Incentives and Socioeconomic Factors Influencing Investment Behavior in Agriculture

Jakob Vesterlund Olsen
Danish Agricultural Advisory Service, Denmark, jvo@landscentret.dk

Mogens Lund
Institute of Food and Resource Economics, University of Copenhagen, Denmark, mogens@foi.dk

Abstract

Investment decisions in Danish agriculture don't always comply with the classical investment theory. This provides the motivation to analyze how socioeconomic factors and investment incentives affect farmers' investment behavior. The analysis is accomplished by investigating three research questions concerning the relationships between different socioeconomic factors, investment incentives and farmers' investment behavior. The results are obtained from a survey among Danish pig producers that has been analyzed by the use of logistic regression. The results show that young farmers with a high production and high debt are more likely to invest in real agricultural assets than other farmers. Furthermore, differences in socioeconomic factors are found to have a significant influence on the investment incentives among farmers.

One implication is that advisors have to be more aware of the goals of the individual farmer when new investments are evaluated. Another implication is the need for an improved knowledge about how to differentiate the investment policies implemented to enhance the commercial opportunities for rural people.

1. Introduction

It has for a long time been recognized that the classical investment theory has failed to explain and predict farmers' investment behavior. In Danish agriculture it has been recognized that farmers make huge investments in e.g. land despite that the calculated net present value (NPV) is less than zero or just has an expected profitability of a few thousand dollars (Jacobsen, 1989). Many explanations are plausible, e.g. not all benefits of the investment is accounted for in the calculations, the assumptions chosen may be too pessimistic, farmers may require a lower risk premium than other investors or farmers have in general other than pecuniary goals when considering an investment opportunity. Gasson et al. (1988) find that profit maximization may not be the only or even the prime objective of farmers. The objective of the paper is to analyze how socioeconomic factors and different types of incentives affect farmers' investment behavior.

The objective is motivated by a need for a better understanding of the investment decisions in agriculture. Agricultural investments in land, new buildings, machinery etc. require financial resources and have a profound influence on the productivity and income development. Investments decisions are more or less characterized as irreversible, which imply that the initial costs of investments are sunk costs. Furthermore, investment decisions are also typically associated with uncertainty concerning the future benefits and costs from the investment. Recently, it has also been argued that the timing is a special characteristic of investment decisions as some options may be lost by making an investment (Dixit & Pindyck, 1994).

Another important motivation for investigating the factors associated with investment behavior is policy making. When the policies for rural development are designed it is important to know how the farmers are going to react on the incentives inherent in the policies. For example, Dixit & Pindyck (1994, p. 6) argue that the interest rate plays a minor role in the investment incentives compared to the future prospects of the business.

The paper is organized as follows. In the next section the three parts of the analysis and the socioeconomic factors included in the analysis are presented. This section is followed by a section describing the data used in the study. The results are presented and discussed in section 4, while section 5 provides some concluding remarks.

2. The model

The relationship between socioeconomic factors, incentives and investment behavior are captured in the conceptual model shown in figure 1. The core concept in the model is investment behavior, which is the

overall propensity to invest in real assets in agriculture; that is how much farmers invest in real assets such as farmland, stables or machinery[1].

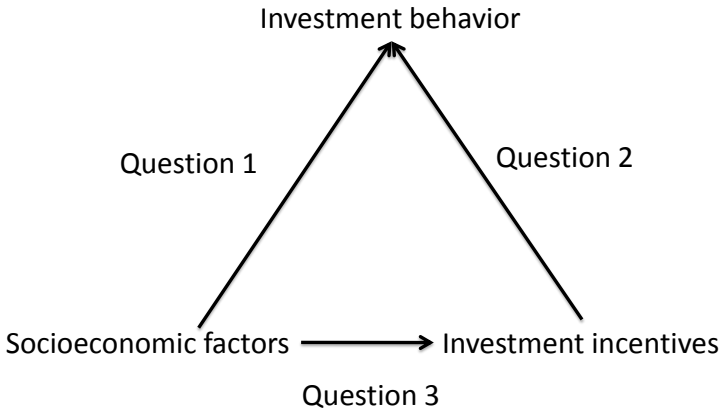

Figure 1. Conceptual model of the analysis of farmers' investment behavior

The socioeconomic factors included in the analysis are revealed from the literature (LaDue et al., 1991; Hennessy & O'Brien, 2008) and include: Off-farm income, farm income, size, debt, management, interest rate, age of the farmer and years of settlement.

Off-farm income is included in the analysis irrespective of the origin of the income. The farm income is measured as the income from farming activities in 2006.

Whereas size is measured as gross farm income in LaDue et al. (1991, p. 75), it is measured as standard gross margin in this study. The standard gross margin is a measure of farm size used by Eurostat (Statistical Office of the European Communities). Larger farms are expected to have a wider portfolio of investments and they may be better to utilize economics of scale and scope (Bergevoet et al. 2004). However, regulative restrictions and decreasing marginal benefits associated with increasing size may restrain very large farms from further investments[2].

The farm debt is measured as the ratio of debt to the total farm assets. It is assumed that the lower this ratio is, the higher is the ability to obtain capital for new investments. Furthermore, it is assumed that total capital

1 No financial investments are included in the analysis.
[2] Thus, in the econometric estimations the standard gross margin is added as a squared term.

available for investments depend on the economic results from farming. Therefore, the income expectation for year 2008 is added as an exogenous variable. Finally, total equity is added as an exogenous variable.

LaDue et al. (1991) argue that the intensity of management has an effect on the investment decisions. Thus, management effects are included in the analysis by formulating and estimating an efficiency index, where the key production numbers are ranged into five groups.

Another exogenous variable in the analysis is the interest costs in 2006 divided by the total farm debt. The variable measures the average interest rate paid. This interest rate is not equivalent to the interest rate for new investments but they are assumed to be correlated. Farmers with the lowest average interest rates are assumed to have more opportunities of making new investments.

Furthermore, the age of the farm manager is expected to have an effect on the investment behavior. Compared to older farmers, it is hypothesized that younger farmers wish to expand their operations and wish to increase the income. Therefore, not only age but also the number of years the farmer has owned his farm is assumed to influence the investment behavior.

The investment incentives investigated here are found relevant from a practical or from a theoretical point of view. The incentives can be seen in table three in section four. The incentives are measured in a five-point Likert scale. Initially the aim was to ask the same questions to all investment types but not all the questions were relevant to all types of investment from a practical point of view.

As illustrated in figure 1 the relationships between the three concepts are analyzed by answering the following questions (where the inquiry number corresponds to the number in figure 1):

1. Which socioeconomic factors have an influence on the decision to invest or not invest?
2. Which incentives are of most importance in investing in land, stables or machinery?
3. Is there any difference in socioeconomic factors influencing the investment incentives in land, stables or machinery?

In order to obtain more generalized information about the three research questions formulated in section 2, a quantitative approach has been chosen for the analysis. The logistic regression function is chosen as the collected data in the survey are ordinal and the logistic regression model is the most important model for categorical response data (Agresti, 2002, p. 165) and does not face strict assumptions (Hair et al., 2006, p. 355). In research question one the model is binary and in research question three the model is multinomial.

3. The data

In order to analyze a homogenous group of farmers, the analysis is based on data from Danish pig producers. About 26.3 million pigs were produced in Denmark in 2007 implying that the industry is highly export oriented (Danish Meat, 2008). The pig producers in Denmark have a high degree of vertical integration with 87 percent of the pigs being slaughtered at farmer owned cooperative slaughterhouses. Furthermore, farmers are typically integrated downwards due to the environmental regulation requiring farmers to own land in order to produce pigs in Denmark.

A survey with questions regarding investment incentives and behavior was completed in February 2008. In total 398 pig producers were randomly chosen in a stratified sample to ensure a broad range of producers with respect to age of owner, size of farm and type of production. The type of production refers to whether they have sows (40 percent), produce finishing slaughter pigs (35 percent) or they are doing both (25 percent). Farms with sows only are coded 1, slaughter pig farms are coded 2 and farms with both production types are coded as 3. Only farms with a workload corresponding to at least one full time job were included in the survey. The response rate in the survey is 60 percent. The socioeconomic variables are presented in table 1.

Table 1. Socioeconomic variables used in the analysis ($ in thousands unless others stated)

Socioeconomic variable	Mean	Standard deviation
Size (Standard Gross Margin)	485	326
Equity	2,334	2,039
Off-farm income	9.9	29
Ratio of debt to assets (percent)	60.4	20
Operator age (years)	44.9	10.2
Production type (code)	1.86	0.79
Farm income	93	137
Years from settlement (years)	16.3	9.5
Interest rate (percent)	4.06	1.18
Expected income	68	138
Size squared	$1.98*10^{12}$	$3.08*10^{12}$
Efficiency (code)	2.57	1.21

A more complete presentation of the survey results can be found in Olsen (2008a), whereas the construction of the questionnaire is documented in Olsen (2008b).

The survey questions were divided into three overall investment categories: land, stables and machinery. About 70 percent of the farmers had made investments in one or more of the categories in the period from 2003 through 2006. Accounts for each farm for the year 2006 are accessible from the accounting database by the Danish Agricultural Advisory Service, National Centre.

4. Results and discussion

Question 1: Which socioeconomic factors have an influence on the decision to invest or not invest?

Measured as standard gross margin the size is a significant variable affecting each of the investment categories as found in La Due et al. (1991). The results are shown in table 2. The larger the farm the more likely it is to belong to the group of farms making new investments. When the size variable is squared, it has a negative effect on the investment propensity. This is interpreted as the largest farms are not investing relatively more than the medium sized farms. The reason might be that the Danish legislation is restricting both the maximum farm size (no. of farm animals on one location) and the total number of farms belonging to one farmer.

Furthermore, the ratio of debt to assets is found to have an effect on the investment behavior. This should be seen in connection with years from settlement, where the farmer is more likely to invest the fewer years he has been farming.

Table 2. Parameter estimates in the model measuring whether the farmer invests or not

Variables	**Estimates**
Intercept	-2.31 (**)
Standard gross margin	9.44 E-7 (***)
Ratio of debt to assets	0.030 (**)
Years from settlement	-0.037 (*)
$(Size)^2$	-6.13 E-14(*)

(*) p < 0,05, (**) p < 0,01, (***) p < 0,001

The Wald statistic and the Likelihood Ratio are both testing a hypothesis about whether the parameter estimates are significantly different from zero. The possibility of all parameter estimates is zero are below 0.001 in the model.

Question 2: Which incentives are of most importance in investing in land, buildings or machinery?

The descriptive results of farmers' incentives for making investments are seen in table 3. It shows the share of total respondents in the survey who agree that the incentive was an important incentive to invest. In

accordance with the classical investment theory it was a priori expected that the economic incentive would be the highest scoring incentive. However, it was not the highest ranked incentive among the surveyed farmers in any of the three investment categories.

With respect to investments in land the highest scoring incentive was to ensure future investment possibilities. This can also be seen as an economic incentive to have the option to invest in the future (Brealey & Myers, 1991). The economic incentive to make additional investments in land is ranked second highest. A reduction of risks was a part of the incentive for half the farmers.

The most important incentive for investments in stables is to establish the physical working conditions necessary to attract skilled workers. The second and third highest ranked incentives are to improve the economic situation and the almost as high ranking incentive to reduce the risks on the farm.

Table 3. Investment incentives of the respondents, in percent

Incentive	**Land**	**Stable**	**Machinery**
Economic	73	69	42
Attractive workplace	51	77	54
To make something happen	22	22	10
Reduce risks	50	63	32
The production facilities were worn out	17	43	81
Independent of the existing facilities	24	20	
To keep up with the structural changes in agriculture	17	18	
Ensure workload to retain employees	50	47	
Environmental concerns	34		
Ensure future investment possibilities	90		
Interest in machinery			25
Take advantage of new technology			67

The most important incentives for making investments in new machinery are that the old machinery is worn out and that the farmers want to take advantage of the new technology. The economic incentive is a less important incentive for making new investments in machinery.

From the nature of the investments it seems naturally, that the incentives for making investments in stables should be the more economically rational, where as the investments in land are influenced by the perceptions of the future economic conditions for farming and the esteem associated with land ownership.

The incentives to invest in stables seem to comply more with the neo-classical economic incentives for making investments than for the other two investment categories.

Question 3: Is there any difference in socioeconomic factors influencing the investment incentives?
The last step is to investigate how the socioeconomic factors influence the incentives to make investments. This is accomplished by dividing the incentive responses into three groups: agree, neither agree nor disagree, and disagree. A logistic regression is performed for each inventive to see whether the socioeconomic variables are significantly influencing the revealed incentives. The parameter estimates are shown in the appendix.

The overall impression of the incentives for making investments in land is that the farms with the larger production do see interdependence between the investment and the existing assets and the largest farms do not invest because the production facilities are worn out or because others are making investments. The interpretation is that they are not forced to making the investments due to worn out production facilities or because other invests but they are making the investments when they see a synergy to their existing production. The younger farmers invest to make an attractive workplace, whereas the older farmers invest due to environmental concerns or regulations. If you are paying a low interest rate, relatively speaking, the higher likelihood you have to agree with the lemming incentive and the incentive to ensure your future investments possibilities. What is here called lemming incentive is related to the herding incentive known from finance (Graham, 1999).

The economic incentive for stable investments is positively related to expected future income which is either due to optimistic farmers and the fact that optimistic CEO's invests more than others (Malmendier & Tate, 2005) or it is due to the fact, that it is the farmers with the higher skills who makes the investments. It is notable that the efficiency is not significantly affecting neither the investment propensity nor the economic incentive for making investments in stables. The younger farmers have a higher likelihood of agreeing that having an attractive workplace is an important incentive. The management / efficiency index is negatively related to the reducing risk incentive which could be interpreted as though farmers, who are able to have a very high efficiency in their production is perhaps more confident that they can handle the difficulties if problems occur hence are not worried about the risks. Jacobsen (1994) found that the gut-feeling of the farmers was decisive of investment decisions because the future is too uncertain to predict.

When investing in machinery equity relates to the attractive workplace and this is explained by the fact that farmers with more equity is able to afford to buy machinery to improve the workplace attractiveness. The interpretation on the production type is that the less specialized the farm is in pig production the more focus on creating an attractive workplace with investments in machinery, and the more it seems as the farmers is interested in machinery. When farmers with the higher interest rate are keener on taking advantage of new technology it is explained by the farmers being convinced that the value from farming comes from the production, and not from value appreciation or interest/currency speculations.

5. Conclusion

The analysis of the investment behavior of Danish farmers shows that young farmers with a high production and high debt are more likely to invest in real assets than other types of farmers. Farmers paying the lower interest rates and investing in land are more likely to invest in order to maintain the options for further expansion of the production. The farmers investing in new stables with the higher income expectations are more likely to emphasize the importance of the economic incentive. Furthermore, if the production efficiency is high, these farmers have less incentive to reduce risks. Concerning investments in new machinery the logistic regressions revealed that the farmers paying low interest rates are more inclined to take advantages of new technology.

One implication of the results is that advisors have to be more aware of the goals of the individual farmer in making investment calculations. Especially, if the goal of the farmer is to keep the options of making future investments, then the investment decisions have to focus on the successive opportunities to invest. Further studies on the incentives to invest are needed as well as advises to the farmers have to be evaluated.

Another implication concerns policies for rural developments. Provision of investment incentives to farmers according socioeconomic factors may ensure an improved multifunctional utilization of land. For example, small farmers may be encouraged to invest in environmental stewardship, whereas business farms are given the incentives to invest in productivity enhancing machinery.

6. References

Agresti, A. 2002. *Categorical Data Analysis.* 2nd ed. Hoboken, NJ: Wiley-Interscience.

Bergevoet, R., Ondersteijn, C., Saatkamp, H.W., Woerkum, C.V., & Huirne, R. 2004. Entreprenurial behaviour of dutch dairy farmers under a milk quota system: goals, objectives and attitudes. *Agricultural Systems,* 80(1), pp. 1-21.

Brealey, R.A., & Myers, S.C. 1991. *Principles of Corporate Finance.* 4th ed. New York: McGraw-Hill.

Danish Meat 2008. *Statistics 2007.* Copenhagen: Danish Meat.

Dixit, A., & Pindyck, R.S. 1994. *Investment under Uncertainty.* Princeton NJ: Princeton University Press.

Gasson, R., Crow G., Errinton A., Hutson J., Marsden T. & Winther, D. M. 1988. The farm as a family business: a review. *Journal of Agricultural Economics,* 39 (1), pp. 1-41.

Graham, J. R. (1999). Herding among Investment Newsletters: Theory and Evidence. *Journal of finance,* 54 (1), pp. 237-268.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. & Tatham, R.L. 2006. *Multivariate data analysis,* 6th ed. Upper Saddle River: Pearson Education, Inc.

Hennessy, T. & O'Brien, M. 2008. Is Off-farm Income Driving On-farm Investment? *Journal of Farm Management,* 13 (4), pp. 235-246.

Jacobsen, B.H. 1989. Farmers' Investment Decisions. In J. Christensen, S. Rasmussen, P. Stryg, & D. P., ed 1989, *Managing Long-Term Developments of the Farm Firm - Strategic Planning and Management.* Copenhagen, Denmark: Wissenschaftsverlag Vauk Kiel KG.

Jacobsen, B. H. 1994. *Farmers Economic Decisionmaking (In Danish: Landmænds Økonomiske Beslutningsadfærd).* København: Statens Jordbrugsøkonomiske Institut.

La Due, E.L., Miller, L.H. & Kwiatkowski, J. H. 1991. Investment Behavior and Farm Business Expansion. *Review of Agricultural Economics,* 13 (1), pp. 73-84.

Malmendier, U. & Tate, G. A. 2005. Who makes acquisitions? CEO overconfidence and the market's reaction. *Journal of Finance,* 60 (6), pp. 2661-2700.

Olsen, J. V. (2008a). *Construction of Questionnaire in the Study of Dansih Pig Producers Investment Beavior.(In Danish: Spørgeskemakonstruktion - I Studiet af Danske Svineproducenters Investeringsadfærd).* Working Paper Copenhagen: Institute of Food and Resource Economics, University of Copenhagen.

Olsen, J. V. (2008b). *Investment Behavior in Danish Pig Industry. (In Danish: Investeringsadfærden Blandt Danske Svineproducenter).* Working Paper: Copenhagen: Institute of Food and Resource Economics, University of Copenhagen.

7. Appendix

Parameter estimates in the logistic regression function relating socioeconomic variables to the incentives to invest. Where a dash is displayed (-) this means no significant relation.

Investing in land

Variable n = 119	Size (SGM)	Equity	Off-farm income	Operator age	Interest rate	Size squared
To make something happen	-	-	-	-0.047(*)	-	-
Production worn out	-	-	-	-	-	-3.74E-14(*)
Independence incentive	-2.72E-7(*)	5.63E-8(**)	2.39E-6(*)	-	-	-
Incentive to keep up with structural changes	-	-	-	-	-65.0(*)	-2.5E-14(*)
Environmental incentive	-	-	-	0.043(*)	-	-
Ensure future investment possibilities	-	-	-	-	-36.07(*)	-

(*) $p < 0,05$, (**) $p < 0,01$, (***) $p < 0,001$

Socioeconomic variables with no significant relation to the incentives to invest in land: ratio of debt to assets, production type, farm income, years from settlement, expected income, and efficiency.

Investing in stables

Variable n = 57	Years from settlement	Expected income	Efficiency
Economic incentive	-	1.06E-6(*)	-
Attractive workplace	-0.12(**)	-	-
Reduce risks	-	-	-0.78(*)

(*) p < 0,05, (**) p < 0,01, (***) p < 0,001

Socioeconomic variables with no significant relation to the incentives to invest in stables: size, equity off-farm income, ratio of debt to assets, operator age, production type, farm income, interest rate, and size squared.

Investing in machinery

Variable n = 72	Equity	Production type	Interest rate
Attractive workplace	6.81E-8(**)	0.91(**)	-
Machinery interest	-	0.65(*)	-
New technology	-	-	-70.95(**)

(*) p < 0,05, (**) p < 0,01, (***) p < 0,001

Socioeconomic variables with no significant relation to the incentives to invest in machinery: Size, off-farm income, ratio of debt to assets, operator age, farm income, years from settlement, expected income, size squared, and efficiency index in stables.