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Systematic Risk in Agriculture: A Case of Slovakia

M. Tóth, D. Lančarič, A. Piterková, R. Savov

Slovak University of Agriculture, Nitra, Slovakia

Abstract

The paper uses the alternative Markowitz portfolio theory approach, by replacing the stock return with return on equity (ROE) and estimates the systematic risk of unquoted agricultural farms. The systematic risk is standardly measured by the mean-variance model and standard deviation of stock return. In case of unquoted firms the information regarding the market rate of return is missing. To assess the risk and return, the use of individual financial statements is necessary. The systematic risk in Slovak agriculture over the period 2009-2012 was 3% of equity or capital invested with the average return 0,048%. We calculated the systematic risk separately for two prevailing legal forms in Slovak agriculture: cooperatives and companies (JSC., Ltd.). Cooperatives represent farms with lower individual risk and lower ROE, but higher systematic risk. Companies represent farms established after 1989. These farms generate higher profit for the owner with lower systematic risk.

Key words

Agriculture, systematic risk, unquoted companies, legal form, return on equity.

JEL: R52, R58, H41.

Introduction

Yield, risk and liquidity are the main factors influencing the investment decision making process. According to the essential literature, there are many ways, how the risk can be assessed (Klieštik, Valášková, 2013). For evaluation of the riskiness of quoted companies are mainly the market data taken into consideration, however, in the case of unquoted companies the financial statements data are to be used.

Risk generally refers to deviation of the evaluated indicator, and its level depends on the volatility over a certain period. The agriculture of Slovak republic, passed during the last decade a period of substantial changes caused by the EU Common Agricultural Policy, new political regulations and quotas, or crisis influence in 2009 that have been ultimately impacting economic development in this sector. The average economic results of a farm in agriculture show very high level of volatility of financial indicators such as ROE, 4.39% in 2007, 0.4% in 2009, 2.84% in 2011, or ROA, 1.76% in 2007, 0.04% in 2009, 1.11% in 2011, (Serenčéš et al., 2014). This unstable and risky development of Slovak agriculture can be subjected to strong variability due to several reasons and factors affecting the farms` production and income.

Another important aspect of assessing the risk is the type of risk. In finance we distinguish between the individual or portfolio risk, and systematic (market) or unsystematic (diversifiable) risk. Individual risk is the risk connected with an individual investment. In this case, the investor does not diversify and invests 100% in single investment opportunity. On the other hand, portfolio risk is a risk of portfolio investment, meaning the investor diversifies his/her assets into two or more investment opportunities. Unsystematic risk is a risk that can be decreased by adding the additional investment into the investment portfolio. It is a part of the total risk that can be eliminated by increasing the number of investments in the portfolio. Remaining part of the total risk is the systematic risk, which cannot be eliminated, despite the number of investments in portfolio.

Riskiness of the agriculture sector consists of many different individual sources of risk resulting from the product prices instability, food industry requirements, biological nature of production, dependency on climatic conditions, seasonality and others. These risks are very rarely completely independent from each other, particularly when measured in terms of their impact on the income variability. For this reason, the classification of different types of agriculture risk seems

very similar, and the boundaries are not strictly specified. Huirne et al. (2004) and Hardaker et al. (2004) distinguished two main types of risk in agriculture. Firstly, the business risk, including the production, market, institutional and personal risks, and secondly, the financial risk resulting from different methods of financing the business activities, fluctuation of interest rate or loans availability. Holzmann and Jorgensen (2001) divided the risk into 6 main categories: natural, health, social, economic, political and environmental. Moreover, they crossed the typology with the dimension of systematic characteristic of different risk and determined the majority of individual agricultural risks to take a form of economic risk, which may not be diversified. Based on this fact, although, number of different divisions has been found (Musser, Patrick, 2002; Harwood et al., 1999), in our study we mainly focused on the systematic (non-diversifiable) and unsystematic risks (diversifiable).

Total risk is standardly measured, according to the Markowitz portfolio theory, by the mean-variance model and standard deviation of stock return (Brealey, Myers, 2007, Hrdý, Krechovská, 2013). However, not all businesses provide the ability to raise their capital in the form of stocks that would be traded in the stock market. These businesses represent so called unquoted companies. However, the stocks, considered in the original model, represent the equity securities, and the return on stock reflects simply the return on equity invested into the business. Therefore, it might be assumed that to be able to measure the risk of unquoted companies, the deviation of return on equity could be considered, as well.

The systematic and unsystematic risks belong to the concept of Capital Asset Prising Model CAPM (Sharpe, 1964; Lintner, 1965) that was built on mean-variance portfolio work of Markowitz (1952). While the unsystematic risk reflects the firm specific risk sources that might be eliminated by the diversification, the systematic risks remains common for all entities in particular sector and can be termed as the market risk. (Brealey, Myers, 2008). The systematic risk measurement in the CAPM, also originally considers the volatility of stock prices and expected returns on securities. Very closely related to the CAPM is the Simple index model (SIM) equation, which is virtually identical to the CAPM equation, but without equilibrium asset pricing implications (Sharpe, 1963, Hubbs et al., 2009). It means that it provides the ability to apply the model to other than security market. It empowers the assumption to measure the systematic risk of unquoted companies, using alternatively the equity ratio.

The systematic risk can vary across the industries, since industries show various resistance patterns against the risk, due to different business attributes (Lee, Jang, 2006). The entities operating within the agriculture sector belong to the unquoted companies, whose securities are not traded on the public stock exchange. The systematic risk estimation of agriculture sector requires the alternative Markowitz theory approach or SIM implication, when the input variables used in analysis are the accounting fundamentals of companies. This alternative approach was applied in the number of previous studies, such as usage of gross and net returns (Gempesaw et al., 1988), crop revenues (Mumey et al., 1992) farm equity returns (Baginski, Wahlen, 2003), book to market ratios (Fama and French 1995) or cash flow variability (Campbell,W uolteenaho, 2008; Cohen et al., 2009; Da, 2009).

The risk analysis of agriculture, using the Markowitz approach or Single index model, has been applied to the number of studies, however many of them did not have aggregate character. They mainly focused on the certain part of agriculture production, for example, Barry (1980) applied the CAPM assumptions to estimate beta for U.S. farm real estate market, Peterson and Leuthold (1987) used the portfolio approach to examine the cattle feeding problem, Prattley et al. (2007) applied the portfolio concept to find appropriate allocation of surveillance resources in animal populations, Barkley et al. (2010) estimated optimal crop diversification. Also, the more aggregate perspective, when the systematic and non-systematic risk of agriculture of whole country has been estimated, can be found. Gempesaw et al. (1988) applied the model to Delaware farm sector market portfolio, Turvey and Driver (1987) used SIM to study the systematic and non-systematic risk of Canadian agriculture, or in more recent study Libbin et al. (2004) applied the Markowitz portfolio model directly to a series of New Mexico farms. Similarly, we decided to focus our study on examining market risk and return of Slovak agriculture sector.

The main objective of the paper is to measure the systematic risk of Slovak unquoted agricultural companies by measuring the volatility of ROE over the period 2009-2012. Applying the alternative Markowitz portfolio theory approach on a dataset

of farms covering 78% of Utilized Agricultural Area (before necessary adjustments) allows to estimate the systematic risk in agriculture of the Slovak Republic.

Materials and methods

Material

We used a data from database of the Slovak Ministry of Agriculture and Rural Development (IL MoARD - PU, 2013), over the period 2009-2012. The database consists of individual farm data, including balance sheets and income statements. Data submission is obligatory for all agricultural farms. For our analysis, data were selected according to the farm legal form to subset of the agricultural production cooperatives (461) and the subset of the capital companies - Joint Stock Company (JSC) and Limited Liability Companies (Ltd.) (535). From the dataset data of the following farms were excluded:

- farms that started or quitted during the observed period 2009-2012,
- farms with negative equity (liabilities exceeding total assets),
- farms with return on equity (ROE) exceeding +/- 100% (average profit or loss exceeds equity) over the observed period.

We used then data of 996 farms, out of which there were 535 agricultural companies and 461 agricultural productive cooperatives,

Methods

We assumed that the return of the investor is based on the profit of the company and the equity invested. Therefore, we considered return on equity ROE (Eq. 1) to be equivalent to the return on stocks, generally used in the case of quoted companies.

$$ROE_i = \frac{Earnings\ After\ Taxes}{Shareholders\ Equity} \quad (1)$$

Where:

ROE_i – return on equity of farm "i"

Measuring volatility of return in the Markowitz portfolio theory is based on the average return over the observed period for each investment. We calculated the average return on equity $EROE_i$ (Eq. 2) for each individual farm.

$$EROE_i = \sum_{i=1}^{t} ROE_i . d_i \quad (2)$$

Where:

d_i – a weight of ROE_i over the observed period (4 years, $d_t = 0.25$)

t – number of years in observed period.

i, j – individual farms.

The individual risk of each farm (σ_i) is calculated using the standard deviation.

$$\sigma_i = \sqrt{\sum_{i=1}^{t} (ROE_i - EROE_i)^2 . d_i} \quad (3)$$

Where:

σ_i – standard deviation of the individual return on equity (individual farm risk),

ROE_i – individual return on equity,

$EROE_i$ – average individual return on equity.

The portfolio risk (σ_p) is determined by three variables:

w_i – weight of the individual investment in portfolio,

σ_i – standard deviation of the individual investment (individual risk),

σ_{ij} – covariance (relation between the ROE_i and ROE_j).

To take into account market portfolio of all agriculture farms, the weight wi of each farm is determined by farm market share, which is the share of the farm` s equity on the total equity of all farms.

The covariance represents the relationship between returns on equity of farms (Eq 4) and Σ covariance matrix (Eq. 5).

$$\sum = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} & \dots & \sigma_{1k} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} & \dots & \sigma_{2k} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} & \dots & \sigma_{3k} \\ & & \dots & & \\ \sigma_{k1} & \sigma_{k2} & \sigma_{k3} & \dots & \sigma_{kk} \end{bmatrix} \quad (5)$$

Portfolio risk is given by Eq. 6.

$$\sigma_p = \sqrt{\sum_{i=1}^{n} w_i^2 . \sigma_i^2 + \sum_{i=1}^{n} \sum_{\substack{j=1 \\ j \neq i}}^{n} w_i . w_j . \sigma_{ij}} \quad (6)$$

Where:

w_i – an individual weight of i-farm (farm`s equity) in a portfolio (total equity of all farms)

n – number of farms,

The expected return on equity of portfolio is estimated by the multiplication of k x 1 vector of individual weights of portfolio (w) and k x 1 vector of corresponding individual expected returns on equity (the sum of multiplication of each farm´s expected ROE and its share in the market portfolio).

$$EROE_p = \sum_{i=1}^{n} EROE_i . w_i \quad (7)$$

Where:

$EROE_p$ – expected portfolio return on equity,

$EROE_i$ – the average return on equity of individual farm.

Results and discussion

The agricultural sector in Slovakia was transformed after 1989, when the centralized economy ceased to exist. Before 1989, Slovak agriculture consisted only of cooperatives and state farms with large acreage. After 1989, all farms turned private. Cooperatives were privatized by the issuing cooperative shares and owners became the holders of these shares. Cooperative shares represent the value that a cooperative member put in the form of intangible assets in, or the value that was produced by his work as an employee of the cooperative. Therefore, the cooperatives in Slovakia have higher equity (own equity, see table 1). Companies were established after 1989 and manage the land of failed cooperatives. Out of remaining 996 farms there were 535 companies (Joint Stock Company (JSC.), Limited Liability Company (Ltd.)) and 461 cooperatives. Table 2 summarises the main results and findings with respect to systematic risk.

By adding all the farms existing over the observed period in the appropriate weight to a portfolio, we simulated the situation what risk investor would face by buying all the farms in agriculture for the price equal to their total equity. The calculated systematic risk in Slovak agriculture over the period 2009 – 2012 was 3.000%. Although, we did not focus on the return to calculate the risk, we also had to calculate the average return (p. a.) over the observed period.

The average return (measured as ROE) in Slovak agriculture over the period 2009 – 2012 was 0.048% which shows that the profitability of the whole sector is really low. In the case of normal distribution of return in the portfolio we can interpret the calculated risk (3.000%) as a confidence interval, where the achieved return would be varying from -2.952% to 3.048% at a confidence level 68.3%.

According to theory by increasing the number of firms in portfolio the total portfolio risk should decrease. However, after dividing the data set into companies and cooperatives, the risk in case of cooperatives is higher than the calculated systematic risk. On the other hand, the risk of the companies is lower.

This is clearly opposing the theory (see figure 1). By buying all the companies doing business in the Slovak agriculture, the investor would earn average return 2.974% with risk 2.414%. This shows the higher profitability of companies compared to cooperatives. Companies are considered

		acreage in hectares	total assets in EUR	sales in EUR	number of employees	number of owners
cooperatives	mean	1439	3 155 148	1 241 342	42	163
	median	1229	2 263 039	878 541	34	102
companies	mean	1042	2 642 128	1 335 221	24	13
	median	692	1 068 682	444 248	13	2
all farms	mean	1227	2 879 580	1 291 769	32	81
	median	936	1 681 029	665 623	22	5

Source: Data of the Agricultural Paying Agency of Slovakia (2013)

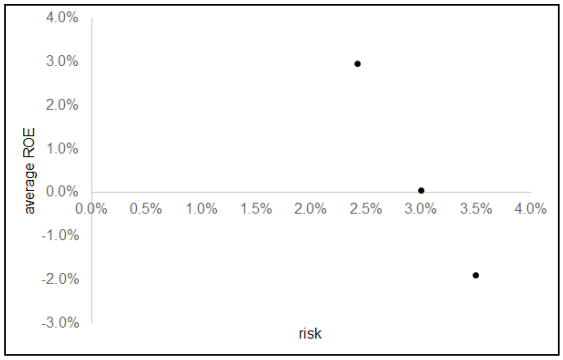
Table 1: Descriptive statistics (average values).

	Number	Average ROE	Portfolio Risk	Average Farm risk	Total equity in bill. EUR	Equity per farm in 1000 EUR
all farms	996	0.048%	3.000%	14.324%	1.509	1,515
companies	535	2.974%	2.414%	16.233%	0.602	1,125
cooperatives	461	-1.897%	3.498%	12.110%	0.907	1,967

Source: Data of the Agricultural Paying Agency of Slovakia (2013)

Table 2: Results summary.

to be more effective, which results from the fact that the companies are a new legal form driven by the private capital and more focused on increasing the owners' wealth.



Source: Data of the Agricultural Paying Agency of Slovakia (2013)

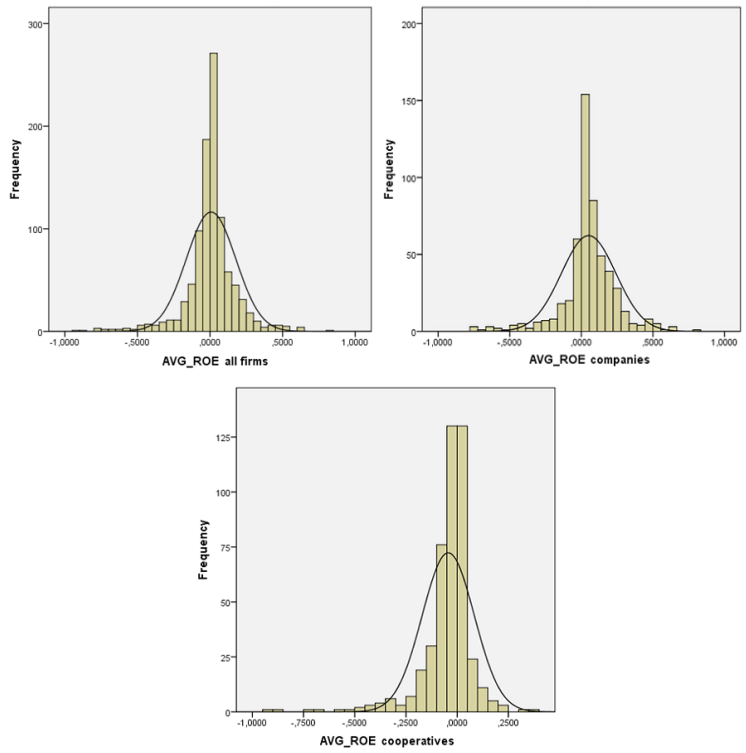
Figure 1: Systematic risk and average ROE visualisation.

The situation in the case of cooperatives is different. They as a group generate loss 1.897% of equity with even higher risk in comparison to companies (3.498%). This can be partly caused by the number of owners in the cooperatives (9 per 100 ha of agricultural land in 2012) in comparison with companies (1.2 per 100 ha of agricultural land in 2012). In addition to that, we have to consider also the differences in average farm risk values (table 1). The average risk of 996 farms without the influence of correlation was 11.324% over the observed period. With the impact of correlation the overall risk decreased to 3%. This means that the returns are not absolutely positively correlated in agriculture. By dividing the data set into companies and cooperatives the average farm risk is in favour of cooperatives. When we compare the average farm risk with the portfolio risk of companies and cooperatives, we can conclude that the individual volatility of cooperatives is lower than the individual volatility of companies, although the portfolio risk in case of cooperatives is higher. The reason is the difference in the average equity per firm, which is almost 75% higher in case of cooperatives. Since the equity is a denominator in formula 1, the same profit is in case of cooperatives achieved with lower volatility.

Observing the distribution of average ROE of individual farms we can conclude that based on the results of Shapiro - Wilk test the assumption of normality was violated. In the histograms (figure 2, 3) we compared the individual average ROE (not weighted) with the addition of each company to portfolio average ROE (weighted).

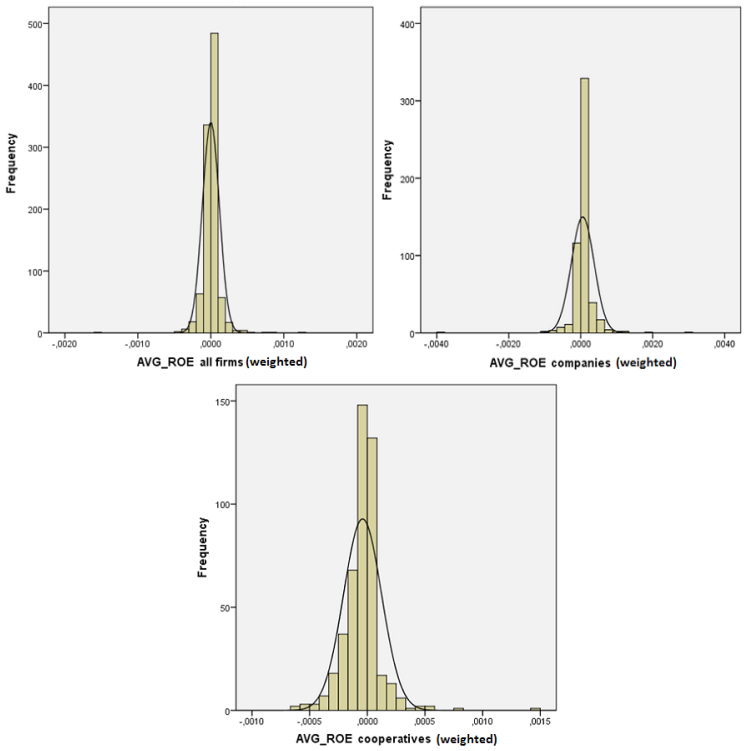
The results show the skewness is almost identical to symmetrical distribution as the skewness is -0.539 in case of weighted average ROE and -0.720 in case of individual average ROE. Therefore, calculated average ROE for the portfolio (weather individual or weighted) can be considered as suitable descriptive characteristic of a sample. Based on the histogram 67% of the farms` individual average ROE ranged from -10% to 10% over the observed period (2009 - 2012). Comparing it with the addition of single company to overall portfolio ROE we can conclude that 82% of the farms ranged from – to + 0.01%. Small farms had higher volatility than large farms, because individual ROE is more volatile than weighted. In the next step we focused on the differences in ROE based on the legal form dividing the whole dataset into two main groups: Cooperatives and Companies. The distribution of companies ROE is more volatile compared to cooperatives (Figure 2, 3). Out of 535 companies the majority of the farms (393) made profit and had positive ROE over the period 2009-2012. Only 142 (26.5%) farms suffered loss. The individual addition of small companies to the overall portfolio ROE consisting of companies only based on the comparison with the weighted ROE is again very small. Companies with higher profitability and companies with very high loss are small. In case of cooperatives out of 461 cooperatives the majority (286) was generating loss. Only 175 (38%) of cooperatives were profitable during 2009-2012. We can conclude that companies are a better legal form for the owner. But, when comparing the volatility of these two legal forms, the individual volatility based on standard deviation is higher in case of companies. On the other hand, based on figure 1, the portfolio consisting of companies only generates higher ROE with lower rate of risk. This is due to the covariance, which is in companies more negative compared to cooperatives.

With respect to systematic risk arises a question, which of the financial data is the most appropriate input variable for risk assessment. There are several ways to classify risk in agriculture. It is usually done by measuring the variability of prices (Briner, Fingert 2013, Goodwin et al., 2000, and others), yield, income, (Vrolijk et al., 2009), gross revenues (El Benni and Fingert 2013), production (Cacho et al., 1999), or any other variables. Since the Markowitz approach uses the equity return (volatility of return on stocks), analogically we decided to estimate agriculture



Source: Data of the Agricultural Paying Agency of Slovakia (2013)

Figure 2: Return on equity distribution – not weighted.



Source: Data of the Agricultural Paying Agency of Slovakia (2013)

Figure 3: Return on equity distribution – weighted.

market risk in Slovakia by considering variability of return on equity (ROE) of individual agricultural farms in one common market portfolio. Similar model has been used by Lee and Jang (2006), who measured the market risk of airline companies with the use of return on assets (ROA), or Baginski and Wahlen (2003), who focused on simple farm equity returns.

One of the negatives of using ROE is that this ratio includes Net income in nominator. Net income might have been adjusted by individual farmers in the sense of tax optimization purposes. In order to objectively evaluate the market risk and return in Slovakia also other types of risks and variables should be taken into consideration.

Applied methodology offers an opportunity to evaluate the impact of Common Agricultural Policy as one of the CAP`s goals is to stabilize the income of farmers in the EU member states (see Rizov et al., 2013; Pokrivcak, 2003).

Based on our results it is not yet possible to evaluate the impact of Common Agricultural Policy as the evaluated period covers only years 2009-2012. Also any policy implications should be stressed after the comparison of more periods and more countries as the CAP has to fulfil the needs of every member state of European Union. For Slovakia we can conclude that in the future the proportion of cooperatives on the total number of farms will decrease in favour of companies. This is due to lower ROE of cooperatives in comparison with companies and higher capital needs of cooperatives.

Conclusion

The risk in the European agriculture is decreased by Common Agriculture Policy in form of subsidies and regulations. The difficulty to measure the systematic risk of agriculture companies results from their unquoted character. The majority of farms in agriculture is unquoted, meaning to assess the market value for return and risk calculation has to rely on financial statements. One of the negatives is that these statements are used for tax purposes, and therefore can be adjusted in sense of tax optimisation.

In the paper we calculated systematic risk of Slovak agriculture using adjusted Markowitz portfolio theory. Based on the dataset of 996 farms over the period of years 2009-2012 we calculated the average return and systematic risk (average return 0.048%; systematic risk 3.000%). The results show that agriculture is a sector with low profitability. To evaluate the level of systematic risk we have to compare it with other sectors or industries. The results can also be used to compare the levels of systematic risk in different time periods. Based on such comparison we can measure the development of the overall stability of the sector. In the case of agriculture, the presented methodology can be used for evaluating the process of meeting the Common Agriculture Policy objective, the agriculture income stabilisation. In further research we will extend the observed period for periods covering EU pre-accession period of the Slovak Republic. The achieved result should imply the effects of CAP instruments on Slovak agriculture.

In the second part of the paper we observed the differences between the two main legal forms in Slovak agriculture. The profitability of companies measured by ROE is higher in comparison to cooperatives, which in average generated loss over observed period. The individual risk is in the case of companies higher, which is partly the result of the lower equity per farm. On the other hand, the portfolio risk of companies is lower than in the case of cooperatives, which is a result of more negative covariance between the returns of companies.

Corresponding author:
Ing. Marián Tóth, PhD.
Department of Finance, Faculty of Economy and Management, Slovak University of Agriculture
Tr. A. Hlinku 2, 949 74 Nitra, Slovakia
Phone: 00421 37 641 4164, E-mail: marian.toth@uniag.sk

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