katchova and Zhao, 2005) as there are only two financing options and the farm operator is most of the time the owner and manager.

The main objective of this paper is to examine the determinants of target capital structure and speed of adjustment of farms. Specifically, this paper aims to examine (1) whether the pecking order, signaling, and trade-off theories explain the farm capital structure decision, (2) the determinants of farm capital structure decision, (3) the adjustment speed towards the target capital structure, if any.

According to the pecking order theory (Frank and Goyal, 2007), farms prefer internal funds to external funds for capital expenditure. Profitable farms have more retained earnings than a less profitable farm suggesting a negative relationship between profit and leverage. However the signaling theory point out that this relationship can also be positive, as lenders are more willing to lend to profitable farms. Hence, the causality between capital structure and profit needs to be examined (Zhao et al., 2004).

To disentangle this causality concern, we employ a dynamic panel system general method of moments (*system*-GMM) approach. It allows us to address the important but often ignored methodological concern in capital structure studies: dynamic endogeneity. It also gives reasonable results in the presence of endogeneity, serial correlation in error terms and dealing with unbalanced panel data (Arellano and Bover, 1995). Based on capital structure theories and previous literature, we include asset structure, farm size, growth (investment) opportunities and risk level as determinants in the dynamic model. We also include the macro-economic determinants (government debt to GDP, inflation and employment) of farm capital structure, which has been given less attention in the literature.

The analyses are based on a unique longitudinal dataset collected for a panel of 1500 Dutch farms for the period 2001-2015. Contrary to previous studies that focus on a single farm type, we take into account four farm types (dairy, livestock, field crop, and horticulture farms). Hence, a larger segment of the farm sector can be analyzed.

Preliminary results show strong evidence of farms preference for internal funds over external funds. Interestingly, we find profit to be negatively related to leverage, supporting the pecking order theory, which has been often rejected for large and stock-listed firms (Ampenberger et al., 2013). Consistent with the signaling theory, we find that size is positively related to leverage. Farm asset structure, growth, investment, and risk significantly determine farm capital structure.

Furthermore, the panel structure of our data allows us to examine the dynamic behavior of the farm leverage ratio. We find that leverage is highly persistent and that lagged leverage is the best predictor of subsequent leverage ratios. Finally, farms appear to have target leverage ratio, and the speed of adjustment is slow and mostly dependent on the size and farm type. To examine the robustness of our findings, we run the models by dividing the sample by farm size, growth opportunities and sample period. The result shows that the impact of profit on leverage is much higher and farms adjust to their target capital much quicker in the post financial crisis periods.

We expect the results to provide new insights on the impact of farm characteristics and macroeconomic factors on capital structure decision and target adjustment speed. For policy-makers, the result gives better insight on the impacts of financial policies on farm viability. For financial institutions, the results help better understand the farm capital decision-making process for risk and profit evaluation. The results also confirm that not only farm specific characteristics, but also macroeconomic factors need to be considered by farms while deciding the target leverage. The findings should also spark discussion about the applicability of pecking order and signaling theories in the farm business.

The paper is structured as follows. The next section provides a theoretical background and conceptual framework. This is followed by a description of the variables, data used, and methodology applied. Next, the results of the empirical analyses are presented and discussed. The last section sets out the conclusion, limitations, and suggestions for further research.

Theoretical Background

Theoretical Review

The seminal paper by Modigliani and Miller (1958) is the basis for many capital structure empirical researches. They contend that the value of a firm is independent of its financing decisions under restrictive assumptions of perfect capital markets with no taxes, transactions costs and arbitrage opportunities. Once these assumptions are relaxed, the question of what determines firm capital structure becomes complex.

In such complex decision-making context, asymmetric information and adverse selection emerged as major elements of capital structure theories in the corporate finance literature. However, empirical tests of these theories are rare for the degree of asymmetric information and the extent of agency problems along with other unobservable factors are difficult to capture with models. Notwithstanding these restrictions, the pecking order theory of Myers (1984) and Myers and Majluf (1984) and the signaling theory are the most widely cited models in the literature.

The pecking order theory roots back to Donaldson (1961). Myers and Majluf (1984) revise the theory and endorse it as an alternative model to the tradeoff theory. According to the pecking order theory, firms have three sources of funding: retained earnings, debt and equity (Frank and Goyal, 2007). The theory states that firms will choose the cheapest source of funding for investment. The theory predicts that the cost gap between internal and external funds attributed to asymmetric information and agency costs makes firms prefer internal to external financing. If firms require external funding, they will issue debt and convertible bonds before issuing equity (Myers and Majluf, 1984). Hence, the pecking order theory suggests farms will first rely on retained earnings to finance their investment needs. After using their retained earnings exhaustively to invest in profitable projects, then farm owners prefer to use debt than issuing equity. The theory thus implies a farm's current leverage level and cash flow are negatively related.

Ross (1977) introduces the signaling theory to the corporate finance literature based upon the problems of the asymmetric information between firm managers and external parties such as lenders and investors. The theory states that managers have better information about the firm and a motive to transfer this knowledge to investors and lenders. The firms that want to send signals that they have good prospects often increase their leverage, calling firm's convertibles, repurchase their outstanding stocks. Adding more debt to the firm's capital structure also shows a credible sign of expected high cash flow (Ross, 1977). According to the signaling theory, farms tend to signal their good expectation about the investment through high leverage or accumulated assets (Zhao et al., 2004). Based on these signals, then lenders will provide loans. Zhao et al., (2004) further argues that if leverage is taken as a signal for farm performance, high leverage farms will exhibit higher investment in the same period. However, investments made in current period may have no immediate effect in terms payoff implying a positive relationship between farm's current leverage and future cash flow.

Though abundant supportive evidence exists for the applicability of the pecking order theory in corporate finance literature, researches explaining the financing behavior of farm businesses using theories are scant. Not only are these studies scant, but the few studies that exist often use a cross sectional data. It is appropriate to use a cross section data during periods of stable financial condition in agriculture. However, we argue that optimal capital structure decisions are a long term concept and have a long-run impact on the survival and success of agricultural firms. As a result, empirical studies need to use a longitudinal research design.

Zhao, Barry, & Katchova (2004) and Zhao et al., (2008) are a few of the exceptions to the above censure. In their papers, they test the applicability of the traditional theories of pecking order, trade-off and signaling theories on farm business using cross sectional time series data from the Illinois Farm Business Farm Management (FBFM). They find farm businesses not only follow the pecking order theory, but also the signaling theory. They also show farm business depend on their size and operation records as financing signals unlike corporate firms who can choose high leverage as a signaling tool to facilitate investment.

In the literature, the signaling theory has been considered with the joint effect of traditional theories of pecking order and trade-off so that together will better reflect the capital structure effect. Barry, Katchova and Zhao (2004) consider these theories jointly to capture the borrower's capital structure decisions with the lender's determination of borrower's credit capacity, thus encompassing both sides in the lender-borrower relationship. Zhao et al., (2008) also develop a model for both conceptual and empirical implications of the pecking order, trade-off, and signaling theories on farm business financing, investment, and expansion process. Other evidence in the applicability of these traditional theories on farm business is, however, less direct.

Hence, insights on the determinants of farm capital structure decisions and applicability of these theories in explaining such decisions benefit farms, lenders, and policy analysts. It is important for financial institutions to understand farm capital structure for risk and profit evaluation. For policy makers, the result will give better insight on the impacts of financial policies on farm viability.

Determinants of Capital Structure

The literature on the determinants of capital structure decisions of farm businesses is wide-ranging and major factors, for example, include: farm profit, financing costs and amount of debt (Zhao, Barry, and Katchova, 2008), asset structure, economies of scale, wealth, risk attitude and adjustment costs (Barry et al., 2000), farm risk management strategies (Katchova, 2005), credit constraints and government payments (Featherstone et al., 2005). Several studies examine the role of farm specific factors in the capital structure decision. Based on the capital structure theories and previous literature, we include farm profit, asset structure, farm size, growth (investment) opportunities and risk level as farm specific determinants. In the following paragraphs, we briefly describe the relationship we expect with farm's capital structure and explain how we operationalize each variable.

According to the pecking order theory, farms prefer internal funds over external funds for capital expenditure (Jahanzeb, 2013). Farms prefer to finance new investment from retained earnings and borrow from lenders (issue debt) only if retained earnings are not sufficient. Profitable farms tend to have more retained earnings. Thus, we expect an inverse relationship between farm profit and leverage. Less profitable farms will use more debt, since they lack internal alternatives. On the other hand, the relationship can be positive, according to the signaling theory, for lenders are more willing to lend to profitable farms. Hence, correct inference of causality requires due attention. Farm profitability is measured as the ratio of farm return and total assets (ROA).

We expect asset tangibility to be positively related to the farm's leverage level. Due to the high vulnerability of the agricultural sector to systematic market risks and natural risks, lenders want farms with assets as collateral to back up their loans. Tangible fixed assets are easily pledgeable and easier to liquidate in case of bankruptcy thereby reducing the cost of financial distress The pecking order theory also supports the positive relationship between tangibility and leverage as tangible farms are easily recognized to lenders and there will be less information asymmetry. Whereas, farms with little collateral may depend on profit based retained earnings for investment. Tangibility is measured as the ratio of fixed assets and total assets.

Larger farms tend to be more diversified in their farm business and, as a result, the probability of total failure is low. Size may also be an indicator of farm's bargaining power. Therefore, size is considered to be positively correlated to leverage. This relationship provides support to the information asymmetry argument of Frank and Goyal (2009) that larger farms are easily noticeable (lenders have information about them) and can get access to loans easily. We use the natural logarithm of total assets (lnAsset) to measure farm size.

The signaling and the pecking order theories illustrate the relationship between a farm's financial leverage and growth (investment) opportunity under asymmetric information. According to the signaling theory, farms attempt to signal their good expectation about the investment through high leverage or accumulated assets. Based on these signals, then lenders will provide loans. When leverage is taken as signal, high leverage farms are expected to exhibit higher investment in the same period. This mechanism will lead to a positive relationship between growth opportunity and leverage. On the other hand, the pecking order theory suggests that farms will first rely on retained earnings to finance their investment needs. After using their retained earnings exhaustively to invest in profitable projects, then farm owners prefer to use debt. This implies a negative relationship between farm growth opportunity and leverage. We use the ratio of investment to total assets to measure farm growth (investment) opportunity.

Higher earnings variability increases the risk that farms may not be able to meet interest and principal payment obligations. This implies a negative relationship between leverage and income variability. However, the information asymmetry and adverse selection argument underline that farms with high-income volatility and operational risk would also be the one to apply for loans, thereby indicating a positive relationship between leverage and risk (volatility). Following De Mey et al., (2015), we use the coefficient of variation of ROA (standard deviation divide by mean) before interest as a measure farm risk (earnings volatility). Table 1 summarizes determinates of target capital structure and expected results.

[Insert Table 1 about here]

Macro-economic factors: evidence exists on the impact of farm specific factor on capital structure decisions. What is often ignored and less investigated is the possible implications of macro-economic factors in the target farm capital structure decision making. A brief consult to th literature reveals that inflation, government debt to GDP and employment level in the industry has a significant impact on capital structure (Frank and Goyal, 2009). We include these variables in our model.

Target Capital Structure and Speed of Adjustment

The trade-off theory postulates that the management of firms assesses the benefits and costs of alternative leverage plans. Unlike the static trade-off theory that provides the solution of the optimal capital structure for one period, the dynamic trade-off theory emphasizes the importance of time, role of expectations and adjustment costs (Fischer, Heinkel and Zechner, 1989). This fetches dynamism in the capital structure decisions of firms. According to the dynamic trade-off theory of capital structure, firms make gradual adjustments towards optimal target capital structure over time. Adjustment to the target would be instantaneous and minimal incentive exists to do so if the cost of adjustment is zero (Flannery and Hankins, 2007).

Due to the presence of market imperfections such as transaction costs and information asymmetry, firms may temporarily deviate from their optimal target leverage. This produces an interesting question of the adjustment speed to target capital structure. Frank and Goyal (2007) stipulate the framework of the target adjustment hypothesis. The framework point out that the adjustment speed towards the target capital structure depends on the adjustment costs and the costs of deviating from the target (Flannery and Hankins, 2007). A slower speed of adjustment is expected when adjustment costs are high, and when the cost of deviating from the target is high, a much faster adjustment speed is expected. Faulkender et al., (2012) noted that the incentive to reduce leverage is greater than that of increasing the same, implying asymmetry in target adjustment, i.e. firms would adjust faster downward that upward.

Fama and French (2002) estimate the target leverage adjustment and find that, on average, firms tend to adjust to their target slowly. Contrary, Flannery and Rangan (2006) use an instrumental variable approach and find that firms do target a long run capital structure. They also report a much faster rate of adjustment that on average a typical firm reduces one-third of the difference between the actual and long run target leverage in a year. They argue that the slower rate reported by Fama and French is mainly attributed to the noise in the estimation strategy of target leverage. Drobetz et al., (2014) find a speed of adjustment about 25% per year supporting the economic relevance of the trade-off and pecking order theory.

The literature is still tuneless in terms of the measurement of yearly adjustment speed rates. For farm business, whenever there are changes in the production structure, it either tie up capital (when capacity increases) or free up capital (when capacity decreases). This results to a shock in the farm target capital structure. Hence, measuring the sped of adjustment is important to understand the overall agility of farms and flexibility to adapt to changing production and finance structure. The measures are usually expressed in terms of the time needed to return to the target capital structure after a shock (Zhao and Susmel, 2008).

Research Design

This section introduces the standard dynamic partial adjustment model, which will lead to the econometric specification of the model used in this article. In addition, the nature of the data and the descriptive statistics of the sample selected farm are provided.

Empirical Model (Dynamic Partial Adjustment Model)

The capital structure decision is expected to be driven by farm specific and macro-economic factors. To account for these factors, we specify a dynamic capital structure model. Let the target leverage of farm i in period t, denoted as $LEV^{*}{}_{\mathrm{it}}$, be a function of farm specific and macroeconomic capital structure determinants, labelled as $\mathrm{X_{it}}$ and $\mathrm{Z_t}$ respectively, and write:

$$(1)\ \mathrm{LEV^{*}}{}_{\mathrm{it}} = \textstyle\sum_{\mathrm{jm}} \beta_{\mathrm{j}}\, \mathrm{X_{i,t}} + \gamma_{\mathrm{m}} \mathrm{Z_t}$$

The dynamic capital structure model set up implies that the target leverage may vary across farms and over time. In frictionless economy, the observed leverage of farm i at time t, LEV_{it}, should be the target leverage ($LEV_{it} = LEV^*_{it}$). Equation (2) below includes only farm specific factors and the general model estimated is of the following linear form:

$$(2)\ LEV_{it} = \alpha + LEV_{it-1} + \beta_1 AST_{it} + \beta_2 FS_{it} + \beta_3 FP_{it} + \beta_4 FG_{it} + \beta_5 FR_{it} + \varepsilon_{it}$$

LEV_{it} is the leverage ratio of farm i at time t, LEV_{it-1} is a lagged leverage variable included to construct a dynamic specification that allows for the possible effect of the AR process and adjustment costs (Byoun, 2008), AST is asset structure, FS is farm size, FP is farm profitability, FG is farm growth opportunity, FR is farm risk level, ε is the error term, which consists of individual effect (μ_i) and disturbance (ν_{it}), β, and α are parameters to be estimated. In equation (3), we add the macroeconomic factors as:

$$(3)\ LEV_{it}=\alpha+LEV_{it-1}+\beta_1 AST_{it}+\beta_2 FS_{it}+\beta_3 FP_{it}+\beta_4 FG_{it}+\beta_5 FR_{it}+\gamma_6 GDP_t+\gamma_7 Inf_t+\gamma_8 Empl_t+ \varepsilon_{it}$$

Where, GDP is government debt to GDP, Inf is inflation and $Empl$ is employment level in the industry. Others are the same to definitions of equation (2).

Equation (2) and (3) assumes a frictionless economy. In their seminal paper, however, Titman and Wessels (1988) show that transaction costs are important determinants of capital structure decision. Such costs tend to prevent firms from attaining target capital structure and adjustment may occur gradually over time depending on the trade-off between not operating at target leverage and the costs of adjustment towards to the target (Frank and Goyal, 2009 and Byoun, 2008). This trade-off suggests that farms adjust their current leverage, LEV_{it} with the certain speed of adjustment, λ_{it} to attain the desired capital, LEV_{it}^* as follows:

$$(4)\ LEV_{it}-LEV_{it-1} = \lambda_{it}(LEV^*_{it}-LEV_{it-1})$$

The specification in equation (4) implies that farms take actions to close the gap between the current leverage level ($\mathrm{LEV_{it}}$) and the level they wish to achieve ($LEV^{*}{}_{\mathrm{it}}$). λ_{it} represents the rate of convergence of $\mathrm{LEV_{it}}$ to $\mathrm{LEV^{*}{}_{it}}$ or is the magnitude of adjustments between two subsequent periods. Hence, the change in leverage depends on the speed of adjustment λ_{it} , and the distance between lagged leverage ($\mathrm{LEV_{it-1}}$) and the target leverage ($\mathrm{LEV^{*}{}_{it}}$).

The existence of adjustment costs is represented by the restriction that $|\lambda_{it}|$ <1, which is the condition that $\mathrm{LEV_{it}} \rightarrow \mathrm{LEV^{*}{}_{it}}$ as $t \rightarrow \infty$. If λ_{it} is 1, it indicates an immediate and full correction of deviations from the target farm leverage. If λ_{it} < 1, it implies that the farm does not fully adjust from period $t-1$ to t due to adjustment costs. If λ_{it} > 1, the farm adjusts more than required and is still not at its target leverage level. Finally, if λ_{it} = 0, it shows absence of adjustment (random leverage hypothesis). Since λ_{it} represents the degree of adjustment, it can be seen as the speed of adjustment and higher values denoting a faster speed of adjustment.

It should be noted that the absence of adjustment costs and the aggregation effect, the inferred relationship will suffer from specification error if the observed farm leverage is regressed on the determinants of target capital structure alone (Heshmati, 2001). In order to avoid a misspecification error, equation (4) can be written as,

(5) $\mathrm{LEV_{it}} = (1-\lambda_{it})\mathrm{LEV_{it-1}} + \lambda \mathrm{LEV^{*}{}_{it}} + \varepsilon_{\mathrm{it}}$

Where, $\varepsilon_{\mathrm{it}}$ is the error term and assumed to have zero mean and constant variance. In addition, to endogenize the adjustment speed parameter, we assume that λ_{it} vary across farm and time, and is a function of predetermined variables $\mathrm{X_{it}}$. Omiting a constant term for the sake of model tarcabilitry, we will have a linear model as:

(6) $\lambda_{\mathrm{it}} = \theta_1 \mathrm{X_{it}}$

Rewriting equation (5) and substituting equation (1) results the following relationship for farm leverage at time t, $\mathrm{LEV_{it}}$:

(7) $\mathrm{LEV_{it}} = (1 - \theta_1 \mathrm{X_{it}})\mathrm{LEV_{it-1}} + \theta_1 \mathrm{X_{it}}(\sum_{\mathrm{jm}} \beta_\mathrm{j}\, \mathrm{X_{it}} + \gamma_\mathrm{m} \mathrm{Z_t}) + \varepsilon_{\mathrm{it}}$

The target leverage is modeled as a linear combination of farm specific and macroeconomics factors and other unobservable determinants. Including this relation of target leverage and multiplying out equation (7), we obtain equation (8), which is the integrated partial adjustment model and basis of our empirical investigation:

(8) $\mathrm{LEV_{i,t}} = \alpha + (1 - \lambda_{it})\mathrm{LEV_{i,t-1}} + \beta_1 AST_{\mathrm{i,t}} + \beta_2 FS_{\mathrm{i,t}} + \beta_3 FP_{\mathrm{i,t}} + \beta_4 FG_{\mathrm{i,t}} + \beta_5 FR_{\mathrm{i,t}} + \gamma_6 GDP_{\mathrm{t}} + \gamma_7 Inf_{\mathrm{t}} + \gamma_8 Empl_{\mathrm{t}} + \varepsilon_{\mathrm{i,t}}$

In equation (8), the explanatory variable farm profit ($\mathrm{FP_{it}}$) is potentially endogenous. According to the pecking-order theory, farms prefer internal funds to external funds for capital expenditure. Profitable farms have more retained earnings suggesting a negative relationship between profit and leverage. On the other hand, the relationship can be positive since lenders are more willing to lend to profitable farms (Zhengfei and Lansink 2006).

Hence, estimating the parameters in the equation (8) using the standard OLS estimator would lead to inconsistent and biased estimators for the error term may be correlated with the lagged dependent variable. To ease this problem, we estimate a first difference Generalized Method Of Moments (GMM), a dynamic panel data estimator suggested by Arellano and Bond (1991), whereby the levels of the right-hand side (rhs) variables lagged twice or more constitute valid instruments (Blundell and Bond , 1998).

The GMM estimator allows us to specify the endogenous variables and involves first differencing that removes the time-invariant, farm-specific effects:

(9) $\mathrm{LEV_{it}} - \mathrm{LEV_{it-1}} = (1 - \lambda)(\mathrm{LEV_{it-1}} - \mathrm{LEV_{it-2}}) + \sum_j \beta_\mathrm{i}\, (\beta_{\mathrm{it}} - \beta_{\mathrm{it-1}}) + \; + \sum_m \gamma_\mathrm{t}\, (\gamma_\mathrm{t} - \gamma_{\mathrm{t-1}}) + \; \varepsilon_{\mathrm{it}} - \varepsilon_{\mathrm{it-1}}$

Thus, the first difference of the farm profit variable (FP) is instrumented by the lagged levels. By construction $(\mathrm{LEV}_{it-1} - \mathrm{LEV}_{it-2})$ is correlated with the error term $(\varepsilon_{it} - \varepsilon_{it-1})$. In addition, Arellano and Bond (1991) proposed a difference GMM, which suggests using the lagged values of all the right-hand variables as instruments for individual i in differences:

$$(10)\ \mathrm{Z}_i = \begin{bmatrix} [LEVi0] & 0 & \cdots & \cdots & 0 \\ 0 & [LEVi0, LEVi1] & \cdots & \cdots & 0 \\ \vdots & \vdots & \ddots & \cdots & \vdots \\ \vdots & \vdots & \cdots & \ddots & \vdots \\ 0 & 0 & \cdots & \cdots & [LEVi0, \ldots \ldots, LEVi, T-p] \end{bmatrix}$$

Where, Z is the matrix of instruments for individual i,$i = 1, \ldots., n$, p is the number of lags, and T is the number of time periods. However, the difference GMM estimator is subject to finite sample bias when these instruments are weak. Thus, Blundell and Bond (1998) propose a new approach, the system GMM, which combines the set of moments in the difference and level equations. In addition, the system GMM suits well datasets with a large number of cross-sections and few time periods.

Note that the specification outlined in equation (8) uses the determinant factors measured at the same period that the target leverage is determined. In long panels, it is common that the lagged explanatory variables are generally used to account for the delay in adjustment towards the target leverage. Lagging the variables also prevent the look-ahead bias and ensure the data is available for managers (farm operator-managers) at the point in time being considered for decision making. Besides, it reduces the endogeneity effect or the correlation between the explanatory variables and the error term (Getzmann et al., 2010). However, for our case we have short panels and using lagged explanatory variables will result in a huge loss of information. Besides, the system GMM better handles the endogeneity issues. The next section presents the data used in this paper.

Data

A high-quality data set, which includes consecutive observations for each farm for many years, is required to examine the variability of farm leverage. In addition, the data must be based on consistent accounting and economic measurement concepts. Obtaining this type of data set is challenging. This paper has benefited from a unique longitudinal dataset of Dutch farms that have been participating in the Farm Accountancy Data Network (FADN).

After the USA, the Netherlands is the second largest exporter of agricultural products (Ge et al. 2013). The Dutch agriculture sector accounts for 2% of the country's economy, 20% of the country's total export value, and 2.5% of employment (Berkhout and van Bruchem 2015). Furthermore, highly educated farmers, large-scale, capital-intensive farming, export orientation, increasing input and output price volatility, and sustainable orientation characterize the Dutch agriculture sector. Hence, the sector provides an interesting context for examining the determinants and adjustment speed to target capital structure.

The Dutch FADN samples are randomly selected using disproportional stratified sampling techniques from the farm census (Ge et al. 2013). Economic size and farm type are the stratification criteria used to select farms. The data we use in this paper are unique in that they constitute the sole source of farm-level, micro-economic data for more than ten years; the samples are representative for 80% of the farms and more than 90% of production in the Netherlands (Ge, et al., 2013) and allow separate estimation of farm types for comparison purposes thanks to the harmonized data-collection procedure, i.e. the bookkeeping principles are identical for all farm types. We obtain the data about the macroeconomic factors (inflation, government debt to GDP, and employment in the industry) from the World Bank.

The panel is unbalanced and covers the period 2001 - 2015. To include a farm in the analysis, we apply the following five criteria: firstly, continuous whole-farm data had to be available from 2001-2015. Secondly, a farm must have debt, as farm target leverage and adjustment will not occur without liabilities. Thirdly, given the problem with calculating the coefficient of variation, farm observations with negative ROA are excluded. Fourthly, given the lag structure of our model and calculation of business risk (earnings volatility) through a three-year moving window, farms need to remain in the sample for at least four years. Finally, to address outlier concerns, extreme values in the dataset are dealt with by dropping the top and bottom 0.5% observations of the variable from the analysis. These criteria reduced the total number of farms included in this study to 1,339 (89 percent of the original farms), reduce the number of observations from 15,682 to 13,677. Table 2 shows the summary statistics of Dutch farms.

[Insert Table 2 about here]

Average farm leverage ratio for all farms over the 2001–15 periods is 36.3%. It shows variation by farm type. The average leverage for dairy farms, field crops, horticulture and livestock are 27.4%, 25.7%, 45.7%, and 41.4% respectively, with horticulture being the largest. Farms on average earn a 2.53% profit. Figure 1 shows the variation in leverage over the years across the four farm types.

[Insert Figure 1 about here]

From a general observation, the average leverage ratio does seem convey an increasing pattern over the years for dairy and livestock farms. The increasing trend of farm borrowing by the Dutch dairy farms suggests the heavy investment to oblige the obligatory manure processing in 2014, and increase their scale ahead of the abolition of milk quotas on April 1, 2015. Farm leverage ratio for horticulture farms reaches its peak in 2011 and 2012. This can be explained by the fact that farms needed extra cash to cover higher energy bill, for cold spring weather in those years. The next section presents the empirical results.

Empirical Results

Determinants of Target Capital Structure

Tables 3 and 4 show the estimation results of the system GMM based on equation (8). The Sargan test, Wald test, and AR (2) second-order serial correlation test are presented to gauge the overall model fit. The Sargan test of over identifying restrictions yields a *p*-value of 0.990 for *model 1(*only farm specific factors) and 0.999 for *model 2* (farm specific and macro-econ0mic factors). This result confirms that the instruments used in the system GMM are valid. The results of the Wald test are significant at the 1% level for all farm types, ensuring the significance of the right-hand side variables. The hypothesis of no second-order autocorrelation of the disturbance term is not rejected at the 5% significance level for both models in Table 3and 4 implying that there is no serial correlation. The result also implies that the key identifying assumption required for the GMM estimator is satisfied.

The results in Table 3 show a significant negative relationship between farm profit (FP) and leverage in all the farm types but dairy farms. Our results confirm the existing evidence in the literature on the determinants of target leverage. The inverse relationship is consistent with Myers' (1984) pecking order theory that internal funding is preferred to external funding. The high profits earned by farms reduce the need for external finance. Similar result is reported by Zhao, Katchova and Barry (2004). However, the estimates show that the relationship between farm profit and leverage ratio is positive and significant for dairy farms. This result is consistent with the signaling theory that the higher profitability of dairy farms sends a positive signal for lends to provide more loans which, reduces financial constraints.

[Insert Table 3 about here]

There is a marked difference in the size of the coefficients of profitability implying a different degree of economic significance of farm profit on the capital structure decision. The negative coefficient, in absolute terms, is the largest for horticulture farms followed by livestock farms. Figure 2 further confirms that compared to other farm types, horticulture farms exhibit a relatively stable profit over the years and the profit level shows an increment after the years of the financial crisis. This is largely attributed to the poor production in Southern Europe during the summer months of the post finical crisis periods, for the price of fruits and vegetables largely depends on what is produced elsewhere. The increment in profit level of the horticulture farms asserts the economic significance of the profit variable on leverage ratio.

[Insert Figure 2 about here]

The estimated relationship between asset tangibility and leverage is significant and positive for dairy farms. This is consistent with the signaling theory that tangible assets are more valuable to creditors should farms go into liquidation. The result also supports the importance of tangible assets as collateral for debt financing in agriculture business. However, the relationship is negative and not significant for other farm types.

We find mixed results about the effects of farm size on leverage. The size of the farm measured by total asset appears to be positively related to leverage in livestock farms. Larger farms are known to be less exposed to bankruptcy risk and hence are likely to get more loans from lenders (Frank and Goyal, 2007). The relationship seems to be significant and negative for dairy farms. Hence, large livestock farms suffer less from asymmetric information and can obtain more debt.

The conventional view that farms with high volatility of earnings should borrow less is only supported for field crop farms. The significant and positive relation between earnings volatility and leverage for horticulture farms is supported by the information asymmetry view that farms with the highest income volatility and operational risk would always be the one to apply for the loans.

The relationship between leverage and farm growth opportunity is significantly positive for all farm types. Results are consistent with the signaling theory that farms attempt to signal their good expectation about the investment through high leverage suggesting that farm with high leverage will exhibit high investment in the same period (Jahanzeb, 2013 and Barry et al., 2000). Table 4 shows the partial adjustment regression results of model 2, where macroeconomic factors, in addition to farm specific factors, are included as determinants of the capital structure decision.

[Insert Table 4 about here]

The coefficients of farm specific factors in model 1 and 2 show similar sign and magnitude, suggesting similar influence on the capital structure decision. Compared to the farm specific effects, the macro economic factors have a less significant effect on the capital structure decision. The government debt to GDP has a significant and positive effect on leverage for horticulture and a negative, but not significant relationship for dairy farms. We don’t suggest that government debt to GDP is a core determinant (economic significance) since the coefficients presented in Table 4 are very small. Mixed results are also found about the relationship between inflation and farm leverage ratio. Lastly, we find a small but significant coefficient showing a positive relationship between employment in industry and farm leverage for dairy, horticulture and livestock farms. The less significant impact of macroeconomic factors, both in sign and magnitude, suggests that farm specific factors are the core determinants of target capital structure decision.

The Adjustment Speed

Our preliminary findings suggest that farm capital structure decision is determined mostly by farm specific factors and to a lesser extent by macroeconomic factors. In this section we report the adjustment speed estimated using system GMM.

The first rows of Table 3 and 4 report the coefficients of the lagged leverage, which is significant and positive at the 1% level for all farm types. The results are consistent with the findings reported by Frank and Goyal (2004). The coefficients are between zero and one implying that farm leverage ratio converges to the target level over time. This also confirms the presence of dynamics in the farm capital structure decision.

From the estimated lagged leverage coefficient values of 0.8541, 0.8379, 0.3472, and 0.9112 in Table 3, for dairy, field crops, horticulture and livestock farms respectively, we infer that farms adjust leverage towards target capital structure and the adjustment speed is 14.59 %($1 - \lambda$) per year for dairy farms, 16.21% for field crops, 65.28% for horticulture farms and 8.88% for livestock farms.

This speed of adjustments corresponds to a half-life✦ of leverage shocks of about 4.4, 3.9, 0.65, and 7.4 years respectively. Compared to findings reported by other studies, the adjustment speed of Dutch farms is slow except for horticulture farms. For instance, studies from the US report adjustment speed at around 25% (Frank and Goyal, 2004).

The slow adjustment to the target leverage is mainly attributed to the high adjustment cost. Two factors might explain the high adjustment cost of Dutch farm business. First, for farm business it is not easy to access loan and equity markets. There are only few financial institutions in the Netherlands that specializes in agricultural financing. Second, since farm businesses are small and medium in size, there is an adverse selection issues as a result of information asymmetry, which makes it adjustments costly. The high adjustment speed by horticulture farms could indicate the ease with which horticulture farms have been able to acquire financing through debt and, hence, have lower adjustment cost. A closer look to Table 4 tells us that the sign and magnitude of the estimated coefficients of model 2 are similar. This suggests that the adjustment speed is not changed, given the effects of macroeconomic factors on the target capital structure decision.

✦ Half-life is the time the process needs to close the gap between the actual and target farm leverage level by half (50%), after a one unit shock to the error term. Hence, half-life is calculated as $log(0.5)/log(\lambda)$ (Faulkender et al., 2012). For example, the λ estimate in Table 3 for dairy farms is 0.8541, which means that a typical dairy farm closes about 14.59% $(1-\lambda)$ of its gab between its current level of leverage and the target in one year. At this rate, it takes approximately 4.4 years for the farm to close half of the gap between the current and target leverage, or about 9 years for the average dairy farm to adjust to its target capital structure after shock.

Robustness Tests

To examine the robustness of our findings, we split our sample using multiple criteria and equation 4 is reestimated. The criteria to split the sample are farm size, growth opportunity and sample period. Table 5 shows the results.

[Insert Table 5 about here]

The results in Table 5 for small and large farms show similar results. Although, all variables have similar impact on small and large farms, the magnitude is higher for large farms. Large farms heavily depend on internal funds and the speed of adjustment is faster than small farms. The much faster adjustment speed by larger farms provide ab interesting evidence for the applicability of signaling theory in explaining farm business capital structure decision , which creditors prefer larger and visible farms. Size also provides a bargaining power for farms, which will reduce the cost of adjustment. We also split the sample into three subsamples based on growth opportunities. The result in Table 5 shows that farms in the lowest and highest growth opportunities are similarly affected by farm specific factors. However, only the leverage ratio of high growth farms is significantly and negatively affected by their asset structure.

Finally, we split the sample into two periods (2001-2007 and 2008-2015), to test for any structural breaks in the farm capital structure decision. The result shows that the impact of profit on leverage is much higher and farms adjust to their target capital much quicker in the post financial crisis periods. Besides, the coefficients of farm type dummies are positive and significant at the 10% level in the post-crisis period, suggesting that farm type specific factors have played a more dominant role in determining target capital structure in the post crisis period than in the pre-crisis period. Overall, the evidence suggests farm capital structure decisions are predominantly influenced by farm specific factors.

Conclusion

In this article, we aim to examine the effects of farm-specific and macroeconomic factors in determining the target capital structure and the speed of adjustment. We apply dynamic panel system GMM estimation to a unique panel consisting of 1500 farms over fifteen years.

We find strong evidence of farms preference for internal funds over external funds. Interestingly, we find profit to be negatively related to leverage, supporting the pecking order theory. Consistent with the signaling theory, we find that size is positively related to leverage. Farm asset structure, growth, investment, and risk significantly determine farm capital structure. Although most of the variables identified in the literature affect the leverage of farms, the degree and importance of these factors are farm type specific Though not strong, macroeconomic factors also determine farm capital structure decision. Hence, the capital structure decision of a farm is not only the product of its own specific characteristics, but partially also the macroeconomic environment in which it operates.

It is worth noting that farm leverage is highly persistent and that lagged leverage is the best predictor of subsequent leverage ratios. Also, farms appear to have target leverage ratio and are reported to adjust their leverage towards the optimal level. The speed of adjustment to the target capital is slow and varies on size and farm type. The speed of adjustment is relatively faster for horticulture farms and relatively slower for livestock farms. This evidence further confirms the existence of dynamics in the farm capital structure decision. This research provides insights to understanding the dynamic nature of farm capital structure and the applicability of capital structure theories in farm business (small and medium size context). Furthermore, the results indicate that the pecking order and signaling theories explain, in part, the farm target capital structure.

This paper has limitations that motivate further research. In spite of the fact that we use high-quality, unique panel data, we rely merely on farm accounting dataset. Future research may complement this with behavioral data on, for example, farm risk attitude and perception. Future research can also test for the applicability of the other theories of capital structure to the farm business and for its impact on farm performance (profitability, survival and viability).

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Table 1. Determinants of Target Capital Structure

	Determinant	Pecking Order Theory	Signaling Theory
1	Farm Profit (FP)	-	+
2	Asset structure (AST)	+	+
3	Farm size (FS)	+	+
4	Growth (Investment) Opportunity (FG)	-	+
5	Risk (Volatility) (FR)	-	-

Table 2. Variables and Summary Statistics of Dutch Farms, 2001-2015

Variable	Explanation	Obs.	Mean	SD
Leverage	Total Debt/Total Asset	15,682	0.363	0.289
Dairy Farms		4,101	0.274	0.163
Field Crops		2,695	0.253	0.204
Horticulture		5,136	0.457	0.375
Livestock		3,750	0.414	0.259
Asset Structure	Fixed Asset/Total Asset	15,682	0.709	0.172
Farm Size	Natural Log of Total Asset	15,682	14.567	0.847
Profit (ROA)	Net Farm Income/Total Asset	15,682	0.0253	0.091
Growth Opportunity	Total Investment/Total Asset	15,682	0.043	0.078
Earnings Volatility	Coefficient of variation of ROA	13,677	0.616	23.70

Table 3. Dynamic Panel Regression Results: Model 1

Variables	Dairy	Field Crops	Horticulture	Livestock
LEV t-1	0.8541***	0.8379***	0.3472***	0.9112***
	(0.020)	(0.042)	(0.135)	(0.067)
FP	0.238**	-0.501***	-1.972***	-0.827***
	(0.119)	(0.165)	(0.528)	(0.1059)
AST	0.0896***	-0.053	-0.0297	-0.0183
	(0.016)	(0.071)	(0.210)	(0.0475)
FS	-0.0234**	-0.0139	0.0875	0.0338*
	(0.0122)	(0.011)	(0.0586)	(0.0205)
FG	0.372***	0.3551***	0.0923*	0.404***
	(0.042)	(0.061)	(0.0620)	(0.0543)
FR	0.00001	-0.0001*	0.0001**	-0.000076
	(0.0002)	(0.00005)	(0.0007)	(0.00057)
-cons	0.3188***	0.2839	-0.8822	-0.4354
	(0.174)	(0.1776)	(0.9946)	(0.3022)
Wald	$\chi^2(6)=482.67$***			
Sargan Test	$\chi^2(151)=945.1$	P-value=0.990		
AR (1)	Z=-7.4523	P-value=0.000		
AR (2)	z=-1.6229	P-value=0.105		

- Numbers in parentheses are robust standard errors
- *******, ******, ***** are significant at the 1%, 5% and 10% level respectively

Table 4. Dynamic Panel Data Estimation Results: Model 2

Variables	Dairy	Field Crops	Horticulture	Livestock
LEV t-1	0.8577***	0.8354***	0.3247***	0.8881***
	(0.0212)	(0.0415)	(0.123)	(0.0706)
FP	0.309**	-0.492***	-1.917***	-0.870***
	(0.125)	(0.165)	(0.5108)	(0.1096)
AST	0.091***	-0.053	-0.0303	-0.0268
	(0.028)	(0.072)	(0.1988)	(0.0532)
FS	-0.0252*	-0.0172	0.0891	0.0509*
	(0.0131)	(0.0141)	(0.0565)	(0.0250)
FG	0.374***	0.3555***	0.1099*	0.3810***
	(0.0425)	(0.0614)	(0.0563)	(0.0534)
FR	0.00002	-0.0001*	0.0001**	-0.00008
	(0.0003)	(0.00005)	(0.00008)	(0.00006)
GDP	-0.0002	0.00011	0.0047***	0.005
	(0.0002)	(0.0003)	(0.0011)	(0.0003)
Inf	-0.008***	-0.001	0.0028**	0.0196***
	(0.0017)	(0.002)	(0.0037)	(0.0029)
Empl	0.0131**	0.0021	0.0706***	0.0333***
	(0.046)	(0.007)	(0.0317)*	(0.0102)
-cons	0.3115**	0.3273***	-1.3492	-0.8125**
	(0.181)	(0.2159)	(0.9085)	(0.3944)
Wald	$\chi^2(9)=459.31$			
S-Test	$\chi^2(151)=849.8$	P-value=	0.9990	
AR(1)	Z=-7.6108	P-value=	0.0000	
AR(2)	z=-1.3314	P-value=	0.1831	

- Numbers in parentheses are robust standard errors
- *******, ******, ***** are significant at the 1%, 5% and 10% level respectively

Table 5. Robustness Tests						
	Farm Size		**Growth Opportunity**		**Sample Year**	
Variables	**Large**	**Small**	**High**	**Low**	**2001-2007**	**2008-2015**
	(0.0942)	(0.0402)	(0.0388)	(0.0343)	(0.0289)	(0.1695)
FP	-1.549**	-0.799***	-0.7432***	-1.45***	-0.833***	-1.985***
	(0.526)	(0.1191)	(0.0973)	(0.4432)	(0.152)	(0.4380)
AST	0.1402	-0.141**	-0.1888***	-0.3508	-0.0355	-0.0846
	(0.1497)	(0.0519)	(0.050)	(0.2293)	(0.0826)	(0.1249)
FS	-0.0623	0.0015	0.0414***	-0.0393	-0.0539**	0.0977
	(0.0694)	(0.0235)	(0.0155)	(0.0402)	(0.0155)	(0.0695)
FG	0.205***	0.339***	0.3467***	0.298***	0.3946***	0.1682**
	(0.0350)	(0.0477)	(0.0337)	(0.0493)	(0.0418)	(0.0588)
FR	0.00006	0.00000	-0.00005	-0.0003	-0,0001	0.0001
	(0.00004)	(0.00002)	(0.00003)	(0.00003)	(0.00043)	(0.00006)*
D-Field	-0.1032	-0.0100	0.0512*	0.0178	0.0108	0.0390
	(0.1138)	(0.0261)	(0.025)	(0.0360	(0.0249)	(0.0384)
D-Horticulture	0.1842*	0.0512**	0.0392	0.057**	0.01131	0.1829***
	(0.0806)	(0.022)	(0.0251)	(0.0254)	(0.0289)	(.0489)
D-Livestock	0.0320	-0.0109	0.0227	-0.0275	0.0160	0.1298*
	(0.1063)	(0.017)	(0.0259)	(0.0346)	(0.0225)	(0.0670)
-cons	1.1814	0.063	-0.398*	0.8123	0.854**	-1.2199
	(1.0964)	(0.340)	(0.2334)	(0.7365)	(0.238)	(1.1121)
Wald (p-value)	$\chi^2(9)$=1090	0.0000	$\chi^2(9)$=3472	0.0000	$\chi^2(9)$=448	0.0000
AR-1 (P-value)	Z=-5.2323	0.0000	Z=-4. 1315	0.0000	Z=-2.3499	0.0188
AR-2 (P-value)	Z=-1.3473	0.1779	Z=-1.7904	0.0734	Z=-0.5769	0.5640

- Numbers in parentheses are robust standard errors
- *******, ******, ***** are significant at the 1%, 5% and 10% level respectively
- The dummy references levels are dairy farms

Figure 1: Farm leverage ratio, 2001-2015

Figure 2. Farm profitability by farm type, 2001-2015