Use of income, and financial behaviour in agricultural firms. An empirical analysis

Svend RASMUSSEN

Cahiers d'économie et sociologie rurales, n° 49, 1998

Svend RASMUSSEN*

Une étude empirique de la gestion financière des entreprises agricoles au Danemark

Résumé – L'auteur analyse ici le comportement financier des agriculteurs danois au cours des années 1980-1993. L'objectif principal a été d'analyser de façon empirique l'influence des modifications des revenus et des réserves de crédit sur les décisions financières des agriculteurs. Certaines hypothèses reposent sur l'œuvre théorique de Barry, Baker et Sanint. Elles se concentrent sur la réaction financière de l'agriculteur quand la totalité des crédits disponibles baisse ou quand les revenus sont modifiés. L'auteur a notamment testé l'hypothèse selon laquelle les agriculteurs très endettés ont un comportement financier différent de celui des agriculteurs qui le sont peu.

Un modèle économique basé sur les comptes de l'exploitation (panel data) a été évalué. Le modèle est un système de huit équations individuelles qui décrivent la consommation privée et l'investissement en différents types d'actifs en fonction du revenu courant de l'année précédente, des modifications dans le capital propre, ainsi que du temps.

Les résultats montrent que la consommation privée, le remboursement de prêts, ainsi que les investissements en actifs financiers et biens immobiliers changent comme prévu selon les modifications apportées au capital propre et au revenu. Ainsi le comportement financier observé est en concordance avec le comportement attendu selon le modèle de Barry, Baker, Sanint (1981). Toutefois, les résultats obtenus ne confirment pas l'hypothèse énoncée ci-dessus.

Les résultats montrent aussi que la tendance marginale à consommer le revenu courant (consommation privée) est très basse dans l'agriculture danoise. Quand le revenu courant augmente, seulement 6 à 8 % sont utilisés pour la consommation privée au cours des deux premières années et environ 15 % pour les investissements en machines. La plus grande partie de l'augmentation du revenu (à court terme) s'accumule en comptes bancaires.

En conclusion, de nouvelles recherches empiriques sur le comportement financier, insistant sur les réactions dynamiques, seraient souhaitables.

Mots-clés :
modèle économétrique, modifications dans les revenus, liquidité, capital propre, réserves de crédit, investissement, consommation

Use of income, and financial behaviour in agricultural firms. An empirical analysis

Summary – *This paper analyses financial behaviour in Danish agriculture during the period 1980-1993. The main objective has been to empirically analyse how changes in income and credit reserves have influenced financial decisions. Hypotheses were established based on the theoretical work by Barry, Baker and Sanint. An econometric model based on panel data (farm accounts) was estimated. The results show that private consumption, repayment of loans, and investments in financial assets and real assets change as expected when equity and income change. The changes take place both within the same year and the following year.*

Key-words :
econometric model, income changes, liquidity, equity, credit reserves, investment, consumption

* *Department of Economics and Natural Resources, The Royal Veterinary and Agricultural University, KVL, Rolighedsvej 23, DK-1958 Frederiksberg C, Copenhagen, Denmark.*
e-mail : Svend.Rasmussen@flec.kvl.dk

THE debt ratio (total liabilities divided by total assets) in Danish agriculture has increased considerably in the last 15 years. According to official statistics from the Danish Institute of Agricultural an Fisheries Economics, the average debt ratio has increased from about 0.32 in 1980 to about 0.54 in 1997 (SJI, 1981 and SJFI, 1997). These average figures cover a large variation between individual holdings. In 1993 the SJI estimated that 11% of full-time holdings had a debt ratio greater than 1.0 (SJI, 1993).

Compared to other EU countries, the indebtedness of Danish agriculture has always been relatively high (Cavailhès and Le Hy, 1993; Reid, 1981). According to Reid, a significant factor in this is the ownership structure in Danish agriculture, where there is a large proportion of owner-occupiers. A significant factor is also the intergenerational transfer of farms. Due to the tax system there is no incentive to hand over farms below market value; this means that young farmers start often by buying a farm at market rate, resulting in a high debt ratio.

The increase in the debt ratio since 1980 is due to a number of reasons. In general, changes in the sectoral average debt ratio may be due to: i) statistical reasons (changes in farm structure), and ii) changes in individual debt ratios. Individual ratios may change due to external factors not being under the control of the farmer (values (prices) of assets and liabilities), and endogenous changes like decisions on consumption, investment, and financing. The question is to what extent the individual farmer has been able to influence the development, and to what extent the individual farmer has deliberately tried to do so by means of financial management.

The main objective of this paper is to empirically analyse how changes in income and credit have influenced observed financial decision making in Danish agriculture during the period from 1980 to 1993.

As the project is primarily based on empirical analysis, the opportunities to identify and test hypotheses concerning financial management are of course limited by the character of the data available. Use of farm accounts data from the Danish Farmers' Union made a very large sample of data available. However, the lack of certain details in the data placed a natural limitation on the character of the analysis which it has been possible to perform. Further, the data only cover owner-occupied farms. Financial management tools available for companies are therefore not included in the analysis. As the data only refer to farmers already established, the decision to become a farmer has already been taken. Furthermore, it was not possible to take into account the option of selling the farm.

The outline of the paper is as follows. In the first part the theoretical framework for analysing financial management is established, and the concepts used in the following sections are defined. The second part provides a description of the hypotheses to be tested, and the resulting data requirements. A formal model is developed in the next section followed by a short description of the data used. The corresponding econometric model and description of estimation is presented and the results are given in the last section followed by final discussion and conclusion.

FINANCIAL MANAGEMENT

To establish a set of concepts and the framework for the analysis the model framework developed by Barry, Baker, and Sanint (1981) was used. Although criticised for its simplicity, this model has been the basis for a number of papers on financial management in agriculture (Collins and Karp, 1995). It is basically a model of liquidity management. Liquidity management is defined as: *"A principal means by which farmers cope with variations in cash flows that arise from uncertain commodity prices, yields, and production costs. The farmer's objective is to ensure that cash can be generated quickly and efficiently in order to meet cash demands"* (Barry *et al.*, 1981, p. 216). Three sets of concepts are important within this model, namely *liquidity of assets*, *credit reserves*, and *credit risk*.

Liquidity of assets refers to the relationship between a firm's composite asset value and cash proceeds which could be expected from the sale of each individual asset to meet liquidity needs. An asset is considered perfectly liquid if its sale would generate cash equal to or greater than the reduction in value of the firm resulting from the sale. Assets become less liquid as their potential sale would reduce the value of the firm by an amount greater than their expected sales value. A number of factors influence the liquidity of an asset, including transaction costs, marketability, time allowed for liquidation, etc. (*ibid.*, p. 217). Synergy effects in relation to other resources of the firm may also be important.

Credit reserves are the unused borrowing opportunities. Holding credit reserves as a source of liquidity thus provides a means of generating cash without being burdened by the costs associated with liquidating productive assets to meet cash demands under unfavourable conditions and then reacquiring the assets later. However, holding reserves also involves costs, because of forgone profit from not using the reserves for investment opportunities. Furthermore, when the reserves are drained through the taking up of additional loans, interest has to be paid on the loans.

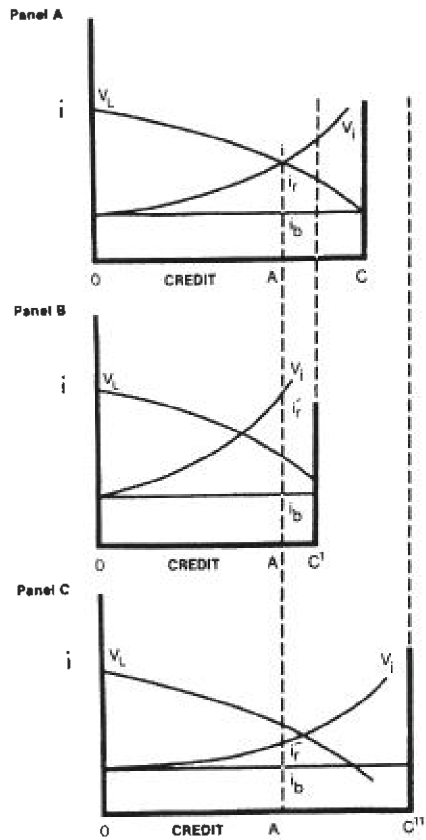
Credit risk is the risk associated with costs and availability of credit. Barry *and al.* show that when the availability of credit is treated as a random variable, then the cost of using credit in borrowing also becomes a random variable (*ibid.*, p. 218).

Barry *et al.* use the well-known mean-variance portfolio model to derive the conditions for optimal debt and the comparative static properties related to optimal debt. The farmer is assumed of maximizing expected utility, where utility is a function of income, and the utility function is the negative exponential with a risk aversion parameter $\lambda > 0$ (*ibid.*, p. 218). When both income and the cost of using credit (borrowing) are treated as stochastic variables, Barry *et al.* derive the conclusion that the optimal debt will increase with increasing returns to assets, decrease with increasing cost of borrowing, and decrease with increasing risk aversion (*ibid.*, p. 219).

The relationship between credit risk and the cost of borrowing is further illustrated in Figure 1, taken from the same authors.

In Panel A the total credit available is *OC*. The interest rate paid to the lender when money is borrowed is i_b. To this is added a liquidity premium i_r, which is the value to the farmer of having the credit reserve, so that the total cost of borrowing the *OA* is $i = i_b + i_r$. As the farmer is assumed to be risk-averse, the value of having credit reserves increases with decreasing reserves, so that the total cost of borrowing is an increasing function V_i. With a decreasing return from investing borrowed money of V_L, the farmer in Panel A will borrow *OA* and reserve *AC*.

Figure 1.
Credit variations
and costs



Source : Barry, Baker and Sanint, 1981

When credit is a random variable, it may drop to for instance OC^1, as shown in Panel B. Because the credit reserves are thus reduced to AC^1, the liquidity premium increases to i'_r, and the total cost of borrowing accordingly increases to $i' = i_b + i'_r$. Therefore, the use of credit (OA) is no longer optimal (loans are too great). In contrast, in Panel C credit has increased to OC^{11}, and the cost of borrowing is therefore reduced to $i'' = i_b + i''_r$. It would therefore be optimal to borrow a greater amount than OA.

The variability in credit availability as illustrated in Figure 1 reflects very well the historical conditions for Danish agriculture. Farm values usually taken as a collateral have varied considerably (see second column of Appendix 3), hence total credit available also varied.

The general forces that may affect the supply of available credit are described in Barry *et al.* (p. 217). Creditworthiness depends on the ability of the farmer to provide assurances that lending risk will be minimal. In evaluating these assurances, the lender considers the farmer's personal characteristics and credit history, managerial qualities, assets (including collateral offered as loan security), and income and repayment expectations.

In Denmark there are two major types of lenders: the mortgage associations, which base their lending on cash generated from issuing bonds, and banks[(1)]. Lending by mortgage associations is regulated by law, and they are not allowed to lend more than 70% of the value of the farm (DLR, 1994). Typically, they provide long term loans (10-30 years) with fixed (nominal) rates of interest. The consequence of the fixed interest rate is that after the loan has been taken up, the cash value of the loan will depend on the price of the bonds on which the original loan was based (and therefore the market rate of interest). To pay off a loan, the borrower has to pay it back in the form of bonds purchased in the open market at prices determined by the current rate of interest[(2)]. Thus, when the market rate of interest increases (decreases), the cash value of the mortgage loan will decrease (increase) in line with the change in the price of the relevant bonds. Bank loans, on the other hand, normally have a variable rate of interest. Bank loans are normally secured by mortgage. Therefore when banks consider providing credit, both the value of the farm, and the (cash) value of the mortgage loans are important information. The expected future cash flow also has a significant influence, and typically one would expect a trade-off between equity and cash flow.

Danish agriculture usually finances both farm take-over and investments in land and buildings (and sometimes also investments in ma-

(1) Commercial banks (Denmark does not have specific agricultural banks).

(2) However, so-called convertible loans may be paid off using cash, though this is profitable only when the price of bonds is above par.

chinery and livestock) with mortgage loans. This is partly because they are long term loans (up to 30 years), but also because the effective rate of interest (from an *ex ante* point of view!) is lower than that for bank loans (Danmarks Statistik).

Considering the above described lending behaviour in Denmark, both the total credit available (*OC* in Figure 1) which typically relates to the sale value of the farm and the (cash) value of the existing loans (*OA*)[(3)] contributes to the variability of the credit reserves (*AC*). Thus, risk related to credit reserves depends on the variance of total credit, the variance of the cash value of loans, and the correlation between the two. The figures in Appendix 3 show that bond prices and prices of farm land for the period 1983-1993 varied considerably during this period with a correlation coefficient of $r = 0.42$. Hence, the variation of both the value of debt and the value of farm land contributed to the variability in credit reserves.

HYPOTHESES

The Barry *et al.*-model is used as a benchmark for setting up testable hypotheses. For our purpose we assume as a starting point that the farmer has chosen an optimal utilization of his credit limits at the given conditions (Panel A). There from follows the first hypothesis:

Hypothesis 1

If the total credit available falls (Panel B in Figure 1) one could expect that the farmer will try to either reduce his debt and/or his risk by increasing the liquidity of assets. If assets become more liquid, the liquidity premium i_r will decrease, and the adjusted cost function V_j will move down, bringing the situation back towards the optimum where V_j and V_L intersect[(4)]. A reduction in debt may be brought about by paying off more than originally planned and/or by borrowing less than originally planned. Reduction of risk may be caused by directing investment to more liquid assets.

The implicit assumption behind the assumed behaviour is that farmers always have at their disposal a set of investment plans that are not yet realized, because they are waiting for the appropriate economic conditions (for instance brought about by a change in the amount of credit available). When these economic conditions occur, the plans are taken out of the drawer, and the investment is implemented. Such behaviour is in accordance with the observations made by Jacobsen (1994).

(3) Both *OA* and *OC* in Figure 1 are in cash terms.

(4) As mentioned earlier, credit reserves may fall due to a decrease in total credit and/or an increase in the (cash) value of existing debt.

Hypothesis 2

The second hypothesis to be tested is that farmers with a high level of financial leverage have a financial behaviour different from farmers with a low financial leverage. This hypothesis does not relate directly to the model above mentionned. However, Kuiper and Thijssen found in their analysis that "*...the ratio equity to equity plus debt, is... an important determinant of private investment in Dutch agriculture...*" (Kuiper and Thijssen, 1996, p. 470). Further, according to assumptions behind the BBS model, farmers with a high leverage are less risk-averse than farmers with a low leverage. The test would therefore indirectly show whether financial behaviour depends on the degree of risk-aversion.

To carry out an analysis to test the hypotheses mentioned above, we need time series data on individual holdings for the following items: credit supply; change in level of debt (repayment and borrowing); investment in assets according to degree of liquidity; private consumption; level of farm income; and financial leverage.

With the exception of credit supply, data on these items are available from farm accounts. Change in level of debt is measured as (net) repayment of loans[5] (*REPA*)[6]. In the accounts available it is possible to differentiate between the following types of investments: financial assets (*FINA*); stocks, including livestock (*STOC*); machinery (*MACH*); buildings (*BUIL*); agricultural property (*REAL*); and other (real) assets and property (*OTHE*). The assumption made is that the degree of liquidity of these assets decreases in the same order stated[7]. Private consumption (*PRIV*) is also available directly from the accounts. Farm income may be available at different levels; the measure of income used here is termed 'Net current income' (*M*), and is defined in Appendix 2. Financial leverage is here measured as total debt divided by total assers.

Credit supply data are not directly available from agricultural accounts. To include the consequences of changes in the cash value of existing loans as mentioned above, it is more relevant to focus directly on credit reserves. As a proxy for credit reserves total equity (*EQ*) is used. This implies the assumption that total credit supply is equal to total value of assets. From a lenders' point of view, this may be considered as a rather high level. On the other hand, there is empirical evidence that lending to farmers may even exceed the value of assets[8]. In any case, the following

[5] Both private and commercial loans are included, as it was not possible to separate the two.

[6] *REPA* (and the corresponding names in the following) are the names of the variables to be used in the formal models established later.

[7] It may be difficult to differentiate the liquidity of buildings, real property and other assets. However, the three types of assets will be considered together at a later stage.

[8] According to Rasmussen and Wiborg (1996), the average debt ratio for young Danish farmers when they first establish themselves is 80-85%. According to SJI (1993), more than 10% of full-time holdings had a debt ratio greater than 100% in 1992/1993.

analysis will only focus on *changes* in credit reserves, and not the absolute level. It is therefore not so critical if the *absolute* level is not completely right.

THE MODEL

Let us assume that at the beginning of year t-1 the farmer has made a consumption and investment plan such that if the plan was implemented and the expected values were realized, the situation one year later (beginning of year t) would be optimal as in Panel A of Figure 1. However, due to risk, the situation at the beginning of year t may correspond to Panel A, Panel B or Panel C, depending on the actual outcome of the random variables involved, including credit reserves. Let us further assume that during year t, the farmer will have an income of M. The decisions to be taken during this year are how this amount of money should be spent on consumption, repayment of loans, and investment in various investment alternatives.

The model (derived in Appendix 1) has the following form:

$$R_{it} = \alpha_1 + \beta_i M_t + \sum_{j=2}^{8} \beta_{ij} p_{jt} + \gamma_i M_{t-1} + \delta_i DE_{t-1} \quad (i = 1, ..., 8) \quad (1)$$

where $R_{1t},...,R_{8t}$ is the amount of money used for private consumption (*PRIV*), investment in financial assets (*FINA*), stocks (*STOC*), machinery (*MACH*), buildings (*BUIL*), agricultural property (*REAL*), other assets (*OTHE*), and repayment of loans (*REPA*), respectively; $p_{1t},..., p_{8t}$ are the matching prices; M_t is income in year t; and DE_{t-1} is the adjusted change of equity[(9)] during year (t-1). All amounts and prices are in real terms (*i.e.* has been divided by the price of consumer goods[(10)]. Finally α_j, β_{ij} (j=1, ..., 8), β_{ij} (i=1, ..., 8; j=2, ..., 8), and γ_i, δ_i (i=1, .., 8) are parameters.

According to the model the use of money for consumption, investment, and repayment of loans (R_{it}) depends on the income within the same year (M_t), the income last year (M_{t-1}), prices (p_{jt}), and the adjusted change of equity last year (DE_{t-1}). The lagged income M_{t-1} is included to formally model changes in the credit available, according to the survey results found by Barry, Baker and Sanint, (1981, p. 223). However, this variable may also capture a simple time lag in the relationship between earning the income M_t and decisions on how to use the income.

(9) Definition in Appendix 2. Instead of *absolute change* of equity, a model with *relative change* (change of equity divided by total assets) was tested. However, this model was not better (no higher R^2 values, and the absolute t-values were typically less).

(10) Therefore $p_{1t} = 1$.

To test the assumption that farmers with a high financial leverage are more responsive to changes in economic conditions than farmers with a low leverage, we need to modify the model in (1) so that the parameters may have values which depend on leverage. This modification will be introduced in the section on estimation.

DATA

The data used for estimation are from the database of farm accounts kept by the Danish Farmers' Union[11]. The database includes accounts from 20-30% of all Danish farms. However, to minimize the potential variability due to age of farmer and size of farm, only farms in the middle group of three age and size groups were actually used[12]. The data include accounts from 1980 to 1992/93 (13 years). As each of the individual farms in the database has a unique code, it is possible to follow the same farm over the years. Not all the farms are represented in all 13 years, however. Farms where the farmer has started farming, and farms where the farmer has ceased farming during the period or has moved to another farm, will have less than 13 observations. It should also be observed that the use of lagged variables (one year lag) implies that the first year (observation) for each farm could not be used for estimation. The data from the farm accounts are summarized in Table 1.

Table 1.
Data description

Time period (years)	1980-1993
Total number of observations	22,099
Total number of farms	2,801
Average number of obs. (years) pr. farm	7.9
Age of farmers (years)	43-54
Farm size (total assets, 10^6 DKK, 1990 price level)	2.1-3.1
Average debt ratio, per cent all farms	54.56
Average income per year (M) (DKK)	231,310

Share of income used for

PRIV	*FINA*	*STOC*	*MACH*	*BUIL*	*REAL*	*OTHE*	*REPA*
0.60	0.06	0.00	0.23	0.10	0.06	0.06	-0.11

All the values on income, consumption, investments, and repayment of loans were directly available from the database, or were derived indirectly by using the accounting model in Appendix 2.

[11] For detailed information on the farms included in the database, please refer to the yearly statistics from the Danish Agricultural Advisory Centre: *Regnskabsstatistik Landbrug* (Agricultural Statistics). Definitions of the data are also to be found in this publication.

[12] The three age and size groups were established by dividing all the observations into three age groups and three size groups respectively, with an equal number of observations in each.

Prices are from various official price statistics[13].

The last row of Table 1 shows average data on how income (M_t) is used. The largest share is used for private consumption (0.60) and for investment in machinery (0.23). The investment and repayment figures are all net figures, *i.e.* (gross) investment minus sales and (gross) repayment minus borrowing respectively. The negative proportions for loan repayment (*REPA*) thus indicate that positive amounts of (net) loans have been taken up as a supplement to income M_t and used to finance consumption and investment.

ESTIMATION

To test the hypothesis mentioned earlier, the model in (1) needs a few adjustments. First of all, as the data are available as panel data, a farm component (dummy variable) is introduced to model the consumption, investment, and repayment *level* of each farm. Also, to test the hypothesis that farms with a high leverage have a different response to economic changes than farms with a low leverage, the parameters of the model are specified in such a way that they may change with the leverage level.

Before the final model was set up, preliminary analyses were carried out to detect the degree of correlation between the independent variables included in model (1). The objective was to avoid problems of multicollinearity.

The analysis showed that apart from the price of real property there was a very high correlation between the price variables[14]. The absolute values of the coefficient of correlation were between 0.75 and 0.94. The high correlation was due to a clear linear time trend in the price variables, with absolute values of coefficients of correlation between prices and time ranging from 0.83 to 0.98. The only price which was relatively independent of other prices and also independent of time was the price of real agricultural property (price of farms/agricultural land). However, the price of farms had a relatively high correlation with the variable measuring the change of equity.

---

(13) Consumer price index from the *Monthly Review of Statistics (Danmarks Statistik)*. Price of financial assets and price of debt estimated as the price of 20-year, 10% bonds based on the interest rate of fluctuating overdrafts according to the *Monthly Review of Statistics (Danmarks Statistik)*. Prices of stocks, machinery, and buildings based on the price statistics from the Danish Institute of Agricultural Economics (SJI, Landbrugets Prisforhold). Prices of (agricultural) property from *'Ejendomssalg 1. halvaar', Told og Skat* (Statistics on traded farms 15-60 ha).

(14) Estimation of correlation based on real prices (prices divided by consumer prices).

With this level of correlation one may expect very unreliable estimates of the price parameters. Estimation of the model confirmed this. Half of the price parameters were not significant at the 1% test level, and only two of the six own price elasticities had the expected negative sign. And in general it was not possible to identify any kind of systematism of the price parameter estimates.

Due to this problem of multicollinearity adjust the model had to be considered. The very high correlation between prices, and between prices and time suggests that most of the variability due to changing prices may be explained by a simple time trend according to the following linear function:

$$p_{jt} = \mu_j t + v_{jt} \qquad (j=2,...,8) \tag{2}$$

where t is time, μ_j is an parameter, and v_{jt} is an error term with $E[v_{jt}] = 0$, $E[v_{it}\, v_{jt}] = \sigma^2$ for $j = i$ and $E[v_{it}\, v_{jt}] = \sigma_{ij}$ for $j \neq i$. If the coefficient of correlation r_{ij} between prices has an absolute value close to one, the error terms for price i and price j will be related as:

$$v_{jt} \cong k_{ij} v_{it} \qquad (j, i=1,...,8) \tag{3}$$

where k_{ij} is a constant.

If we use (2) and (3) in the model (1) it becomes:

$$R_{it} = \alpha_1 + \beta_i M_t + t \sum_{j=2}^{8} \beta_{ij} \mu_j + v_{it} \sum_{j=2}^{8} \beta_{ij} k_{ij} + \gamma_i M_{t-1} + \delta_i DE_{t-1} \tag{4}$$

Performing the summation we get:

$$R_{it} = \alpha_i + \beta_i M_t + t\, \phi_i + v_{it} h_i + \gamma_i M_{t-1} + \delta_i DE_{t-1} \tag{5}$$

Where ϕ_i and h_i are the two sums in (4). The term $v_{it}h_i$ is a "normal" error term which will add to the other error term to be included in the final statistical model. (Thus, the error term e_{iht} introduced in (6) below includes the error term $v_{it}h_i$).

Based on the above analysis it was decided to remove all the price variables from the model and to substitute them with a single time variable t (15).

The remaining independent variables (income M_t, lagged income M_{t-1}, adjusted change of equity DE_{t-1}, and time t) had low correlations. The highest correlation was between time t and adjusted change of equity last year (DE_{t-1}) (coefficient of correlation around 0.30). However, this was not a serious problem. The absolute values of the coefficients of corre-

(15) Although this replacement was not necessary, it achieves a convenient simplification. We are aware that it may introduce bias into other coefficients. However, the other parameters only changed marginally as a result of the replacement.

lation between income this year (M_t), income last year (M_{t-1}), and adjusted change of equity (DE_{t-1}), were all less than 0.05. Therefore, the estimated coefficients for these variables were not influenced by multicollinearity.

Based on these considerations and analysis, the final model to be estimated is:

$$R_{iht} = d_{ih} + \alpha_{ik} + \beta_{ik} M_{ht} + \phi_{ik}\, t + \gamma_{ik} M_{ht-1} + \delta_{ik} DE_{ht-1} + e_{iht} \quad (6)$$

$$(i=1, ...,8), \quad (h=1,...,H), \quad (k=1,...,K), \quad (t=1,...,T)$$

where i refers to the eight 'demand' equations (*PRIV,...,REPA*), h refers to the individual farms (H is the number of farms in the sample), k refers to leverage level (K is the number of leverage groups), t is time (T is number of years), and e_{iht} is an error term with an expected value of zero, a variance of σ^2, and covariances of σ_{ij}.

The model is a so-called dummy-variable model (Judge *et al.*, 1985, p. 530) with an intercept ($d_{ih} + \alpha_{ik}$) that may vary both over farms and over leverage groups. However, the model also allows the slope coefficients to vary over leverage groups. This facilitates the possibility of making statistical tests on the differences between farms with different leverages[(16)].

Before estimation, the farm component d_{ih} was removed from model (6) by deducting the expected values (averages) with respect to t for each i and h for all variables. Thus the models estimated are based on variables measuring the deviation *within* farms[(17)].

RESULTS

To interpret the results in relation to the hypotheses stated previously, it is necessary to consider the degree of liquidity for the assets involved. Financial assets (*FINA*) and stocks (*STOC*) are here considered to be assets with ***high liquidity***, and machinery (*MACH*) and fixed assets (*BUIL, REAL, OTHE*) are considered to be assets with ***low liquidity***. This means that if the farmer wants to increase the liquidity of the total portfolio of assets as a response to a reduction in credit available, he/she

(16) Five leverage groups were defined, on the basis of the objective that the number of observations in each group should be (almost) equal. The five groups were defined according to debt ratio (total liabilities divided by total assets) with the following limits: < 30%, 30-50%, 50-70%, 70-95%, > 95%.

(17) Estimation was performed using *SAS* 6.12 under WINDOWS 95. The system of eight equations was estimated using PROC SYSLIN. The restrictions (3a) and (4a) mentioned in Appendix 1 were imposed, and therefore the system wasestimated using Seemingly Unrelated Regression (*SUR*). All the models (except the model for agricultural property (*REAL*)) were highly, statistically significant based on F-tests, with F-values from 7.0 (*BUIL*) to 127.2 (*STOC*).

would reduce investments in fixed assets and machinery, and/or increase investments in financial assets and stocks.

The estimated parameters are shown in Table 2, 3, 4, and 5. In all the tables, the first column shows the t-statistic for the coefficient in the second column of the table. The coefficients in the second, third, fourth, fifth, and sixth column are the estimated slope coefficients for observations with a debt ratio of < 30%, 30-50%, 50-70%, 70-95%, and > 95% respectively. The last column shows the F-statistic from testing the hypothesis that the five slope coefficients are all equal. F-values are given if the hypothesis is rejected at the 1% test level, and "*ns*" is used to indicate that the differences are not significant.

Change of equity (DE_{t-1})

When equity increases, the credit reserves will increase and influence the financial behaviour as described in hypothesis 1. According to the hypothesis one would expect that when credit (DE_{t-1}) increases, private consumption will increase, repayment of loans, investment in financial assets and stocks will decrease, and investment in machinery and fixed assets will increase.

Table 2. **Estimated coefficients of adjusted change of equity (DE_{t-1})**

	t	δ_{i1}	δ_{i2}	δ_{i3}	δ_{i4}	δ_{i5}	F
PRIV	8.7540	0.0083	0.0054	0.0025	0.0029	0.0008	8.2129
FINA	0.5270	0.0029	0.0197	0.0172	-0.0047	0.0242	4.3540
STOC	-3.6220	-0.0105	-0.0064	-0.0092	-0.0086	-0.0176	*ns**
MACH	6.2030	0.0178	0.0173	0.0131	0.0092	0.0135	*ns*
BUIL	-0.1250	-0.0004	0.0041	-0.0014	0.0028	0.0068	*ns**
REAL	0.0440	0.0002	0.0075	0.0068	-0.0017	0.0099	*ns**
OTHE	1.2600	0.0033	0.0043	0.0018	0.0046	0.0094	*ns**
REPA	-2.3330	-0.0215	-0.0519	-0.0308	-0.0044	-0.0471	3.9966

Note: The t-values in the first column refer to δ_{i1}. The F-values refer to the test of H_0: $\delta_{i1} = ... = \delta_{i5}$ (when all other parameters are allowed to be different between leverage groups) against H_1: $\delta_{ij} \neq \delta_{ik}$ for at least one pair j and k. *ns* = no significant difference between the leverage groups at the 1% significance level. *ns** = no significant difference between the leverage groups for any parameters at the 1% significance level (from a prior stage of testing).

To interpret the results, consider farms with a debt ratio of less than 30% (second column). Private consumption increases by DKK 8.30 in the *following year* when adjusted equity during *this year* increases by DKK 1,000. This figur is highly significant (t-value 8.7540). The coefficient *decreases* significantly (F-value 8.2129) with increasing leverage, and is almost zero (0.0008) when the debt ratio is larger than 95% indicating a clear difference between the leverage groups. Thus, the higher the leverage, the lower is the influence on private consumption the year after when adjusted equity changes.

The results in Table 2 show that the estimated parameters have the correct sign except financial assets (*FINA*), where only δ_{i4} is negative[(18)]. Also *BUIL* and *REAL* have individual parameters with "wrong" (negative) sign, but they are not significantly different from zero.

With respect to stocks, machinery, buildings, agricultural property, and other assets, there are no significant differences between the leverage groups (*ns*). For repayment of loans, the *negative* figures indicate that *net borrowing increases* when equity increases. The difference between the five coefficients is just significant (F-value 3.9966), but the picture is unclear, and only the difference between δ_{i4} and δ_{i5} is significant at a 1% test level.

In summary, the results show that an increase in equity (credit reserves) has as the consequence that private consumption and investment in machinery increase, stocks are reduced, and repayment of loans is reduced. It appears too that the increase in private consumption decreases with increasing leverage. These results are in accordance with the expected behaviour.

Income last year (M_{t-1})

Changes in last years income may have an influence on credit reserves, because lenders become more willing to supply credit. According to this hypothesis, one would expect that when income (M_{t-1}) increases, private consumption the following year will increase, repayment of loans, investment in financial assets and stocks the following year will decrease, and investment in machinery and fixed assets in the following year will increase. (Same behaviour as when equity increases).

Table 3.
Estimated coefficients of lagged income (M_{t-1})

	t	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}	F
PRIV	7.2830	0.0244	0.0385	0.0381	0.0357	0.0369	*ns*
FINA	-0.5510	-0.0106	-0.0016	0.0114	0.0078	0.0059	*ns*
STOC	-6.6720	-0.0686	-0.0566	-0.0750	-0.0600	-0.0553	*ns**
MACH	5.2180	0.0528	0.0618	0.0546	0.0666	0.0618	*ns*
BUIL	1.6980	0.0178	0.0452	0.0575	0.0337	0.0378	*ns**
REAL	1.6880	0.0329	0.0355	0.0270	0.0594	0.0511	*ns**
OTHE	3.8400	0.0350	0.0230	0.0407	0.0475	0.0308	*ns**
REPA	-2.5720	-0.0837	-0.1459	-0.1543	-0.1906	-0.1691	*ns*

Note: The t-values in the first column refer to γ_{i1}. The F-values refer to the test of H_0: $\gamma_{i1} = ... = \gamma_{i5}$ (when all other parameters are allowed to be different between leverage groups) against H_1: $\gamma_{ij} \neq \gamma_{ik}$ for at least one pair j and k. *ns* and *ns** : See Note in Table 2.

(18) An F-test showed that σ_{i4} is less than both δ_{i3} and δ_{i5} at a 1% test level.

The results in Table 3 show that the estimated parameters all have the correct sign except financial assets (*FINA*), where three of the coefficients are positive. However, none of these coefficients are significantly different from zero. When the income last year increases both private consumption and investment in long term assets (*MACH*, *BUIL*, *REAL*, and *OTHE*) increases as expected. However, there are no differences between the five leverage groups.

The results are (as expected) quite similar to those of Table 2. Therefore, the financial behaviour seems to be the same whether changes in economic welfare during a year are due to changes in (adjusted) equity or to changes in (current) income. However, the change in private consumption when (current) income (M_{t-1}) changes does not vary between leverage groups as is the case with private consumption when equity changes.

Income this year (M_t)

The parameter β_{ik} is the marginal rate of 'consumption' of 'good' i when income M changes. As these marginal rates add up to one, we might just as well refer to these numbers as 'proportions of marginal income' or 'proportions of income changes'. Thus, these parameters refer to how much of an increase in income of DKK 1 is used for each of the eight 'goods' considered. The estimates are shown in Table 4.

Table 4.
Estimated coefficients of income (M_t)

	t	β_{i1}	β_{i2}	β_{i3}	β_{i4}	β_{i5}	F
PRIV	10.4020	0.0370	0.0425	0.0417	0.0466	0.0278	5.2056
FINA	21.6660	0.4426	0.2893	0.2053	0.1525	0.0888	49.9893
STOC	18.6990	0.2044	0.2227	0.2174	0.2106	0.2097	*ns**
MACH	7.5380	0.0811	0.0988	0.0870	0.0785	0.0484	3.8446
BUIL	1.8430	0.0205	-0.0141	0.0220	0.0185	0.0034	*ns**
REAL	1.0070	0.0209	0.0281	0.0369	0.0055	0.0064	*ns**
OTHE	4.6960	0.0456	0.0680	0.0473	0.0554	0.0346	*ns**
REPA	4.2700	0.1479	0.2647	0.3423	0.4325	0.5808	25.9491

Note: The t-values in the first column refer to β_{i1}. The F-values refer to the test of $H_0: \beta_{i1} = ... = \beta_{i5}$ (when all other parameters are allowed to be different between leverage groups) against $H_1: \beta_{ij} \neq \beta_{ik}$ for at least one pair j and k. *ns* and *ns**: See Note in Table 2.

It is interesting to note that private consumption only changes very little when income changes. The proportion of income changes used for private consumption is at a level less than 0.05. F-tests show that there is no significant difference between four of the five groups. Only the group with very high leverage (> 95%) has a proportion (0.0278) which is significantly lower than the other groups (1% test level).

The proportion of marginal income used for investment in financial assets (cash, deposits in bank accounts, bonds, mortgage deeds, etc.) is very high (0.44) when leverage is low, and very low (0.09) when leverage is high. For repayment of loans, the picture is just the opposite; when leverage is low, 0.15 of marginal income is used for loan repayment, but 0.58 when leverage is high. These results are probably a consequence of the definitions used in agricultural accounts: when the current account (cash credit account) used by most farmers to handle short-term incoming and outgoing payments is in credit (has a positive value), it is defined as a financial asset; and when the account is overdrawn (has a negative value), it is defined as a loan. Therefore, money placed on the account will be defined as financial investment or loan repayment, depending on whether the balance of the account is positive or negative. With a high debt ratio the cash credit account will typically be overdrawn, and thus money placed on the account will be defined as loan repayment. The opposite is the case when the debt ratio is low.

To get a clearer picture it would therefore be better to add the two. Doing this produces the result that the proportion of marginal income used for investment in financial assets plus repayment of loans is around 0.55-0.60 when the debt ratio is less than 95%, and a little higher (0.67) when the debt ratio is at the highest level (> 95%). But the differences are not significant (1% test level).

The proportion of marginal income used for investment in stocks is around 0.20. Investment in machinery take a proportion of around 0.08-0.10, but only half this (significantly different from the other groups at the 5% test level) when the debt ratio is very high (> 95%). Investment in other assets take a proportion of 0.04-0.06, while investment in buildings and agricultural property typically take an insignificant proportion of less than 0.02 with no significant difference between leverage groups.

If we consider all the consequences of changes in (current) income (both M_t and M_{t-1}), the results in Table 3 and 4 show that a change of income changes private consumption both in the same year (Table 4) and in the following year (Table 3). However, the changes are not very large. The largest part of an increase in current income is used for repayment of loans and/or investment in financial assets within the same year[19] (Table 4). The following year, a (minor) proportion of this money is taken out again and used for other purposes (Table 3).

[19] Correspondingly, the largest part of a *decrease* in current income is financed by taking up new loans and/or by selling financial assets.

If we look at stocks, we can see the dynamic picture clearly: 0.20 of an increase in current income is invested[20] in stocks within the same year (Table 4). The following year, stocks are reduced (Table 3), and thus part of the money is taken out again and used for other purposes.

Changes in income also influence investment in machinery and other assets, both within the same year and in the following year. This coincides with the hypothesis that investment plans are available and timing of investment is chosen depending on the liquidity situation. A proportion of 0.08-0.10 of the income changes is used for investment in machinery in the same year, and further 0.05-0.06 is invested in the following year. This means that if income increases by DKK 1, investment in machinery will increase by around DKK 0.13-0.16 during the two years. Investment in other assets takes a proportion of 0.04-0.06 of income changes within the same year, and further 0.02-0.04 is invested in the following year. By adding the coefficients β_{ik} and γ_{ik} in Table 3 and 4 we find that if income increases by DKK 1, investment in all fixed assets (buildings, agricultural property, other assets) will increase by around DKK 0.17-0.22 during the first two years. (For both machinery and fixed assets the proportions are less when the debt ratio is > 95%).

Time parameter (t)

The estimated values of the time parameter (t) of the model are shown in Table 5.

Table 5.
Estimated coefficients of time (t)

	t	ϕ_{i1}	ϕ_{i2}	ϕ_{i3}	ϕ_{i4}	ϕ_{i5}	F
PRIV	-5.5390	-741	-676	-527	-955	-1778	8.9289
FINA	-0.2160	-166	-687	-464	223	-640	*ns*
STOC	-2.7530	-1133	-1706	-1596	-1436	-2675	*ns**
MACH	-1.4460	-585	-685	-443	-970	-2158	*ns*
BUIL	-0.3750	-157	-331	218	99	-1429	*ns**
REAL	0.0770	60	-495	398	-1327	-3130	*ns**
OTHE	-0.9820	-359	-1440	-1683	-1265	-1209	*ns**
REPA	2.3650	3080	6020	4097	5630	13018	5.6359

Note: The t-values in the first column refer to ϕ_{i1}. The F-values refer to the test of H_0: $\phi_{i1} = \ldots = \phi_{i5}$ (when all other parameters are allowed to be different between leverage groups) against H_1: $\phi_{ij} \neq \phi_{ik}$ for at least one pair j and k. *ns* and *ns**: See Note in Table 2.

[20] The decision to invest in stocks is probably not taken as an explicit decision. In agriculture, some of the income changes within a year are typically in the form of increasing stocks (herd, harvest from crops, etc.), and there is no time (before the end of the accounting year) to transform this increase in stock into other uses.

The coefficients are difficult to interpret, due to the fact that the coefficients capture a mixture of variables (see the discussion in Section on estimation). However, it is clear from the results that time has had a negative influence on private consumption, investment and borrowing, especially for farms with high leverage. Whether this influence is due to the increasing (real) prices of assets or due to other time dependent factors is difficult to say.

DISCUSSION AND CONCLUSION

The influence of changes in credit reserves on consumption, investment and loan repayment as described in the hypotheses based on the Barry *et al.* – model is supported by the results of the analysis: private consumption increases, repayment of loans/investment in financial assets decreases, investment in stocks decreases, and investment in machinery and fixed assets increases, when credit reserves increase. Both changes in equity and changes in current income have the influence which one would expect.

However, the hypothesis that farmers with a high leverage have another response to changes in credit than farmers with a low leverage is not supported by the results. Only the relation between changes in (adjusted) equity and changes in private consumption was influenced by the level of leverage; farmers with low leverage were more responsive to changes in (adjusted) equity than farmers with high equity. The explanation may be that farmers with high debt ratio already have a low *level* of private consumption, and that higher income therefore is primarily used for loan repayment with a view to reducing the debt ratio.

With regard to changes in current income, the survey referred to in Section on hypotheses carried out by Barry, Baker, and Sanint (1981) showed that lenders are more willing to supply credit when income the preceding year had been high. However, the relationship between lagged income and financial behaviour found in the present paper may also be due to the fact that when current income has been high during the preceding year, there are simply more resources available for consumption and investment the next year because some of the (extra) money has been saved in the form of financial assets, stocks, or repayment of loans. Thus, the idea that lenders are actually more willing to provide larger loans just because current income in the preceding year was high cannot be verified by the results in this paper.

The models on investment in buildings and agricultural property have relatively low F-values indicating that the models have a relatively low degree of explanation. The low *t*-values on the estimated coefficients indicate the same. A good reason for this is that the decision to invest in these items are long term decisions, which can simply not be explained by short term/'static' variables such as the ones included here.

Investments in agricultural assets (machinery, buildings, agricultural property) are typically long-term decisions which one would expect are only to a very limited extent determined by short-term economic factors included in this model. However, the positive coefficients on *MACH*, *BUIL*, and *REAL* in Table 3 and 4 indicate that some of the money available from changes in current income is used even within the same year to carry out investments in fixed assets and machinery. One would expect that it would take some time to plan and carry out such investments. Therefore, the results found here support Jacobsen's (1994) findings that often plans for investments are ready, just waiting for the right conditions to arise to be carried out.

The main results of the analysis may be divided into three parts: the empirical results, the hypotheses testing, and the methodology.

The empirical results show that the marginal propensity to consume current income (private consumption) in Danish agriculture is very low. When current income changes, only 0.06-0.08 is used for private consumption during the first two years. The major part of (short term) income changes are accumulated in bank accounts (cash credit accounts), followed by investments in stocks and machinery.

Concerning hypotheses testing, the main conclusion is that the observed financial behaviour amongst Danish farmers is in accordance with the expected behaviour when applying the Barry, Baker and Sanint (1981) model. However, the results did not clearly support the hypothesis that financial behaviour depends on the level of leverage.

Concerning methodology, the analysis showed that the model used is too simple to explain the details in the relation between (current) income, capital gains, consumption, investment, and financing. Long term investments are clearly determined by other factors than short term development in income and equity. And the dynamic relationship between investment and production was not explicitly stated.

Credit is often used in a discontinuous manner for large investments. If investments are high in one year, they are probably low in the following year(s). This dynamic relationship has not been considered in the present analysis, and use of a model with lagged terms on investments probably would have produced more clear results on this subject.

It is important that further empirical research is carried out concerning financial behaviour in agriculture. More consideration should be given to the dynamic relationships. One way to (further) identify these dynamic relationships would be to use qualitative questionnaires or interviews as in Jacobsen (1994).

In this paper the focus has been on the behaviour of a certain group of farmers (middle-aged, with medium-sized farms). It would be interesting to carry out analyses which focus on the differences between groups of farmers (different ages and sizes of farms). Young farmers probably have a financial behaviour pattern which is different from that of older farmers. Young farmers may also have better opportunities to carry out risk management, for instance by combining farming with off-farm employment.

REFERENCES

BARRY (P. J.), BAKER (C. B.), and SANINT (L. R.), 1981 — Farmers' credit risks and liquidity management, *American Journal of Agricultural Economics*, 63, pp. 216-227.

CAVAILHÈS (J.) and LE HY (A.), 1993 — The economic and financial position of young farmers and installation aid policy in Europe, *in*: *Capital and Finance in West- and East-European Agriculture*, Contributed paper, 32nd EAAE-seminar, Wageningen, The Netherlands, pp. 157-184.

COLLINS (R. A.) and KARP (L. S.), 1995 — Static vs. dynamic models of proprietary capital structure: Discussion and preliminary empirical evidence, *Agricultural Finance Review*, 55, pp. 1-9.

DANMARKS STATISTIK — *Statistisk månedsoversigt* (Monthly review of statistics), Danmarks Statistik, Copenhagen.

DLR, 1994 — *Landbrugshåndbog 1994* (Agricultural handbook 1994), Dansk Landbrugs Realkreditfond, Copenhagen.

GRAVELLE (H.) and REES (R.), 1992 — *Microeconomics*, 2nd edition, New York, Longman Publishing.

JACOBSEN (B. H.), 1994 — *Landmænds økonomiske adfærd.* (Farmers' economic decision making behaviour), Rapport n° 81, Statens Jordbrugsøkonomiske Institut (Institute of Agricultural Economics).

JUDGE (G. G.), GRIFFITHS (W. E.), HILL (R. C.), LÜTKEPOHL (H.), and LEE (T.-C.), 1985 — *The Theory and Practice of Econometrics*, New York, John Wiley and Sons, Inc., 2nd ed.

KUIPER (W. E.) and THIJSSEN (G. J.), 1996 — Determinants of private investment in Dutch agriculture, *European Review of Agricultural Economics*, 23/4, pp. 455-472.

LANDBRUGETS RÅDGIVNINGSCENTER (Danish Agricultural Advisory Centre) — *Regnskabsstatistik Landbrug (year)*, (Agricultural Statistics), Skejby, Denmark.

RASMUSSEN (S.) and WIBORG (T.), 1996 — Gældsprocenten i dansk landbrug: Udvikling siden 1981 og sammenligning med andre EU lande (The debt ratio in Danish agriculture: Figures since 1981, and comparisons with other EU countries), *Tidsskrift for Landøkonomi*, 183, n° 3, pp. 189-200.

REID (I. G.), 1981 — Farm finance and farm indebtedness in the EEC, *Journal of Agricultural Economics*, 22, pp. 265-273.

SJI — *Landbrugets prisforhold (year)* (Agricultural price statistics), Serie C, Statens Jordbrugsøkonomiske Institut (Danish Institute of Agricultural Economics).

SJI, 1981 — *Landbrugsregnskabsstatistik 1980-81* (Agricultural accounts statistics 1980-81), Statens Jordbrugsøkonomiske Institut (Danish Institute of Agricultural Economics), Serie A, n° 65.

SJI, 1993 — *Dansk landbrugs økonomi og fremtidsudsigter* (Economic perspectives for Danish agriculture), Statens Jordbrugsøkonomiske Institut (Danish Institute of Agricultural Economics), Unpublished paper written for the Ministry of Agriculture.

SJFI, 1997 — *Landbrugsregnskabsstatistik 1996-97* (Agricultural accounts statistics 1996-97), Statens Jordbrugs-og Fiskeriøkonomiske Institut (Danish Institute of Agricultural and Fisheries Economics), Serie A, n° 81.

TOLD OG SKAT — *Ejendomssalg 1. halvaar (year)* (Sale of farms, 1st half-year year), Statens Information, Copenhagen.

APPENDIX 1

Derivation of the model

A consumer demand model is used as the formal framework for derivation of a consistent econometric model. This makes it possible to take into consideration budget restrictions related to the decision variables, and to include the influence of prices in a consistent way.

In the language of consumer demand, the decision problem may formally be stated as:

$$\text{Max } U(I_1, I_2, I_3, I_4, I_5, I_6, I_7, I_8) \tag{1}$$

subject to the budget constraint that:

$$M_n - \sum_{j=1}^{8} P_j I_j = 0 \tag{2}$$

where U is a utility function, I_1 is the quantity (bundle) of consumer goods consumed in year t; I_2, I_3, I_4, I_5, I_6, I_7 are the quantities of financial assets, stocks, machinery, buildings, real property, and other real assets, respectively, bought in year t, and P_j (j=1,...,7) are the corresponding prices; I_8 is the quantity of (net) repayment of loans in year t and P_8 the price of debt (bonds); M_n is income in year t in nominal terms. All prices refer to year t. In the model, utility is provided through the immediate consumption I_1, and through capital investments (I_2, I_3, I_4, I_5, I_6, I_7) and loan repayment (I_8) which provide utility through expected future consumption based on income from future production and/or from future sale of assets and/or by take up of new loans.

If we use a simple linear form of demand functions and divide all prices and income by P_1, the corresponding system of Marshallian demand equations (Gravelle and Rees, 1992, p. 87), is:

$$R_i = (P_i / P_1) I_i = \alpha_i + \beta_i M + \sum_{j=2}^{n} \beta_{ij} \cdot p_j \quad (i = 1,...8) \tag{3}$$

where R_1,...,R_8 is the amount of money used for private consumption (*PRIV*), investment in financial assets (*FINA*), stocks (*STOC*), machinery (*MACH*), buildings (*BUIL*), real property (*REAL*), other assets (*OTHE*), and repayment of loans (*REPA*), all in real terms, *i.e.* divided by P_1; M is the income in real terms (M_n divided by P_1); and p_2,..., p_8 are the prices P_2, ..., P_8 in real terms (*i.e.* divided by P_1). Finally α_j, β_j (j=1, ..., 8), β_{ij} (i=1, ..., 8; j=2, ..., 8) are parameters. In this model, demand is homogeneous of degree zero in prices and income and the sum of the β_j's will be equal to one, so that β_j measures the proportion of income (M) used for activity j. To fulfil the budget restriction (2), the intercepts and the price parameters should sum to zero across equations. This means that the following restrictions apply:

$$\sum_{i=1}^{8} \beta_i = 1, \quad \sum_{i=1}^{8} \alpha_i = 0, \quad \sum_{i=1}^{8} \beta_{ij} = 0, \quad (j = 2,...8) \tag{3a}$$

To test the hypotheses stated in the text, the model system in (3) is extended by including a linear term of change in equity during the preceding year (t-1). We also want to test the finding by Barry *et al.* that there is a positive relationship between the credit available for a farm and the level of farm income in the preceding year (Barry, Baker, and Sanint, 1981, p. 223). Therefore the model is extended by including a linear term of gross income in the preceding year (t-1). Thus, the extended model is:

$$R_{it} = \alpha_i + \beta_i M_i + \sum_{j=2}^{8} \beta_{ij} p_{jt} + \gamma_i M_{t-1} + \delta_i DE_{t-1} \quad (i = 1,...,8) \tag{4}$$

where R_{it} and p_{jt} now explicitly refer to year t, M_{t-1} is the income year t-1, DE_{t-1} is the (adjusted) change of equity during year (t-1)[21], and γ_i and δ_i (i=1, .., 8) are parameters. To still fulfil the budget restriction (2) the following two restrictions have to be added to the ones already mentioned in (3a):

$$\sum_{i=1}^{8} \gamma_i = 0, \quad \sum_{i=1}^{8} \delta_i = 0. \tag{4a}$$

[21] The income M_{t-1} is included when the change of equity (DEQ_{t-1}) is calculated (see Appendix 2). As the income M_{t-1} is already included in model (4), the change of equity was adjusted by deducting the term M_{t-1} (see Appendix 2).

APPENDIX 2

Accounting model

a) Income statement, year *t*

Gross output (value of production)

\- total production costs, cash (excl. interest and rent)

= Current income, agriculture

\+ interest on financial assets

\+ wage income

\+ other income

= Total current income

\- interest on existing loans

\- rent on land

\- personal taxes

= Net current income (M_t)

\- private consumption

= Own financing

\- net investment, financial assets

\- net investment, inventories and livestock

\- net investment, machinery

\- net investment, buildings

\- net investment, agricultural property

\- net investment, other (including private) assets

\- net repayment of loans

= 0

b) Change in value of equity

Own financing (see above)

\- depreciation

= Consolidation

\+ change in value, assets

\- change in value, debt

\+ remuneration of debt

= Change in value of equity (DEQ_t)

\- net current income (M_t)

= Adjusted change of equity (DE_t)

APPENDIX 3

Price of bonds and prices of farm land, 1983-1993

	Bond prices	Prices of farm land
1983	77.44	93
1984	77.83	99
1985	88.99	113
1986	96.10	139
1987	87.95	126
1988	94.79	117
1989	98.32	113
1990	94.35	114
1991	98.62	113
1992	97.84	108
1993	99.29	100

Sources: *Bond prices*: Realkredit Danmark, Price of 10%, 30 years, open series.

Prices of farm land: Ejendomssalg 1. Halvår. Told og Skat (Official Statistics on traded farms). Index (1993 = 100) of price per ha (farms 10-60 ha) deflated by consumer price index.