Financial structure and strategies of
Dutch pig farming businesses

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Abstract

The thesis investigates the financial structure and strategies of Dutch pig farms by testing the trade-off, pecking-order and signaling hypotheses. Using farm panel data from the Farm Accountancy Data Network, statistical analysis on capital components and econometric analysis on a linear system of three simultaneous equations are performed. The statistical results indicate that capital structure, on average, was mainly composed of equity and long-term debt. Equity followed an opposite trajectory of long-term debt between 1995 and 2008. Over the fourteen years, unfavourable events, e.g. animal disease outbreaks, low selling prices and high costs, and favourable events, e.g. high selling prices and export, took place in turn and caused the decrease or increase in equity and debt. With respect to financial strategies, the econometric results suggest that Dutch pig farms have short- and long-term debt targets and partially adjust to them, while the farms show a preference ordering for financial sources where long-term loans are preferred to short-term loans. The estimation also implies that Dutch pig farms can signal their good performance to lenders by long-term debt.
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1 Introduction

1.1 Background

Pig farming plays a crucial role in the Dutch economy: 15% to 21% of total gross value added was contributed by agriculture, forestry and fishing and around 200,000 regularly employed persons were involved in agriculture between 2006 and 2011. During these six years, the number of pig farms accounted for about 10% of the whole agriculture farms (all types of farms) and over 70% of all housed animal farms (Statistics Netherlands, 2013). This sector faced and continues to face challenges. Challenges can be new regulations for health, nutrition and operation, e.g. new pig animal welfare regulations which came into force across the European Union on January 1, 2013; adverse events, e.g. animal disease outbreaks, rising feed prices, and changing market demand and prices; intensive competition for increasing farm sizes, because the majority of Dutch pig farms are in between the small and medium size and on average below economic scales; and so on. To survive in the future, Dutch pig farms have to rise to these challenges, e.g. to comply with the requirements, by making substantial investments. The new investments can be financed by various ways each accompanied by different risk and costs. So the financial management of new investments is a very important issue for pig farms.

A number of financial choices are available for pig farms to manage investments. Compared with large corporate firms, which have direct access to capital markets and show a complicated capital structure, accessible financial sources are relatively limited for most pig farming businesses and mainly composed of internal funds, short- and long-term debt. Even so, the possibility to combine distinct sources provides pig farms a range of financing choices. Furthermore, financial choices differ in advantages and disadvantages from one another. For example, pig producers can benefit from internal funds because of low cost and risk but often fail to meet their financial needs as a result of insufficient amount of internal funds. In contrast, debt is less finite and beneficial to lower tax payments. But the use of debt comes at the expense of high cost, risk and restrictive requirements. Similarly for the combination use, pig farms enjoy and suffer from different benefits and drawbacks depending on how funding sources are combined. Pig farmers must decide which financial strategy to select given their situation. So insight into how financial decisions are made is meaningful and important, particularly under the realization of the significant relationship between capital structure and firm competitiveness. The influence of capital structure on firm value and performance is concluded by Myers (1984) and Graham (2000). Before investigating financial decisions by Dutch pig farmers, attention should be paid to their capital structure.
and the change in the size and components, as capital structure is a static result of past financial decisions.

Making financial decisions is a vital but complex process. A number of interdependent factors influence the decisions, including current and future investment opportunities, capital costs, repayment ability, and risk. For instance, current investment reflects total fund demand and acts as a key factor for the whole amount of financial sources needed. In return, some types of financial sources like cash flows can constrain or expand the total need as well as current investment. It is meaningful to investigate financial decisions and to get insight into all the interdependent factors. But in practice, the majority of factors are not directly observable, not to mention the difficulty of studying their mutual relations. A more appropriate method relates to financial strategies. These strategies as practical principles guide firms to select sources and construct capital structure with the consideration of main factors and correlations, e.g. capital costs and investment opportunities over time. Thus, financial decisions of Dutch pig farms can be categorized into distinct financial strategies.

There are numerous financial strategies which a farmer could implement and which vary in objectives and content. In this thesis, we concentrate on three types of financial strategies: Dutch pig farmers could have a long-run leverage target; there is a sequence of financial sources used for investments starting from cheaper to more expensive funds; the farms could signal their performance to lenders. Three financial theories explain the strategies. Starting with the target strategy, the trade-off theory indicates an optimal capital structure and firms are expected to adjust towards this structure, because there are two types of factors for and against the use of debt (Barry and Ellinger, pp. 101-104; 2012). Subsequently, the pecking-order theory shows that firms rank internal funds higher than external funds according to the cost levels of different funds (Barry and Ellinger, pp. 104-105; 2012). Ultimately, the signaling theory implies that firms of good performance can distinguish themselves from the bad ones by sending signals to lenders, as the cost for bad firms to mimic good firms outweighs the benefits (Hillier, Ross, Westerfield, Jaffe, and Jordan, pp. 446; 2010). These theories have already been tested in many empirical studies separately or jointly. This thesis will investigate the financial strategies of Dutch pig farms by joint consideration of the three theories.

The investigation can benefit Dutch pig farmers, lenders, especially ones primarily serving pig producers, and policy makers. In general, the strategies can deliver information of attitudes or behaviour of the Dutch pig farmers, like whether they are long-run planners or risky borrowers, and information of the financial environment whether farms can be
differentiated according to their quality. Specifically, pig farmers can review their financial strategies and check whether and what differences exist between the farms and the whole sector. For lenders, the understanding of customers’ financial patterns is beneficial for the profit and risk evaluation, in particular relating to the last strategy. Additionally, the outcomes are helpful for the government to assess and supervise the financial situations in pig farming. Also, the government can benefit from the results to objectively forecast the influence of relevant financial policies or projects.

1.2 Research Objective

To investigate the financial structure and strategies of Dutch pig farms by testing the trade-off, pecking-order and signaling hypotheses.

1.3 Research Questions

1. What is the capital structure of Dutch pig farms?
2. How has the capital structure evolved over time?
3. Which financial theories apply to Dutch pig farms?
   - Is the trade-off theory applicable? That is, do Dutch pig farms partially adjust their short- or long-term debt level towards the target?
   - Is the pecking-order theory applicable? That is, do Dutch pig farms prefer own funds to short-term loans, followed by long-term loans?
   - Is the signaling theory applicable? That is, do Dutch pig farms signal their good performance to lenders?
   - Are cash flow, return on assets (ROA) and leverage credible signals of performance and ability to service a loan?
2 Literature and Modelling

This section firstly reviews the theoretical underpinnings and empirical findings for the determinants of capital structure (the trade-off, pecking order and signalling theory) as well as mutual relationships between these theories. Subsequently, the major hypotheses linking with Dutch pig farming businesses are inferred and presented. Finally, an empirical model is constructed to test these hypotheses.

2.1 Literature Review

2.1.1 Trade-off Theory

According to the static trade-off theory, there is an optimal capital structure for firms which minimizes their average capital cost (Barry and Ellinger, p. 101-104; 2012). The optimal structure, namely the optimal debt ratio, is determined by trading off between the benefits and costs of the debt use. Factors that favor the use of debt mainly refer to the advantage of a debt tax shield, whereas administrative, agency and financial distress costs constrain the amount of debt used. These factors influence firms’ financing behaviour towards the optimal capital structure in the following dynamic way. At the beginning, the cost-reducing tax effect of debt outweighs other costs. This leads to a higher use of debt, but the increase often comes at the expense of larger administrative, agency and financial distress costs due to the rising likelihood of repayment, credit and liquidity risk. That means the level of leverage increases, accompanied by decreasing additional benefits. Then there appears one point where the costs of debt become equal to the tax benefit and after which the costs dominate. It can be inferred that the best capital structure is where firms take full advantage of capital resources (debt and equity), namely the point where there is no additional benefit, that is where the marginal benefits and costs are equal. So the static trade-off theory predicts that firms have target debt ratios and will adjust to the targets, when they deviate from the optimal ratios. This is evidenced by Hovakimian et al. (2001), who found firms, either increasing or decreasing the amount of new capital, made financial choices to target their optimal capital structure.

However, few firms, in reality, can implement an optimal capital structure. Firms often fail to fully adjust their capital structure to the targets, as the immediate adjustment is costly in imperfect capital markets (Zhao et al. 2008). Besides, the target capital structure of a firm varies over time due to changeable internal and external environment, like interest rates. This increases the difficulty and the cost of full adjustment. Practical firms have to make another trade-off between the costs of adjustment and operation with suboptimal leverage (Flannery and Rangan 2006). All of these cast doubt on the explanatory power of the static trade-off
theory, as the theory does not take adjustment costs and time lags into account (Myers 1984). Following this, partial adjustment models, also called the partial-adjustment-trade-off theory, appear to relax the above limitations of the static trade-off theory. The partial adjustment models allow incomplete adjustment and changes in the target capital structure by firm and time. Flannery and Rangan (2006) and Jalilvand and Harris (1984) supported the partial-adjustment-trade-off theory with the finding that firms operated in imperfect markets and adjusted only partially to their long-run financial targets.

2.1.2 Pecking-order Theory

The pecking-order theory, developed by Myers (1984) and Myers and Majluf (1984), argues that firms have a preferred hierarchy of financial sources (Barry and Ellinger, p. 104-105; 2012). Firms generally prefer to finance investment opportunities by internal funds instead of external funds. This is caused by gaps between the costs of internal and external funds which arise from capital market imperfections. In imperfect capital markets, asymmetric information problems exist in lender-borrower relationships, which leads to an increase in agency costs of lenders for the efforts to screen, monitor etc. borrowers (Jensen and Meckling 1976). This further results in adverse selection problems and finally transfers part of the costs from the lenders to borrowers. In other words, if firms use external funds, they will bear additional agency costs owing to the existence of asymmetric information. The pecking order theory, thus, assumes that borrowers know more about the firms’ prospects than debt lenders and outside investors. So it is less costly for firms to use internal funds (e.g. retained earnings, cash flows and financial assets) than external funds.

Often, firms acquire external sources, because their financial needs are difficult to be sufficiently met by internal funds. In this case, firms are expected to behave in a way to minimize costs, namely using cheaper external finance sources first. Differences in additional costs among external finance sources exist and again relate to asymmetric information and adverse selection. Concerning the information of firms, some outside investors (like banks) know more, while some (like individual investors) know less. With the similar mechanism mentioned above, the information difference in investors lead to gaps among costs of external funds. It is assumed in the pecking-order theory that debt costs borrowers less than new issues of common stock. Thus the theory asserts that firms use external sources in an order of straight debt or leasing first, followed by debt that can be convertible to equity and finally new issues of equity securities. There are many empirical studies in support of the theory, for example, Donaldson (1961), Baskin (1989), Jensen et al. (1992), and Shyam-Sunder and C Myers (1999). Additionally, Chen et al. (1999) and Degryse et al. (2009) found evidence in Dutch firms.
2.1.3 Signalling Theory

The signalling theory implies that a high-performing firm can distinguish itself from a low-performing one by sending credible signals to lenders (Hillier, Ross, Westerfield, Jaffe and Jordan, p. 446; 2010). The signalling behaviour of valuable firms can be motivated by the aim to obtain financial resources easier or at a lower cost. As firms have a clear idea of their status and prospects (asymmetric information), a good firm searching for funds can convey its advantageous information (signals) to lenders, who, in return, can infer from these signals whether the firm is credible and worthy of the investments. Thus, the signalling behaviour can minimize asymmetric information and adverse selection problems in the borrower-lender relationship.

There are factors that can serve as credible signals. Credible signals function to differentiate between high-performing and low-performing firms and then, set a necessary requirement on potential factors: the signalling factors cannot be used by bad firms to mimic good firms. Bad firms fail to take advantage of valid signals due to drawbacks of the imitation, like high extra costs and future costs outweighing benefits. The key signals include profitability, repayment capacity, solvency and liquidity (Zhao et al. 2004, Zhao et al. 2008). In this thesis, profitability and liquidity are measured by return on assets (ROA) and cash flow respectively. Debt is also one typical signal to evaluate firm value. Poitevin (1989) demonstrated that debt acted as a costly signal to separate valuable and less valuable firms. Specifically, debt distinguished low cost entrants who issued debt from high cost entrants who only used equity. The reason is that the cost of debt, e.g. the possibility of bankruptcy, compared with its benefits, rendered debt more unattractive to high cost entrants. So increasing debt can signal positive information of firm performance. Moreover, there are other signals, like convertibles (Harris and Raviv 1985), the optimal combination of dividends and leverage (Ravid and Sarig 1991), and stock repurchase (Bhattacharya and Dittmar 2003). As these financial signals seldom occur in farm businesses, the detailed explanation is ignored.

2.1.4 Which Theory?

Many studies have been conducted to compare the trade-off theory with the pecking-order theory. Internal and external funds, like cash flow and debt, are substitutes for each other in the trade-off theory, but show an order of priority in the pecking-order theory. Besides, the pure pecking-order theory suggests that firms have no preferred capital target (Myers, 1984; pp. 451, Hillier, Ross, Westerfield, Jaffe and Jordan, 2010; pp. 104, Barry and Ellinger, 2012; etc.). Under this, initial studies tested the hypothesis that the trade-off theory is against the pecking-order theory but the majority rejected it. For example, Vogt (1994) and Shyam-Sunder and C Myers (1999) found the concurrence of the theories in practice and opposite to
the original hypothesis. The same results were displayed by Frank and Goyal (2007), who explained the mixed results generated by the conditional characteristics of both theories, and by Fama and French (2002), who suggested other factors could exist beyond the current theories. Many other studies also demonstrate that the theories do not contradict each other and together work in real life. That is, the trade-off theory concerns firms’ long-run behaviour patterns, while the pecking-order theory investigates their short-run behaviour. Apart from econometric approaches, Graham and Harvey (2001) and Brounen et al. (2006) applied the survey method and also found evidence in support of the simultaneous existence of both theories. Finally, the concurrence was supported by de Bie and de Haan (2004) for Dutch firms and Barry et al. (2000) for farms.

In addition, some empirical research has been conducted to compare the pecking-order theory with the signalling theory. The two theories indicate seemingly contradictory relationships between debt and cash flow. The former theory suggests a negative relationship, where cash flow is preferred by farms over debt, whereas the latter implies a positive relationship, where high leverage or debt acts as a good signal of higher cash flow. But Shenoy and Koch (1996) demonstrated that the theories existed simultaneously in practice and proposed a justification. The concurrence can be explained by the difference of the theories in roles and time. The pecking-order theory, in the view of borrowers, focuses on the contemporaneous relations among financial choices, namely current cash flow and current debt. In contrast, the signalling theory concentrates on the borrower-lender relationship and suggests an intertemporal relationship between current debt level and future cash flow. This means that in the same period, cash flow and debt are negatively connected, whereas current debt is positively related to future cash flow. Zhao et al. (2004) also found significant evidence supporting the concurrence of both theories for farm businesses.

2.2 Hypotheses

The joint consideration of three theories is applicable. Significant support has been found for the simultaneous applicability of both the trade-off and pecking order theories and the pecking-order and signaling theories. Even though few studies have been completed on the comparison between the trade-off and signalling theories, the mentioned relationships between the theories and relevant explanations clearly support the concurrence of the three theories. Moreover, Zhao et al. (2008) demonstrated the simultaneous existence of three theories in farm businesses. Following the above, we can retain three hypotheses:

Hypothesis 1 (H1): Dutch pig farms have both long- and short-term financial targets (debt) and partially adjust debt levels towards them each year.

Hypothesis 2 (H2): Dutch pig farms use financial sources in a sequence and prefer cash flow
to short-term loans and finally long-term loans.

Hypothesis 3 (H3): Dutch pig farms can signal their high performance to lenders. The credible signals are composed of cash flow, return on assets (ROA), and long- and short-term debt.

2.3 Empirical Modelling

Based on the conceptual framework and previous empirical studies presented in the previous section, a system of simultaneous equations is developed to investigate whether the formulated hypotheses (H1, H2 and H3) apply to Dutch pig farms. This system mainly follows Vogt (1994), Barry et al. (2000) and Zhao et al. (2008) and is composed of the following three simultaneous equations:

\[
\begin{align*}
\text{pld}_it &= \alpha_1 + \alpha_2pcf_{it} + \alpha_3psd_{it} + \alpha_4pinv_{it} + \alpha_5(psld_{it}^* - psld_{it-1}) + FE_{1t} + YE_{1t} + \varepsilon_{it} \tag{1} \\
\text{psd}_it &= \beta_1 + \beta_2pcf_{it} + \beta_3pld_{it} + \beta_4pinv_{it} + \beta_5(pssd_{it}^* - pssd_{it-1}) + FE_{2t} + YE_{2t} + \mu_{it} \tag{2} \\
\text{pinv}_{it} &= \gamma_1 + \gamma_2pcf_{it} + \gamma_3psd_{it} + \gamma_4pld_{it} + \gamma_5ROA_{it-1} + \gamma_6psd_{it-1} + \gamma_7pld_{it-1} + \gamma_8pcf_{it-1} \\
&\quad + FE_{3t} + YE_{3t} + \upsilon_{it} \tag{3}
\end{align*}
\]

where \(i = 1, 2, ..., N\) indexes firms and \(t= 1, 2, ..., T\) indexes the time period. \(pld_{it}, psd_{it}\) and \(pinv_{it}\) are the change in long- and short-term debt and investment respectively, \(pcf_{it}\) is cash flow, \(psld_{it}^*\) and \(pssd_{it}^*\) are the targets of long- and short-term debt levels, \(psld_{it-1}\) and \(pssd_{it-1}\) are stock variables of long- and short-term debt at year \(t-1\), \(FE\) and \(YE\) are farm and year dummies, \(ROA_{it-1}\) is farm's return on assets at time \(t-1\), \(psd_{it-1}, pld_{it-1}\) and \(pcf_{it-1}\) are lagged variables. Expressions \((psld_{it}^* - psld_{it-1})\) and \((pssd_{it}^* - pssd_{it-1})\) , contained in equations (1) and (2), estimate the deviations of long- and short-term debt from the target levels. Furthermore, considering the potential for large differences in farm sizes, variables in this system are scaled by the closing valuation of total assets for each time period to reduce heteroscedasticity. \(ROA, FE\) and \(YE\) are already ratios and not normalized.

In comparison with other variables, target debt ratios are not observed. Information about the target ratios is often missing due to difficulty to observe and variability in time and individuals. To estimate the target ratios, we follow the assumption of Vogt (1994) to separate the target ratios into two components. One component varies over time in response to the change in the macro-economic environment, like changing interest rates, inflation rates. The other one varies from one individual firm to another because of firm-specific influences, such as different target customers and processing techniques. Then the target debt ratios can be captured by the year and farm dummy variables and merged into YE and FE in the system of
equations. Finally, \( \varepsilon_{it} \), \( \mu_{it} \) and \( \nu_{it} \) are error terms, all identically distributed random variables with mean of zero. Besides, we assume that \( \text{var}(\varepsilon_{it}) = \sigma_1^2 \), and \( \text{cov}(\varepsilon_{it}, \varepsilon_{it-1}) = 0 \), \( \text{cov}(\varepsilon_{it}, \mu_{it}) \neq 0 \), and \( \text{cov}(\varepsilon_{it}, \nu_{it}) \neq 0 \). The assumed properties of variances and covariances are the same for \( \mu_{it} \) and \( \nu_{it} \).

The variables in the simultaneous equations can be categorized as endogenous, exogenous and dummy variables. The endogenous variables (investment, long-term debt and short-term debt) are interdependently and contemporaneously determined in the system. The system has sets of exogenous variables which are predetermined, including cash flow and lagged exogenous (cash flow, stock long- and short-term debt, ROA) and lagged endogenous variables (long- and short-term debt). In addition, two types of dummy variables (farm and year dummies) are used to account for the variations unobserved in farm characteristics and time periods.

On the basis of the trade-off theory, H1 suggests the existence of long- and short-term debt targets in Dutch pig farms and predicts the partial movement of the farms towards the respective targets. If the stock long- and short-term debt in the previous time periods \( (\text{psld}_{it-1} \text{ and } \text{pssd}_{it-1}) \) are less than the target levels \( (\text{psld}_{it}^* \text{ and } \text{pssd}_{it}^*) \), the pig farms likely increase their debt levels in the time period \( t \). This implies a positive dynamic relationship between the previous debt levels and the debt targets. Parameters \( \alpha_5 \) and \( \beta_5 \), which represent the adjustment speed for long- and short-term debt, are expected to be significantly larger than 0. Moreover, both speeds should be lower than 1.0, because most farms cannot implement immediate adjustment in imperfect capital markets.

In contrast to H1 which places more emphasis on the long-run financial strategy, H2 concentrates on the short-run strategy. H2, inferred from the pecking-order theory which investigates the contemporaneous relationships between cash flow, short-term debt and long-term debt, proposes a preference order of Dutch pig farms in the use of financial sources (cash flow \( \succ \) short-term debt \( \succ \) long-term debt)\(^1\). When the pig farms finance new investments, they prefer cash flow to short-term loans and finally employ long-term loans. So negative relations among cash flow, short- and long-term debt are expected as well as a significant positive relationship between each financial source and investment. Parameters \( \alpha_2 \), \( \alpha_3 \), \( \beta_2 \) and \( \beta_3 \) should be significantly smaller than 0, while positive coefficients are expected on cash flow, short- and long-term debt in equation (3). Furthermore, the sequence of financial sources implies a larger impact of short-term debt on cash flow and investment.

\(^1\) \( A \succ B \) denotes A is preferred to B.
than long-term debt, namely the relations $\alpha_2 > \beta_2$ and $0 < \alpha_4 < \beta_4$ significant. The sequence also expects the relationship $\gamma_2 > \gamma_3 > \gamma_4$ in equation (3).

Different from H1 and H2, H3 follows the signalling theory and is concerned with the borrower-lender relationship. It indicates that high-performing pig farms in the Netherlands can distinguish themselves from the average ones and inform lenders of farms’ good performance by sending credible signals. Besides, H3 predicts cash flow, return on assets and debt can be used as credible financial signals for Dutch pig farms. These signals should be credible for both borrowers and lenders. High-performing pig farms can benefit from valid signals to obtain loans for future investments. Lenders can rely on credible signals to make lending decisions, which requires the signals to act as indicators of borrowers’ future good performance. Thus, positive dynamic relationships between each signal (lagged cash flow, return on assets and debt) and current investment are expected. The debt signal is further split into long- and short-term debt to accommodate the characteristics of investment. Compared with the short-term loans, long-term loans are more often used for expensive long-run investments and then expected to be a more effective signal for fixed investments. This implies a significant and positive value for $\gamma_5, \gamma_6, \gamma_7$ and $\gamma_8$ as well as the relation $\gamma_6 < \gamma_7$ in equation (3).
3 Data and Methods

3.1 Description of the Data

In this thesis, the empirical analysis will use a database from the Farm Accountancy Data Network (FADN). The database contains annual farm-level information on economic and financial data and uses a stratified rotating sample where the panel of farms usually change in 5-6 years and few farms remain more than 10 years. From the complete database, we selected the pig farms from the Netherlands between 1995 and 2008. For all the Dutch pig farms in the sample, at least 70% of their total revenues come from the sales of pigs for every year.

Variables used to describe capital structures of Dutch pig farms comprise of stock long- and short-term debt, total assets, total debt and equity. Stock long-term debt is the closing valuation of the loans of at least one year’s duration, including long- and medium-term loans. Stock short-term debt is measured as the total closing cash value of the loans of less than one year’s duration and outstanding cash payments consisting of short-term loans and creditors. Total assets are the sum of fixed assets and current assets at closing valuation. Fixed assets are composed of agricultural land, permanent crops, improvements to land, quotas and other prescribed rights (including acquisition costs), forest land, buildings, fixed equipment, machines, tractors, cars and lorries, irrigation equipment, and breeding livestock (including breeding heifers, dairy cows, other cows, breeding goats, ewes, breeding sows). Current assets contain all livestock (except breeding livestock) and circulating capital (including stocks of agricultural products and other circulating capital). Total debt and equity are deduced from the financial functions where total debt is the sum of long- and short-term debt and where equity equals to the value by subtracting total debt from total assets.

The system of simultaneous equations contains more variables. These variables are:
1 Investment is measured as the purchase value of new fixed assets, which consist of agricultural land, permanent crops, land improvements, farm buildings, acquisition costs, quotas and other rights, forest land including standing timber, machinery and equipment. But this measure excludes the sales of fixed assets, depreciation, maintenance fees (except major repairs or conversions which change the value of machinery and/or equipment) and subsidies on investments.
2 Changes in long- and short-term debt are measured as the difference between the closing- and opening- valuations of total stock long- and short-term debt, respectively.
3 Cash flow is measured as total cash income less total cash expenses that arise in
operating activities or sales of fixed assets. Cash income from operating activities contains sales of products and livestock, other receipts, subsidies and taxes arising from current production and investment activities. Cash operating expenses include all costs paid and purchases of livestock. The sales of fixed assets can be only cash income and the components of fixed assets are the same as that described in investment.

4 ROA is measured as the ratio of profit to total assets. Profit is the value of net farm income minus a charge for unpaid family labour. Net farm income concentrates on remuneration to fixed production factors (work, land and capital) and the entrepreneur’s risks (loss or profit). It measures the value of total output (including crops and crop products, livestock and livestock products and other output), subsidies and taxes less total intermediate consumption, depreciation of capital assets, and total external factors (work, land and capital not belonging to the holder). The payment to family labour is measured by multiplying the family labour hours by the average labour price per hour, which is the total number of wages, social security charges and insurance paid for wage earners in the sampled farms divided by their total working hours for each year.

Summary statistics of the key variables used in the thesis and other farm characteristics are shown in Table 1. The typical Dutch pig farm in the panel had €1,520.03 (*1000) of owned assets, which consisted of €681.22 (*1000) of long-term debt and €131.50 (*1000) of short-term debt. The annual cash flow and profit averaged €90.90 (*1000) and €3.87 (*1000), respectively. For each year, the typical farm spend €82.76 (*1000) for new investments together with an increase of €33.41 (*1000) in long-term debt and of €6.96 (*1000) in short-term debt. Besides, the std. deviation of each variable is high, especially for total assets (sd. = 1,290.31*1000) and stock long-term debt (sd. = 696.35*1000). This, as well as the minimum and maximum values of each variable, indicates big differences in total assets, debt, cash flow, and profit sizes of the sampled farms.
Table 1: Summary statistics of Dutch pig farms.

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flow (1,000€)</td>
<td>1527</td>
<td>90.90</td>
<td>163.29</td>
<td>-817.60</td>
<td>1,850.43</td>
</tr>
<tr>
<td>Long-term debt (1,000€)</td>
<td>1527</td>
<td>33.41</td>
<td>236.34</td>
<td>-1,051.15</td>
<td>2,230.05</td>
</tr>
<tr>
<td>Short-term debt (1,000€)</td>
<td>1527</td>
<td>6.96</td>
<td>126.58</td>
<td>-1,314.22</td>
<td>2,584.95</td>
</tr>
<tr>
<td>Investment (1,000€)</td>
<td>1527</td>
<td>82.76</td>
<td>197.02</td>
<td>0.00</td>
<td>2,254.23</td>
</tr>
<tr>
<td>Stock value of long-term debt</td>
<td>1527</td>
<td>681.22</td>
<td>696.35</td>
<td>0.00</td>
<td>5,068.73</td>
</tr>
<tr>
<td>Stock value of short-term debt</td>
<td>1527</td>
<td>131.50</td>
<td>302.06</td>
<td>0.00</td>
<td>4,699.01</td>
</tr>
<tr>
<td>Profit (1,000€)</td>
<td>1527</td>
<td>3.87</td>
<td>131.51</td>
<td>-1,075.20</td>
<td>1,249.04</td>
</tr>
<tr>
<td>Total assets (1,000€)</td>
<td>1527</td>
<td>1,520.03</td>
<td>1,290.31</td>
<td>144.35</td>
<td>8,231.49</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>1527</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notice: euro amounts are current euros.
Source: Own calculation based on the FADN database, 1995-2008.

### 3.2 Methods

The system of simultaneous equations cannot be consistently estimated by ordinary least squares (OLS). This is caused by the characteristic of simultaneous equations, where the endogenous variables in each equation are correlated with the disturbances and which violates an assumption of the OLS regression model. So the estimation of simultaneous equations is inconsistent with OLS and requires other more suitable approaches which are based on the principle of instrumental variables.

Identification precedes the estimation to resolve a fundamental problem whether we can obtain the estimates of the parameters in each simultaneous equation. Identification of each equation can be completed by the order and rank conditions. The order condition, as a necessary but insufficient condition for identification, ensures the existence of at least one solution. In contrast, the rank condition is both necessary and sufficient to ensure the exact solution. Three cases appear from the order and rank conditions: unidentified (either the order or rank condition unmet), exactly identified (both the order and rank condition met) and over-identified (only the order condition met). In this thesis, equations (1) and (2) are over-identified, while equation (3) is exactly identified.

With the proof of identification, we can proceed to estimate the simultaneous equations by Two-Stage Least Squares (2SLS). 2SLS is a widely used method for simultaneous equations due to its computational simplicity and estimates each equation separately in the two stages.
The first stage obtains the fitted values of each endogenous variable by a regression on all exogenous variables. The next one provides the parameter values. The instruments used in the system are the same for all equations and contain all exogenous, lagged endogenous and dummy variables. Besides, because the thesis uses unbalanced panel data, a random-effects model is combined with the 2SLS estimation. The random-effects model is a regression model with a compound random constant term, where the unobserved firm effects ($FE_i$) are treated as random variables and put into the error terms, and estimated on the basis of the generalized least squares (GLS) principle which relaxes the assumption of OLS to allow the error terms to be correlated or with unequal variances. Lagged endogenous variables are assumed in both 2SLS and the random-effects model to be uncorrelated with the error terms, exogenous and dummy variables.

The simultaneous equations are re-estimated by Three-Stage Least Squares (3SLS). Compared to 2SLS which neglects cross-equation information caused by separate estimation of each equation, 3SLS is a system method of jointly estimating endogenous variables. Theoretically, 2SLS and 3SLS perform equally well under exact identification conditions. But when there exist over-identified equations, 3SLS becomes more efficient by taking advantage of correlations between cross-equation error terms. Efficiency gains are achieved by additional stages on 2SLS. That is, in the second stage which obtains 2SLS estimators, 3SLS continues to estimate the cross-equation correlation matrix by residuals and finally in the third stage, computes the parameter estimates on the basis of GLS. The estimation process requires the whole system to be specified correctly in 3SLS, as 3SLS transmits the effect of a wrong specification in one equation to other equations. Besides, 3SLS has the same assumption as 2SLS that there is no correlation between instrument variables and error terms. The instruments are de-meaned exogenous, lagged endogenous and dummy variables. Why de-meaned variables are used relates to the fixed-effects model in the following discussion.

The re-estimation approaches panel data by the fixed-effects model. Unlike the random-effects model, the fixed-effects model treats the unobserved firm effects ($FE_i$) as non-random variables and eliminates them by subtracting the within-firm mean of each variable (endogenous, exogenous and dummy variables) from the respective observed value. Then the fixed-effects model gets the transformed equations consisting of de-meaned variables. Moreover, the fixed-effects model controls for unobserved heterogeneity problems in panel data and allows firm effects to be correlated with independent variables. This suggests that if the firm effects are correlated with other explanatory variables, the fixed-effects model performs better than the random-effects model. However, the fixed-effects model cannot
estimate the coefficients of the time-invariant variables due to them being removed from the equations. If there is no correlation between the omitted variables and other explanatory variables, then the random-effects model is preferred, because it is more efficient.

Therefore, the system of three simultaneous equations is firstly estimated by 2SLS with random-effects and then re-estimated by 3SLS with fixed-effects. In general, 3SLS is more efficient approach for simultaneous equations than 2SLS. Regarding random- and fixed-effects, the random-effects model is generally preferred, except one situation where the correlation between the firm effects and other explanatory variables exists.

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2 The estimation of both 2SLS with random-effects and 3SLS with fixed-effects uses Stata/IC 10.1 statistical software.

3 See e.g. Greene (2011) and Wooldridge (2010) for details.
4 Empirical results

This section shows the findings of the statistical analysis for Dutch pig farms. Firstly, the results of the statistical analysis on capital components (stock long- and short-term debt and equity) are presented for the financial situations of pig farms connected with past events, followed by the results of the statistical analysis on five financial variables (long- and short-term debt, cash flow, investment and ROA) which act as main factors in financial strategies and cause the change in capital structure. Finally, the results from the econometric analysis conducted on the simultaneous equations reveal financial strategies of pig farms in the Netherlands.

4.1 Capital structure

Table 2 presents the summary information on capital structure of Dutch pig farms from 1995 to 2008 with 1527 observations. The typical capital structure was made up of debt and equity with almost equal shares. Specifically, total debt (mean = 0.52, sd. = 0.29) of the typical Dutch pig farm was slightly higher than equity (mean = 0.48, sd. = 0.29) with long-term debt (mean = 0.44, sd. = 0.27) as the main component. And the mean value of long-term debt was much larger than short-term debt (mean = 0.08, sd. = 0.11). According to the minimum and maximum values, there were some cases where debt overwhelmed equity. For example, when the ratio of equity to total assets for a farm equalled to -1.05, the farm had borrowed a great deal of money which cannot be paid back by their current own assets.

Table 2: Summary of capital structure for Dutch pig farms.

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total debt</td>
<td>1527</td>
<td>0.52</td>
<td>0.29</td>
<td>0.00</td>
<td>2.05</td>
</tr>
<tr>
<td>Stock long-term debt</td>
<td>1527</td>
<td>0.44</td>
<td>0.27</td>
<td>0.00</td>
<td>1.51</td>
</tr>
<tr>
<td>Stock short-term debt</td>
<td>1527</td>
<td>0.08</td>
<td>0.11</td>
<td>0.00</td>
<td>1.07</td>
</tr>
<tr>
<td>Equity</td>
<td>1527</td>
<td>0.48</td>
<td>0.29</td>
<td>-1.05</td>
<td>1.00</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>1527</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notice: variables are measured in ratios to total assets.
Source: Own calculation based on the FADN database, 1995-2008.

Figure 1, 2 and 3 display the frequencies of ratios of each variable (stock long- and short-term debt and equity) to total assets by histograms. The distributions of the ratios of long-term debt and equity didn’t deviate significantly from the normal distribution, even though the distribution was a bit skewed to the left for long-term debt and to the right for equity. The most frequent ratios of long-term debt to total assets was between 0.00 and 0.05, followed by the second most frequent from 0.35 to 0.60, compared with the ratio of equity between 0.40
and 0.50. It reflects that Dutch pig farms were mainly managed by the mixed use of equity and debt, but there were still a significant number of individual farms in operation totally by own equity. Regarding short-term debt, the distribution was highly skewed with the majority observations close to zero. The figure indicates the majority of Dutch pig farms seldom used short-term debt.

**Figure 1:** Frequency of the ratio of stock long-term debt to total assets.

**Figure 2:** Frequency of the ratio of stock short-term debt to total assets.

**Figure 3:** Frequency of the ratio of equity to total assets.

Source: Own calculation based on the FADN database, 1995-2008.
Figure 4 illustrates fluctuations of each capital component in Dutch pig farms during the period 1995 to 2008. The figure directly shows the yearly average changes in the ratios of stock long- and short-term debt and total debt to total assets, whereas it displays the ratio of equity to total assets as the gap between 1.00 and total debt. From the figure, we can see that debt and equity played an equally important role in Dutch pig farms. Specifically, total debt remained roughly stable and fluctuated around its mean value (0.52). As for long-term debt, it dominated total debt but with relatively small influence in the last several years (2000-2008), seemingly caused by an increase in short-term debt. Besides, the change trends of long-term debt and total debt were the same over the fourteen years. Concerning short-term debt, it firstly remained almost unchanged, then showed an opposite trend of long-term debt and total debt in 2001, and finally closely followed from them.

The variables shown in the figure are volatile over these years. There seems a general trend. That is, in good years, the amount of total debt decreased, while the equity size increased. In contrast, bad years witnessed the raise in total debt and the reduction in equity. Total debt was decreasing from 1995 to 1997. In 1997, the classic swine fever outbreak took place in the Netherlands, followed by low pork prices in 1998 and 1999. The outbreak and low selling price as bad events caused losses for Dutch pig farms and then an increase in total debt. Then the foot and mouth disease outbreak infected Dutch pig farms in 2001, after which production costs for pig farming increased because of environmental and animal welfare restrictions and also the second agricultural land purchase program of the Dutch government (Bob 2003, January 30). Similarly, these unfavourable events led to the expansion of total debt until 2003. After 2003, the situation became positive due to an upward trend in the size of the national pig herd, production, exports and selling prices ('Dutch pig farming industry records better results in 2004' 2005). Dutch pig farms profited from the positive changes and paid back some debt. That is the reason for an decrease in the debt size during this period. But in 2007, Dutch pig farms increased their debt level, because current low selling price and sharply rising costs made them lost money.

Furthermore, the results show the existence of time lags between events and changes in capital structure. When the events referred to animal disease outbreaks, like the classic swine fever and foot and mouth disease outbreaks, it took almost one more year for the events to come into effect on capital structure. The occurrence of the animal disease outbreaks in 1997 and 2001 did not lead to a rise in total debt within the year but in the following year, namely 1998 and 2002. The reason for the delay is that animal disease outbreaks often involved with the destruction of livestock, which mostly inhibited the normal operating activities in the following year and resulted in the loans borrowed by farms for
continuing their operation. By comparison, capital structure were more sensitive to the events which related to selling price and costs. The time between the occurrence of these events and the expected effect on capital structure was frequently within one year. This is obvious particularly in the year 2007, which saw low selling price and sharply rising costs together with an increase in total debt. Different from animal disease outbreaks, selling price and costs directly affected pig farmers’ current income and caused an increase in total debt.

![Figure 4: Capital structure of Dutch pig farms.](source)

Source: Own calculation based on the FADN database, 1995-2008.

### 4.2 Financial variables

From the above, we know how the financial structure changed over time as well as the possible reasons (events). But we do not know how these changes are formed, as capital structure only describes the static situations and lacks information on the financial strategies of Dutch pig farms. Thus, it is necessary to be further explored. The information of five financial variables (long- and short-term debt, cash flow, investment and ROA) as the bridge between capital structure and financial strategies is shown below.

Table 3 contains the results summarizing the descriptive statistics of five financial variables for Dutch pig farms on the basis of 1527 observations from 1995 to 2008. The annual long-
Long-term debt changed the most (mean = 0.07, std. = 0.10), in contrast to the changes in cash flow (mean = 0.00, std. = 0.06) and return-on-asset (mean = 0.00, std. = 0.09). Regarding short-term debt and investment, the yearly change ratios were in medium sizes. Short-term debt (mean = 0.01, std. = 0.11) was a bit less than investment (mean = 0.04, std. = 0.08). Every year, the typical Dutch pig farm borrowed a new debt, where long- and short-term debt accounted for 7% and 1% of current total assets, and allocated 4% of total assets for new investments.

Table 3: Summary statistics of financial factors for Dutch pig farms.

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term debt</td>
<td>1527</td>
<td>0.07</td>
<td>0.10</td>
<td>-0.48</td>
<td>0.61</td>
</tr>
<tr>
<td>Short-term debt</td>
<td>1527</td>
<td>0.01</td>
<td>0.11</td>
<td>-0.52</td>
<td>0.55</td>
</tr>
<tr>
<td>Cash flow</td>
<td>1527</td>
<td>0.00</td>
<td>0.06</td>
<td>-0.27</td>
<td>0.66</td>
</tr>
<tr>
<td>Investment</td>
<td>1527</td>
<td>0.04</td>
<td>0.08</td>
<td>0.00</td>
<td>0.61</td>
</tr>
<tr>
<td>ROA</td>
<td>1527</td>
<td>0.00</td>
<td>0.09</td>
<td>-0.33</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Valid N (listwise) 1527

Notice: variables are measured in ratios to total assets.
Source: Own calculation based on the FADN database, 1995-2008.

Figures 5-9 present the histograms of the five financial variables (long- and short-term debt, cash flow, investment and ROA). Except for investment, whose distribution was highly skewed, the distributions of other variables were approximately normal with slightly skewed tails. Specifically, the variables (long-term debt, cash flow and ROA) distributed a bit skewing to the left. Considering the highest frequency of the financial variables, long-term debt ranged most often between -0.05 and 0.00, compared to short-term debt (-0.02 to 0.03), cash flow (-0.02 to 0.12), investment (0.00 to 0.025) and ROA (-0.09 to 0.07). These figures shed light on individual farms and reflect some indifferent information from the mean values in Table 3. The largest number of Dutch pig farms experienced positive cash flows at the end of each year and also reduced long-term debt, whereas most farms made no new investment.
Figure 5: Frequency of the ratio of long-term debt to total assets.

Figure 6: Frequency of the ratio of short-term debt to total assets.

Figure 7: Frequency of the ratio of cash flow to total assets.

Figure 8: Frequency of the ratio of investments to total assets.
Figure 10 shows the average ratios of the yearly change in long- and short-term debt, cash flow, investment and profit to total assets. The fluctuations of long-term debt ratio was consistent with the changes in stock long-term debt in Figure 4 from 1995 to 2008 and can be explained by the same events, like the classic swine fever outbreak in 1997, the foot and mouth disease outbreak in 2001. The relationship between the yearly change and stock fluctuation in short-term debt was the same as long-term debt. Particularly, from Figure 10, both long- and short-term debt significantly increased in 1998, 2002, 2007 and 2008 with the ratios larger than 0, whereas in 2004, both reduced with the annual ratios below 0. In 2001, long-term debt decreased faster than the rising speed of short-term debt.

The fluctuations of the other financial factors, especially cash flow and ROA, were much more volatile than long- and short-term debt in the fourteen years. Cash flow and ROA showed similar movements, as ROA partially depends on cash flow. Since 1997, the value of ROA was often negative, which indicates that the typical Dutch pig farm lost money in 1998, 1999, 2001-2003, 2007 and 2008. As mentioned before, these years witnessed either low selling price or high productions costs for Dutch pig farms. Besides, pig farms in the Netherlands were affected by the classic swine fever outbreak from February 4, 1997 to January 15, 1998 and the foot and mouth disease outbreak from March to April in 2001 (Merks 2001). The results can be fully explained by the above events except the year 1997, when Dutch pig farms were confronted with the classic swine fever outbreak of one year’s
duration but still gained earnings on average. According to Vrolijk et al. (2006), most Dutch pig farms profited from high pork prices in 1997, as they were located outside the infected region which mainly referred to the southern part of the Netherlands. Meanwhile, the majority losses of infected pig farms for destroyed pigs were compensated by the Government (Horst et al. 1999). These two events made the average net earnings of Dutch pig farms positive during the year 1997 in despite of the disastrous animal disease outbreak. The income level of Dutch pig farms were strongly determined by selling prices and production costs (Backus et al. 2006).

Though Dutch pig farms made losses in these years, cash flow was positive, except two years 1998 (negative) and 2007 (0). That means the two years (1998 and 2007) were rather difficult for Dutch pig farms, particularly 1998. This was also evident by the values of ROA, which was the lowest in 1998 and the second lowest in 2007. Moreover, there was an opposite trend between cash flow and ROA in 1997. The rising cash flow was mainly the consequence of the compensation paid by the Government for infected pigs. But the compensation brought no additional value to farmers’ profit, as it was calculated as both the income and costs in ROA. Regarding investment, either in good years or bad years, Dutch pig farms on average used money for new investments. The results found in Figure 10 were in line with the previous analysis on capital structure.

Figure 10: Fluctuations of financial factors for Dutch pig farms.
Source: Own calculation based on the FADN database, 1995-2008.
**4.3 Simultaneous system estimation**

Table 4 presents the results of the 2SLS and 3SLS estimation on the simultaneous equation system for Dutch pig farms with 1259 observations. Consistent with H1, the significant negative coefficients on the lagged stock long- and short-term debt ($pstd_{t-1}$ and $pssd_{t-1}$) demonstrate that Dutch pig farms have both long- and short-term debt targets and only partially adjust to them. Besides, Dutch pig farms show a faster speed of adjustment for short-term debt than long-term debt. The size of the coefficient estimate on short-term debt ($\beta_5^{2sls} = -0.057; \beta_5^{3sls} = -0.196$) is larger than that of long-term debt ($\alpha_5^{2sls} = -0.041; \alpha_5^{3sls} = -0.121$).

The estimation results support H2 that Dutch pig farms have a preference ordering for financial sources, but indicate a different preference ordering. As anticipated, the significant and negative coefficients of short-term debt and cash flow in equation (1) and long-term debt and cash flow in equation (2) display negative relations among cash flow, short- and long-term debt. The positive relationship between each financial source and investment is also shown by the positive coefficients on investment in equations (1) and (2) as well as the positive coefficients of cash flow, short- and long-term debt in equation (3). But only the coefficients representing the relationship between long-term debt and investment are significant. Subsequently, the coefficients to test the financial order illustrate that Dutch pig farms prefer long-term debt to short-term debt opposite to that in H2, which assumes short-term debt has greater effect on cash flow and investment than long-term debt. The size of the cash flow coefficient in the long-term debt equation ($a_2^{2sls} = -0.482; a_2^{3sls} = -0.622$) exceeds that of the short-term debt equation ($\beta_2^{2sls} = -0.200; \beta_2^{3sls} = -0.311$). Similarly, the coefficient of investment estimated on long-term debt ($a_4^{2sls} = 0.583; a_4^{3sls} = 0.158$) shows a larger absolute value than that on short-term debt ($\beta_4^{2sls} = 0.087; \beta_4^{3sls} = 0.152$), especially considering the coefficient is insignificant for short-term debt. The short- and long-term debt coefficients in equation (3) are also supportive of the more important role of long-term debt than short-term debt. Finally, there is no evidence in favour of the primary position of cash flow in Dutch pig farms’ investing activities, as the coefficient of cash flow ($y_2^{2sls} = 0.137; y_2^{3sls} = 0.121$) in equation (3) is insignificant and far less than that of long-term debt ($y_4^{2sls} = 0.528; y_4^{3sls} = 0.506$). This may be caused by the limited amount of available cash flow which fails to meet the demand of Dutch pig farms for investment. Then external debt takes its place and appears more influential. But this cannot reject cash flow as the first financial choice for Dutch pig farms, because it is very likely for farms to manage other activities firstly instead of further investment and deplete the majority of cash flow.
The parameter estimates in equation (3) provide evidence for H3 that high-performing pig farms in the Netherlands can employ financial signals to convince lenders of farms’ good performance. The coefficients of lagged cash flow, return on assets, short- and long-term debt, which are presumed as credible signals, are all above 0 as predicted, except the coefficient of lagged short-term debt estimated by the 2SLS method ($\gamma_{6}^{sts} = -0.003$). Also, the absolute value of the lagged long-term debt coefficient ($\gamma_{7}^{2tls} = 0.106, \gamma_{7}^{3tls} = 0.103$) outnumbers that of lagged short-term debt ($\gamma_{6}^{2sts} = -0.003, \gamma_{6}^{3sts} = 0.022$). Both are consistent with H3 but only the coefficient for lagged long-term debt is significant. So long-term debt is a more valid signal for high-performing pig farms to gain access to loans and for lenders to assess borrowers’ credit risk than the rest financial signals (cash flow, return on assets and short-term debt). However, there are two crucial points to be noticed about the validity of these signals. Firstly, this thesis considers investment as the indicator of performance. This holds for most situations, where farms often manage further investments on the basis of good past performance. But it is still possible for some bad-performing farms to make new investments. In this case, the results in support of H3 become problematic. Secondly, investment are measured by fixed assets. Fixed assets are the crucial component of investment, but pig farms can have more extensive investment than fixed assets, e.g. investing in stock livestock and future contracts of feeding stuff. That is, the finished analysis based on fixed assets may only cover part of practical information and insufficiently provide the whole view of farms’ performance.
Table 4: 2SLS and 3SLS simultaneous system estimation for Dutch pig farms.

<table>
<thead>
<tr>
<th>Variables</th>
<th>2SLS</th>
<th>3SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Long-term debt</td>
<td>Short-term debt</td>
</tr>
<tr>
<td>Endogenous variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term debt (p(_{ld_t}))</td>
<td>-0.197</td>
<td>0.528***</td>
</tr>
<tr>
<td></td>
<td>(0.106)</td>
<td>(0.117)</td>
</tr>
<tr>
<td>Short-term debt (p(_{sd_t}))</td>
<td>-0.572***</td>
<td>0.142</td>
</tr>
<tr>
<td></td>
<td>(0.167)</td>
<td>(0.214)</td>
</tr>
<tr>
<td>Investment (p(_{inv_t}))</td>
<td>0.583**</td>
<td>0.087</td>
</tr>
<tr>
<td></td>
<td>(0.186)</td>
<td>(0.128)</td>
</tr>
<tr>
<td>Exogenous variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash flow (p(_{cf_t}))</td>
<td>-0.482***</td>
<td>-0.200***</td>
</tr>
<tr>
<td></td>
<td>(0.047)</td>
<td>(0.042)</td>
</tr>
<tr>
<td>Lagged stock long-term debt (p(<em>{ld</em>{t-1}}))</td>
<td>-0.041***</td>
<td>0.092</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td></td>
</tr>
<tr>
<td>Lagged stock short-term debt (p(<em>{sd</em>{t-1}}))</td>
<td></td>
<td>-0.057***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.016)</td>
</tr>
<tr>
<td>Lagged ROA (RO(<em>{A</em>{t-1}}))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged short-term debt (p(<em>{sd</em>{t-1}}))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged long-term debt (p(<em>{ld</em>{t-1}}))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged cash flow (p(<em>{cf</em>{t-1}}))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time dummies</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Farm observations</td>
<td>1259</td>
<td>1259</td>
</tr>
<tr>
<td>(\chi^2) for H(_0) (all slope parameters = 0)</td>
<td>449.14</td>
<td>127.40</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>

Notice: standard deviations are in parentheses. \(*\), \(**\), \(***\) Significance at the 10%, 5%, and 1% levels, respectively, based on two-tailed tests. \(^a\) denotes insignificant time dummies at the 10% level. 

Source: Own calculation based on the FADN database, 1995-2008.
5 Summary, Discussion and Conclusion

5.1 Summary

This research investigates the financial structure of Dutch pig farms from 1995 to 2008 by statistically analysing capital components (stock long- and short-term debt and equity) and financial variables (long- and short-term debt, cash flow, investment and ROA). Dutch pig farms, on average, operated with an approximately equal amount of equity and debt (mainly long-term debt) as well as a yearly positive increase in debt (particularly long-term debt) and new investments. The results also show that the majority of the farms in each year received positive cash, paid back some long-term debt, made no new investment and seldom used short-term debt. Besides, there are a few pig farms, whose debt cannot be covered by equity. During the 14 years, some unexpected events, like animal disease outbreaks, took place and influenced the changes in capital structure.

Knowing the historical financial structure, our next step is to examine the financial strategies of Dutch pig farms. On the basis of theoretical work on the trade-off, pecking-order and signalling theories, we set up three hypotheses for Dutch pig farms. The first hypothesis assumes that farms have both long- and short-term financial targets (debt) and partially adjust debt levels towards them each year. The second one predicts that farms use financial sources in a sequence and prefer cash flow to short-term loans and finally long-term loans. The final one expects that farms can inform lenders of their high performance by credible signals which are composed of cash flow, return on assets (ROA), and long- and short-term debt.

A system with three simultaneous equations is constructed to test the hypotheses. The system contains three types of variables (endogenous, exogenous and dummy variables). Investment, long-term debt and short-term debt as endogenous variables are determined interdependently by each other. Exogenous variables comprise of strictly exogenous variables (current and lagged cash flow, stock long- and short-term debt, the debt targets and ROA) and lagged endogenous variables (lagged long- and short-term debt) which are predetermined in the system. Moreover, farm and year dummies are used to specify the unobserved variations in farm characteristics and time periods. Unlike other variables which are practically measurable, the measures of the debt targets (both long- and short-term debt) and firm dummies follow certain assumptions.

The empirical analysis uses unbalanced panel data from the FADN database and two
different methods (2SLS with random-effects and 3SLS with fixed-effects) to estimate the simultaneous equations. The FADN database contains annual financial data from 1995 to 2008. Pig farms in the analysis are defined as the farms whose yearly revenues from the sales of pigs account for at least 70% of their total revenues. Regarding the methods, both the random-effects and fixed-effects models are applied to panel data but differ in assumptions mainly referring to the correlation between firm effects and independent variables. For the estimation of the simultaneous equations, 3SLS is more efficient than 2SLS due to the consideration of cross-equation information.

Results are, in general, consistent with the hypotheses with slight differences in the pecking-order and signalling hypotheses. As expected, Dutch pig farms partially adjust to the debt targets with a faster adjustment speed of short-term debt than long-term debt. Additionally, Dutch pig farms show a preference ordering for financial sources. But the preference ordering is slightly different from the hypotheses, where Dutch pig farms prefer the use of long-term debt to short-term debt. Finally, long-term debt is found to be a credible signal to distinguish the high-performing pig farms from the low-performing ones in the Netherlands.

5.2 Discussion

Variables contained in the empirical model are the most relevant and useful ones for the hypotheses testing (H1, H2 and H3). Variables that influence the endogenous variables (investment, long- and short-term debt) but are not closely related to the studied financial strategies and the thesis objective are not taken into account, e.g. geographic conditions which often act as one determinant of investment but irrelevant to the objective. That is, the selected variables are imperfect to reflect the full and detailed information of Dutch pig farms. But the selected variables are suitable for this thesis considering the objective, time and cost constraints. With respect to the constructed empirical model, it applies linearity regression. The reason for the application of linearity in the thesis, instead of non-linearity, mainly concerns the economically linear relationships between the selected variables, e.g. negative linear relationships among cash flow, long- and short-term debt. This suggests that the results of non-linear models have less explanatory meaning, even if non-linear models fits the data better. Thus, the selected variables and linear model can function well to investigate the financial behaviour of Dutch pig farms.

The majority of the variables used for the description of capital structure and the investigation of financial strategies are practically measured, except the targets of long- and short-term debt and firm dummies. The measure of the debt targets follows Vogt’s assumption which separates the target into two components: one varying over time and captured by year
dummies and the other varying across individual firms and captured by farm dummies. If the debt targets can be measured by indicators or a model, results can be more valid. But in the present, there is no basic research about this type of measures and Vogt’s assumption seems the most suitable way till now. Similarly, firm dummies, as unobserved variables, are measured under assumptions and vary from one method to another. Both the random-effects and fixed-effects models assume time-invariant characteristics of firm dummies. But the fixed-effects model allows firm dummies with variability in individuals and correlation with observed variables, in contrast to the random-effects model. Even though the correlation between firm dummies and observed variables is not practically understood, the quality of results are assured in this thesis by using both the random-effects and fixed-effects models, especially considering similar results being found.

Unbalanced panel data are used in the thesis and collected by the FADN system from 1995 to 2008. The whole time horizon of the data is 14 years, but the time length of individual observations mostly ranges between 5 and 6 years. As lagged variables are involved in the system of equations, a number of yearly observations disappear, particularly with the existence of time gaps for individual observations. Then longer continuous time horizons of the entire data and individual observations can produce more efficient results. Besides, total assets in the database only contain ownership assets. Actually, some farm businesses employ leased assets as well, like land leasing, equipment leasing, and some leasing contracts cover almost the whole life of leased property. Then the measure of total assets by ownership assets excludes leased assets, especially for the farms which operate with a relatively large portion of leased assets. Also, the database lacks information about the average labour price, which is used to measure the opportunity cost of family labour. On the basis of sample farms, we calculate the average labour price per hour by the total number of wages, social security charges and insurance paid for wage earners divided by their total working hours for each year. But the calculation may face representative problems due to a larger number of Dutch pig farms beyond the sample. Future research is desirable to get better measures of total assets and the average labour price from other databases.

All the variables are in current euros. The reason is that financial behaviour appears under the present situation, instead of economic situations considering deflation. For instance, when Dutch pig farms undertake new investments, they usually take present financial variables into account, e.g. available cash, current investment prices, current debt levels and available debt sources, other than the deflation of these variables. Except $ROA$, $FE$ and $YE$, all the variables are scaled by total assets and measured in ratios. Inflation has limited effect on these ratio variables according to the cancellation of inflation effect in ratios, especially
when the same inflation rates are assumed. On the other hand, the undeflated variables may
decrease the explanatory power of the summary information, that is Table 1 which presents
summary statistics in euro amounts over 14 years. When Table 1 is individually seen from
other parts, the presented statistics may provide little valuable information due to the lack of
inflation in the long time horizon. But the undeflated summary information shown in Table 1 is
suitable and necessary in this thesis for continuity. The objective of the thesis does not
require to take into account the dependence of variables on inflation.

The robustness of results has been checked using 2SLS with random-effects and 3SLS with
fixed-effects to the estimation of simultaneous equations. According to the results, financial
strategies of Dutch pig farms are insensitive to the underlying assumptions in the two
methods, like the correlation of firm effects with the explanatory variables. Apart from the
methods, there are alternative ways for the robustness check, like using data from other
databases or changing measures of variables (e.g. targets of debt, total assets, ROA,
investment etc.). But the FADN database is, so far, the only source providing detailed
microeconomic data of agricultural sectors in the European Union. So it is appropriate for the
thesis to only check the validity of results by the two methods, especially with the
consideration of the time and cost constraints. Besides, both 2SLS and 3SLS consider
lagged endogenous variables as exogenous variables with the assumption of no correlation
between exogenous variables and disturbances. These variables (lagged endogenous
variables), however, are actually predetermined in the system and not strictly exogenous.
That is, 2SLS and 3SLS are inefficient to estimate dynamic panel data where correlations
between the predetermined variables and error terms exist. Generalized Method of Moments
(GMM) can be applied to the system of equations to further improve efficiency and to correct
for possible inconsistency of 2SLS and 3SLS estimation. But till now, most software cannot
deal with dynamic panel data in a system of simultaneous equations, e.g. Stata which can
only estimate dynamic panel data in a single equation.

Results demonstrate the applicability of three theories in Dutch pig farms, but need more
time and other types of research design to get a more clear view of the theories and the
specific case (Dutch pig farms). The current trade-off theory mainly indicates the adjustment
behaviour of firms towards long- and short-term debt targets, but no justification explains the
difference in the adjustment speeds of long- and short-term debt. This unexplored open area
can be one direction for future research. Besides, Dutch pig farms behave slightly different
from the pecking-order hypotheses, where long-term debt is preferred to short-term debt and
no significant evidence is found for the primary preference of cash flow. Insight into the
causes goes beyond the thesis and requires further research designs which take a wider
view of the financial behaviour and situations. For example, the design can be interviews, questionnaires, or construct a new model to explore the behind reasons, like whether policy support leads to the more important role of long-term debt than short-term debt or whether cash flow is usually depleted before investment decisions. Moreover, it appears from the results that long-term debt is a relatively valid signal in comparison with other financial signals (cash flow, return on assets and short-term debt). But the validity of long-term debt as a credible signal needs more evidence, like using a more representative indicator for performance other than fixed investments.

The trade-off, pecking-order and signalling theories as well as the methods can be also applied to different agricultural sectors, different industrial sectors and different countries. Future research aiming to investigate the financial strategies of corporate firms, especially the ones which can easily issue security for funds (e.g. the publicly held companies), needs more data and a more complicated model for the estimation with more types of financial sources available. Furthermore, future research can incorporate other financial strategies, like the market-timing theory, into the current three theories for corporate firms.

5.3 Conclusion

Capital structure of Dutch pig farms varies over time. In sum, the sampled farms, on average, had capital structure that was mainly composed of equity and long-term debt. Between 1995 and 2008, equity and long-term debt followed opposite trajectories. Specifically, equity decreased in the years (from 1997 to 2000, 2001 to 2003 and 2006 to 2007) with the occurrence of unfavourable events which caused losses for the farms, like animal disease outbreaks, low selling prices and high costs, and increased in the other years accompanied by favourable events which made the farms profitable, like high selling prices and exports. Regarding short-term debt, it only accounted a small portion of capital structure and remained roughly unchanged except a sharp increase in the year 2001.

The three theories are jointly applicable to Dutch pig farms. Results are consistent with the trade-off theory that Dutch pig farms partially adjust both short- and long-term debt levels towards the targets. In addition, Dutch pig farms show a significant preference for long-term loans than short-term loans, which supports the existence of a preference ordering indicated in the pecking-order theory. Ultimately, it appears from the results that Dutch pig farms can inform lenders of their good performance by signals, especially using long-term debt as the credible signal.
Reference


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