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Country and industry factors as determinants of corporate financial liquidity in the European Union countries

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Abstract

Financial liquidity is considered as one of the most important features of corporate performance. This study is meant to verify whether the short-term solvency depends more on the specific features of the country, where an enterprise operates, or whether it is more heavily influenced by the industrial factors. The relative importance of the industry and country effect in financial liquidity ratios is evaluated with the use of multivariate statistical methods, involving mainly cluster analysis. The study involves 13 industries in 10 European Union countries, including Poland in the period 1999–2005. The study is based on the harmonised and aggregated financial reports from the European Commission BACH database. Findings provide empirical evidence that industrial factors constitute a more important determinant of corporate financial liquidity than country-specific factors. The results of the analysis may be useful for optimising investment diversification strategies.

Keywords: industry effect, country effect, financial liquidity

JEL: G32, L25, O52

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1. Introduction

The aim of the study is to analyse the influence of industry and country factors on corporate financial liquidity parameters in the selected European Union countries. The analysis is also meant to compare the intensity of these two kinds of factors and therefore to establish the relative importance of the industry effect and the country effect in financial liquidity. The industry effect can be interpreted as the occurrence of certain factors specific for a particular industry and therefore affecting economic entities of that industrial sector in a similar way (Dempsey, Laber, Rozeff 1993, p. 4). The country effect is interpreted likewise. Therefore, the main scientific problem of the research is to verify which of the two above-mentioned factors has a larger effect on corporate short-term solvency.

Corporate financial liquidity can be considered in two basic aspects, i.e. in terms of assets liquidity and in terms of assets-to-liabilities relationship. Financial liquidity in the first aspect refers to the convertibility of assets into cash. The other aspect of financial liquidity is related to the fact that assets are treated as a guarantee of liabilities payment. Therefore, depending on the urgency of liabilities payment, two kinds of liquidity can be distinguished:

– long-term solvency – referring to the long-term surplus of assets over liabilities;

– short-term solvency, also called technical solvency, referring to the company's ability to pay current liabilities on time (Wędzki 2003, p. 33).

Although liquidity is sometimes also considered as the ability to cover unexpected cash expenses (Schall, Haley 1991, p. 736), in the context of the following analysis, the term will be treated as short-term solvency, according to the definition above.

The methodology of the research involves mainly clustering analysis, which allows to evaluate the relative importance of the effects in question by comparing the obtained clustering results with industrial and territorial division of objects.

2. Literature review

The majority of the existing studies concerning the influence of the industry and country factors tend to focus on corporate performance reflected mainly in stock returns. This paper however, is one of the few attempts to determine the influence of the two factors on fundamental ratios, which can be an equally important criterion for investment decisions. It is particularly true in the case of liquidity, as the disruptions in this area often indicate serious financial troubles preceding corporate failure. Another reason for adopting an approach where liquidity is analysed instead of the more common profitability is the fact, that there does seem to be a significant relationship between working capital management and profitability (Lazaridis, Tryfonidis 2006; Garcia-Teruel, Martinez-Solano 2007; Raheman, Nasr 2007; Ramachandran, Janakiraman 2009; Samiloglu, Demiraunes 2008; Uyar 2009; Vishnani, Bhupesh 2007; Deloof 2003). A thorough study of literature on this relationship was made by Gill, Biger, Mathur (2010).

Finding the factors which influence the covariance in stock returns between countries has long been a challenge both for the theory and practice of portfolio management. The early research in this area (Grubel 1968; Levy, Sarnat 1970; Solnik 1974) prove a low correlation between returns

in different countries and provide arguments that the benefits from international diversification outweigh the diversification costs resulting e.g. from higher transaction costs, cultural and regulation differences or political and exchange risk. However the primary reasons for such benefits are not fully explained. Many researchers claim that they result from differences in monetary and fiscal policies, from percentage rate changes, budgetary deficits and economic growth rates. Others believe that the source of regional diversification is the diversity of industrial structures across countries.

Industrial factors were first considered as potential determinants of returns in the 60's. A clear significance of these factors is shown in the analysis of American stock returns (King 1966; Meyers 1973). In the international context the importance of industries was first revealed by Lessard (1974), whose analyses of stock market indices and industrial indices showed the prevalence of the country effect over the industry effect. Grinold, Rudd, Stefek (1989), also confirm these results, although they reveal significant differences depending on country and industry which is expressed in the conclusion that: "Most countries are more important than industries, but the most important industries are more important than less important countries". A major part of the literature favours similar conclusions concerning the dominance of country factors over industrial ones (Drummen, Zimmermann 1992; Beckers et al. 1992; Heston, Rouwenhorst 1994; 1995; Beckers, Connor, Curds 1996; Griffin, Karolyi 1998; Kuo, Satchell 2001).

The only exception within this fairly homogenous literature is the study by Roll (1992), who found industry factors more important. Some broader studies by Beckers, Connor and Curds (1996) show that the industry factors are more significant if the stocks are classified into 36 different industries than if they are classified into just 7 main branches. In each case however, country effects seem to dominate. Moreover, they prove that the European Union member countries are characterised with a significantly higher integration level than other countries. Griffin and Karoloi (1998), who analysed the classification into 9 and then 66 industries, reached the same kind of conclusion. The more detailed classification enhances industry effects. They also introduced the distinction of countries in terms of regions. The inclusion of the most important developing countries in the sample shows their lower level of international integration.

As the correlations are crucial in terms of benefits from international diversification, there have been many attempts to explain which specific country factors are responsible for low correlation levels. Surprisingly, not all of them are directly linked with the international markets' integration. The literature study shows the likely reasons for their low correlation. Some works show that they result from different industrial structures across countries, which is reflected in the construction of stock market indices. As different industries are not correlated, the capital markets involving different industries are not going to be correlated either. According to Roll (1992) the industry factors are of key importance. He suggested three dominating factors responsible for the volatility of return from domestic portfolio: technical index construction, industry structure reflected in the index and exchange rate changes. The study involving daily data for 24 domestic indices from April 1988 to March 1991 shows that industry factors explain about 40% of returns volatility, whereas exchange rates – about 23%. It is argued however, that these results strongly favour the industry effect, as the variables considered constitute industrial return rates (which include influences from outside the given industry), rather than industrial factors (which are the accurate measures of industry-related volatility).

However, according to Heston and Rouwenhorst (1994), the impact of pure industry factor is insignificant, unlike country factors, which dominate over industrial ones and any other kinds of influences. With the use of monthly return rates in 7 industries and in 12 European countries in the period 1978–1992, they argue that the method of distinguishing industry factors used by Roll includes country effect, which is why it overestimates industry factors. They show that only less than 1% of domestic indices diversity is explained by the industrial structure reflected in them. According to their model constructed for the purpose of evaluating the importance of industry factors, any return rate can be decomposed into four basic elements: global market factor (common for all stocks), 'pure' country factor, 'pure' industry factor and a specific factor characteristic for a given firm. The term 'pure' is supposed to emphasise that country and industry factors are free from any other influences.

The theory about the relatively low influence of industry factors is also confirmed by other studies (Lessard 1976; Grinold, Rudd, Stefek 1989; Drummen, Zimmermann 1992), which, however, reveal a more important role of industries. Similar conclusions can be drawn from studies concerning developing countries (Serra 2000; Phylaktis, Xia 2006). They confirm that market return rates are mainly affected by country factors and that international correlation does not depend on industrial structure of indices.

A considerable part of differences between countries can be explained by a different level of exposure to general market risk (Ferson, Harvey 1993). Another potential factor determining the differences in financial results between national stock markets is the market segmentation resulting from investments mainly in domestic markets. In this case different market behaviours result from the variety of preferences and evaluations made by investors from different countries, as the majority of stocks are held by domestic investors. Another reason for market segmentation is the diversity of policy and institutional environment across countries. This might cause economic shocks affecting firms only in one country, as well as global shocks, but affecting various national markets in a different manner.

However, some more recent studies (Weiss 1998; Rouwenhorst 1999; Baca, Garbe, Weiss 2000; Cavaglia, Brightman, Aked 2000; L'Her, Sy, Tnani 2002; Brooks, Del Negro 2004; Flavin 2004) show that the industry effects equal or even exceed country effects, which, in turn, suggests that a combination of cross-country and cross-industry diversification might prove more effective than traditional international diversification.

The recent shift in the relative importance of country and industry effect might be due to the progress of corporate globalisation process as well as the integration of financial markets. During the last decades, many firms aimed at consolidating and optimising their activity globally, which was demonstrated in a series of mergers (Cavaglia, Cho, Singer 2001). As a result, firms have become more diversified internationally, which is why they are less affected by economic shocks specific for one country (Freimann 1998). Such tendencies blur the borders between countries and change the relative importance of country and industry effect. Therefore, these are the global industry factors which should play the main role within the integrated markets. This thesis is also supported by many practitioners. According to the report about the influence of the euro on European financial markets (Galati, Tsatsaronis 2003) in 1997 only 20% of managers recognized the superiority of portfolio diversification strategies based on industries, whereas 50% considered national factors as dominating ones. In 2001, however, the proportion was inversed with about 75%

of managers recognizing cross-industry investment strategies as more effective and only about 10% still believing in the country effect dominance.

The analysis of more than 4000 stocks from 20 developed countries from the period 1997–2000 (Sonney 2007) shows, that the influence of industry factors on return rates increased considerably, in some cases surpassing even country effect.

The literature review reveals that the researchers of the country and industry effects are far from being unanimous in terms of the prevalence of one of the two effects. Up to the early 90's capital allocation strategies were based on the assumption that country factors constitute the main source of the variability of stock returns. That is why the international diversification was considered the most effective method of reducing this variability in asset management. The main conclusion emerging from the review of studies in this area is the dominance of country factors over industrial ones as determinants of stock returns. However, some other and usually more recent analyses contribute to the output of this area by bringing different results, which attribute bigger significance to industrial factors. Nowadays, practitioners tend to recognise the superiority of global investment strategies based on industries. The shift of the paradigm concerning asset allocation is usually explained as a natural consequence of the globalisation process and the progress of financial markets integration.

Although the vast majority of studies dealing with industry versus country effect is based on the stock market returns, there are also some which focus on the corporate financial liquidity diversity. Generally, it has been empirically proved that the level of financial liquidity is strongly affected by the kind of activity (e.g. production, trading, etc.) as well as by industry (Hawanini, Viallet, Vora 1986). Similarly, different strategies of working capital management were observed across Polish industries (Wędzki 2003, p. 167–169) and American firms (Trejo-Pech, Weldon, Gunderson 2008). A significant industry effect on firms' investment in working capital is also documented by Shin and Soenen (1998) and Chan et al. (2006). The major conclusion resulting from the studies concerning corporate liquidity is its heavy dependence on industry. However, none of the studies attempts to compare the relative importance of the industry effect with the country effect.

A clear lack of homogeneity among the researchers of the country and industry effects and their relative importance implies the need for further investigation of the problem. Some contradictions between the results of different studies, depending on the methodology, period or population make it clear that it is purposeful to apply alternative methods of solving the problem, also within the European area.

3. Hypotheses and methodology

When the means of variables vary across countries and (or) industries, it should be verified whether the observed differences are statistically significant. In order to do so, the univariate ANOVA (analysis of variance) was applied (Fisher 1954). The method makes it possible to evaluate the significance of differences between a number of means and also provides the probability of the fact that the selected factors are the reason for the diversity of group means. Therefore the basic hypotheses are as follows: $H_0 : \bigwedge_{i,j} \mu_1 = \mu_2 = ... = \mu_t$, against the alternaltive hypothesis: $H_1 : \bigvee_{i,j} \mu_i \neq \mu_j$, $i \neq j$. If the means are significantly different, it can be intuitively inferred that

the analysed factor affects the dependant variable. Applying the ANOVA method requires the fulfillment of certain assumptions concerning the normal of distribution of variables: $N(\mu_i, \sigma_i)$, $i = 1, 2,..., k$ as well as variance homogeneity: $\sigma_1^2 = \sigma_2^2 = ... = \sigma_t^2$. Not meeting the normality assumption completely, however, usually does not affect the final results, as the statistical tests remain valid. Practical experience shows that non-normality, which is more often a rule rather than an exception in financial analyses, has little impact on the ANOVA results. Similarly, certain non-homogeneity of variance is acceptable (Domański 1990, pp. 117–118).

One of the easiest ways to initially measure the strength of country and industry factors impact on liquidity ratios is to compare the correlation coefficient values between pairs of countries and between pairs of industries. If the similarity of ratios corresponded with countries, it would be shown in relatively higher Pearson values for countries than for industries.

Given the numerousness of data, both in terms of objects and variables, it is difficult to identify clear patterns of similarity within the analysed group. Therefore, a natural procedure when dealing with a relatively large number of data is organizing the elements of the population according to some criteria, i.e. classifying them. Classification of objects which are combinations of both country and industry should provide some information about the domination of one of the two effects in question in terms of corporate liquidity. Therefore the following hypotheses could be formulated:

(1) country factors have higher influence on corporate liquidity than industry,

(2) industry factors have higher influence on corporate liquidity than country,

(3) the influence of industry factors and country factors on corporate liquidity is similar.

If different industry sectors from the same country had a tendency to group in the same clusters (due to their mutual similarity), it would mean that the first hypothesis is true. At the same time we could also expect that the same industry from different countries would be scattered into various clusters due to their dissimilarity. In other words, the obtained clusters would be closer to the national than to the industrial division of the objects.

However, if the same industry from different countries was classified into the same cluster, whereas countries were dispersed, regardless of industry, the second hypothesis would be favoured. It would mean that the resulting categorisation is more similar to industrial than national classification of the population.

It might also occur that none of the two first hypotheses above is favoured, as there might be clusters where it is difficult to indicate a dominating element of either a country or industry. This would prove that none of the two effects prevails when affecting corporate liquidity and that the intensity of country and industry factors impact on corporate liquidity is comparable. Thus, the third hypothesis would prove most likely to be confirmed.

One of the grouping methods, which allows for distinguishing internally homogenous groups of objects is the cluster analysis (Hartigan 1975). The algorithm of the employed agglomeration procedure groups the objects with the use of squared Euclidian distance, which requires previous standardisation of all variables. In order to determine the distances between new clusters formed by linked objects, i.e. the amalgamation procedure, the hierarchical Ward's method was chosen which tends to form less numerous clusters (Ward 1963).

Another clustering algorithm, which could be used for verifying the grouping results, is e.g. *k*-means grouping. The *k*-means classification method assigns each point to the cluster whose center is the nearest. This centroid is the average of all the points in the cluster – that is, its coordinates are the arithmetic mean for each dimension separately over all the points in the cluster. The main advantages of this algorithm are its simplicity and speed which allows it to run on large datasets.

The choice of the methodology employed in this study can be justified with the character of data, which – as mentioned previously – constitute a relatively large set of objects (industries, countries and industries in countries) characterized with the use of several diagnostic variables. Therefore, the multivariate analytical methods seem a natural tool, which make it possible to simplify the data structure and identify the major regularities. It does not mean, however, that the application of taxonomic methods is the only reasonable approach in this case. The study of the existing research shows that statistical multivariate analysis often proves effective in solving similar analytical problems (Cinca, Molinero, Larraz 2005; Gupta, Huefner 1972; Leal, Powers 1997; Sell 2005; Helg et al. 1995; Boillat, Skowronsky, Tuchschmid 2002).

4. Data description

The analysis involves 13 industries according to the NACE classification (Nomenclature statistique des Activités économiques dans la Communauté Européenne) in 10 European Union countries, including 9 member countries of the euro zone (A – Austria, B – Belgium, D – Germany, FIN – Finland, FR – France, I – Italy, NL – Netherlands, ES – Spain and P – Portugal) and PL – Poland. Industrial sectors in countries constitute the observational units and at the same time they are the objects classified. The taxonomy of economic activity by NACE is two-leveled: one-letter level (sections) and two-digit level (divisions). This analysis involves enterprises grouped at the level of section, i.e. thirteen industries. Table 1 shows the industrial range of the research as well as the three-letter symbols attributed to each industry which are applied in the following parts of the paper. Several industries were excluded from the analysis due to a very limited data availability.

The object of the analysis is the corporate liquidity, in the broad sense, measured with the use of financial ratios describing such parameters as the elasticity of assets (i.e. the structure of assets measured as the share of current assets in the total of assets), short-term solvency (liquidity ratios) or working capital turnover. The choice of ratios corresponds with the static approach to liquidity (Jerzemowska 2006, p. 136). The measures of working capital are also considered useful tools for liquidity evaluation, as the amount of working capital is (Bernstein 1993, p. 87):

- the part of assets ensuring payment of exigible creditors,
- a buffer protecting against operational losses,
- a safety margin against the potential consequences of market risk related mainly to the external factors.

The ratios were computed for each of the aggregated group of enterprises in each industry, each country and each year in the period 1999–2005. The source of the data is the European Commission, which publishes the harmonised and aggregated financial reports in the BACH database (Bank for the Accounts of Companies Harmonised). The analysis involved the following financial ratios:

X_1 – current assets/short-term liabilities;
X_2 – (current assets – inventories)/short-term liabilities;
X_3 – (cash and cash equivalents)/short-term liabilities;
X_4 – costs of goods sold/inventories;
X_5 – sales/accounts receivable;
X_6 – cash/assets;
X_7 – current assets/assets;
X_8 – (current assets – inventories)/assets;
X_9 – inventories/net working capital;
X_{10} – inventories/current assets;
X_{11} – sales/net working capital.

Most of the ratios are stimulants, with the exceptions of ratios X_9 and X_{10}, which are considered anti-stimulants. Although some of the ratios (X_1–X_3) should formally be considered nominants, they were also treated as variables whose higher values mean a better object evaluation, as practically there is no over-liquidity within the analysed population. The ratios were normalised according to [0; 1] unitarisation formula (Borys 1978).

The basic descriptive statistics of the analysed ratios (means and standard deviations) are presented in the Tables 2 and 3, which correspond with the two cross-sections of the analysed population, i.e. cross-industry section and cross-country section, respectively. The statistics confirm obvious differentiation of ratios both across industries and across countries. In terms of cross-industry diversity, the biggest spread can be observed in the case of ratios X_3, X_4 and X_{10}, whereas when looking at the other section, the variable X_5 seems most distinguishable. Also, even some roughly performed visual analysis of the tables reveals that the ratio X_{11} has weaker discrimination force.

5. Results and discussion

In order to verify, whether the liquidity ratios' differentiation is statistically significant, the univariate ANOVA was employed. The discriminating properties of ratios were evaluated with the use of F statistics, the values of which are presented in Tables 4 and 5. The Tables correspond with the two factors considered, i.e. country and industry factor.

It can be seen from the Tables, that the vast majority of ratios is characterized with good discrimination properties both for countries and for industries. The only exception is the working capital turnover ratio (X_{11}) which does not differ significantly across industries in five countries and across countries in seven industries. It is also worth mentioning that the relation of inventories to working capital (X_9) is another ratio which does not vary significantly between countries in several industries. However, it does discriminate between industries in all countries, but Portugal. Noticeably, Poland is the country with the biggest number of ratios – namely three – which do not differ significantly across industries.

The initial method applied for verifying the hypotheses – as mentioned in the methodology section – is based on the correlation between pairs of countries and between pairs of industries. The correlations calculated for the two sections are presented in Tables 6 and 7.

A quick glance at the two tables reveals that generally the coefficient values for cross-industry section tend to be lower than for cross-country section. However, in order to make a more formal comparison, a detailed comparative analysis of these values should be performed. As the number of countries analysed (10) is different from the number of industries (13), the corresponding parts of Tables 6 and 7 cannot be compared directly, by e.g. counting the number of higher cross--country coefficient values for each ratio. Therefore the comparison can be made with the use of proportion e.g. of the presence of negative values to the total number of values or of the occurrence of highly positive values in relation to their total number. These results are shown in Table 8, which clearly shows that for all ratios, except X_{11} the proportion of negative coefficients is higher for cross-industry section, which proves that liquidity ratios are more often dissimilar between industries than between countries. Also, the number of strong similarities between ratios is higher for countries than for industries, which is shown by the higher proportion of highly positive correlations (> 0.7) between countries than between industries. The average rate of negative values of coefficient for countries is 11%, whereas for industries 37%. The average proportion of highly positive values of coefficient is 30% for countries and only 16% for industries.

The above-demonstrated non-homogeneity of the analysed population, as well as discovery of certain similarities between objects, creates the natural need to organise the objects better, i.e. to classify them, e.g. with the use of cluster analysis. The diagnostic variables in cluster analysis should be characterised with significant variability and independence. The variability of ratios was examined with the use of variability coefficient. Within the set of initially proposed variables, none of them is a stable variable. However, taking into account the interdependence of variables (presented in Table 9), their substantial content, as well as the information capacity, from the three pairs of strongly correlated variables ($r_{X_7,\ X_8} = 0.95$; $r_{X_1,\ X_2} = 0.86$; $r_{X_3,\ X_6} = 0.73$) three of them were eliminated: X_2, X_6 and X_8. As a result the final set of diagnostic variables was reduced to eight ratios: X_1, X_3, X_4, X_5, X_7, X_9, X_{10} and X_{11}.

The results of the agglomerative cluster analysis for industries in countries are presented in Figure 1. The symbols characterising each item referring to its country and industry are explained in the data description section. After the exclusion of the missing data, the analysis involves the total of 120 cases. Due to the fact that the majority of variables, with only few exceptions, does not have significant variance in time, it was assumed that the clustering procedure will be performed with the use of mean variables, which constitute an approximated representation of a certain typical level of each characteristics within the whole seven-years' period. Cutting the branches of the tree-diagram where the linkage distance is 5 allows the identification of eight clusters of similar homogeneity and number of objects. The identification of the nature of each cluster can be facilitated by the comparison of the number of the same industries and countries within each group, which is shown in Table 11.

The first two clusters (from the top) do not demonstrate any clear character, neither industrial nor national. In the first cluster the countries most numerously represented are Spain, Finland and France. However, industries such as agriculture and manufacturing appear with similar frequency. Also an undefined character is specific for the second cluster, concentrated around both Netherlands and Poland, but also around construction and real estate industry. The structure of the following, third, cluster can be identified more clearly as industrial one, due to the mining and real estate industry. The nature of the fourth cluster is also quite specific, as it contains mainly

education industry from different countries, which determines its industrial character. The fifth cluster however, is quite unusual, as it is the only one which demonstrates a clearly national character. This is due to the presence of as many as seven Polish industries. This implies a natural question about the reasons for such separation of Poland from other countries. The analysis of primary data (average liquidity ratios, not reported here) revealed that the reason behind the distinctness of most Polish industries is the relatively low level of liquidity parameters. This might indicate that there are bigger payment obstructions in these industries, or that (which seems less likely) the Polish firms prefer more aggressive strategies of liquidity management. The elements of the following three clusters tend to group again according to industries rather than countries. The dominating industries are respectively: hotels and restaurants industry and electricity in the sixth cluster, transport industry in the seventh cluster and construction and trade in the last – eighth cluster.

Summing up the character of each of the identified clusters in terms of evaluation of the relative importance of industry and country factors, it can be stated that in only one of eight clusters, the similarity of objects is determined by country factors. Two clusters do not demonstrate any clear structure dominated by either industry or country. In the majority of clusters, i.e. in the remaining five, it is the industry effect which is exposed.

The results of the clustering algorithm applied to industries in countries also allow to identify objects which are particularly susceptible to the influence of the analysed effects. As for the countries, the country-specific factors are most clearly visible in the case of Poland. The industry effect, in turn, is the most easily observable in the trade and construction industries, which are characterised by relatively low liquidity ratios in most countries. The biggest dispersion of industries among different clusters, which suggests weaker influences of common industrial factors, can be seen in the community services and health care industry. The countries with the weakest country-specific character are Belgium and Germany, although in the case of the latter, it might be related to the exclusion of several industries due to the missing data.

When performing the earlier mentioned alternative classification procedure, i.e. the *k*-means grouping, the number of clusters must be declared beforehand. In order to facilitate the comparison of the grouping results between the two methods, the number of clusters in the *k*-means grouping should correspond to the previous results. That is why it was also set at eight clusters. The grouping results, i.e. the detailed structure of each cluster is shown in Table 10.

Although the structure of the clusters identified with the use of *k*-means grouping is quite different from the clusters formed by agglomerative method, the main conclusions remain similar. The number of industry-dominated clusters in both methods is the same, as can be seen in Table 11 containing synthetic results from both grouping methods. In the *k*-means method the industry--oriented clusters are: first (real estate and health care), fifth (electricity and hotels), sixth (trade), seventh (construction and trade) and eighth (hotels and transport). Only two clusters proved country-oriented: second (Netherlands and Finland) and third (Poland), whereas one cluster (the fourth) did not demonstrate any clear prevailing item.

The grouping results are convergent not only in terms of the number of country- and industry--affected clusters, but also in terms of the items which proved particularly specific and therefore dominating. Again trade and construction in terms of industries and Poland as a country revealed their strongest specificity.

When performing clustering algorithms, it is worth verifying whether the quality of grouping is similar between the two methods applied. One of the most universal and effective measures used for evaluating grouping results is the method of silhouette index (SI) proposed by Rousseeuw (1987). The index value provides information about the quality of the group structure. The higher the SI, the clearer and more accurate the grouping (Kauffman, Rousseeuw 1990). The SI value for agglomerative clustering results is 0.333, which is close to the index value for *k*-means grouping method: 0.308. The similarity of SI values proves that the quality of grouping results for both clustering methods is alike.

6. Summary and conclusions

With reference to the main aim of the research, which was to determine the relative importance of industry and country effect in corporate liquidity, it can be stated that, according to the analytical results, the liquidity ratios remain under a slightly bigger influence of industrial factors. It is indicated by the classification results, which show that the majority of the distinguished clusters tends to follow industrial patterns more than regional ones. These remarks suggest some significant implications in terms of optimising investment diversification strategies. If it is the industry effect which should be recognized as the dominating one, then the role of the diversification based on cross-industry sections should increase in comparison to the traditional cross-country diversification method.

However, it should be borne in mind that the above recommendation refers to the analysed territory, i.e. a group of ten highly-integrated countries, most of which are already members of the euro-zone. Extrapolation of these suggestions to other regions of the world, or even Europe, should therefore be done very carefully. Considering a bigger number of countries in the analysis, or performing the research in other continents could verify the hypotheses differently and probably expose the bigger role of regional factors. Therefore, despite the observed prevalence of industry--common regularities, the significance of geographical diversification should not be belittled.

It can be expected that, according to the tendency initiated by the end of the previous century, the role of industry-specific factors will continue to grow. Consequently, the importance of the international diversification is likely to decrease gradually. The probability of such changes seems to increase as the integration progresses.

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Annex

Figure 1
Cluster analysis results for average liquidity ratios from 1999–2005

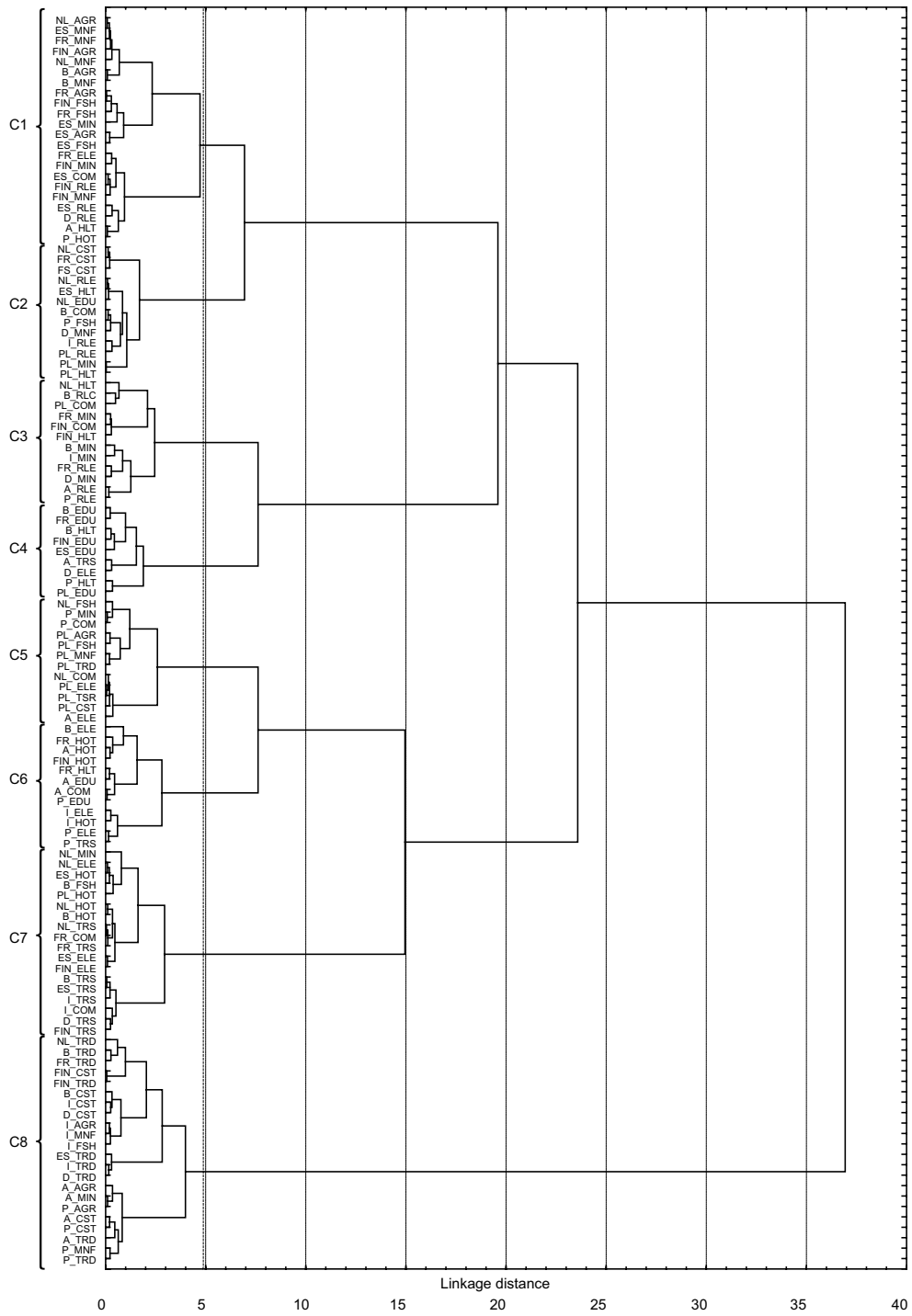

Table 1
Industrial sections by NACE

NACE	Section	Symbol
A	Agriculture, hunting and forestry	AGR
B	Fishing	FSH
C	Mining and quarrying	MIN
D	Manufacturing	MNF
E	Electricity, gas and water supply	ELE
F	Construction	CST
G	Wholesale and retail trade	TRD
H	Hotels and restaurants	HOT
I	Transport, storage and communication	TRS
K	Real estate, renting and business activities	RLE
L	Public administration and defence	–
M	Education	EDU
N	Health and social work	HLT
O	Other community, social and personal service activities	COM
P	Activities of households	–
Q	Extra-territorial organisations and bodies	–

Source: BACH database.

Table 2
Descriptive statistics for industrial liquidity ratios: means (μ) for all countries form 1999–2005 and standard deviation (δ)

Ratio		AGR	FSH	MIN	MNF	ELE	CST	TRD	HOT	TRS	RLE	EDU	HLT	COM
X_1	μ	0.808	0.836	1.000	0.558	0.258	0.592	0.480	0.000	0.102	0.760	0.653	0.965	0.687
	δ	0.227	0.302	0.379	0.197	0.224	0.274	0.224	0.130	0.152	0.326	0.143	0.373	0.368
X_2	μ	0.199	0.246	0.697	0.174	0.219	0.129	0.000	0.008	0.175	0.657	0.711	1.000	0.569
	δ	0.160	0.141	0.375	0.148	0.172	0.208	0.172	0.143	0.213	0.356	0.280	0.372	0.332
X_3	μ	0.353	0.469	0.309	0.000	0.171	0.087	0.005	0.327	0.189	0.515	0.994	1.000	0.666
	δ	0.077	0.208	0.390	0.195	0.293	0.118	0.137	0.118	0.205	0.270	0.266	0.343	0.303
X_4	μ	0.000	0.119	0.360	0.062	0.699	0.014	0.178	0.511	0.914	0.076	1.000	0.666	0.316
	δ	0.051	0.202	0.295	0.038	0.316	0.075	0.098	0.249	0.248	0.138	0.316	0.306	0.285
X_5	μ	0.481	0.662	0.431	0.326	0.481	0.252	0.802	1.000	0.332	0.000	0.666	0.657	0.615
	δ	0.227	0.143	0.314	0.177	0.296	0.102	0.259	0.251	0.274	0.116	0.134	0.296	0.217
X_6	μ	0.378	0.431	0.128	0.166	0.000	0.547	0.384	0.358	0.157	0.282	1.000	0.834	0.460
	δ	0.156	0.251	0.242	0.210	0.052	0.262	0.189	0.160	0.084	0.267	0.145	0.247	0.225
X_7	μ	0.457	0.419	0.322	0.562	0.000	1.000	0.880	0.126	0.107	0.290	0.462	0.490	0.346
	δ	0.155	0.212	0.203	0.148	0.065	0.023	0.115	0.120	0.115	0.279	0.209	0.250	0.092
X_8	μ	0.319	0.303	0.356	0.544	0.000	1.000	0.815	0.188	0.200	0.412	0.746	0.781	0.481
	δ	0.117	0.110	0.258	0.132	0.121	0.176	0.196	0.161	0.164	0.340	0.272	0.251	0.125
X_9	μ	0.696	0.758	0.845	0.624	0.864	0.664	0.000	1.000	0.929	0.900	0.928	0.972	0.878
	δ	0.251	0.325	0.254	0.211	0.221	0.271	0.183	0.248	0.192	0.187	0.148	0.155	0.171
X_{10}	μ	0.000	0.134	0.533	0.238	0.819	0.137	0.044	0.831	1.000	0.750	0.989	0.960	0.763
	δ	0.147	0.298	0.276	0.201	0.177	0.246	0.207	0.078	0.045	0.196	0.048	0.056	0.126
X_{11}	μ	0.660	0.669	0.556	0.718	0.688	0.628	1.000	0.000	0.314	0.542	0.498	0.281	0.604
	δ	0.366	0.398	0.383	0.330	0.388	0.324	0.333	0.440	0.341	0.391	0.265	0.302	0.322

Source: calculations based on BACH database.

Table 3
Descriptive statistics for national liquidity ratios: means (μ) for all industries form 1999–2005 and standard deviation (δ)

Ratio		NL	B	FR	ES	I	A	D	P	FIN	PL
X_1	μ	0.525	0.168	0.567	0.288	0.200	0.000	0.556	0.134	1.000	0.463
	δ	0.244	0.296	0.346	0.249	0.288	0.325	0.322	0.313	0.306	0.287
X_2	μ	0.781	0.311	0.647	0.367	0.243	0.000	0.526	0.141	1.000	0.522
	δ	0.252	0.328	0.275	0.305	0.281	0.250	0.345	0.304	0.342	0.279
X_3	μ	0.585	0.537	0.405	0.177	0.000	0.173	0.191	0.106	1.000	0.677
	δ	0.245	0.330	0.289	0.267	0.262	0.337	0.332	0.298	0.317	0.271
X_4	μ	1.000	0.713	0.346	0.345	0.418	0.000	0.283	0.290	0.212	0.198
	δ	0.286	0.358	0.293	0.292	0.398	0.281	0.414	0.341	0.307	0.364
X_5	μ	0.178	0.392	0.205	0.062	0.000	0.445	0.292	0.216	0.932	1.000
	δ	0.258	0.247	0.315	0.293	0.291	0.273	0.306	0.255	0.323	0.328
X_6	μ	1.000	0.310	0.265	0.000	0.133	0.327	0.213	0.204	0.780	0.602
	δ	0.289	0.284	0.273	0.338	0.301	0.310	0.335	0.255	0.288	0.292
X_7	μ	0.541	0.335	0.867	0.445	1.000	0.141	0.781	0.332	0.423	0.000
	δ	0.327	0.287	0.296	0.272	0.377	0.345	0.384	0.333	0.278	0.338
X_8	μ	0.834	0.474	0.954	0.531	1.000	0.101	0.498	0.305	0.367	0.000
	δ	0.302	0.316	0.271	0.261	0.295	0.353	0.386	0.311	0.268	0.310
X_9	μ	0.586	0.400	0.604	0.000	0.416	1.000	0.265	0.900	0.634	0.089
	δ	0.261	0.299	0.263	0.271	0.303	0.262	0.368	0.275	0.344	0.232
X_{10}	μ	1.000	0.778	0.530	0.572	0.473	0.356	0.000	0.398	0.252	0.385
	δ	0.321	0.397	0.372	0.393	0.410	0.391	0.370	0.288	0.298	0.358
X_{11}	μ	0.934	1.000	0.863	0.979	0.593	0.000	0.712	0.282	0.811	0.479
	δ	0.236	0.230	0.277	0.253	0.280	0.286	0.327	0.267	0.262	0.234

Source: calculations based on BACH database.

Table 4
Univariate analysis of variance across industries: F statistics and p values; $p = 0.05$ (non-significance is marked)

Country	Ratio										
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
NL	77.478	98.258	65.342	22.449	18.564	64.226	70.316	64.623	5.101	165.523	1.736
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.075
B	47.121	66.742	49.646	19.219	17.963	167.025	170.477	173.016	7.536	213.55	1.568
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.119
FR	60.128	46.21	33.471	59.062	101.606	65.775	284.095	157.589	542.62	389.498	121.533
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ES	7.227	7.302	8.141	23.749	67.375	21.887	76.389	63.531	60.793	92.042	4.067
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
I	10.924	15.554	4.172	43.455	20.079	19.219	55.844	51.256	17.87	158.413	0.844
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.589
A	8.864	7.605	9.13	13.516	10.58	14.821	40.657	26.965	13.053	39.885	2.118
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.019
D	56.169	103.672	3.3	467.617	89.702	21.101	220.909	48.526	16.134	303.633	1.631
	0.000	0.000	-0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.165
P	41.076	9.9	6.94	58.979	8.874	6.926	228.084	110.834	1.204	78.027	0.847
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.298	0.000	-0.603
FIN	31.791	44.818	78.188	106.101	17.166	85.177	158.068	59.689	36.468	101.391	5.499
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PL	1.853	1.821	2.91	3.605	0.414	26.99	131.7	74.83	7.448	48.06	2.179
	-0.055	-0.060	-0.002	0.000	-0.954	0.000	0.000	0.000	0.000	0.000	-0.021
All countries	8.000	9.565	14.14	27.88	4.269	36.90	127.1	58.60	17.89	115.0	2.238
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.009

Source: calculations based on BACH database.

Table 5
Univariate analysis of variance across countries: F statistics and p values; $p = 0.05$ (non-significance is marked)

Industry	Ratio										
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
AGR	28.64	39.58	24.78	29.82	15.8	20.52	73.97	60.67	30.49	62.22	33.85
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
FSH	7.836	1.374	8.793	2.578	5.904	22.45	44.68	11.13	1.428	23.54	1.616
	0.000	-0.245	0.000	0.000	0.000	0.000	0.000	0.000	-0.224	0.000	-0.162
MIN	7.994	9.073	10.66	38.07	4.831	19.99	21.69	16.62	0.162	51.77	0.335
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.997	0.000	-0.960
MNF	30.37	49.12	9.457	8.131	182.6	20.64	183.6	123.7	9.221	86.63	6.134
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ELE	27.18	17.82	13.76	28.38	21.44	39.01	23.7	23.26	1.073	38.58	1.24
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.396	0.000	-0.289
CST	6.05	52.55	26.1	2.202	160	39.17	10.71	48.43	42.88	36.11	12.1
	0.000	0.000	0.000	-0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TRD	31.85	37.25	45.77	9.167	73.13	21.42	53.24	60.63	14.66	37.24	16.27
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HOT	45.18	42.78	33.21	21.32	28.58	75.79	61.8	66.5	1.646	27.78	1.981
	0.000	0.000	-0.007	0.000	0.000	0.000	0.000	0.000	-0.134	0.000	-0.066
TRS	12.39	13.23	7.762	10.88	0.085	19.62	19.48	18.94	1.035	29.88	0.895
	0.000	0.000	0.000	0.000	-1.000	0.000	0.000	0.000	-0.424	0.000	-0.536
RLE	14.72	17.98	24.97	66.49	155.4	80.24	187.1	191.6	0.051	67.93	0.156
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.000	0.000	-0.997
EDU	4.567	40.71	37.29	4.718	11.88	18.7	24.04	36.61	4.032	4.8	7.033
	-0.001	0.000	0.000	0.000	-0.003	-0.001	0.000	0.000	-0.002	0.000	0.000
HLT	152.5	151.5	71.49	8.372	181.8	38.75	214.3	177.7	1.321	13.61	1.369
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.262	0.000	-0.241
COM	2.83	2.29	3.804	29.3	13.17	43	47.94	45.19	3.262	12.76	3.26
	-0.011	-0.035	-0.001	0.000	0.000	0.000	0.000	0.000	-0.004	0.000	-0.004
All industries	12.05	11.03	24.85	10.39	2.618	39.41	9.58	15.83	1.822	6.356	1.677
	0.000	0.000	0.000	0.000	-0.006	0.000	0.000	0.000	-0.061	0.000	-0.091

Source: calculations based on BACH database.

Table 6
Correlation coefficients for liquidity ratios between countries

Ratio	Country	NL	B	FR	ES	I	A	D	P	FIN	PL
X_1	NL	1.000									
	B	0.444	1.000								
	FR	-0.304	0.115	1.000							
	ES	-0.107	0.250	0.706	1.000						
	I	-0.074	0.186	0.559	0.905	1.000					
	A	-0.042	0.550	0.622	0.701	0.798	1.000				
	D	-0.780	0.039	0.530	0.739	0.792	0.414	1.000			
	P	0.372	0.358	0.125	0.111	0.328	0.541	-0.035	1.000		
	FIN	0.190	0.112	0.272	0.386	0.313	0.185	0.791	-0.031	1.000	
	PL	-0.196	0.048	0.121	0.071	-0.235	-0.031	-0.223	-0.152	0.618	1.000
X_2	NL	1.000									
	B	0.548	1.000								
	FR	-0.075	0.600	1.000							
	ES	0.242	0.596	0.796	1.000						
	I	-0.363	0.530	0.721	0.801	1.000					
	A	0.075	0.607	0.695	0.504	0.542	1.000				
	D	-0.812	0.172	0.356	0.465	0.790	0.040	1.000			
	P	0.624	0.529	0.194	0.175	0.085	0.337	-0.401	1.000		
	FIN	0.470	0.544	0.350	0.472	0.365	0.125	0.594	0.248	1.000	
	PL	-0.111	0.212	0.426	0.279	0.008	0.147	-0.238	-0.072	0.692	1.000
X_3	NL	1.000									
	B	0.466	1.000								
	FR	0.335	0.516	1.000							
	ES	0.037	0.002	0.544	1.000						
	I	-0.475	0.551	0.348	0.043	1.000					
	A	0.320	0.163	0.533	0.331	0.282	1.000				
	D	-0.267	0.862	0.502	0.093	0.401	0.081	1.000			
	P	0.565	0.237	0.533	0.504	0.278	0.447	-0.170	1.000		
	FIN	0.707	0.462	0.409	0.466	-0.054	0.427	0.306	0.626	1.000	
	PL	0.128	0.156	0.367	0.723	0.027	0.477	0.256	0.502	0.735	1.000
X_4	NL	1.000									
	B	0.279	1.000								
	FR	0.189	0.607	1.000							
	ES	0.162	0.789	0.806	1.000						
	I	0.362	0.489	0.696	0.545	1.000					
	A	0.126	0.558	0.332	0.609	0.621	1.000				
	D	0.207	0.994	0.482	0.930	0.870	0.919	1.000			
	P	0.335	0.735	0.280	0.623	0.599	0.791	0.997	1.000		
	FIN	0.142	0.661	0.740	0.915	0.497	0.810	0.788	0.660	1.000	
	PL	0.305	0.646	0.819	0.809	0.701	0.137	0.548	0.250	0.607	1.000

Ratio	Country	NL	B	FR	ES	I	A	D	P	FIN	PL
X_5	NL	1.000									
	B	0.491	1.000								
	FR	0.254	0.414	1.000							
	ES	0.449	0.359	0.653	1.000						
	I	0.765	0.448	0.835	0.841	1.000					
	A	0.293	0.236	0.640	0.516	0.400	1.000				
	D	0.368	0.138	0.754	0.914	0.666	0.646	1.000			
	P	0.223	0.461	-0.055	0.106	-0.045	0.186	0.089	1.000		
	FIN	-0.042	0.054	0.550	0.338	0.230	0.803	0.725	-0.189	1.000	
	PL	0.471	0.639	0.543	0.484	0.524	0.535	0.657	0.109	0.184	1.000
X_6	NL	1.000									
	B	0.825	1.000								
	FR	0.356	0.518	1.000							
	ES	0.250	0.559	0.510	1.000						
	I	0.709	0.528	0.024	0.194	1.000					
	A	0.648	0.770	0.512	0.505	0.536	1.000				
	D	0.590	0.920	0.545	0.931	0.659	0.721	1.000			
	P	0.768	0.770	0.558	0.279	0.508	0.702	0.597	1.000		
	FIN	0.786	0.944	0.452	0.611	0.437	0.820	0.870	0.628	1.000	
	PL	0.694	0.663	0.338	0.069	0.168	0.790	-0.304	0.515	0.694	1.000
X_7	NL	1.000									
	B	0.799	1.000								
	FR	0.617	0.733	1.000							
	ES	0.643	0.685	0.813	1.000						
	I	0.759	0.813	0.661	0.697	1.000					
	A	0.718	0.667	0.825	0.845	0.634	1.000				
	D	0.743	0.756	0.925	0.928	0.644	0.928	1.000			
	P	0.705	0.791	0.800	0.923	0.822	0.774	0.953	1.000		
	FIN	0.554	0.634	0.843	0.764	0.646	0.873	0.930	0.732	1.000	
	PL	0.330	-0.031	0.014	-0.007	-0.115	0.214	-0.081	-0.097	0.110	1.000
X_8	NL	1.000									
	B	0.785	1.000								
	FR	0.623	0.612	1.000							
	ES	0.644	0.598	0.747	1.000						
	I	0.595	0.782	0.223	0.294	1.000					
	A	0.718	0.603	0.792	0.725	0.458	1.000				
	D	0.160	0.076	0.601	0.534	-0.015	0.727	1.000			
	P	0.654	0.623	0.547	0.798	0.548	0.717	0.730	1.000		
	FIN	0.605	0.622	0.875	0.593	0.404	0.735	0.639	0.630	1.000	
	PL	0.516	0.253	0.297	0.092	0.190	0.448	-0.009	0.082	0.426	1.000

Ratio	Country	NL	B	FR	ES	I	A	D	P	FIN	PL
X_9	NL	1.000									
	B	-0.066	1.000								
	FR	0.359	0.707	1.000							
	ES	0.271	0.713	0.929	1.000						
	I	0.391	0.746	0.857	0.790	1.000					
	A	0.526	0.618	0.600	0.604	0.837	1.000				
	D	0.919	0.825	0.928	0.838	0.921	0.962	1.000			
	P	-0.232	0.714	0.562	0.602	0.514	0.548	0.808	1.000		
	FIN	0.354	0.452	0.726	0.615	0.585	0.682	0.944	0.214	1.000	
	PL	0.278	0.718	0.852	0.879	0.738	0.577	0.842	0.736	0.401	1.000
X_{10}	NL	1.000									
	B	0.894	1.000								
	FR	0.805	0.674	1.000							
	ES	0.733	0.628	0.771	1.000						
	I	0.844	0.777	0.774	0.688	1.000					
	A	0.810	0.881	0.680	0.815	0.859	1.000				
	D	0.701	0.750	0.211	0.396	0.846	0.612	1.000			
	P	0.729	0.854	0.668	0.715	0.749	0.782	0.760	1.000		
	FIN	0.681	0.581	0.690	0.772	0.804	0.877	0.743	0.593	1.000	
	PL	0.868	0.777	0.886	0.833	0.817	0.829	0.442	0.693	0.651	1.000
X_{11}	NL	1.000									
	B	-0.525	1.000								
	FR	0.047	-0.242	1.000							
	ES	-0.059	0.119	0.084	1.000						
	I	-0.161	0.538	-0.094	0.322	1.000					
	A	-0.103	0.004	-0.386	0.019	0.442	1.000				
	D	-0.057	0.456	0.665	0.753	0.502	0.447	1.000			
	P	-0.180	0.179	-0.605	0.324	-0.023	-0.091	0.418	1.000		
	FIN	-0.087	-0.034	0.840	-0.049	0.180	0.051	0.808	-0.821	1.000	
	PL	-0.022	0.234	-0.727	0.484	0.118	0.012	0.845	0.858	-0.863	1.000

Source: calculations based on BACH database.

Table 7
Correlation coefficients for liquidity ratios between industries

Ratio	Industry	AGR	FSH	MIN	MNF	ELE	CST	TRD	HOT	TRS	RLE	EDU	HLT	COM
	AGR	1.000												
	FSH	0.379	1.000											
	MIN	0.245	0.586	1.000										
	MNF	0.778	0.097	0.229	1.000									
	ELE	0.377	0.087	0.246	0.144	1.000								
	CST	0.612	-0.259	0.112	0.922	0.048	1.000							
X_1	TRD	0.649	-0.143	0.220	0.885	0.211	0.904	1.000						
	HOT	0.410	-0.058	-0.435	0.631	-0.323	0.492	0.314	1.000					
	TRS	-0.097	-0.257	0.334	-0.027	0.162	0.289	0.324	-0.567	1.000				
	RLE	0.675	0.078	0.153	0.399	0.584	0.499	0.584	-0.246	0.445	1.000			
	EDU	-0.395	0.073	-0.207	-0.491	-0.127	-0.566	-0.569	-0.199	-0.593	-0.190	1.000		
	HLT	-0.165	-0.414	-0.236	0.268	0.052	0.416	0.373	0.416	0.153	-0.217	-0.474	1.000	
	COM	-0.229	-0.025	-0.283	-0.465	-0.042	-0.365	-0.186	-0.085	-0.480	0.016	0.867	-0.236	1.000
	AGR	1.000												
	FSH	0.425	1.000											
	MIN	0.164	0.294	1.000										
	MNF	-0.316	0.531	0.198	1.000									
	ELE	0.145	0.012	0.506	0.048	1.000								
	CST	0.133	0.651	-0.007	0.632	0.111	1.000							
X_2	TRD	-0.100	0.018	-0.107	0.753	-0.039	0.544	1.000						
	HOT	-0.557	0.521	-0.062	0.881	-0.257	0.382	0.391	1.000					
	TRS	0.443	0.352	0.594	0.071	0.362	0.436	-0.175	-0.300	1.000				
	RLE	0.277	0.368	0.064	0.238	0.371	0.676	0.332	-0.024	0.395	1.000			
	EDU	0.133	0.330	0.253	0.007	0.035	-0.331	-0.550	0.014	0.042	-0.121	1.000		
	HLT	-0.434	-0.175	-0.081	0.541	0.201	0.176	0.350	0.403	0.015	-0.210	-0.320	1.000	
	COM	0.372	-0.121	-0.205	-0.336	-0.101	-0.531	-0.320	-0.364	-0.321	-0.122	0.729	-0.464	1.000
	AGR	1.000												
	FSH	0.514	1.000											
	MIN	-0.090	-0.178	1.000										
	MNF	-0.061	-0.274	0.380	1.000									
	ELE	-0.342	-0.120	0.660	0.352	1.000								
	CST	0.492	0.579	0.347	0.623	0.231	1.000							
X_3	TRD	0.142	-0.405	0.033	0.353	-0.479	0.107	1.000						
	HOT	0.416	0.027	0.214	0.717	-0.376	0.393	0.735	1.000					
	TRS	0.008	-0.384	0.242	0.747	-0.017	0.035	0.355	0.115	1.000				
	RLE	-0.076	0.374	0.134	0.314	-0.206	0.091	0.013	0.328	0.389	1.000			
	EDU	0.261	-0.012	-0.319	0.369	-0.366	0.218	0.386	0.296	-0.283	-0.170	1.000		
	HLT	-0.111	-0.336	0.177	0.040	0.512	-0.389	0.157	0.192	0.109	-0.250	-0.489	1.000	
	COM	0.067	-0.183	-0.156	-0.594	-0.042	-0.603	-0.345	-0.444	0.360	0.054	0.096	-0.215	1.000

Ratio	Industry	AGR	FSH	MIN	MNF	ELE	CST	TRD	HOT	TRS	RLE	EDU	HLT	COM
	AGR	1.000												
	FSH	-0.058	1.000											
	MIN	-0.327	-0.205	1.000										
	MNF	0.779	-0.108	-0.627	1.000									
	ELE	0.012	0.322	0.175	0.174	1.000								
	CST	0.232	-0.495	-0.167	0.068	-0.763	1.000							
	TRD	0.423	-0.039	-0.632	0.880	0.368	-0.298	1.000						
X_4	HOT	0.306	-0.065	-0.102	0.382	0.227	-0.028	0.336	1.000					
	TRS	0.318	0.188	-0.482	0.819	0.468	-0.449	0.853	0.230	1.000				
	RLE	-0.037	-0.303	0.321	-0.250	0.186	-0.146	-0.173	0.698	-0.280	1.000			
	EDU	0.355	0.251	-0.412	0.152	-0.555	0.563	-0.213	0.534	-0.388	0.250	1.000		
	HLT	-0.180	0.837	-0.068	-0.046	0.648	-0.291	-0.097	0.164	0.157	-0.353	0.110	1.000	
	COM	0.082	-0.138	0.206	0.076	0.399	-0.328	0.252	0.878	0.146	0.840	-0.140	-0.128	1.000
	AGR	1.000												
	FSH	-0.279	1.000											
	MIN	-0.083	-0.102	1.000										
	MNF	0.062	0.210	0.089	1.000									
	ELE	-0.397	0.154	0.586	0.154	1.000								
	CST	-0.374	0.068	0.340	-0.487	0.266	1.000							
	TRD	0.607	0.190	0.188	0.577	-0.174	-0.089	1.000						
X_5	HOT	-0.356	0.364	-0.429	-0.414	-0.628	0.174	-0.309	1.000					
	TRS	-0.415	-0.478	0.260	0.211	0.521	0.195	-0.315	-0.434	1.000				
	RLE	0.319	-0.160	0.143	-0.287	-0.138	0.547	0.474	-0.130	-0.223	1.000			
	EDU	0.375	-0.705	0.137	-0.421	-0.226	-0.094	-0.229	-0.154	0.229	0.079	1.000		
	HLT	0.134	0.039	-0.201	-0.062	-0.394	-0.388	-0.026	0.336	-0.233	-0.331	0.385	1.000	
	COM	0.052	-0.554	0.080	-0.635	-0.309	0.278	-0.386	0.270	0.222	0.029	0.919	0.475	1.000
	AGR	1.000												
	FSH	0.684	1.000											
	MIN	-0.433	-0.178	1.000										
	MNF	0.495	0.152	-0.014	1.000									
	ELE	0.368	-0.200	-0.481	0.500	1.000								
	CST	0.648	0.737	0.121	0.522	0.326	1.000							
X_6	TRD	0.487	0.402	0.090	0.911	0.285	0.694	1.000						
	HOT	0.715	0.331	-0.085	0.745	0.371	0.572	0.754	1.000					
	TRS	0.464	-0.105	-0.153	0.762	0.568	0.291	0.700	0.754	1.000				
	RLE	0.181	-0.336	-0.215	0.597	0.692	-0.022	0.289	0.456	0.733	1.000			
	EDU	-0.323	-0.333	-0.233	-0.747	-0.251	-0.531	-0.588	-0.141	-0.509	-0.075	1.000		
	HLT	-0.273	-0.625	-0.053	0.085	0.501	-0.406	0.069	0.032	0.758	0.606	-0.178	1.000	
	COM	-0.049	-0.022	-0.093	0.454	0.262	-0.052	0.214	0.444	0.257	0.522	0.641	-0.194	1.000

Ratio	Industry	AGR	FSH	MIN	MNF	ELE	CST	TRD	HOT	TRS	RLE	EDU	HLT	COM
	AGR	1.000												
	FSH	0.481	1.000											
	MIN	-0.843	-0.203	1.000										
	MNF	0.896	0.738	-0.580	1.000									
X_7	ELE	0.154	-0.392	-0.314	-0.078	1.000								
	CST	0.731	0.517	-0.496	0.722	0.148	1.000							
	TRD	0.706	0.656	-0.517	0.794	0.144	0.904	1.000						
	HOT	0.496	0.726	-0.553	0.421	0.108	0.500	0.625	1.000					
	TRS	0.363	0.198	-0.355	0.056	-0.161	0.414	0.276	0.607	1.000				
	RLE	0.156	-0.043	-0.382	-0.043	-0.177	-0.170	-0.019	0.229	0.038	1.000			
	EDU	-0.568	-0.390	0.351	-0.771	-0.042	-0.636	-0.527	-0.015	0.160	0.467	1.000		
	HLT	0.107	-0.410	-0.197	-0.248	-0.156	-0.040	-0.124	-0.013	-0.104	0.573	0.061	1.000	
	COM	-0.723	-0.206	0.484	-0.650	-0.094	-0.901	-0.780	-0.192	-0.352	0.037	0.572	-0.160	1.000
	AGR	1.000												
	FSH	0.318	1.000											
	MIN	-0.649	-0.282	1.000										
	MNF	0.540	0.934	-0.094	1.000									
	ELE	0.630	-0.087	0.174	0.322	1.000								
	CST	0.639	0.497	-0.132	0.520	0.103	1.000							
X_8	TRD	0.518	0.811	-0.026	0.874	0.489	0.544	1.000						
	HOT	0.625	0.675	-0.441	0.721	0.204	0.217	0.568	1.000					
	TRS	0.809	0.350	-0.389	0.205	-0.120	0.542	0.171	0.745	1.000				
	RLE	0.297	-0.312	-0.588	-0.275	-0.188	-0.218	-0.070	0.166	0.143	1.000			
	EDU	0.083	-0.287	0.358	-0.260	0.198	-0.314	-0.080	0.331	0.410	0.412	1.000		
	HLT	0.061	0.030	-0.561	-0.040	0.197	0.037	0.227	0.092	-0.121	0.359	-0.398	1.000	
	COM	-0.314	-0.190	0.369	-0.302	0.093	-0.572	-0.325	0.038	-0.049	0.067	0.645	-0.558	1.000
	AGR	1.000												
	FSH	-0.318	1.000											
	MIN	0.641	-0.377	1.000										
	MNF	0.677	-0.383	0.778	1.000									
	ELE	0.785	-0.542	0.670	0.736	1.000								
	CST	0.499	-0.138	0.555	0.183	0.417	1.000							
X_9	TRD	0.384	-0.851	0.317	0.375	0.359	0.353	1.000						
	HOT	0.020	0.229	0.108	-0.475	-0.065	0.748	0.100	1.000					
	TRS	0.382	-0.136	0.900	0.722	0.544	0.377	0.093	0.045	1.000				
	RLE	0.664	-0.132	0.929	0.781	0.691	0.429	0.138	0.080	0.897	1.000			
	EDU	0.808	-0.242	0.754	0.850	0.880	0.374	0.187	-0.147	0.791	0.878	1.000		
	HLT	0.320	-0.360	0.449	0.916	0.254	0.037	0.239	-0.503	0.305	0.284	0.279	1.000	
	COM	0.447	-0.156	0.778	0.694	0.664	0.455	-0.027	-0.135	0.731	0.722	0.766	0.668	1.000

Ratio	Industry	AGR	FSH	MIN	MNF	ELE	CST	TRD	HOT	TRS	RLE	EDU	HLT	COM
	AGR	1.000												
	FSH	-0.304	1.000											
	MIN	-0.019	0.400	1.000										
	MNF	0.557	-0.089	0.107	1.000									
X_{10}	ELE	0.163	0.430	0.041	0.204	1.000								
	CST	-0.263	-0.296	-0.294	-0.329	-0.594	1.000							
	TRD	-0.056	0.129	0.270	0.739	0.195	-0.210	1.000						
	HOT	-0.487	-0.295	0.160	0.074	-0.076	0.331	0.594	1.000					
	TRS	-0.093	-0.122	-0.409	0.544	0.455	-0.393	0.555	0.290	1.000				
	RLE	-0.163	0.446	0.239	-0.314	-0.185	-0.021	-0.124	-0.154	-0.393	1.000			
	EDU	-0.061	-0.552	0.007	-0.158	-0.669	0.303	0.072	0.311	-0.280	-0.198	1.000		
	HLT	-0.053	0.489	0.176	0.444	0.348	-0.462	0.246	-0.133	0.389	0.015	-0.533	1.000	
	COM	-0.182	-0.190	0.392	-0.322	0.077	-0.237	-0.135	0.219	-0.091	0.594	-0.441	-0.127	1.000
	AGR	1.000												
	FSH	0.708	1.000											
	MIN	0.979	0.580	1.000										
	MNF	0.979	0.713	0.961	1.000									
	ELE	0.807	0.258	0.817	0.760	1.000								
	CST	0.984	0.712	0.976	0.991	0.760	1.000							
X_{11}	TRD	0.753	0.409	0.698	0.729	0.539	0.694	1.000						
	HOT	-0.189	-0.299	-0.198	-0.455	-0.217	-0.140	-0.445	1.000					
	TRS	0.606	0.495	0.651	0.570	0.236	0.682	0.427	-0.260	1.000				
	RLE	0.993	0.763	0.922	0.841	0.673	0.896	0.536	-0.187	0.644	1.000			
	EDU	0.914	0.625	0.880	0.902	0.837	0.903	0.570	-0.335	0.746	0.906	1.000		
	HLT	0.164	0.376	0.287	0.817	0.149	0.225	0.242	-0.528	0.293	0.205	0.151	1.000	
	COM	0.761	0.733	0.780	0.834	0.540	0.805	0.420	-0.394	0.752	0.804	0.788	0.512	1.000

Source: calculations based on BACH database.

Table 8

Proportion of negative and highly positive correlation coefficient (*r*) of liquidity ratios between countries and between industries (%)

Correlation between	*r*	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
Countries	<0	27	16	9	0	9	2	11	4	4	0	42
	>0.7	16	9	9	36	16	31	56	27	51	67	11
Industries	<0	44	37	40	46	50	40	53	38	22	22	15
	>0.7	6	4	3	9	1	12	10	8	26	54	46

Source: calculations based on BACH database.

Table 9
Correlation matrix of diagnostic variables

Ratio	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
X_1	1.000										
X_2	0.862	1.000									
X_3	0.257	0.344	1.000								
X_4	-0.307	-0.097	0.125	1.000							
X_5	-0.310	-0.373	-0.084	0.222	1.000						
X_6	0.015	0.139	0.727	0.107	-0.050	1.000					
X_7	0.181	0.183	-0.242	-0.313	-0.571	0.023	1.000				
X_8	0.110	0.146	-0.177	-0.187	-0.554	0.035	0.948	1.000			
X_9	0.069	0.097	0.306	-0.041	0.264	0.299	-0.136	-0.117	1.000		
X_{10}	0.044	-0.163	-0.200	-0.744	0.071	-0.242	0.093	0.030	-0.015	1.000	
X_{11}	0.201	0.277	0.222	-0.047	-0.032	0.007	-0.014	-0.026	0.623	-0.051	1.000

Source: calculations based on BACH database.

Table 10
K-means grouping results

Cluster number							
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
NL_HLT	NL_AGR	NL_HOT	FR_AGR	B_ELE	NL_FSH	B_AGR	NL_MIN
B_MIN	NL_MNF	NL_COM	FR_FSH	B_EDU	NL_TRD	B_MNF	NL_ELE
B_RLE	NL_CST	A_ELE	FR_MIN	FR_HOT	FR_TRD	B_CST	NL_TRS
B_HLT	NL_RLE	D_MNF	ES_AGR	FR_HLT	ES_TRD	B_TRD	B_FSH
FR_RLE	NL_EDU	P_MIN	ES_FSH	I_ELE	I_AGR	I_FSH	B_HOT
I_MIN	B_COM	P_COM	ES_MIN	I_HOT	I_TRD	I_MNF	B_TRS
I_RLE	FR_MNF	PL_AGR	FIN_FSH	A_HOT	D_TRD	I_CST	FR_TRS
A_RLE	FR_ELE	PL_FSH	FIN_COM	A_TRS	PL_TRD	A_AGR	FR_EDU
D_MIN	FR_CST	PL_MIN		A_EDU		A_MIN	FR_COM
P_RLE	ES_MNF	PL_MNF		A_COM		A_CST	ES_ELE
P_EDU	ES_CST	PL_ELE		D_ELE		A_TRD	ES_HOT
P_HLT	ES_RLE	PL_CST		P_ELE		D_CST	ES_TRS
FIN_EDU	ES_HLT	PL_TRS		P_TRS		P_AGR	ES_EDU
FIN_HLT	ES_COM	PL_HLT		FIN_HOT		P_MNF	I_TRS
PL_RLE	A_HLT					P_CST	I_COM
PL_EDU	D_RLE					P_TRD	D_TRS
PL_COM	P_FSH					FIN_CST	P_HOT
	FIN_AGR					FIN_TRD	FIN_TRS
	FIN_MIN						PL_HOT
	FIN_MNF						
	FIN_ELE						
	FIN_RLE						

Table 11
Numbers of industries and countries in clusters

Industry	Symbol	Cluster number															
		agglomerative clustering								*k*-means grouping							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Agriculture	AGR	5	-	-	-	1	-	-	3	-	2	1	2	-	1	3	-
Fishing	FSH	3	1	-	-	2	-	1	1	-	1	1	3	-	1	1	1
Mining	MIN	2	1	4	-	1	-	1	1	3	2	2	2	-	-	1	1
Manufacturing	MNF	5	1	-	-	1	-	-	2	-	3	2	-	-	-	3	-
Electricity	ELE	1	-	-	1	2	3	3	-	-	2	2	-	4	-	-	2
Construction	CST	-	3	-	-	1	-	-	6	-	3	1	-	-	-	6	-
Trade	TRD	-	-	-	-	1	-	-	9	-	-	-	-	-	6	4	-
Hotels	HOT	1	-	-	-	-	4	4	-	-	-	1	-	4	-	-	4
Transport	TRS	-	-	-	1	1	1	7	-	-	-	1	-	2	-	-	7
Real estate	RLE	3	3	4	-	-	-	-	-	6	4	-	-	-	-	-	-
Education	EDU	-	1	-	5	-	2	-	-	3	1	-	-	2	-	-	2
Health	HLT	1	2	2	2	-	1	-	-	4	2	1	-	1	-	-	-
Community services	COM	1	1	2	-	2	1	2	-	1	2	2	1	1	-	-	2
Country																	
Netherlands	NL	2	3	1	-	2	-	4	1	1	5	2	-	-	2	-	3
Belgium	B	2	1	2	2	-	1	3	2	3	1	-	-	2	-	4	3
France	FR	4	1	2	1	-	2	2	1	1	3	-	3	2	1	-	3
Spain	ES	6	2	-	1	-	-	3	1	-	5	-	3	-	1	-	4
Italy	I	-	1	1	-	-	2	2	5	2	-	-	-	2	2	3	2
Austria	A	1	-	1	1	1	3	-	4	1	1	1	-	4	-	4	-
Germany	D	1	1	1	1	-	-	1	2	1	1	1	-	1	1	1	1
Portugal	P	1	1	1	1	2	3	-	4	3	1	2	-	2	-	4	1
Finland	FIN	5	-	2	1	-	1	2	2	2	5	-	2	1	-	2	1
Poland	PL	-	3	1	1	7	-	1	-	3	-	8	-	-	1	-	1