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Farm diversification strategies and their relations to farm financial performance: evidence from Swedish agriculture

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Abstract

Purpose – This paper aims to provide empirical evidence of the relationship between diversification strategies in farm businesses and farm financial performance. We distinguish diversification into agricultural diversification and farm diversification into non-agricultural activities, depending on the source of farm business revenues.

Design/methodology/approach – We used panel data from 2016 to 2020 for Swedish farms and estimated two-way fixed-effects models across the different farm types to control for farm-level unobserved heterogeneity and eliminate potential bias that can be caused by excluding unobserved variables that evolve over time.

Findings – The results indicate a heterogeneous relationship between agricultural and farm diversification and farm financial performance across farm types. In particular, agricultural and farm diversification are related to farm financial performance for dairy farms, and agricultural diversification is associated with farm financial performance for granivore farms. Regarding mixed, other grazing livestock and field-crop farms, we find no relationship between either type of diversification and financial performance.

Originality/value – The results are important because they highlight that farmers may not have the necessary financial incentives or financial means to adopt diversification strategies, although such strategies are considered desirable from a societal point of view, as they may contribute to positive environmental effects (agricultural diversification) and more prosperous rural areas (farm diversification). Consequently, from a policy perspective, our findings suggest that public support may be needed to strengthen farmers' possibilities to engage in diversification activities. For farmers and their advisors, our results may also contribute to more informed decision-making regarding diversification activities.

Keywords Agricultural diversification, Farm diversification, Farm financial performance, Sweden

Paper type Research paper

1. Introduction

The diversification of farm businesses has been considered one of the key measures to develop and revitalize the agricultural sector and rural areas more generally in Europe, and has also been acknowledged for its positive contribution to the environment. Thus, diversification is supported through public funding. For instance, during the 2014–2021 period of the Common Agricultural Policy (CAP), crop diversification was regulated as a part of "greening", aimed at

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promoting environmentally and climate-friendly practices (European Commission, 2018a). Furthermore, farms that diversified into non-agricultural activities, such as developing value-adding products, offering tourism services, and other similar activities received support (the LEADER initiative for local development) because such activities are considered to contribute to the economic development of local communities and strengthen the social fabric (European Commission, 2018b). Still, exactly how the diversification of farm businesses is related to their financial performance is not well understood, although this is vital for understanding farmers' incentives and possibilities to adopt diversification strategies, even without public support. In this paper, we therefore explore how the diversification of farm businesses is related to their financial performance. In our analyses, we distinguish between two types of diversification: farm diversification and agricultural diversification.

From a review of the previous literature, farm businesses are considered to be "farm diversified" if they obtain revenue from activities outside of what can be perceived as regular agriculture, such as tourism or on-farm processing activities (Hansson *et al*., 2010; Barnes *et al*., 2015). In addition, farms are considered "agriculturally diversified" if they receive income from two or more agricultural enterprises, such as crop and livestock production (Hansson *et al*., 2010; Barnes *et al*., 2015). We accommodate this distinction in order to make the contribution of each diversification type to the performance of farm businesses more apparent.

Over the past few decades, diversification has received great attention in the agriculture-related literature. In particular, previous studies have focused on the determinants of diversification (Dries *et al*., 2012; Meraner *et al*., 2015; Pfeifer *et al*., 2009) and on farmers' motives to diversify (Barbieri and Mahoney, 2009; Hansson *et al*., 2013; Northcote and Alonso, 2011). Still, only a few studies have investigated how different types of diversification are related to the economic outcomes of farm businesses (Barnes *et al*., 2015; Harkness *et al*., 2021). Despite the significant contribution of these studies and their importance for policy suggestions, the perspective of linking different types of diversification to farm financial performance has not been examined previously. This study fills this gap in the literature by investigating this relationship. In particular, in order to study how agricultural and farm diversification is related to farm financial performance, we apply a fixed-effects panel model and use Swedish accounting data for farms observed between 2016 and 2020.

In addition, previous studies have shown that the type of production matters for the economic performance of farm businesses (Harkness *et al*., 2021; Slijper *et al*., 2022), and also that engagement in diversification activities can vary according to farm type (Dries *et al*., 2012; Meraner *et al*., 2015). In particular, different types of farms may have varied endowments and other needs. For instance, farmers operating arable farms may be more likely to engage in diversification activities due to the seasonality of production, while farmers who operate farm businesses without such seasonal variation might be less eager to diversify. Thus, this paper aims to explain the heterogeneity across different farm types. Understanding how different diversification strategies are related to farm financial performance across different farm types should be helpful for both advisors and policymakers. In particular, they would be able to suggest targeted approaches to farmers that could potentially stimulate economic performance in the agricultural sector and encourage rural development.

In agricultural research, financial performance is evaluated through one or several indicators. Assessing financial performance relying only on a single indicator may not provide comprehensive information because one variable reflects only a limited aspect of financial performance. Thus, in this study, we focus on three performance indicators. Specifically, we evaluate financial performance using return on assets (ROA), debt to assets (DtA), and asset turnover rate (ATO). ROA represents the profitability aspect of farm financial performance, DtA represents the solvency aspect, and ATO illustrates the financial efficiency. Although using multiple indicators can provide better information for financial assessment than relying on only one, it can be challenging to provide a clear interpretation of the results because some factors may improve particular aspects of financial performance while worsening others. To address this issue, Yi and Ifft (2019) suggested developing a composite indicator from the

individual indicators. In this study, we developed a composite indicator for farm financial performance using factor analysis. In doing so, we offer a new perspective on measuring farm financial performance given that the composite indicator conveys information from three different financial aspects.

After examining a range of different farm types based on the production focus and creating a composite indicator, we found that the results indicate a heterogeneous relationship between diversification strategies and financial performance. Also, there are significant differences across farm types regarding both their engagement in diversification strategies and their financial performance. These findings could be useful to inform both farm advisors and policymakers about which farm types can benefit most from diversification strategies.

The rest of the paper is organized as follows. The next section summarizes the literature on diversification and farm performance in the agricultural sector. Section 3 describes the data and estimation strategy of this study, and section 4 presents the results. Finally, section 5 provides the discussion and section 6 the conclusions.

2. Diversification and farm performance: a review of the literature

Diversification is considered a valuable strategy for the development of European agriculture, and large number of studies has focused on the concept of diversification across Europe (Dries *et al*., 2012; Hansson *et al*., 2010; Meraner *et al*., 2015; Miaris *et al*., 2022; Zasada and Piorr, 2015). Although there is no established definition of diversification due to the distinctiveness of the concept, based on existing studies we can distinguish the diversification of farm businesses into two types, namely: farm diversification and agricultural diversification (Barnes *et al*., 2011, 2015; Forleo *et al*., 2021; Graskemper *et al*., 2022; Hansson *et al*., 2010; Harkness *et al*., 2021; Salvioni *et al*., 2013). Farm diversification is defined as involvement in income-generating activities outside conventional agricultural enterprises such as crops and livestock. In particular, it involves the diversification of farm resources such as labour, capital, and land, which were previously devoted to conventional agricultural enterprises into activities that are not considered conventional (Barnes *et al*., 2015; Dries *et al*., 2012). This view of farm diversification is similar to the one used in several other studies (Barbieri and Mahoney, 2009; Hansson *et al*., 2010; Ilbery, 1991). In contrast, agricultural diversification is taken to imply that farm businesses obtain revenues from several different agricultural enterprises, such as dairy and grain (El Benni *et al*., 2012; Hansson *et al*., 2010; Harkness *et al*., 2021).

There are arguments supporting the idea that farmers' motives for diversifying are predicated upon both economic and non-economic outcomes. For instance, an increase in income, a reduction in income variability, making the farm business appealing to potential successors, and keeping the business within the family, were all considered important motives in the diversification decision-making process (Hansson *et al*., 2013). Similarly, Barbieri and Mahoney (2009) have pointed out that the goals of diversification are intricate and extend beyond purely economic aspects, and De Rosa *et al*. (2019) explained that, among others, one motive to diversify into non-agricultural activities was the desire to regenerate and sustain cultural heritage.

The concept of diversification has also been studied from another perspective, which focuses on the determinant factors of the diversification decision. A study by Meraner *et al*. (2015) showed that socioeconomic and geophysical farm characteristics affect the decision to diversify. In addition, Bartolini *et al*. (2014) found that proximity to tourist areas and urban markets are key determinants of diversification, and Dries *et al*. (2012) underlined the broader role of social capital and networks in developing diversification activities. Moreover, existing studies have investigated the links between agricultural policies and diversification activities (Bartolini and Viaggi, 2012; Maye *et al*., 2009) and the efficiency of diversified farms (Forleo *et al*., 2021). The presence of numerous studies on diversification indicates widespread interest in this concept and its importance for the agricultural sector.

Unlike most previous studies, which focused on the underlying motives, the determinants, or how policies are related to diversification, a perspective that has so far received limited

attention is how diversification is related to the economic outcomes of farm businesses. A study by Barnes *et al*. (2015) investigated how agricultural and farm diversification are associated with the economic viability of farms, and found that both types of diversification have a positive relationship with viability. Harkness *et al*. (2021) examined how agricultural and farm diversification are related to farm income variability, and found that agricultural diversification has a negative relationship with income variability, whereas farm diversification has a positive relationship. The limited insights into how agricultural and farm diversification are related to farm financial outcomes call for further investigation in this domain. We contribute to the literature by exploring how farm and agricultural diversification are farm financial performance are related to each other. Investigating these relationships is important because it contributes to the understanding about the role of both diversification types in stimulating the financial conditions of farms and could provide information that is useful to farmers when managing their businesses.

There are numerous studies in the agricultural literature that focus on farm financial performance (Katchova and Dinterman, 2018; Khanal *et al*., 2018; Mishra *et al*., 2009; Yi and Ifft, 2019). Some of these studies have used only a single financial indicator as the dependent variable. For example, Purdy *et al*. (1997) and Langemeier and Jones (2000) used mean return on equity, while Gloy *et al*. (2002) and Mishra *et al*. (2009) used ROA. In contrast, some studies used multiple financial indicators. For instance, Haden and Johnson (1989) used cash farm income, net farm income, and returns to operator labour and management, while Mishra *et al*. (1999) used modified net farm income, operator's labour and management income, and operator's management income. Also, based on the Du Pont model, Mishra *et al*. (2012) used net profit margin, ATO, and debt to equity ratio, and later on, Nehring *et al*. (2015), based on the Du Pont expansion, used the operating profit margin ratio, ATO, and the inverse of equity to asset ratio.

Using only a single financial indicator can potentially invite criticism because, by doing so, only a bounded aspect of farm financial performance is investigated. Using several performance indicators can address this concern. However, using several indicators may invite criticism related to the interpretation of the results. To manage this issue, we created a composite indicator consisting of three aspects of farm financial performance (i.e. ROA, ATO, and DtA). We also considered that different farm types might have different levels of diversification and differences in their financial performance. Hence, we estimated models for different farm types, to explore the relationship between diversification and financial performance in those farms.

3. Data and methods

3.1 Data

Data for this analysis was obtained from the Swedish Farm Accounting Data Network (FADN). FADN is the only source of economic micro-level data that adheres to the same accounting principles across the European Union. The Swedish FADN data represents unbalanced panels of approximately 1,000 farms per year, meaning that some farms included in the dataset are not observed during every period.

FADN contains detailed information related to monetary units (e.g. production costs, production value, subsidies, taxes, assets value, liabilities, etc.) and non-monetary units (size, location, production typology, environmental orientation, production quantities, labour, land, etc.), from which we can assess both the type of farm business diversification and the detailed farm performance indicators that are of interest here. We used data from 2016 to 2020. In total, the sample includes 4,813 observations and, on average, contains approximately 963 farms per year. Farms that did not appear in the panel for at least two consecutive years were excluded. In total 1,154 individual farms tracked of which 78 unique mixed farm businesses, 435 unique dairy farm businesses, 299 unique other grazing livestock farm businesses, 105 unique granivore farm businesses, 7 unique horticulture farm businesses, and 230 unique field-crop

farm businesses. Table 1 presents the structural characteristics of the farms included in the sample.

3.2 Variables

3.2.1 Financial performance indicators. We used three financial indicators that represent three individual aspects of financial performance: profitability (ROA), efficiency (ATR), and solvency (DtA). ROA is measured as the ratio of net farm income, plus the interest paid, to the total average farm assets [1] for farm *i* in year *t* (Katchova and Dinterman, 2018). In general, higher rates of ROA are preferable, because higher ROA indicates well-managed farms in terms of generating profit. We measured ATR as the ratio of total farm revenue to total farm assets for farm *i* in year *t* (Slijper *et al.*, 2022). A higher ATR implies that the farm's assets are used more efficiently. Finally, DtA is defined as the ratio of total farm liabilities to total farm assets for farm *i* in year *t* (Katchova and Dinterman, 2018). Generally, when the DtA ratio increases, financial distress might become a possibility and, subsequently, a lower DtA may be more desirable.

Turning to the measurement of farm financial performance as one indicator, we used factor analysis. Factor analysis is a statistical technique that reduces the number of indicators in the analysis by describing their linear combinations (Stata, 2013). We exhibit the factor analysis separately for each farm type because different farm types have different financial characteristics. The Supplementary material presents further information about factor analysis.

3.2.2 Diversification indicators. The level of specialization of farms within the range of agricultural enterprises can be measured using the Herfindahl-Hirschman Index (HHI) (Harkness *et al.*, 2021). This index relates the square ratio of the revenue from each agricultural enterprise to the total agricultural revenue in order to determine the degree of specialization. The benefit of using this index is that it gives more weight to activities that contribute more to the total farm revenue. It is straightforward that a more specialized farm can score higher on the HHI scale, which ranges from zero to one. For convenience, we define agricultural diversification as $1 - HHI_j$; thus, more agriculturally diversified farms are closer to 1.

As discussed earlier, farm diversification includes income-generating activities such as contract work, agri-tourism, farm shops, renting our agricultural land, hiring out of equipment, etc [2]. The sum of such activities is the total income related to farm diversification activities. By dividing this sum by the total farm income, we obtain the farm diversification measurement

Table 1. Descriptive statistics of the sample; years 2016–2020

Variable	Mean	Std. dev.
Age of farmers, in years	55.53	10.45
Female, in %	0.045	–
Farm size, in ha	155.2	156.4
Number of farms yearly, in no.	962.6	–
Number of unique farms	1,154	–
Farm type: horticulture, in %	0.002	–
Farm type: field-crops, in %	0.203	–
Farm type: mixed, in %	0.067	–
Farm type: other grazing livestock, in %	0.279	–
Farm type: granivores, in %	0.090	–
Farm type: dairy, in %	0.360	–
Average livestock units per ha, in no.	0.809	0.750
Total labour input, in AWU	2.086	1.962
Farming efficiency (ratio)	1.658	2.746
Number of observations, in no.	4,813	–

(Barnes *et al.*, 2015). Table 2 presents the descriptive statistics for all variables included in the analysis. Further information regarding the definition and summary statistics of the variables used in the analysis across years and farm types can be found in Tables A.I–A.III.

3.3 Estimation method

To explore the relationships between agricultural and farm diversification with the financial performance of farm businesses, we estimated the following model:

$$y_{it} = \beta_0 + \beta_1 FarmDiv_{it} + \beta_2 AgrDiv_{it} + \beta_3 X_{it} + \alpha_i + \tau_t + \varepsilon_{it} \quad (1)$$

where y_{it} is the farm financial performance measured in terms of ROA, ATO, and DtA on farm i in year t. *FarmDiv* is the level of farm diversification for farm i in year t and *AgrDiv* is the level of agricultural diversification for farm i in year t. The variable X_{it} is a vector for control variables (i.e. farmer's age, farm size, percentage of rented land, amount of total direct payments, whether located in a less favoured area, intensity of crop inputs, amount of labour). The variable farmer's age included as a as a categorical dummy to control for potential differences in farmers' behaviour across different stages of their life cycle and the variable farm size included in logarithmic terms and accompanied by its squared term to account for potential U-shaped or inverted U-shaped relationships. Moreover, considering that unobserved factors, such as managerial abilities, could influence farms' financial outcome, we include α_i, which controls for farm-level unobserved heterogeneity. Also, we include τ_t, which is a time-fixed effects variable and controls for factors that potentially affect farms and vary over time.

4. Results

Before presenting the estimation results for the various model specifications in Section 4.2, we consider it instructive to begin by looking at some descriptive evidence to check whether there are differences across farm types. In this spirit, Section 4.1 presents insights into the existence

Table 2. Summary statistics of variables used in the analysis

Variable	Measurement unit	Type	Mean	Std. dev.
*Dependent variables**				
Return on assets	(%)	Continuous	0.042	0.077
Asset turnover ratio	(%)	Continuous	0.224	0.214
Debt to assets	(%)	Continuous	0.268	0.245
Explanatory variables				
Farmer age below 40	(0/1)	Dummy	0.097	–
Farmer age above 65	(0/1)	Dummy	0.194	–
Farm size	Ha on a logarithmic scale	Continuous	4.69	0.833
Rented land	(%)	Continuous	0.513	0.332
Total direct payments[#]	(SEK/ha)	Continuous	8.53	0.369
LFA	(0/1)	Dummy	0.565	–
Crop input intensity	(SEK 10,000/ha)	Continuous	0.190	0.572
Labour input	(AWU)	Continuous	0.676	1.63
Agricultural diversification	(%)	Continuous	0.284	0.199
Farm diversification	(%)	Continuous	0.127	0.176

Note(s): The base year for the age of farmers is 2022. [#]Inverse hyperbolic sine transformation (Bellemare and Wichman, 2020). *Monetary variables are deflated using the Consumer Price Index and Producer Price Index (Jordbruksverket, 2023)

of statistically significant differences in the mean values of the variables included in the analysis by their farm types.

4.1 Differences across farm types

A comparison of average values for the dependent and independent variables across different farm types is given in Table 3. The overarching results for the financial indicators are that different farm types differ significantly from each other in terms of ROA, ATO, and ATR. In particular, in column (a), mixed farms and dairy farms differ significantly in terms of all three financial indicators. Similarly, there are significant differences between the average values of mixed farms and farms specializing in granivores, as depicted in column (c). Also, we obtain equivalent results between dairy farms and farms specializing in other grazing livestock, dairy farms and field-crops, farms specializing in other grazing livestock and granivores, and granivores with field-crops, as illustrated in columns (e), (g), (h), and (j).

Turning to the variable agricultural diversification, Table 3 illustrates significant differences in its mean values across the vast majority of farm specializations. The results for farm diversification are similar, which indicates that different types of farms tend to diversify their income sources at different levels. Overall, the results presented in Table 3 highlight the significant differences in mean values across farm types for the dependent and explanatory variables, and show that farms with different production specializations may have different endowments and requirements, indicating the importance of separating the analysis across farm types.

4.2 Estimation results

Tables 4 and 7 present the results for the relationships between farm and agricultural diversification and farm financial performance. Table 4 presents the results of both types of diversification with ROA, while Table 5 presents the results regarding ATO. Turning to Table 6, we illustrate the results relating to the association of farm and agricultural diversification with DtA and, in Table 7, we present the results for the relationship of agricultural and farm diversification with overall farm financial performance. All estimated regressions in each table are separated according to different farm types (i.e. mixed farms, dairy farms, farms specializing in other grazing livestock, granivores, and field-crops). Also, we controlled for farmers' age, farm size, percentage of rented land, amount of total direct payments, whether located in a less favoured area, the intensity of crops input, amount of labour, and farm- and time-fixed effects.

4.2.1 Results relating to profitability of farm businesses. The estimates presented in Table 4 show that agricultural diversification is positively related at the five percent level of significance with profitability for dairy farms, as illustrated in column (2). In addition, the relationship between agricultural diversification and profitability for granivores is negative and significant at the ten percent level, as pointed out in column (4). However, we found no relationship at any conventional level of significance between agricultural diversification and ROA for mixed farms, farms specializing in other grazing livestock, or field-crops according to the results depicted in columns (1), (3), and (5).

Turning to farm diversification, the results in column (2) show that farm diversification has a positive and statistically significant relationship with profitability for dairy farms at the one percent level of significance. In addition, we found that farm diversification has no significant association with profitability for any other type of farming, as reported in columns (1), (3), (4), and (5).

Regarding farmers' age, we found that farmers younger than 40 and older than 65 years tend to have a negative relationship with profitability compared with farmers between 40 and 65 years across the majority of farm types. Moreover, farm size has a non-linear relationship with ROA for dairy farms. Also, rented land and total direct payments have a positive association with ROA for all farm types; however, these relationships are statistically significant only for dairy farms and farms specializing in other grazing livestock. It is worth noting that we found a negative value for crop input intensity and labour input for every farm

Table 3. Comparison of average values for variables used in the analysis by farm type

	p-value for *t*-test of difference in means of dependent and independent variables									
	(a) (1)–(2)	(b) (1)–(3)	(c) (1)–(4)	(d) (1)–(5)	(e) (2)–(3)	(f) (2)–(4)	(g) (2)–(5)	(h) (3)–(4)	(i) (3)–(5)	(j) (4)–(5)
Dependent variables										
Return on assets (ratio)	***	–	***	–	***	–	***	***	–	***
Debt to asset (ratio)	***	–	***	–	***	***	***	***	–	***
Asset turnover rate (ratio)	***	***	***	–	***	***	***	***	***	***
Explanatory variables										
Farmer age below 40	–	–	–	–	–	–	**	**	***	–
Farmer age above 65	***	–	***	***	***	–	***	***	***	***
Farm size	–	***	***	***	***	***	***	–	–	–
Rented land	***	–	**	**	***	***	***	***	***	–
Total direct payments[#]	***	***	***	***	***	***	***	***	***	*
LFA	***	***	–	***	**	***	***	***	***	*
Crop input intensity	***	***	–	***	***	***	***	***	***	***
Labour input	***	–	***	–	***	**	***	***	***	***
Agricultural diversification	***	***	***	***	***	***	***	–	***	***
Farm diversification	***	**	***	*	***	–	***	***	–	***

Note(s): The base year for the age of farmers is 2022. [#]inverse hyperbolic sine transformation (Bellemare and Wichman, 2020). (1)-mixed, (2)-dairy, (3)-other grazing livestock, (4)-granivores, (5)-field-crops. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$, " – " no statistically significant difference

Table 4. Estimation results using farm and year fixed effects – dependent variable: return on assets

	(1)	(2)	(3)	(4)	(5)
Farmer age below 40	−0.045***	−0.006	−0.006	0.003	−0.003
	(0.008)	(0.010)	(0.018)	(0.015)	(0.009)
Farmer age above 65	0.002	−0.011	−0.005	−0.028*	−0.011
	(0.011)	(0.008)	(0.013)	(0.017)	(0.007)
Farm size (log)	−0.237	−0.111*	0.058	0.028	0.005
	(0.230)	(0.065)	(0.053)	(0.061)	(0.111)
Farm size^2 (log)	0.026	0.015**	−0.000	−0.006	0.002
	(0.023)	(0.006)	(0.006)	(0.009)	(0.011)
Rented land	0.009	0.030	0.033**	0.025	0.049
	(0.048)	(0.024)	(0.016)	(0.038)	(0.032)
Total direct payments[#]	0.022	0.066***	0.087***	0.011	0.001
	(0.020)	(0.018)	(0.021)	(0.013)	(0.021)
LFA	0.018	0.031	0.011	−0.064***	0.010
	(0.014)	(0.021)	(0.010)	(0.015)	(0.034)
Crop input intensity	−0.064	−0.026	−0.022	−0.073	−0.012
	(0.047)	(0.023)	(0.036)	(0.048)	(0.0152)
Labour input	−0.034**	−0.006	−0.019*	−0.004	−0.002**
	(0.013)	(0.003)	(0.010)	(0.008)	(0.001)
Agricultural diversification	−0.000	0.048**	−0.017	−0.115*	0.004
	(0.017)	(0.023)	(0.018)	(0.067)	(0.029)
Farm diversification	0.031	0.127***	0.040	−0.340	0.054
	(0.033)	(0.039)	(0.027)	(0.314)	(0.036)
Observations	323	1,733	1,345	434	978
R-squared	0.207	0.157	0.087	0.193	0.057
Year FE	YES	YES	YES	YES	YES

Note(s): Clustered robust standard errors are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. [#]inverse hyperbolic sine transformation (Bellemare and Wichman, 2020)

type for columns (1)–(5); however, we found significant results only for labour input. In particular, there is a statistically significant negative relationship between labour input and profitability for mixed farms, farms specializing in other grazing livestock, and field-crops, as reported in columns (1), (3), and (5).

4.2.2 Results relating to efficiency of farm businesses. Table 5 presents the estimated coefficients for separate regressions across farm types regarding financial efficiency. We found that agricultural diversification has a positive and statistically significant relationship with ATO at the one percent level for dairy farms. However, we found no statistically significant relationship between agricultural diversification and ATO for the other farm type specializations (i.e. mixed farms, other grazing livestock farms, granivores, and field-crop farms). The estimates regarding the relationship between farm diversification and ATO indicate non-significant results for the majority of farm types. Nevertheless, for dairy farms in column (2), we found a positive and statistically significant relationship at the ten percent level.

Furthermore, we found that farmers below the age of 40 are likely to be related with less ATO than farmers between 40 and 65 years, considering the consistent negative sign across all farm types, although these results are not statistically significant at any conventional level. We obtained similar results for farmers above 65 years of age compared with farmers between 45 and 60 years of age. Interestingly, the results for farm size indicate a non-linear statistically significant relationship with financial efficiency for the majority of farm types. Also, rented land was found to have a positive and significant association with ATO, as reported in columns (2)–(5). The results for total direct payments indicate that overall subsidies tend to contribute to financial efficiency, particularly for dairy farms and farms specializing in other grazing

Table 5. Estimation results using farm and year fixed effects – dependent variable: asset turnover ratio

	(1) Mixed	(2) Dairy	(3) Other grazing livestock	(4) Granivores	(5) Field-crops
Farmer age below 40	−0.007	−0.014	−0.015	−0.002	−0.014
	(0.013)	(0.014)	(0.017)	(0.014)	(0.024)
Farmer age above 65	−0.037*	0.002	−0.001	−0.022	−0.027*
	(0.020)	(0.010)	(0.010)	(0.020)	(0.015)
Farm size (log)	−0.313	−0.185*	−0.138**	0.132**	−0.311*
	(0.367)	(0.096)	(0.068)	(0.053)	(0.163)
Farm size^2 (log)	0.033	0.018*	0.019**	−0.019**	0.036**
	(0.038)	(0.010)	(0.007)	(0.008)	(0.016)
Rented land	0.029	0.117**	0.089***	0.098*	0.317***
	(0.054)	(0.048)	(0.027)	(0.053)	(0.108)
Total direct payments[#]	0.055	0.043*	0.070***	−0.022	0.005
	(0.044)	(0.023)	(0.023)	(0.026)	(0.030)
LFA	−0.002	0.069**	0.010	−0.099***	0.056
	(0.017)	(0.034)	(0.013)	(0.014)	(0.056)
Crop input intensity	0.005	0.033	0.054	0.006	−0.014
	(0.065)	(0.027)	(0.043)	(0.029)	(0.017)
Labour input	−0.000	0.007**	0.008	0.020**	0.001
	(0.011)	(0.003)	(0.011)	(0.008)	(0.003)
Agricultural diversification	−0.032	0.084***	0.025	−0.056	0.019
	(0.032)	(0.027)	(0.018)	(0.045)	(0.046)
Farm diversification	−0.043	0.102*	0.034	0.013	−0.022
	(0.050)	(0.054)	(0.032)	(0.175)	(0.045)
Observations	323	1,733	1,345	434	978
R-squared	0.146	0.179	0.096	0.164	0.124
Year FE	YES	YES	YES	YES	YES

Note(s): Clustered robust standard errors are in parentheses: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. [#]inverse hyperbolic sine transformation (Bellemare and Wichman, 2020)

livestock. Finally, we found mixed results for farms located in LFA areas but a positive relationship between labour input and financial efficiency. In particular, labour input is statistically positively associated with ATO for dairy farms and granivores.

4.2.3 Results relating to solvency of farm businesses. We found no statistically significant relationship between agricultural and farm diversification and farm solvency (Table 6). Nevertheless, for model specifications in columns (2)–(5), the signs of the coefficients are negative.

Turning to the variable of farmer age younger than 40 years, we found a statistically significant difference compared to farmer age between 40 and 65 years for the DtA, regarding mixed and dairy farms. Regarding the relationship between farmer age above 65 with DtA, we found statistically significant negative results for other grazing livestock and field-crop farms. In addition, for farm size we found a statistically significant non-linear relationship with financial solvency for grazing livestock farms and that the variable rented land has no significant relationship with DtA. Moreover, total direct payments were found to have a significant relationship with DtA for granivores, and farms located in LFA areas have a negative relationship with DtA for mixed and granivore specializations. Moreover, crop input intensity has no significant coefficient at either model specification, and labour input intensity has a negative significant relationship with DtA for farms specializing in other grazing livestock.

4.2.4 Results relating to overall financial performance of farm businesses. The results regarding the relationship between agricultural diversification and overall farm financial performance are presented in Table 7. In particular, these results indicate a mixed relationship between agricultural diversification and overall financial performance, which varies according to farm type. For instance, for dairy farms in column (2), we found a statistically significant

Table 6. Estimation results using farm and year fixed effects – dependent variable: debt to asset

	(1) Mixed	(2) Dairy	(3) Other grazing livestock	(4) Granivores	(5) Field-crops
Farmer age below 40	0.115***	0.039**	−0.018	−0.028	0.102
	(0.030)	(0.018)	(0.023)	(0.029)	(0.081)
Farmer age above 65	0.001	0.008	−0.026*	0.017	−0.045**
	(0.047)	(0.017)	(0.014)	(0.015)	(0.022)
Farm size (log)	0.193	−0.173	0.262**	0.132*	−0.013
	(0.677)	(0.215)	(0.106)	(0.076)	(0.174)
Farm size^2 (log)	−0.025	0.017	−0.021**	−0.010	0.006
	(0.069)	(0.020)	(0.010)	(0.011)	(0.020)
Rented land	−0.054	0.026	−0.077	−0.029	−0.102
	(0.134)	(0.034)	(0.048)	(0.075)	(0.125)
Total direct payments[#]	−0.055	−0.022	−0.014	0.060*	0.016
	(0.046)	(0.053)	(0.034)	(0.033)	(0.038)
LFA	−0.296***	−0.005	−0.007	−0.020*	0.007
	(0.052)	(0.025)	(0.023)	(0.011)	(0.018)
Crop input intensity	−0.031	0.037	0.020	0.042	0.004
	(0.097)	(0.040)	(0.044)	(0.043)	(0.005)
Labour input	−0.004	0.001	−0.018**	0.007	0.004
	(0.031)	(0.003)	(0.008)	(0.006)	(0.007)
Agricultural diversification	0.077	−0.001	−0.030	−0.028	−0.027
	(0.067)	(0.033)	(0.026)	(0.046)	(0.029)
Farm diversification	0.022	−0.010	−0.021	−0.097	−0.063
	(0.074)	(0.071)	(0.027)	(0.076)	(0.061)
Observations	323	1,733	1,345	434	978
R-squared	0.187	0.082	0.071	0.209	0.078
Year FE	YES	YES	YES	YES	YES

Note(s): Clustered robust standard errors are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. [#]inverse hyperbolic sine transformation (Bellemare and Wichman, 2020)

positive relationship, whereas for granivore farms in column (4), we found a statistically significant negative relationship. In addition, we found no significant association with the other farm types in columns (1), (3), and (5).

Regarding the association between farm diversification and overall farm financial performance, we found positive and statistically significant results for dairy farms, as indicated in column (2). However, there is no evidence of a statistically significant relationship for the other farm types, as reported in columns (1), (3), (4), and (5).

Overall, the age variables highlight that farmers younger than 40 years of age and those older than 65 years of age show no statistically significant difference from farmers between 40 and 65 years of age; however, the signs of the estimated coefficients suggest a similar negative trend. Moreover, the results for farm size indicate a statistically significant non-linear relationship only for dairy farms, as reported in column (2). The farm size coefficients for the other types of farming are not significant at any conventional level. It is also worth noting that rented land has a significant association with farm financial performance for dairy, other grazing livestock, and field-crop farms, as indicated in columns (2), (3), and (5). Total direct payments have a positive significant relationship with overall financial performance only for dairy and other grazing livestock farms at the one percent significance level. The signs of the estimated coefficients for the other model specifications are equivalent, but not statistically significant. Moreover, the results for LFA indicate a mixed relationship between this variable and overall financial performance. In particular, LFA for mixed and granivore farms has a negative significant relationship with overall performance, whereas for dairy farms it has a positive relationship. Finally, for labour input, we found significant results only for mixed farms, as reported in column (1).

Table 7. Estimation results using farm and year fixed effects – dependent variable: overall farm financial performance

	(1) Mixed	(2) Dairy	(3) Other grazing livestock	(4) Granivores	(5) Field-crops
Farmer age below 40	−0.129	−0.044	−0.128	−0.020	0.128
	(0.082)	(0.093)	(0.143)	(0.110)	(0.139)
Farmer age above 65	−0.095	−0.053	−0.079	−0.205	−0.166**
	(0.186)	(0.074)	(0.104)	(0.130)	(0.065)
Farm size (log)	−2.293	−1.603**	0.240	0.607	−0.525
	(2.901)	(0.693)	(0.533)	(0.441)	(0.682)
Farm size^2 (log)	0.246	0.188***	0.031	−0.087	0.082
	(0.304)	(0.069)	(0.058)	(0.066)	(0.070)
Rented land	0.057	0.654**	0.353*	0.306	0.589**
	(0.485)	(0.316)	(0.198)	(0.272)	(0.284)
Total direct payments[#]	0.225	0.559***	0.715***	0.101	0.040
	(0.269)	(0.171)	(0.165)	(0.112)	(0.138)
LFA	−0.436***	0.449*	0.087	−0.615***	0.154
	(0.167)	(0.250)	(0.096)	(0.114)	(0.250)
Crop input intensity	−0.501	−0.008	0.117	−0.391	−0.068
	(0.491)	(0.232)	(0.336)	(0.317)	(0.088)
Labour input	−0.251**	−0.010	−0.100	0.022	−0.001
	(0.121)	(0.026)	(0.083)	(0.056)	(0.014)
Agricultural diversification	0.041	0.615***	−0.048	−0.864*	0.008
	(0.254)	(0.220)	(0.159)	(0.441)	(0.201)
Farm diversification	0.131	1.185***	0.314	−2.219	0.099
	(0.392)	(0.395)	(0.272)	(2.147)	(0.229)
Observations	323	1,733	1,345	434	978
R-squared	0.262	0.197	0.111	0.195	0.091
Year FE	YES	YES	YES	YES	YES

Note(s): Clustered robust standard errors are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. [#]inverse hyperbolic sine transformation (Bellemare and Wichman, 2020)

5. Discussion

This paper aimed to explore the relationship between farm and agricultural diversification and farm financial performance measured as ROA, ATO, and DtA. Additionally, we estimated these relationships considering that farms of different types would have a variety of endowments and requirements, causing heterogeneity across farm types. Moreover, this paper explores the relationships between farm and agricultural diversification and overall farm financial performance. This was achieved using factor analysis to create a composite indicator of farm financial performance. We used a fixed effects model in combination with data from the Swedish agricultural sector between 2016 and 2020.

Our findings highlight that different types of farms display systematic and significant differences in their mean values for agricultural and farm diversification. These insights indicate dissimilarities across farm types, and we provide two explanations for these: the first is related to the seasonality of production activities, and the second is about the "compatibility" of primary production activities with diversification activities. Regarding seasonality, farmers with seasonal production activities are more likely to have additional available time, which allows them to search for other sources of income from diversification strategies. This line of reasoning is in the spirit of the results of Dries *et al*. (2012), who found that seasonality was a critical factor in explaining diversification. For instance, farm types with more labour-intensive production activities have less time to pursue diversification activities across the season and therefore tend to have lower levels of diversification than those with less intensive production activities. Regarding "compatibility", some diversification types, such as

agritourism and accommodation, might be less attractive to some potential consumers if the farms are engaged in the production of pigs or poultry (i.e. granivore specialization). Therefore, it might be less likely to observe diversification activities within some farm specializations because their production orientation might be less suitable.

As expected, the relationship between agricultural and farm diversification and farm financial performance indicators was found to be complex. This heterogeneity in the results of diversification across the financial indicators highlights the importance of using a composite indicator to obtain more comprehensive information and arrive at clearer conclusions. It is noteworthy that agricultural and farm diversification have a positive and significant association with overall farm financial performance for dairy farms. These results may be attributed to the fact that dairy farms exhibit on average the lowest levels of farm diversification and engage in among the least agricultural diversification (see Appendix; Table A.III). Thus, for dairy farms, increasing engagement levels with diversification could be an opportunity to receive revenues from additional activities and improve their overall financial outcome. Moreover, for granivore farms, we found that agricultural diversification has a negative association with overall financial performance, while farm diversification has no significant relationship. This result indicates that agricultural and farm diversification are two distinct diversification strategies, which may result in heterogeneous associations with the economic outcome of farms. This finding is supported by Barnes *et al*. (2015), who found farm diversification to be significantly related to short-term farm viability, whereas agricultural diversification had no significant relationship. Similarly, Harkness *et al*. (2021) found that agricultural diversification had a positive relationship with a farm's economic outcome (i.e. reduced income variability), while farm diversification had a negative relationship (i.e. increased income variability).

The findings from this research should be interesting for agricultural policy as they highlight possible relationships between diversification strategies and farm financial performance. The findings suggest a need for policymakers to assess which farms can benefit from diversification strategies and that therefore might be more willing to adopt such policies. For instance, dairy farms might be more willing to participate in diversification strategies than granivore farms. Also, we have made a first step in creating a composite measurement of farm financial performance that facilitates the interpretation of our results for policymakers. The findings reinforce the need to measure financial performance as an indicator to achieve a holistic view of farm business performance. Based on these insights, future policy designs that aim to stimulate farm financial performance could embrace a similar holistic approach.

Some limitations should be acknowledged. Differences in sample size across the farm types can impact the statistical significance of results, limiting the possibilities to compare across farm types. Furthermore, the environmental and societal contributions of diversification strategies have not been considered or discussed. Thus, further insights into how diversification strategies are related to or impact upon environmental aspects (i.e. biodiversity indicators) would improve our understanding of the broad role of diversification in agriculture. Also, additional insights into how diversification strategies are related to social dimensions (i.e. employment in rural areas) would provide crucial information for future policy design. Moreover, to better capture the societal benefits of diversification strategies, future studies could focus on either regional-level or farm-level analyses.

6. Conclusions

To our knowledge, this is the first study that explores the relationships between diversification and farm financial performance. The results indicate that dairy farms' financial performance is positively related with their diversification activities. The results also point to the possibility that other farm types lack financial incentives to engage in diversification activities. However, the findings need to be interpreted with caution because the benefits of diversification might not always be reflected through market mechanisms and therefore may not accurately reflect

societal preferences. Thus, policymakers might need to provide appropriate financial incentives to allow farmers to engage in diversification activities by considering their broader role in society. For instance, diversified farmers can be financially incentivized due to their contribution to the creation of public goods (e.g. benefits to the environment, and local communities).

Notes

1. Due to limitations in the dataset, we were not able to include unpaid management costs.
2. For detailed description see SE 256 - Other output in: European Commission (2022). FARM ACCOUNTANCY DATA NETWORK (FADN) - Definitions of Variables used in FADN standard results.

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Supplementary material

The Supplementary material for this article can be found online.

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