1. INTRODUCTION

In recent years, the increasingly more pronounced time-based competition has increased the significance of supply chain management (SCM) as well as that of the cooperation between companies. Companies participating in time-based competition must be able to change their strategies in a flexible way (for example, according to the demands of a 'dominant' partner), and/or to integrate and optimize their processes in new business models (along the supply chain). The significance of supply chain management is well presented by the survey of DMSCA (Diverse Manufacturing Supply Chain Alliance) in 2010, according to which costs of supply chain management depending on the sectors vary between 7% and 13% (given in percentage of the income). At the same time, in case of the best-performing companies of a given sector, these costs can be can be minimised between 3% and 5.5% by the proper management of the supply chain processes and partnership relations, which results in a 50% cost advantage for the leading companies of the given sector over their competitors. (DMSCA, 2010)
Naturally, competition between supply chains can also be seen in the food industry I selected as the field of my investigation, having crucial influence on the operation of small and medium-sized enterprises operating in the industry. The importance of small and medium-size enterprises in the food industry is well presented by the approximately 35-40% share of SME sector (excluding micro-enterprises) from the whole food industry, as well as by their realized export profit of 30-40%.
(Kralovánszky, 2011). The SMEs of food industry have to face not only the demands of the time-based competition, but also the characteristics of the supply chain of the sector (dominant retail chains, special transportation and storage requirements, tracking and traceability). In spite of the several difficulties, operation as integrated part of supply chains in food industry can be favourable for small and medium-sized enterprises as it may have positive effect on their technological development, organisational studies and the conditions of market access.

1.1.The purposes of the thesis

The focus of my dissertation is on the partnership relations of small and medium-sized enterprises in food industry and the integration factors of the supply chain. I have set out the following objectives related thereto.

Creating my own definition of supply chain. Since the appearance of supply chain management as an independent discipline, several definitions have been created for the determination of supply chain. By the development and expansion of the discipline, more and more characteristics have been determined by both researchers and practical experts. For the successful preparation of my dissertation I considered the review of the most important definitions, correlations, development of the discipline important, consequently I have created my own definition of supply chain.

Examining the supply chain partnership relations of small and medium-sized enterprises in food industry. The purpose of the questionnaire I prepared for the survey is to be able to characterise the supply chain relationships of small and medium-sized enterprises in food industry by using the information acquired thereby on the basis of the criteria selected by me.
The characteristics of my survey is to review the factors of cooperation between companies on supplier and customer sides separately thus providing an excellent opportunity to evaluate and compare supplier and customer relationships separately.

The effect of supplier chain integration on the performance of SMEs in the Hungarian food industry. One of the most frequently researched areas of the discipline of management is supplier

chain integration, especially, the effect of the integration on company performance. The cause of giving priority to this topic, among others, was that in the competition of supply chains, the intention of optimizing internal company structures and processes is not sufficient any more, companies must form efficient partnership relations with their suppliers and customers in order to achieve the highest possible customer satisfaction.
Supply chain management causes several difficulties to the Hungarian small and medium-size enterprises (for example, expectations of dominant partner, high cost of changing partners, etc.) at the same time, it also has more potential benefits for the participants of the SME sector. (Figure 1.)
In my dissertation, among others, I am seeking to ascertain whether supply chain management, strengthening supply chain partnership relations, deepening integration may be some kind of tools of improving/overcoming the disadvantageous positions of small and medium-size enterprises. In order to do this, by using part of the valuables measured in my questionnaire, I developed a so-called supply chain integration ratio used for measuring the rate of integration. I examined, both on supplier and customer side, how the performance of companies in food industry is influenced by the rate the integration.

Figure 1.

The role of position in the supply chain and size class in the rate of integration. As the classification by activities of each company, practically indentifying the position of the companies in the supply chain, was available in my research data base, I examined how their positions in the chain influence certain (’soft’ and ’hard’) factors of the integration. For example, can it be stated regarding the examined small and medium-size enterprises that the depth of integration increases or decreases approaching customers? Although the research includes only three levels of the supply chain (producers, wholesalers, retailers), exploring possible correlations is considered a significant result and provides proper basis for formulating further research purposes and for the initiation of even more detailed examinations. In addition, I examined, whether company size classes (small/medium-sized company) have any role in the strength of partnerships established with chain members.
The comparison of the characteristics of partnerships of Hungarian and German SMEs. Further purpose of my dissertation is to compare the characteristics revealed within the range of Hungarian small and medium-sized companies in food industry with the partnership features of the German (within that from Bavaria) SMEs pursuing the same business activities.
On one hand it is important because it provides a benchmark for each feature thus we can know where the small and medium-sized companies in the Hungarian FMCG/food sector are compared to the Bavarian companies. On the other hand, it may provide a benchmark for the Hungarian SMEs, in case my initial assumption that the small and medium-sized companies of the German food industry are on a higher level of supply chain integration (higher level of confidence, more willingness to share information, more mature supply chain management attitude, etc.) than the Hungarian companies.

1.2. The structure of the thesis

In the first step of my review of relevant literature, I will review the relevance and most important Hungarian features of the examined population, small and medium-sized companies as well as that of the environment, food industry, of the review (chapter 2.1.), in order to acquire sufficient knowledge about the sectors for my subsequent supply chain examinations. Then, after the review and interpretation of several definitions, I will create my own supply chain management definition. (chapter 2.2.2.). Stadtler and Kilger (2008) collected the functional and structural criteria of the chains for the characterization of the supply chains of a certain sector (chapter 2.2.3.), which I will supplement with a third group set up by the characteristics of integration (partnership relations) (chapter 2.3.2.). For the establishment of this group of characteristics, I will review those factors,

which have a crucial role in the strength of the integration between the supply chain members. I will put a special emphasis on the role of sharing information (chapter 2.3.3.) and confidence (chapter 2.3.4.) in supply chain partnership relations and on the effect thereof on company performance (chapter 2.3.5.), as well as on the significance of power relations between chain members (chapter 2.4.)

Based on previous research results I will present the potential advantages and difficulties carried by supply chain management and cooperations within chains for small and medium-sized companies and the way it influences their performance. (chapter 2.5.).
Subsequently, I will review the main characteristics of the Hungarian food industry (chapter 2.6.1) with regards to supply chains. Although the range of relevant Hungarian literature is not particularly wide, I will describe the supply chains of the food industry by the use of these sources, based on the previously presented functional, structural and integrational criteria groups set up by me (chapter 2.6.2.).
After the review of the topics of relevant literature in connection with my dissertation, I will introduce the method of my research, which is a survey done in the range of companies from Hungary and Germany by personal interviews on questionnaires, and I will also outline the most important objectives of individual questions of my questionnaire (chapter 3.1.). I will present the steps and features of establishing company samples (Hungarian and German) and I will interpret the applied performance indicators (chapter 3.2.). In addition, I will introduce my research hypotheses (chapter 3.3.) and briefly the theoretical background of statistical methods applied later (chapter 3.4.).

Subsequently, I will introduce the results received from hypothesis testing (chapter 4.), consisting on one hand of the detailed description of research results based on Hungarian samples, on the other hand of the comparisons to the conclusions drawn from the surveys in Germany. Finally, on the basis of the research results, I will draw up my conclusions and suggestions.

2. MATERIAL AND METHOD

The research presented in my dissertation is of descriptive and analytic nature as its basic purpose is to describe the behaviour of certain companies, as well as to reveal the cause and effect relationship between the examined factors. In addition, my research is a single cross-sectional research, as I have taken sample from the population only once and information thereof provides the basis of the analysis.

2.1.The sample of companies

Such small and medium-sized companies may be classified into the population of the research (by which I mean companies employing minimum 10 and maximum 249 employees), which deal with the production, wholesale (463) and retail (472) of food (10), drinks (11) and tobacco (12) in FMCG/Food sector. In the Hungarian food industry 1.855 small and 422 medium-sized companies operated in the year of the search of the questionnaire (2011). In the same size classes 20.000 small and 4.800 medium companies operated in Germany. The distribution of population (signed by grey background) based on size class and activities in presented by table 1.

Table 1.

The data base compiled by myself, contained slightly more than 600 Hungarian and 500 German small and medium-sized companies in food industry. The Hungarian questionnaires were filled in by face-to-face search, by the help of interviewers (previously prepared students of logistics). Companies in Germany returned the questionnaires filled in by them on-line, after consultations by phone. The

questionnaires were filled in by a strategic leader (mostly logistics managers and executive directors) of each company. I have found 196 Hungarian and 32 German questionnaires appropriate to be evaluated from nearly 450 questionnaires returned by Hungarian companies and 60 questionnaires returned by German companies. In accordance with this, the subsequently presented results are based on the data of 196 companies in the case of Hungarian companies (N=196) and 32 companies in the case of German SMEs (N=32).

By the comparison of the companies of the two countries I joined the two samples in order to provide comparability. I used random sampling for the development of the complete (joined) sample.
I regard the composition of the sample suitable for doing my examinations as the distribution of the companies in the sample by company activity sectors (position in the supply chain) properly represents the population, illustrated by Figure 2. The composition of the sample meets the criteria to be able to extend the conclusions I made about the integration differences of certain levels of the supply chain to the entire population.

In order to do the targeted examinations, I collected secondary data as well, calculating the performance indicators (ROE, ROA,ROS) of companies in the sample thereby. As the search (sampling) of the questionnaires was done in 2011, the sources of data used for the calculation of performance indicators were the annual reports of companies for the year 2011. Information from the balance sheets, profit and loss statements and supplementary notes of Hungarian companies was available on the electronic report portal of the Ministry of Public Administration and Justice, while in the case of the German companies it was available on the webpage of the German Ministry of Justice (Bundesministerium der Justiz, Bundesanzeiger Verlag).

Figure 2.

2.2. Research hypotheses

During my research I formulated six hypotheses, some of which I broke down to further sub-hypotheses. The hypotheses of my dissertation mainly deal with the factors of partnership relations determining supply chain integration, with the connection between integration and company profitability, and they also involve comparative research about the similarities and differences between the integration of Hungarian and German small and medium-sized enterprises. I created the first four hypotheses (H1, H2, H3 and H4) about the sample made from Hungarian companies exclusively.

My first hypothesis (H1) examines whether the operation of systems based on the pull principle, which requires close cooperation, (stocking by suppliers (vendors) /VMI/ and delay) influences the performance of companies.

H1. Those Hungarian small and medium-sized companies, which supply their customers by the application of supply chain methods based on the pull principle (VMI, delay), operate in a more profitable way.

H1.1. Those Hungarian small and medium-sized companies in food industry, which manage the stocks of their customers themselves (application of VMI), operate in a more profitable way.

H1.2. Those Hungarian small and medium-sized companies, which supply their customers by the application of the method of delay, operate in a more profitable way.

The second (H2) of the dissertation examines the connection between the degree of integration between the supply chain members and the performance of the examined companies in food industry. A more detailed presentation of the supply chain integration ratio developed to measure the degree of integration (hereinafter: SCI ratio) is contained by the chapter entitled: 'Results'.

H2. Those SMEs in the food industry, which established stronger integration with their supply chain partners, have higher profitability ratios.

H2.1. Those SMEs in the food industry, which established a higher degree of integration with their suppliers, have higher profitability ratios.

H2.2. Those SMEs in the food industry, which established higher degree of integration with their customers, have higher profitability ratios.

The research objectives of the dissertation included the examination whether the company size (small/medium-sized company) and/or the position in the supply chain (proximity to the customer, to the source of information on demand) influences the degree of integration. In the research the position of small and medium-sized companies in the supply chain is identified by their TEÁOR numbers (food, drinks producers, retailers and wholesalers).

H3. Small and medium-sized companies establish stronger cooperation both with their suppliers and customers.

H4. As we approach customers in the supply chain, the aggregate integration ratio decreases.

The next two hypotheses (H5, H6) already focus on the comparison of the integration features of Hungarian and German small and medium-sized enterprises. The fifth hypothesis (H5) concentrates on confidence, one of the most important 'soft' factors of intercompany relations, in order to reveal differences between Hungarian and German companies. For the measurement of confidence the possibility of comparison between the companies of the two countries is provided by the so-called confidence indicator developed by involving more variables.

H5. German small and medium-sized companies show a higher degree of confidence in their supply chain partners than Hungarian small and medium-sized companies.

H5.1. German small and medium-sized companies in food industry have more confidence in their suppliers than Hungarian small and medium-sized companies.

H5.1. German small and medium-sized companies in food industry have more confidence in their customers than Hungarian small and medium-sized companies.

My last hypothesis (H6) compares the strength of supply chain partnership relations of Hungarian and German companies by the application of SCI ratio.

H6. German small and medium-sized companies are on a higher level of supply chain integration (their aggregate supply chain integration ratio is higher) than Hungarian SMEs in food industry.

H6.1. German small and medium-sized companies establish stronger integration with their suppliers (on supplier side their supply chain integration ratio is higher) than Hungarian SMEs in food industry.

H6.2. German small and medium-sized companies in the food industry establish stronger integration with their customers (on customer side their supply chain integration ratio is higher) than Hungarian SMEs in food industry.

In the next subdivision of this chapter I will provide a brief description of some features of the statistical methods applied in my dissertation.

2.3. Statistical methodology

More types of statistical methods were required by the features and quantity of the collected information as well as by the examination of the established hypotheses. The practical analyses of my dissertation were based on the works of Pallant (2005), Sajtos and Mitev (2007), Tyrrell (2009), as well as that of Huzsvai and Vincze (2012), and the short theoretical review in my dissertation is also mainly based on this literature.

For the justification of the hypotheses formulated in my dissertation I applied the *analysis of variance (ANOVA)* and *the method of linear correlation and regression analysis* and the method of *cross tabulation analysis* from the most frequently applied statistical methods for examining and justifying structures. Furthermore, I applied an asymmetry test (*calculation of 'Eta' indicators*) (besides regression analysis) for the determination of cause and effect relationships between the variables used the during the analysis of variance. From the data compressing and data structure revealing methods I used *factor analysis* in case of more examinations as well. I will exclude the presentation of the theoretical background of the above-mentioned methods from my thesis booklet due to the limited length thereof.

During all my examinations I took into consideration the limiting conditions of the applied methods and examined the fulfilment of the conditions of application of methods. I completed the statistical analyses at 5% significance level of the models regarded as validity criterion. During my research I did the statistical examinations by the help of SPSS 19 programme package, I used the Excel spreadsheets of MS Office software package for the visual presentation of the results.

3. RESULTS

In my dissertation I examined more factors of the integration features of the small and medium-sized enterprises in food industry. Here, however, due to the limits of length, I will only present the results of more complex examinations thus I will exclude the general experience of the questionnaire survey.

3.1.The connection between pull systems (VMI, delay) and company profitability

If we examine the attitude of Hungarian companies towards modern supply chain methods, we can state that the modern principles examined by us are applied at a higher rate on suppliers' side. The application frequency of modern supplier solutions in the examined Hungarian SMEs is practically equal to the result of the research done by Nyhuis and Hasenfuss (2006) on German small and medium-sized enterprises, who considered the approximately 20-25% rate of application quite low.

According to my first hypothesis (HI), those Hungarian small and medium-size enterprises who supply their customers by applying supply chain methods based on the pull principle operate with higher profitability. I tested the statement regarding supplier stocking and the method of delay by the analysis of variance. As shown in table 2., significant difference can be recognized between small and medium-sized enterprises applying supplier stocking and delay and those who do not apply such supplier methods in the return on equity (VMI F sig.: 0.000, delay F sig.: 0.007), return on assets (VMI F sig.: 0.000, delay F sig.: 0.023) and return on revenue (VMI F sig.: 0.000, delay F sig.: 0.046)

Table 2. shows the average value of each indicator according to categories (applies/not applies).

Table 2.

Based on the above examinations significant differences can be found in the examined relations, however, it is not proven whether the application of the methods results in higher productivity indicators or companies who operate more profitably decide on introducing and applying these methods. Revealing this cause and effect relationship shall be done in subdivision 3.4., the cause thereof is that a cause and effect relationship shall also emerge in subdivision 3.3. and I consider it reasonable to reveal these relationships at the same time from the aspects of length and transparency as well.

3.2. Developing the supply chain integration ratio

My objective, regarding the development of supply chain integration ratio, was to present the highest possible number of partnership variables measured by the questionnaire in the ratio to make the explanatory power of the model acceptable for reflecting the degree of integration reliably. I planned to include more types of variables in the ratio, by help of the method of factor analysis (where it was necessary), subsequent to the standardisation of variables. In order to achieve better matching, I removed the distorting and/or not relevant variables from the ratio both on supplier and customer sides thus the remaining variables (table 3.) already show the degree of integration homogeneously on the input (supplier SCI) and output (customer SCI) sides as well.

Table 3.

In order to be able to characterize the degree of integration by a single ratio (aggregate SCI) (independently from whether it rather belongs to the customer or supplier side), I measured the distance of each individual from the origin in the dimension of supplier and customer SCIs. Figure 3. shows those four categories in which the companies examined by me can be classified depending on the degree of supplier and customer supply chain integration. I denominated them in the following way:

- *SMEs committed to integration:* small and medium-sized enterprises belonging to the first quarter of figure 3. (29% of Hungarian companies), their integration rate is high both on supplier and customer sides of the supply chain (the farther they are from the origin, the higher it is).
- *Supplier-oriented SMEs*: these companies can be found in the second quarter of the plane (20% of the companies), their integration rate is positive on the supplier side, but negative on the customer side.
- *Customer-oriented SMEs*: interviewed companies in the fourth quarter, whose integration is high on customer side, but low on the supplier side (19% of the interviewed Hungarian companies).
- *Non-cooperating SMEs*: companies in the third quarter, both integration ratios thereof are low (32% of companies).

For the preparation of appropriate statistical examinations, I assigned a nominal scale to the metric values of the received ratios. For this, I divided the variables into three along their terciles, and I determined the low, medium or high evaluation of the ratio. Categorization of SCI ratios is necessary

to be able to make certain analyses and comparisons in a more efficient way. Moreover, this technique makes graphic presentation and interpretation thereby easier.

Figure 3.

3.3. Effect of supply chain integration on the performance of Hungarian SMEs

Developing supply chain integration ratio on supplier and customer side as well as an aggregate one, made the testing of my second hypothesis (H2) possible, that such SMEs in the food industry who established stronger integration with their supply chain partners have higher profitability ratios. I examined this statement not only with regards to the SCI ratio, but also regarding integration on supplier side (H2.1.) and customer side (H2.2.) separately. My hypotheses were tested by the analysis of variance (ANOVA), the results thereof are shown by figure 4.

Figure 4.

From the examined profitability ratios ROE (F sig.: 0.023) and ROA (F sig.: 0.032) show significant connection with the aggregate SCI ratio of the examined SMEs in food industry. This means, that the ROE and ROA values are significantly different in each category of the aggregate ratio. If we examine the connection between profitability and the degree of integration on the supplier side, we repeatedly experience that return on assets of examined SMEs (F sig.: 0.007) and return on equity (F sig.: 0.034) are significantly different in each supplier SCI category. However, in the case of supply chain integration ratio on supplier side, only the values of ROE are significantly different in each category of the ratio (F sig.: 0.042). All significant connections are linear and have positive directions. At the same time, the question arises, whether (as in subdivision 3.1. as well) higher degree of integration results in higher profitability or the otherwise also competitive, more profitable companies are more willing to establish strong supply chain cooperations? I will provide a detailed examination of the question in subdivision (3.4.).

3.4. Examination of the cause and effect relationships of correlations related to company performance

The objective of the present subdivision is to confirm the results of my examinations done so far regarding my first (subdivision 3.1.) and second (subdivision 3.3.) hypotheses, as well as to determine the directions (cause and effect relationships) of the revealed correlations.
According to the most simple explanation, (Freedman et al., 2005) in the case of mixed connections, qualitative variables form the cause, quantitative (interval) variables form the effect. In my dissertation, in case of testing the above-mentioned correlations I used the analysis of variance based on such mixed connections to test my hypotheses, where the quantitative variable is to be considered dependent (cause) and the qualitative is the independent (effect) variable. (Northcott, 2008, Morgan et al., 2011) In this respect, I consider the direction of causation according to the theses proper, at the same time, I will justify this more efficiently by further examinations (two methods) in the subdivision below.

As the first step of the determination of the cause and effect relationships of the connections proven before, I prepared a linear regression model, including the variables I measured the profitability of the companies by (dependent variables) and those, which I assume, determine the profitability of the companies (independent variables). According to the result of the regression model, (which I do not show here in detail due to the limited length of my study) the aggregate integration ratio, confidence on customer and supplier side as well as the application of VMI on customer side have crucial role in

the changing of the ROA ratio, while confidence on supplier and customer side and application of VMI on output side show significant connection with ROE ratio. The above-mentioned variables determine 20.2% of the change of ROA ratio, the other 79.8% comprise factors besides the variables of the questionnaire (involved in the model). The regression equation of ROA ratio can be written out in the following way:

Formula

According to the regression model there is significant connection between the aggregate SCI ratio and the ROA ratios, but there is no connection between the aggregate SCI ratio and the ROE ratios.
I applied the analysis of variance for the first examination of the H2 hypothesis, where I measured the SCI ratio on nominal scale thus it was a categorical indicator. However, I applied regression in case of the analysis described above, where I interpreted and handled the aggregate SCI ratio as a metric (continuous) variable. By the categorization of aggregate SCI ratio (by converting the metric scale to a nominal one) the 'fineness' (high resolution) of data disappears, becomes simple (by this it also goes with the loss of data) thus connection not occurring in metric data becomes somewhat stronger in the simplified nominal structure so here differences appear. This explains the fact that results differ by the two methods, that is, in case of the analysis of variance there is significance connection between the aggregate SCI and ROE ratios of the companies, while this connection cannot be shown by the application of regression.

Based on the results of the regression model I have made two important conclusions. On the one hand, the direction of the examined connections could be seen, that is, higher degree of integration (aggregate SCI) causes higher profitability, and the application of VMI on customer side results in higher profitability ratios, not vice versa. At the same time, no connection could be proven between delay on customer side and profitability by regression. The other important conclusion is that the correlation "higher degree of integration results in higher profitability" can be shown not only by the examination of SCI as categorical variable (nominal), but also by its application as continuous (metric) variable.

For the determination of cause and effect relationships I calculated so-called 'Eta' (η) indicators in the second step, to which the variables had to be converted to nominal scale. In my case the cause and effect examination is necessary for the application of VMI and delay on customer side in relation to profitability as well as for the degree of integration (SCI ratio) in relation to profitability. As VMI, application of delay on output side and the degree of integration variables have been measured on nominal scale so far as well, only profitability variables had to be converted.

Values of (η) ratios are shown by table 4. The value of ratios refer to the strength of the connection and two values can be found in the table regarding each connection, supposing that either one or the other ratio has the role of the effect. The value of ratios is typically not too high, but in this case not the justification of the existence of the connection, rather the orientation about its direction is important to me. Based on the results of the calculations, the role of effect is fulfilled typically by performance indicators (green background), while SCI ratios and application of VMI on customer side have the role of cause. However, the application of delay on the side of output is rather an effect (red background), against other variables, that is, companies operating in a more profitable way apply the method of delay in the direction of their customers at a higher rate.

Table 4.

The associative examinations made above, had results similar to the previously presented regression, that is, the higher degree of variables, which I consider independent variables, result in higher profitability ratios. An exception thereto is the application of delay on customer side, which rather has the role of effect.
In view of the above results and the results of subdivision 3.1. **I regard my first hypothesis (H1) only partly justified**, as the analysis of variance and results of the examinations to reveal cause and effect relationships justified that such small and medium-sized enterprises supplying their customers with the application of the principle of stock management by supplier (vendor) (VMI), operate in a more profitable way. The same cannot be stated in case of applying delay on customer side.
Although the results of the analysis of variance justified that the difference between SMEs applying and not applying the method is significant in the case of all three examined profitability ratios, at the same time, the connection (based on the results of the association examination) is probably reverse.
That is, companies operating in a more profitable way decide to introduce the method, and it is not introduced by the companies to operate in a more profitable way. In view of the above**, I regard my H1.1. hypothesis justified, and I reject my H1.1. hypothesis.**

Summarizing the results of the connection between the degree of supply chain integration and profitability, we can state that **my second hypothesis (H2) was justified**, that is, companies with a higher degree of integration both on supplier and customer side are able to achieve higher profitability and more effective operation. Even if we were not able to show significant differences in the case of one of the two profitability ratios (ROE) by one of the examination methods (regression). In addition, **my H2.1. partial hypothesis**, according to which those SMEs in FMCG/Food sector having suppliers better integrated on the supplier side operate more profitably (differences between each supplier SCI category are significant in the case of both examined profitability ratios, ROE and ROA and cause and effect relationships are also justified**.) was also proven. I regard my second partial hypothesis (H2.2)** belonging to the examination **only partly justified** as in case of customer side integration only one of the performance ratios (ROE) shows significant differences, in addition, the direction of connection is in compliance with previous assumptions.

3.4. The role of company size in the degree of supply chain integration

During my research I wanted to ascertain that the assumption of company size influencing the degree of integration is right. In order to do this, I formulated my third hypothesis (H3), according to which medium-sized companies establish a higher degree of integration with their suppliers and customers as well than small companies. I assumed that medium-sized companies have more mature attitude to supply chain management thus managing cooperation in the chain has a (bigger) role in their corporate strategy.

I have done the comparisons with regards to size categories limited by staff number and net revenue as well. I have checked the hypothesis by both metric SCI ratios (ANOVA. table 5.), and nominal ratios (association strength, Cramer Test V, table 6.)

Table 5.

I received similar results in the case of both examinations either by the use of staff number or net revenue as the basis of establishing size categories. In the distribution of the individuals of the sample (small enterprise/medium-sized enterprise) from the examined two supply chains only the customer SCI is significantly different. In the case of metric ratios F sig.: 0.046, in the case of nominal ratios the Cramer V test value refers to weak (0.181), but significant (0.040) relationship. Starting from the net revenue, in the case of metric ratios F sig.: 0.015, in the case of nominal ratios the Cramer V test

value refers to medium strong (0.309), significant (0.003) relationship. No significant difference can be shown on the supplier side in the integration ratio of small and medium-sized companies either grouping them on the basis of staff number or that of net revenue.

Table 6.

In view of the above results it cannot be surely stated that medium-sized companies in food industry are on a higher level of integration in the supply chain than small companies. At the same time, it is proven that medium-sized companies establish stronger relationships with their customers than small companies, that is, **my third hypothesis (H3) was justified as well.**

3.5. The role of position in the supply chain in the strength of the integration

According to my fourth hypothesis (H4) the aggregate integration ratio of companies decreases approaching towards the customers in the supply chain. I examined this statement with regards to the integration ratio on the output and input side as well in order to be able to interpret the results received about the aggregate integration ratio better and more exactly. Although food and drinks producers are situated on the same level (producers) of the supply chain, I have separated them. The reason for this is that if I can successfully justify my hypothesis, I can determine the integration features of the four groups (food, drinks producers, wholesalers, retailers) based on the variables in the SCI ratio.

According to the results of the analysis of variance necessary for the justification of the hypothesis, in the integration ratio (aggregate SCI) there is significant difference (F sig.: 0.036) between each level of the supply chain. In the case of SCI on customer side (F sig.: 0.008) there is significant difference, at the same time, in the case of SCI on supplier side we cannot mention significant difference. Figure 5. illustrates perfectly that supply chain integration is high in the case of drinks production (with respect to all three indicators), in the case of food producers it is medium (the value near zero indicates this), in the case of wholesale it is also medium and in the case of retail it is the lowest.

In view of the above results **my hypothesis has been justified** as the aggregate integration ratio **(H4)** decreases approaching the customer in the supply chain. (The same can be concluded about the supply chain ratio on customer side.) Based on this, we can characterize SMEs in food industry involved in the examination, based on the variables of partnerships in the supply chain by different 'integration patterns', characteristics shown by table 7.

Figure 5.

By most of the variables in the integration index I experienced that they follow the tendency outlined on the basis of aggregate SCI ratio. (table 7.) Where I experienced little difference between each level of the supply chain, I indicated the tendency by broken line, where the difference is bigger, I used continuous arrow. Exceptions to the decreasing tendency are VMI and delay, in addition, the decreasing tendency does not appear by the frequency of the distribution of knowledge and experience, which integration ratio is not characteristic in case of either sector anyway. By these variables I indicated by dotted line that the above-mentioned tendency does not appear. Regarding table 7. I have to note that I added the variables of informal control, calculating the average of the responses to the questions. This variable has to interpreted in the opposite way as the lower its value is, the higher is the level of confidence in the partners (it is shown by the reverse arrow.) Based on the examination of the results of the connection between the aggregate integration ratio and the position in the supply chain, I recognized the following characteristics of the integration with regards to the individual participants.

Drink producers: there is a high rate of applying the VMI method both on input and output sides and they can be characterised by strong willingness of risk and information sharing. They share a high rate of information with their supply chain partners by electronic data sharing (EDI). All these show well that they establish strong cooperation mainly with their customers where they focus on the durability of the relationship, the periodical supervision and evaluation of communication and relationship with the partner. Drink producers typically trust their partners, which is well presented by the fact that exercising control over their partners is not a characteristic feature of them. They did not formulate special expectations of strengthening supplier and customer relationships, that is, probably they are contented with the cooperations they established.
Food producers: the strength of integration on suppliers' and customers' side of food producers typically applying modern supply chain methods at a medium rate is closer to that of wholesalers than drink producers. Their characteristics are very similar to the integration features of wholesalers, but in their case the durability of the cooperation with the their customers and the evaluation and development of partnership relations has a bigger role and they have higher confidence in their customers. For developing their customer relationships they consider their customers' meeting their deadlines precisely, signing longer-term supplier contracts and establishing common information systems important. They regard, from their expectations from their suppliers, the more efficient way of handling problems, the flexibility of partners and establishing common information system the most important.

Wholesalers: in spite of having lower aggregate integration ratio than that of producer companies, interestingly, they apply the method of VMI and delay at a high rate both on input and output sides. 'Soft' integration factors (confidence, evaluation of relationship, communication) are not considered too important by them. They also indicated meeting payment deadlines as an important expectation from their customers, and they require the realization of common innovation. Furthermore, they would like to know the strategic objectives of their customers in order to make cooperations more effective. Besides, they require risk sharing with the suppliers and they would improve the precision of their suppliers as well as their the compliance with food safety regulations.

Table 7

Retailers: retailers can be characterized by the lowest integration on customer side. On output side they can be characterized by lower level of confidence, information and risk sharing, their customer relationships are weaker. Their lack of confidence in their customers is illustrated well by their control of partners more often than companies operating on other levels of the supply chain. They formulated two important expectations from their customers: providing benefits and relatively stable purchase prices.
Their supplier integration ratio is higher than that of wholesalers and approximates to food producers. Higher supplier integration is due to higher confidence in suppliers and higher rate of application of modern supplier chain solutions on input side. Although they have stated to have confidence in their suppliers, most of them emphasized the higher degree of confidence, establishing confidence relationships as their most important expectations from suppliers. In addition, they regard such supplier developments, which improve their compliance with the requirements of traceability important.

3.4. Comparison of Hungarian and German research results

I examined two important factors by the comparison of Hungarian and German small and medium-sized companies in food industry: on one hand, by highlighting the degree of confidence from the factors of integration, on the other hand, the degree of integration (Hungarian and German companies

together), I had to develop the supply chain integration ratio once more thereto. However, I have to note that due to the relatively small size of the Bavarian sample (32 companies), results received about German companies can be regarded less well-founded than those of the Hungarian examination. The significance of the subdivision is on one hand in the foreign outlook and in the comparative analysis based on an identical questionnaire and on the other hand in signing the directions of further researches.

I used more indicators for measuring the level of confidence. I regarded acquiring information about companies' scale of formal and/or informal control of their partners both on supplier and customer side important for the determination of the variables of confidence. In addition, I also consider the openness of companies about asking for advice for the development of their corporate processes (including their common ones) a question of confidence (confidence in partner's expertise). Besides, confidence and has a crucial role in sharing knowledge, experience as well as information (especially information on stock) with supply chain partners. I developed two-two ratios (sharing and controlling ratio on supplier and customer side) for indicating confidence.

Figure 6.

My fifth hypothesis (H5) assumes that German small and medium-sized companies in food production show higher degree of confidence towards their supply chain companies than Hungarian small and medium-sized companies. I intersected the above-mentioned customer and supplier confidence factors by the seats of the companies (figure 6.) Having done test F of the analysis of variance I experienced that in the distribution of the group by seats, the variance of companies is significantly different both in the variables of customer (*F sig*.: 0.013), and supplier (*F sig*.: 0.000) confidence.

In view of the results described above we can state that **my fifth hypothesis (H5) is completely fulfilled**, that is, German small and medium-size companies have higher confidence in their suppliers than Hungarian small and medium-size companies (H5.1.), and the same can be said concerning the supply chain customer partner relationships of Hungarian and German small and medium-size companies (H5.2.) as well. In consequence of the low degree of confidence, cooperations of Hungarian SMEs are less durable (it is also reflected by the answers to certain questions of the questionnaire) and I assume, cooperations can be seen in less strong forms of partnership (for example: strategic cooperations rarely occurs). Consequently, more developed supply strategies (pull supply chain strategies; VMI, delay) requiring strong cooperation, appear at a lower rate by the Hungarian small and medium-size companies. Besides, lower level of confidence in suppliers results in lower level of company performance (see for example, the research results of Panayides and Lun /2009/.

In order to justify my assumption about the strength of the integration of Hungarian and German SMEs, I prepared the SCI ratios developed for the whole sample (supplier, customer and on their basis: aggregate). Having compared the SCI ratios developed from the whole sample with SCI ratios developed from the Hungarian sample, we can experience a high degree of similarity between them. SCI index on customer side contains the same variables in case of the Hungarian and the whole samples as well, while the in case of the SCI ratio of the whole sample contains two variables (length of cooperation, formal control of suppliers) less. The high level of similarity is also shown by the Pearson's correlation coefficients: on supplier side r = 0.986, *sig*: 0.000; on customer side r = 0.957, *sig*: 0.000.
Following the principle similar to the previous one, the degree of integration is expressed by the distance of each individual from the origin in the dimension of customer and supplier SCIs (figure 6.). The already presented integration groups based on the integration ratios including companies of the two countries are the following:

- *SMEs committed to integration*: 26% of Hungarians, 37.5% of Germans.
- *Supplier-oriented SMEs*: 15.8% of Hungarians and 21.8% of Germans interviewed.
- *Customer-oriented SMEs*: 21.5% of Hungarian, 12.5% of German small and medium-sized enterprises.
- *Non-cooperating SMEs*: 36.7% of Hungarian, 28.1% of German companies.

Having done the sample tests of the analysis of variance necessary for the justification of the hypothesis, I experienced a significant difference between the degree of supply chain integration of German and Hungarian companies on supplier side (*F sig*.: 0.000) and between their aggregate integration ratio (*F sig*.: 0.001) At the same time, difference on customer side is less significant. Thus the difference between Hungarian and German companies is significant statistically as well, which is also well illustrated by figure 7.

Figure 7.

I have made the following conclusions based on the aggregate SCI ratios of the small and medium-sized enterprises in the food industries of the two countries:

- The application frequency of the modern supply chain solutions, principles shows a mixed picture. Application frequency of VMI is nearly the same regarding the companies of the two countries, either on input or on output side. The method of delay is applied at a higher rate by German companies and risk sharing appears at a higher rate at Hungarian companies, although the difference is not significant. There is significant difference in the application of EDI as it is nearly 16% on supplier and a bit over 20% on customer side. The same in the case of German SMEs is 24% and 31 %. Providing the transparency of costs is not characteristics of the companies of either country.

- One of the main reasons of the difference in the integration ratios is *the characteristics of partner relationships in the supply chain*. While in the case of Hungarian SMEs relationships of medium strength are dominant both on supplier and customer side, German small and medium-sized companies operate in typically strong forms of cooperations, for example in the frame of strategic alliances. The ratio of participation in strategic alliances in the case of German small and medium-sized enterprises is 34% both on supplier and customer side in contrast with the 5% and 8% we can experience by Hungarian SMEs.

- The conclusion that German companies can be characterized by longer-term partnership relations then Hungarian companies is related to the above statement. The rate of supplier relationships with the duration of more than 3 years is a bit more than 60% by Hungarian companies, by German SMEs it is nearly 74%. In respect of customer relationships the difference is even more marked: cooperations with the duration of more than 3 years constitute 47% by Hungarian companies and 74% by German companies.

- Hungarian companies find communication with their partners and *common evaluation of their cooperation* less important. Evaluation can typically be made on the basis of practical experience as the companies of neither country find the development and application of *performance indicators related to cooperations* particularly important.

- Either by the use of previously presented confidence indicators or that of the variables contained by the integration ratio, we can experience that Hungarian SMEs are considerably behind concerning *confidence* . (it can also be experienced by looking at the variances of confidence separately.)

- If we look at the *expectations* of the examined companies *from their partners in the chain*, we can experience interesting differences. Hungarian companies, unlike the Germans, expressed several objections, which can be categorised in two groups. On the one hand they mentioned their expectations about common activities, objectives (common developments, common information system, stabile, longer-term cooperation, establishing relationships based on common confidence), on the other hand those by which they are able to improve mainly their own operation (flexibility of partner, information from partner). German companies typically formulated such expectations that can improve the operation of more members of the chain, for example: developing the transparency of processes and costs in the chain, unifying the systems of traceability.

- Based on the previous examinations we can state that German small and medium-sized enterprises are on a higher level of integration than Hungarian SMEs thus **my sixth hypothesis (H6) is fulfilled.** By the examination of supplier and customer side separately, I experienced that German small and medium-sized enterprises establish significantly stronger integration with their suppliers (H6.1.) than Hungarian companies (H6.2.) Hypothesis H6.2. cannot be justified, although there is difference between German and Hungarian SMEs on customer side as well, it is not significant (*F sig*.: 0.101).

4. NEW OR NOVEL SCIENTIFIC RESULTS

More scientific works deal with the operation of supply chains in food industry, several studies have the objective of measuring the degree of supply chain integration and we can also find such examinations targeting the relationship between the SMEs and supply chain management. At the same time, the topic of my dissertation is situated in the intersection of the above areas of investigations, filling up the void constituting the examination of the partner relationships and integration of small and medium-sized companies in the supply chain. During my research I have formulated the following new and novel scientific results:

1. By the application of variables measured in my research questionnaire **I developed a supply chain integration ratio**, by which the strength of cooperation of each company with its supply chain partners can be measured. The developed ratio can be obtained by integration ratios on supplier and customer sides. As *variables contained by the ratios are not sector-specific*, their objective is

to measure the degree of integration in general, *they can also be applied in other sectors*. As variables contained by ratios on input and output sides are nearly identical, they provide the opportunity to compare cooperations on customer side and to reveal the emphatic and less essential elements of the supply chain partnerships of small and medium-sized enterprises in the food industry. I have classified the examined SMEs by the development of the ratio into four groups depending on the degree of their integration on the supplier and customer side, specifying thereby the rate of the *four supply chain integration strategies* determined by the ratios (*commitment to integration, supplier-oriented, customer-oriented non-cooperating SMEs*) characterizing small and medium-sized enterprises.

By the application of two statistical methods I justified that a **higher degree of supply chain integration is accompanied by higher profitability** for small and medium-sized companies in the food industry. Thus strengthening supply chain partnerships can mean a kind of 'way out', but at least help for the members of the SME in the difficult situation characteristic thereof. By the integration ratio on the supplier and customer side I justified that companies of the examined sector are able to obtain significantly higher performance by increasing the degree of integration on supplier or customer side separately. I have shown by breaking down the supply chain ratio to factors *the areas where companies should reconsider their corporate strategies*: mainly confidence in their partners should be strengthened, investments in modern supply chain solutions should be undertaken and establishing long-term partner relationships based on communication and the evaluation and development of cooperation should be targeted. Emphasizing one of the factors of the supply chain integration ratio I separately examined the way profitability of the examined companies is influenced by the application of supplier stocking on customer side. I justified that ***such small and medium-sized companies of the sample operating in the food sector, which supply their customers by the application of the method of VMI, are able to achieve higher profitability.*** (it was justified by three profitability ratios as well). Although the effect of the above-mentioned pull method on profitability has already been examined by several researchers, the novelty of my research results lies in my revealing of the above-mentioned connection with regards to the participants of the SME sector in food industry and that being significantly influenced by the characteristics of the sector. (dominant role of retail chains and its consequence, characteristics of the products, etc.) Consequently, the above-mentioned method can be applied by less companies, which makes research more difficult.

2. **I proved that company size and position in the supply chain has influence on the strength of integration.** One of the new approaches of my dissertation is examining the degree of supply chain integration depending on their position of the companies in the supply chain. During the examination – by the application of integration ratio – I found that a *tendency of decreasing integration ratio of small and medium-sized enterprises from producers (including drinks and food producers) through wholesalers to retailers can be justified* in a given stage, including three operators, of the supply chain. By breaking down the integration ratios to their factors, I determined 'integration samples' with regards to small and medium-sized companies in the food industry included in the sample, which each level of the supply chain can be characterized by. Thus *I identified the strongest integration links and the deficiencies that can be detected on each level of the supply chain.* By breaking down the ratio to variables I presented the way, among others, the

degree of certain ’soft’ factors (e.g.: confidence, common evaluation of partnership relations) as well as the application frequency of ’hard’ factors (e.g.: electronic data exchange or application frequency of risk sharing methods) decreases. In addition, I justified that the decreasing tendency of the degree of integration from the upstream towards the downstream stage in the case of partnership relations on customer side is even more significant than in case of the aggregate integration ratio.

I proved that **Hungarian medium-sized companies in the food industry cooperate with their suppliers at a higher degree of supply chain integration than small companies.** I justified my statement in the case of limiting size category by staff number and net revenue as well. The same could not be proven with regards to supplier relationships. That is, size has an effect on the strength of integration on the output side of companies in the examined industry.

3. I prepared the comparative analysis of the degree of supply chain integration of Hungarian and German (Bavarian) small and medium-sized companies in the food industry. However, by the evaluation of the results we have to bear in mind the relative small number of individuals in the German sample compared to the Hungarian sample and to the German population. Although the received results have be treated by reservations, the revealed differences are so significant, in spite of the low number of individuals in the German sample, that they outline the factors in which Hungarian SMEs in food industry are behind quite well.

   During the comparative analysis I statistically justified that **German companies have a higher degree of integration.** I stated that the above-mentioned correlation is especially true about the partnership relations of companies with their suppliers. On the basis of all these, I determined *such integrational (related to partnership relations) factors in which German companies surpass participants of the Hungarian SME sector*. By comparing the integrational features of the companies of the two countries I concluded that such differences are basically due to the objectives of partnership relations (shorter term, company-focused attitude/ longer term, thinking in chain) and confidence in partners. By empiric analysis I proved that *Hungarian small and medium-sized enterprises in the food industry have lower level of confidence in their supply chain partners compared to Bavarian companies in the sample.* In addition, I showed that the mentioned difference is more significant between the companies of the two countries on supplier side. It is shown by the examination that Hungarian companies more often control the activities of their partners, less often share their information on stocks, knowledge, experience and information on stocks and they do not really ask the opinion of their partners for the development of their own processes.

4. SUGGESTIONS

Based on the experience and research results I acquired during the preparation of my dissertation, my suggestions for the small and medium-sized companies of the Hungarian food industry are summarized in Figure 8.

Figure 8.

One of the most important statements and suggestions at the same time of my dissertation is related to the attitude of small and medium-sized companies in the food industry to supply chain management and to their partnership relations in the chain. Companies of the examined sector regard supply chain management and suiting the requirements of thereof a kind of force; due to their short term attitude, their short-term difficulties and challenges, possible investments push long-term advantages into the background. My research results refer to the fact that the intention of moving into the direction of stronger cooperation exists within Hungarian companies, but it cannot be realized without the appropriate level confidence. The low level of confidence is one of the biggest barriers of increasing the efficiency of supply chains in Hungarian food industry. In my view, *corporate culture should be changed radically from the presently non-cooperating strategy to the direction of a more cooperating strategy, in which there is enough emphasis on the conscious, goal-oriented establishment, maintenance and development of partnership relations.* The companies of the Hungarian FMCG/Food sector mainly focus on the performance of their own companies. This attitude should be changed into such direction that if the efficiency of a given part of the chain improves (better coordinated logistics processes, shorter lead times, lower time cost, better product identification, lower stock levels), individual companies could operate in a more efficient way.

The realization of the above-mentioned may seem simple theoretically, but the practical realization thereof might be hindered. From the aspect of supply chain management small and medium-sized companies are often characterised by strategic (lack in the commitment and expertise of the management, deficient or lacking knowledge of the advantages of having e-support) as well as operative, management and process management (difficulties in the introduction of supply chain methods, applying improper criteria of selecting partners, workforce with low qualification) deficiencies. I find *the goal-oriented training of employees in* the examined range of companies, *in which the knowledge of logistics and supply chain management must have enough emphasis as well as establishing such attitude that extends further than the limits of the individual company* and prepares for meeting the requirements of time-based competition necessary.

The small and medium-sized companies of the Hungarian food industry must move from the typically distant relationship to the direction of committed partner relationships as it was justified by my research that *stronger cooperation is accompanied by higher performance*. To this, *they must find such fields of integration*, processes where relationships must be deepened in order to cooperate successfully. A successful partnership relation does not mean the strongest possible cooperation in the most possible fields, but the proper selection of those fields the linking thereof is beneficial for both partners. Confidence has crucial role in this process as without the proper level thereof cooperation is doomed to failure. In my opinion, *SMEs in the Hungarian food industry first must create a climate of trust within the company, which the establishment of confidence with supply chain partners can be build on.* Companies must be aware that confidence is a long-term, two-way process thus they must set aside their short-term, profit-oriented attitude.

Meeting the expectations of the dominant member of the chain can also be accompanied by benefits for SMEs, at the same time, it often requires significant additional investment from small companies, in which they can see not long-term profitability and the possibility of extracting further profit, rather the difficulties and force. At the same time the suggestion can be formulated for such small and

medium-sized companies operating as suppliers of bigger companies (and the nature of the product to be supplied as well as the partner makes it possible) that *they should make investments into such infrastructure supporting supply, which are based on modern supply principles (for example VMI) and EDI systems supporting such principles. In my opinion, investments supporting supply chain management may be realized reasonably by the application of external* sources (for example, Development Credit Programme for the participants of SME sector.).

For the small and medium-sized companies of FMCG/Food sector the research results of my thesis may be prevailing in the realisation of integration processes also from the aspect that *integration links on the individual levels of the supply chain can be different thus establishing different integration strategy on each level is recommended.* Food producers have to develop in the field of 'hard' integration factors, consequently they should increase the rate of application of more developed provision principles, in addition, they should put more emphasis on the development of common information systems on input and output sides as well. Wholesalers are recommended to put more emphasis on 'soft' integration factors and common developments, innovation activities. The broader awareness of the strategic objectives of their suppliers and customers could develop their operations. Retailers are also recommended to develop 'soft' partner relationship factors, mainly to increase confidence in their partners, and improve traceability in the relationship with their suppliers and retailers.

Based on the results of the comparative analysis of Hungarian and German small and medium-sized companies, by the expansion of the developed supply chain integration ratio, the determination of such supply chain integration benchmarks would be beneficial to the Hungarian companies, their supply chain relationships could be strengthened by targeting thereof. Naturally, the proper selection of partners must obtain an important role in this process, Hungarian SMEs must have clear objectives and proper partner selection criteria therefor.
Supply chain integration of small and medium-sized companies could be largely helped by establishing such forms of cooperations, 'clusters', (such types are for example, clusters in the automobile industry) providing opportunity for the realisation of benefits from sharing knowledge and experience, as well as for learning from bigger companies. Such *new forms of cooperations* can increase willingness for innovation and can help the faster and more efficient adaptation and application of different supply chain management methods.

In my opinion, besides the several integration factors mentioned above, a key element of the long-term supply chain relationships is *the evaluation of the relationships from time to time together with the partners*. This has a specially important role in the business environment typical of nowadays, which can be characterized by fast changing market demands, rapidly developing technology and increasingly complex supply chain networks. I find it important to develop such relationship-specific ratios (quantifiable or even non-quantifiable), which can describe the efficiency of common activities.

Summarising the above concepts, I would like to emphasize that surviving for small and medium-sized companies in the food industry and operating efficiently is not easy due to the specific power relations (dominance of retail chains), the increasing expectations in the field of food safety, and the increasingly intense competition in the sector. At the same time, supply chain management, strong

cooperation based on confidence can be the keys of success for the participants of SME sector. However, it requires the change of attitude, goal-oriented training and reconsidering corporate strategy, in which cooperative attitude reaching beyond the borders of their own companies should have an emphatic role.