

Chapter 2

Country and Industry Factors as Determinants of Corporate Performance: Research Methodology

2.1 Review of Previous Research on Corporate Performance Diversity

Corporate performance diversity has long been the subject of a number of studies performed with various research methods in such areas as finance, accounting or industrial economics. Researchers focus on different aspects of this diversity, for example, depending on geographical region, industry, company size or strategy.

In industrial economics there have been at least three different methodological approaches employed for analysing markets. The primary – and still the most common methodology – is a case study of an industry. The case studies, however, do not lend themselves to easy generalisations. This weakness has led the industrial economists of the 50s of the previous century to the cross-sectional econometric analyses. Econometric methods based on panel data were also used. This kind of methodology was established at the beginning of the last decade of the previous century. This allowed the observation of market dynamics based on time series. Another methodological approach in this area was the study of cases observed in a long time, covering almost the entire history of the market. The attractiveness of this method in comparison with the panel data was based on the use of long time series (according to the age of the industry), which enabled the formulation of reliable conclusions about the dynamics of the market and eliminated the possibility that the panel could reflect the characteristics found only in a few years, when the panel was created (Geroski & Mata, 2001).

An important tool widely used in contemporary research of corporate performance is the discrimination analysis, which is gaining more and more supporters in the area of business diagnostics. The discrimination analysis enables constructing a formula that identifies the belonging of objects to the distinguished classes. The simplest practice in this methodology is the division into two groups. The construction of the membership rule is based on multi-dimensional information about each object and its assignment to a given category (Lipiec-Zajchowska, 2003; Rószkiewicz, 2002).

One of the discrimination methods most commonly used in practice and the most popular is a linear discriminant function, i.e. the hyper-plane which separates two or more groups. Bankruptcy prediction models, also called early warning systems, are designed to reveal deteriorating economic and financial situation of an enterprise (Zaleska, 2002, p. 12). Identification of problems should occur well in advance, thus enabling the introduction of appropriate measures to prevent the failure.

The increasing popularity of discrimination methods, mainly due to their easy application, sometimes leads to an alternative use of traditional financial analysis and discriminant analysis. When referring to enterprises, the discriminating functions are designed to classify them, i.e. to categorise them into groups according to some specific criteria. A typical example of such categorisation with the use of discriminating function is to assign companies to one of two groups: the solvent ones and the ones threatened with bankruptcy. This is meant to identify the risk of a failure early enough – before it becomes a fact (Koralun-Bereźnicka, 2006).

The issue of predicting corporate bankruptcy with the use of financial ratios is also one of the most frequent themes of research in the area of corporate finance. Studies in this area often focus on the predictive abilities of ratios when identifying the bankruptcy risk. These studies have their origins in the first half of last century – initiated by Fitzpatrick (1932), and then continued by Smith and Winakor (1935), and Horrigan (1965). In the early studies a one-dimensional methodology prevailed, which was meant to identify the ratios with the best abilities to separate unthreatened business from the bankrupts. A milestone in this area is the study by Beaver (1966), which in turn was a starting point for another important study on the theory of financial ratios as predictors of bankruptcy (Wilcox, 1970). The research shows, among others, that some ratios are characterised by stronger predictive abilities, which makes that they perform their function of predicting bankruptcy better than other ratios. This is particularly true about the ratios which include cash flows.

The discrimination models owe their popularity largely to E. Altman (1968, 1993, 2001; Altman, Haldeman, & Narayanan, 1977), whose contribution to the development of these functions, including multivariate ones, resulted in the significant spread of knowledge in this area. Over the past several decades, a number of models were constructed, which aimed at an early detection of potential bankruptcy. The variables used in them were both financial ratios, as well as information about cash flows which are crucial to the survival of a company. In fact it is argued that more companies go bankrupt as a result of the cash problems than due to unprofitability. As a result of a series of modifications of the primary discriminating functions, meant to predict the solvency of companies, the set of workable models for discriminant analysis has now become quite numerous. It is suggested however, that in order to improve the predictive accuracy of the bankruptcy forecasting models, they should be constructed separately for each industry (McGurr & DeVaney, 1998). Therefore, it could be concluded that the industrial specificity is strong enough to affect the quality of the results obtained with the use of the models. A comparative analysis of bankruptcies across industries, carried out among others

in Canada, is empirical evidence that the industrial membership can be a factor influencing the probability of bankruptcy (Fisher & Martel, 2000).

Apart from the evaluation of the bankruptcy probability of individual companies, there have also been attempts to assess the risk in a wider context – by industries (Falk & Heintz, 1975). The aim of the study by Falk and Heintz was to classify industries according to the risk level measured with financial ratios. The relationship between business risk and financial ratios was also the subject of many other studies, most of which, however, focused on the factors relating to companies. It turned out, for example, that financial ratios are characterised with good predictive properties with respect to the quality of securities issued by companies, as well as financial difficulties (Beaver, McNichols, & Rhie, 2004).

Financial ratios were also the basis for classification of companies into categories with a similar level of risk with the use of cluster analysis (Melnyk & Mathur, 1972). The grouping results resembled to some extent the industrial categorisation of companies. Similar conclusions result from a study by Gupta (1969), who detected that certain patterns in the industrial financial ratios show a systematic resemblance to the characteristics of industries. The occurrence of the industry effect was also identified in a study of the profitability ratios of enterprises from different industrial sectors (Ball & Brown, 1968). Another notable conclusion was that companies seek to coordinate the values of some ratios with the industry mean (Lev, 1969).

Methods which employ artificial intelligence, such as neural networks, prove an appropriate and increasingly popular tool for classification of businesses (Brabazon & Keenan, 2004). Neural networks were applied for example in order to search for isolated groups within the same industry, namely banking sector, which distinguishes this study from those seeking for differences between industries (Serrano-Cinca, 1998). A preceding research in the area of finance is a study, which uses cluster analysis to verify the ability of financial statements to reveal the hidden industrial characteristics (Gupta & Huefner, 1972). It was meant to verify if the companies from different industries were characterised with some similar values specific to each industry. This type of study has later become a broad stream of research.

A common research theme in terms of financial ratios is their distribution properties, particularly the question of normality of this distribution. An example might be an attempt to determine the characteristics of distributions of the selected financial ratios of the listed companies in Malaysia from the period 1980 to 1996, some of which were bankrupt (Sori, Hamid, Ali, Annuar, & Shamsher, 2006). Observations from the three industries were subjected to normality tests, which showed that in all examples only one variable (current to total assets) was normally distributed. The improvement in terms of normality was noted after eliminating unusual observations and data transformation and only when individual industries were analysed separately. However, in many studies of ratios, the assumption of normal distribution was treated as a necessary condition for multivariate analyses. Verification of this assumption in the early stage of the analysis is also recommended by other researchers (Afifi & Clark, 1990; Karels & Prakash,

1987), who suggest that multivariate discriminant analysis procedure will be optimal if the condition of normality is met; otherwise some of the conclusions might be erroneous. Other authors, however, point to the difficulties in meeting the normality assumption, arguing that the deviation from the normal distribution, at least in the area of economics and finance, appears to be the rule rather than an exception (Eisenbeis, 1977). Some aspects of the ratios' distribution are also discussed in the study by Deakin (1976). Rejection of the normality assumption is also confirmed by some British publications (Bougen & Drury, 1980). Similar conclusions can be drawn from other studies focusing on the selected aspects of financial ratios' distribution, which were undertaken in European countries, for example, in relation to larger industrial enterprises from the stock exchange in Ireland (Lucey, 2003). The research shows that many of the fundamental assumptions underlying the traditional financial analysis, including the normality of distribution are no longer met.

One of the key elements of assessing the corporate attractiveness is the financial statements analysis, which however entails certain difficulties. The purpose of the traditional ratio analysis, based on the financial statements is to enable comparability between companies and at different points in time by eliminating the size effect. The removal of the size effect is based on the proportionality of the numerator and denominator in a financial ratio. The problem of proportionality of ratios caused a major debate in the literature (Fieldsend, Longford, & McLeay, 1987; McLeay & Fieldsend, 1987; Whittington, 1980). The research on this controversial issue (Lev & Sunder, 1979; McDonald & Morris, 1984, 1985) show that the assumption of proportionality is not satisfied in all the industries analysed. Lack of proportionality in ratios is also confirmed by the results of other studies based on the data from Finland (Perttunen & Martikainen, 1989), Spain (Cinca, Molinero, & Larraz, 2005) or France (McLeay & Fieldsend, 1987). However, the degree of failure of this theoretical assumption depends on the industry and company size. The issue of proportionality in ratios was also examined in terms of its dynamics in time, which also confirmed the existence of the industry effect (Feildstein, Longford, & McLeay, 1987).

An important research topic of financial ratios is also the question of their cross-industry comparability. A study by Ketz et al. (1990, p. 2) of the similarities and differences between different taxonomies of ratios in several industries provides evidence for this comparability. In a review of several industries in the United States, they look for certain patterns of ratios as well as try to determine the degree of similarity between the identified structures. The authors challenge the traditional ways of ratios classification, which do not necessarily reflect the actual relations between them. Statistical approach provides, according to the authors, an empirical verification of these relationships and classifications based on real data. The study involved a set of 32 ratios in seven industries (automotive and aerospace, chemicals, electronics, food, textile, retail and steel industry) in over 10 years' period from 1978 to 1987. The selection of ratios was guided by their common use in other studies and practice, which ultimately led to the inclusion of the following ratios:

1. Cash/current liabilities,
2. Cash/sales,
3. Cash/total assets,
4. Cash/total liabilities,
5. Operational cash flow/sales,
6. Operational cash flow/total assets,
7. Operational cash flow/total liabilities,
8. Cost of goods sold/inventory,
9. Cost of goods sold/sales,
10. Current assets/current liabilities,
11. Current assets/sales,
12. Current assets/total assets,
13. Current liabilities/total liabilities,
14. Inventory/current assets
15. Inventory/sales
16. Inventory/working capital,
17. Long-term liabilities/total assets,
18. Operating profit/sales,
19. Operating profit/total assets,
20. Operating profit/total liabilities,
21. [Operating profit + depreciation]/sales,
22. [Operating profit + depreciation]/total assets,
23. [Operating profit + depreciation]/total liabilities,
24. Liquid current assets/current liabilities,
25. Accounts receivable/inventory,
26. Accounts receivable/sales,
27. Sales/accounts receivable,
28. Sales/total assets,
29. Total liabilities/total assets,
30. Working capital/sales,
31. Working capital/total assets,
32. Working capital/total liabilities.

When analysing the above list of ratios, one must notice the duplication of variables, such as ratios 26 and 27. The inclusion of a ratio which is nothing but a reciprocal of another ratio does not provide any new information. Not including the ratios of return on equity or return on assets, which are so common elsewhere, is also puzzling.

The main methodological tool used in the study was the factor analysis as a method to ensure the effective representation of the variables in the form of ratios by a smaller number of variables called factors. Similar variables are therefore combined to form one common factor. An example of similar variables can be a pair of ratios 10 and 24, both of which have a similar structure: the same denominators and similar nominators, including cash, short-term investments and receivables. They describe the same analytical area, i.e. corporate liquidity, and

therefore it can be expected that they are influenced by the same factor. However, the ratios 3 and 18 may serve as an example of dissimilar variables as they measure different business areas: monetary situation and profitability. Furthermore, these variables do not have to show a similar way of variability; the increase of ratio 3 may be accompanied by the decline of the ratio 18, which would be unlikely in the previous couple of ratios. Although the factor analysis used in this study, does not fully resolve all the problems of ratios classification, it offers a more reliable basis for the creation of taxonomies. In addition, the established ratio classification schemes for the analysed industries allow for further exploration of the similarities between these taxonomies, and as a result for studying the stability of the ratio structures both across industries and in time.

Another important research issue is the international diversification of corporate financial condition and its variation depending on the size of the company, which means the occurrence of the country effect and the size effect in financial ratios (Cinca et al., 2005). In a study based on the BACH database, the authors calculated a set of 16 financial ratios, which were then subjected to multivariate statistical analysis meant to identify the effect of country and size. The data refers to three size groups of enterprises in 19 industries of 11 countries in 14 years. In total, including the missing data, there were 6,428 observations. The examined ratios include the following:

1. Gross operating profit/net turnover,
2. Net profit/net turnover,
3. Net profit/equity,
4. Consumption of goods and services/net turnover,
5. Value added/net turnover,
6. Staff costs/net turnover,
7. Staff costs/value added,
8. Interest charges/net turnover,
9. Interest charges/debt owed to credit institutions,
10. Financial result/net turnover,
11. (Own funds – unpaid share capital)/balance sheet total,
12. Total debt/balance sheet total,
13. Financial debt/balance sheet total,
14. Long-term debt/(long term debt + short term debt),
15. Provisions for liabilities and charges/balance sheet total,
16. Net turnover/total assets.

It can be assumed that the above set of ratios, although much narrower than the group of ratios adopted for the comparative study of the U.S. industrial sectors, is sufficient for characterising the most important analytical areas of corporate activity, but avoids unnecessary repetitions. The analytical tools used in the study include discriminant analysis, multidimensional scaling and cluster analysis. The analyses show that the ratios do differ across sizes of companies, but the way they differ, depends on a country. It can be concluded that profitability does not depend significantly on the size of a company, but that the differences in this area arise in

international comparisons. The authors also showed the occurrence of the country effect in Europe and that the size effect may be considered only within each country separately.

Other studies on financial structures of European companies, also using the BACH database, are not fully unambiguous (Gallizo & Salvador, 2002; Rivaud-Danset, Salais, & Dubocage, 2001; Serrano-Cinca, Mar-Molinero, & Gallizo, 2001, 2002). They show the diversity of the results and conclusions drawn by different researchers, which can be explained by the fact that in the studies that focused on the size effect, the country effects were ignored, whereas in the studies of the country effects, the different shares of large and small enterprises in individual countries were not taken into account. Therefore, it can be concluded that these two effects can not be considered separately.

The size effect was also detected in the capital markets (Cooke, 1992; Rees, 1995) and in bankruptcy prediction (Ohlson, 1980; Peel, Peel, & Pope, 1986). Small enterprises are more likely to fail than large businesses. Moreover, it can be expected that roughly half of the small enterprises of the analysed area will go bankrupt within 5 years' time (Storey, Keasey, Watson, & Wynarczyk, 1987). The company size also appears to affect the debt structure (Chung, 1993), the tendency to export (Calof, 1994; Julien, Joyal, Deshaies, & Ramangalahy, 1997), the cost of equity (Archer & Faerber, 1966) and financial structure (Gupta, 1969). Small enterprises have limited access to capital markets – as opposed to large firms, which can raise funding by issuing shares or bonds. The same applies to the banking sector, where credit availability is smaller for small businesses than for large ones (Gatward & Sharpe, 1996).

The above examples of research problems associated with corporate performance diversity reveal the complexity and, above all, the multidimensionality of this issue. The volatility of financial ratios as performance measures is tested from many different points of view, for example, by size, industry or the bankruptcy likelihood. There is also a variety of research methodology applied in this area, where the significant and growing importance of multivariate statistical analysis is notable.

2.2 Relative Importance of Country and Industry Effects in Stock Returns in Light of Previous Research

The industry and country effects have been repeatedly tested in different economic areas. One of the still most frequently studied problems is the impact of the national and industrial factors on the behaviour of market rates of return. The industry and country effect in relation to stock returns involve their diversity depending on the industry and country, respectively. Therefore, the industry effect can be defined as the occurrence of certain factors specific for a particular industrial sector and

affecting economic entities of that industry in a similar way (Dempsey, Laber, & Rozeff, 1993). The country effect is interpreted likewise.

It has been empirically proven many times that both effects are important from the point of view of returns variability. However, an important theme of many studies is to determine which of the effects is the dominant source of variability in rates of return. Over the past several years many authors, both academics and practitioners, have tried to assess the relative importance of the national and industrial factors. The comparison of these two effects is important above all in terms of investment diversification efficiency. If these are mainly industrial factors which are responsible for rates of return, portfolio managers should use investment strategies based on cross-industry sections. However, the traditional strategy of portfolio diversification by country would be more justified if the returns variability depended mainly on domestic factors. Many attempts to resolve the problem of the relative importance of the country and industry effects have resulted in formulating some suggestions about how to diversify investment portfolios, as well as how to conduct research in the area of finance (Koralun-Bereźnicka, 2009b).

Despite the seemingly rather obvious connection between the relative importance of the country and industry effects and the benefits of portfolio risk reduction, the literature does not state clearly which kind of diversification – cross-industry or cross-country – is more effective (De Moor & Sercu, 2005). This means that even if the industry factors influenced the rates of return stronger than the domestic factors, in some cases international diversification could still provide greater benefits of risk reduction (Adjaouté & Danthine, 2003). The following review of results from different studies in this area will allow to notice the trends in changes of significance of the analysed factors, as well as to organise the conclusions in this regard.

2.2.1 Country Effect as the Main Source of Stock Returns Volatility

As the source of the benefits from international diversification is the countries differentiation, there have been many attempts to establish which country-specific factors are responsible for low levels of correlation of market returns. 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. Contrary to the natural associations, not all of these factors are directly linked with the degree of international integration of markets. A literature review will reveal the likely underlying causes of their low correlation.

Some studies indicate that this situation is a result of different industrial structures in different countries, which are reflected in the construction of stock indices. Since there is no correlation between different industries, consequently, capital markets, composed of a variety of industries, will also not correlate.

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 outcome 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.

A major part of the literature favours the dominance of the country factors over the industrial ones (Beckers, Grinold, Rudd, & Stefek, 1992; Beckers, Connor, & Curds, 1996; Drummen & Zimmermann, 1992; Griffin & Karolyi, 1998; Heston & Rouwenhorst, 1994, 1995; Kuo & Satchell, 2001; Rouwenhorst, 1999). The only exception within this fairly homogenous literature is the study by Roll (1992), who found the industry factors more important. Some broader studies by Beckers et al. (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 seven main branches. In each case however, country effects seem to dominate.

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 seven 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 the country and industry factors are free from any other influences. Therefore, the country factor for a given domestic market is the return on the portfolio, which includes investments in that country alone, without taking into account the global or industrial risk. Similarly, the industrial factor is associated with the return on the portfolio restricted to a given industry. This decomposition allows for a clear and direct distinction between global and industry-specific components, which affect asset prices.

Similar conclusions can be drawn from a study concerning developing countries (Serra, 2000), which confirms that market return rates are mainly affected by country factors and that international correlation does not depend on industrial structure of indices. Taking into account the detailed industrial classification shows, however, that the omission of the industry effect leads to a significant loss of diversification benefits. Other studies of the emerging markets also provide similar conclusions about the dominance of the country effect over the industrial ones, in contrast to the developed economies (Phylaktis & Xia, 2006).

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.

The occurrence of many different factors of a political, economic, cultural or social character, specific for individual countries makes that the international diversity of market returns remains significant. That is why a strategy of investments diversification based on countries should still be a considerable source of risk reduction.

2.2.2 The Importance of Industry Factors for Market Rates of Return

Industrial factors were first considered as potential determinants of returns in the 60s. 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 et al. (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".

According to Roll (1992) the industry factors are of crucial importance. He suggested three dominating factors responsible for the volatility of return from domestic portfolio:

- Technical index construction, which leads to broad and diverse indices (mainly due to a very diverse number of securities included in the national indices)
- Industry structure reflected in the index which may explain some variation;
- Changes in both real and nominal exchange rate influencing the variance of indices denominated in national currencies.

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 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).

The theory about the relatively low influence of industry factors is also confirmed by other studies (Drummen & Zimmermann, 1992; Grinold, Rudd, & Stefek, 1989; Lessard, 1976), which, however, reveal a more important role of industries. Apart from the differences relating to the analytical periods or range of the research, the identification of a stronger influence of the industry has its origin in the problem, which appeared in the study by Roll, where the industrial index was used as the proxy of the industrial factors and domestic indices replaced country factors. As a result, industrial indices included domestic influences to the same extent as domestic indices – industrial influences.

Using a more detailed industrial classification also revealed interesting differences in the variance of the indices across industries. Namely, in the non-exporting industries, such as media, industrial construction and real estate, domestic factors explain a relatively larger part of the indices volatility due to the high transport costs. However, in the industries producing goods subject to international trade, such as cars, computers, office equipment, pharmaceuticals or semiconductors, the industry-specific factors have a larger share in explaining the variance. Heston and Rouwenhorst (1995), however, speculate that the inclusion of non-European countries would reveal a greater role of the country effects.

A useful way of measuring the relative importance of the country and industry factors is distinguishing between exporting and non-exporting industries. For companies in certain industries the variability in the global industry may be more significant for their returns, since their profitability, cash flow and asset values are more sensitive to the following factors:

- Fluctuations of the prices of production factors used in the industry and traded internationally,
- Fluctuations of the prices of finished goods sold by companies in foreign markets,
- Changes in the competitiveness of foreign firms in relation to domestic exporters and competitive importers.

The coal industry, producing homogeneous goods subject to international trade may serve as an example of such an industry. Supply shocks and conditions of demand for coal are important factors affecting production costs, profitability, as well as current and future operating cash flows of coal extracting companies, which trade it around the world. Similarly, sudden changes in exchange rates affect the relative costs of production factors and prices of coal products, and thus the competitiveness of domestic and foreign coal suppliers.

The distinction between the exporting companies and non-exporters is derived from the industrial economics and exchange rates theory. The early macroeconomic models by Dornbusch (1973, 1987) are based on the hypotheses referring to how the exchange rate changes affect the level of wages, prices of goods and assets in exporting and non-exporting industries. In the case of export goods, for which the exchange rate is the relation of prices of domestic and foreign goods, exchange rate

changes impact the cost of production factors and prices of goods, which in turn affects the profitability of the sector.

In the financial literature, the impact of fluctuations in exchange rates on market values and investment decisions of enterprises in exporting and non-exporting industries is modelled by Adler and Dumas (1984), as well as Levi (1994). The empirical studies by Bodnar and Gentry (1993), in turn, provide an industrial analysis of sensitivity to changes in exchange rate and focus mainly on the differences between the exporting and non-exporting industries. Since the exporting industries have a common source of variance, due to the relative changes in costs and prices, the theory predicts that the share prices of these companies are more vulnerable to fluctuations in exchange rates, which is confirmed by empirical studies. Fluctuations in prices of raw materials and goods constitute an industry-specific factor of performance differentiation – more important for companies operating in international markets.

Some more recent studies, e.g. by Weiss (1998), Baca, Garbe, and Weiss, (2000), Cavaglia, Brightman, and Aked (2000), L'Her, Sy, and Tnani (2002), Brooks and Del Negro (2004) or Flavin (2004) show, however, that in recent years, the industry effects match with the regional ones, and sometimes even exceed them, which suggests that the investment strategy combining the international and cross-industry diversification may be more effective in reducing risk than the strategy limited to the traditional international diversification.

2.2.3 Impact of Integration on the Relative Importance of Country and Industry Factors

The influence of the integration process should be particularly evident in the relative importance of the two kinds of factors: the country, where a company operates and the industry in which it holds the main activity. It could be expected that the greater the segmentation of markets, the more significant the impact of national factors. Thus, in the integrated capital markets, the global industrial factors should play a key role (Koralun-Bereźnicka, 2009c). Most practitioners are of the opinion that in the evolution of stock returns the industry specificity is more important than domestic factors.

The recent changes in the relative importance of the country and industry effects may result from the globalisation of companies and integration of financial markets (Koralun-Bereźnicka, 2008b). The activities of many companies over the last decade were focused on the consolidation and rationalisation of operations globally, manifested mainly through international expansion and a series of mergers and acquisitions. For example, the number of cross-border mergers and acquisitions increased from an average of 40 billion dollars a year in the period 1989–1993 to an average of 400 billion dollars in 1994–2000 (Cavaglia, Cho, & Singer, 2001). As a result, companies have become more diversified internationally, which is why they

are less sensitive to the country-specific economic shocks affecting their domestic markets. At the same time, however, due to the progress of the integration of global financial markets, they are subject to similar changes (Freimann, 1998; Goetzmann et al., 2005). These developments tend to blur the borders between countries and reduce the importance of the country effect.

The relative importance of the country and industry factors as determinants of international stock returns in the euro area was also a subject of research from the perspective of portfolio performance (Eiling, Gerard, & de Roon, 2005). A study covering the period 1990–2003 shows that significant changes are noticeable in the structure of equity returns in the euro area, although the industrial and national portfolios are indistinguishable in terms of mean, variance and Sharp's indicators. While national returns showed greater variability, but a weaker correlation than the industrial returns in the early 90s of the last century, an inverse relationship was observed at a later stage, i.e. in the second half of the last decade and in the early twenty-first century, which was the period of transition to euro. Furthermore, according to the authors' conclusions, even in a highly-converged group of the economies of the euro area, the international diversification within one industry does not provide such benefits as the total diversification both across countries and across industries.

The earlier mentioned study by Beckers et al. (1996) shows that the industry factors are more significant when the industrial classification is more detailed. Nevertheless, each time the country effect remains predominant. In addition, the researchers conclude that the member states of the European Monetary Union have a much higher level of integration than other countries. Griffin and Karolyi (1998), who also examined both the main division, as well as the more specific classification, draw similar conclusions. The more detailed the industrial classification, the clearer the industry effect. The authors also introduced the distinction between countries belonging to different regions of the world. The inclusion of the major developing countries in the sample showed their lower degree of integration at the international level.

According to a report on the impact of the euro on the European financial markets (Galati & Tsatsaronis, 2003), in 1997 only 20 % of managers acknowledged the superiority of portfolio diversification strategy based on the industries, whereas 50 % found domestic factors as dominant. However, in 2001 these proportions were reversed, with almost 75 % of managers believing that the effectiveness of investment strategy based on the industries is higher than the international one, and only 10 % still believing in the superiority of the country effect. Bolliger (2004) provides further evidence, showing that most banks and brokers decided on the reorganisation of research departments by industries, rather than by countries.

Another confirmation of the changes concerning the relative importance of the two effects is the way of presenting the results of listed companies in the financial press, where most securities are classified by industries, rather than by markets. This tendency is particularly noticeable in Europe. Another example of the radical changes taking place in this area may be the expansion of the international

investment funds. The question which remains unanswered is whether the superiority of the industry factors as determinants of returns assumed by practitioners is reflected in the theory. The problem of the relative importance of the country and industry factors was the subject of many studies long before the recent advancement of the financial markets integration. However, there is no clear and convincing evidence to support the practical convictions, as most empirical results show that the domestic influences are stronger than the industrial ones.

The analysis of more than 4,000 securities from 20 developed countries of the years 1997–2000 shows a significant increase of the industrial factors impact on returns (Sonney, 2007, p. 22). In some cases it even exceeds the country effect. The research also provides another conclusion: limiting the sample to the eight member countries of the European Monetary Union reveals a greater impact of the industry effect in comparison with the country effect. One might suppose that this result is a natural consequence of the convergence of economic and fiscal policies in the Community. It appears, however, that this is not the direct cause, as the growing importance of the industry factors was observed in all developed countries. Therefore the shift should be attributed to the increasing globalisation of the world economy rather than to the economic convergence of the euro zone countries. Despite the occurrence of so many factors that integrate financial markets, there are also some forces preventing the total globalisation of this area. Many of them can be observed especially in developing countries. These include, among others, political risk, not complying with corporate governance principles or the poor functioning of national financial systems. The problem remaining in the developed countries, in turn, is the persistence of differences in economic policy, taxation and legal regulations. Despite intensive efforts to harmonise accounting standards, there are still significant differences, even between European countries.

Moreover, despite the clearly marked trend in the recent years among the European companies towards the internationalisation of production and sales, for many of them domestic markets still remain the main area of business. The globalisation process is often curbed by a number of psychological barriers. Although the development of information technology is so advanced that current information virtually from around the world is readily available, investors remain largely not familiarised with foreign markets and the local commercial procedures. Their knowledge about foreign markets is mostly still lower than about the domestic markets, which is why the former may be perceived as more risky. This is particularly true about smaller markets (Kang & Stulz, 1997). Foreign investors also bear the consequences of the distance (Coval & Moskowitz, 2001), different language and culture (Grinblatt & Keloharju, 2001), and even differences in time zones. Even institutional investors, with much greater freedom in economic activity abroad, still have a tendency to remain strongly attached to national markets.

2.2.4 *Financial Ratios Versus Market Returns*

The corporate fundamental analysis can provide a reference point for market rates of return generated by companies. Although not all studies in this area yielded the expected results, most of them proved to be accurate in identifying the relationship between financial ratios and business risk.

There are two main streams distinguishable in the studies of the links between financial ratios and the market rates of return. The first one focuses on the relationship between the stock returns and market ratios, i.e. those ratios which relate to the share price or capitalisation of the company. The most common ratios here are the price-earnings ratio, the dividend yield, which is the relation of the dividend to the share price, and the ratio of book-to-market value. The main objective of this research stream is to identify the possible predictors of these indicators for future rates of return (see e.g. Campbell & Shiller, 1988; DeJong & Whiteman, 1991; Fama & French, 1988; Fama & Schwert, 1977; Goetzmann & Jorion, 1993; Hodrick, 1992; Kothari & Shanken, 1997; Lamont, 1998; Lewellen, 2004; Pontiff & Schall, 1998). Because of the weak link of this research stream with the empirical part of this study, where the above ratios are not analysed, it is not further discussed here.

It is worthwhile, however, to devote some more attention to the other stream within the analysed area of research, which looks for the relationships between financial ratios based on book values and market rates of return. The range of the results concerning the theoretical and empirical links between the accounting and market rates of return is very wide – from the confirmation of a strong and useful correlation (Jacobson, 1987) to the total negation of this relationship (Fisher & McGowan, 1983), although the latter of these extremes is rarely acknowledged in the literature.

For example, the results of research of different industries in the United States and Japan confirm the occurrence of various relationships (mostly nonlinear) between the premium return on equity and financial ratios, which include: return on assets, return on sales, fixed assets and total assets turnover, liquidity ratios, creditors turnover period, stock turnover period, interest cover ratio, debt ratio and equity multiplier (Pahor & Mramor, 2001). Furthermore, the analysis shows that these relationships are largely independent from both industry and country.

Another study, performed on the listed companies in Tehran, aimed at answering the question whether there is a significant relationship between the premium returns and the selected financial ratios (Modares, Abedi, & Mirshama, 2008). The tests indicated that in the analysed periods the variability of ratios including profit category in their construction (return on assets, return on sales and price-earnings ratio) explained changes in premium returns. This in turn proved that in some periods investors, who used the profits for predictive purposes, could achieve premium incomes.

The diversity of the research results indicates that the relationship between the market rates of return and financial ratios based on book values is not obvious. This

in turn implies that the inference about the relationship between the drivers of the corporate performance characterised by fundamental financial ratios and the effectiveness of investment portfolio diversification measured by the ratio of risk to the rate of return also does not always have to be clear. As for the use of financial statements analysis for fundamental investments, the results in this area seem to be more promising, since the relationship between accounting values (the accounting amounts, ratios and their increments) and future market returns are confirmed both in theory (Edwards, Kay, & Mayer, 1987) and in practice. A study of the links between the return on equity adjusted for risk and the selected financial ratios for companies in Slovenia in various industries separately, confirmed the occurrence of these relationships. It also revealed, however, that the ratios that determine the rate of return vary across industries (Mramor & Marmor-Kosta, 1997).

Despite the apparent divergence of views in the literature about the relationship between the book and market values, many researchers assume the existence of strong links, for example, between the return on equity and the market rate of return on this capital, although it is not unanimously confirmed. So far, however, there is no better substitute found for the market rate of return, when it is not available.

2.2.5 Summary of Studies Review

The review of the previous research on the country and industry effects reveals that up to the early 90s the capital allocation was based largely on the assumption that the country factors are the main source of variability in rates of return. Therefore, the international diversification was generally recognised as the most effective method of reducing the volatility in asset management. The main conclusion emerging from the literature in this area is the dominance of the country factors over the industrial ones as determinants of the returns. However the second half of the last decade of the previous century brings in new results in this area. At present, practitioners are willing to acknowledge the supremacy of global investment strategies based on the industries. The shift is usually explained as a natural consequence of the increasing globalisation and integration of financial markets.

A clear lack of consensus among researchers on the evaluation of the relative importance of the country and industry effects gives rise to further verification of this problem. Some contradictions between the results obtained by different researchers, depending on the method used, the period of study or research sample, prove that it is purposeful and advisable to use alternative methods of resolving the issue and continue exploring the research problem, which particularly concerns the area of integrated Europe.

2.3 Empirical Research of the Impact of Country and Industry Factors on Corporate Performance: Aims and Data Description

The main objective of the study is to evaluate the influence of the country and industry factors on corporate performance in the selected European Union countries. The intended result of the analysis should therefore be the identification which factors – national or industrial ones – have a greater impact on financial condition of enterprises. In order to solve the key problem of this research, which can be defined as an assessment of the relative importance of the country and industry effects in corporate performance, a comparative analysis of the diversity of entrepreneurial economic and financial results is applied, both internationally and across industries.

The analysis of the empirical data derived from the aggregated and harmonised financial statements will help to verify hypotheses on the occurrence of the country and industry effects, displayed in the diversification of economic and financial parameters of companies depending on the country and industry, respectively. Consequently, the study will indicate which of these two effects is dominant in affecting the corporate performance.

Therefore, the hypothesis to be verified can be formulated as follows: the country-specific factors have a greater impact on the corporate performance than the industrial factors. If companies belonging to different industries from the same country were more similar than businesses in the same industry, but from different countries, this would mean that there is no reason to reject the hypothesis. If, however, the companies of the same industry from different countries were less diverse than enterprises from different industries of one country, it would mean that the hypothesis is falsified and that these are industrial factors which are more responsible for the corporate performance than the country-specificity. A fairly uniform diversification of corporate performance across industries and across countries would indicate that the impact of the industrial and national factors on the financial condition of enterprises is comparable in terms of strength. In brief, the main research problem can be reduced to the question whether, for example, the performance of companies in the agricultural industry in Italy is more similar to the performance of the Italian companies of the mining industry, or is rather closer to the situation of the agricultural enterprises in Portugal.

Moreover, a number of more specific research problems were formulated. One of them is to verify whether corporate performance parameters differ significantly across industries, as well as internationally. Another issue which requires attention is whether the observed differences are noticeable in case of all industries, countries and ratios, or only some of them. The comparative financial analysis of enterprises across countries and across industries should enable assessing whether and to what extent their performance differs in these two cross-sections, and in which countries and industries the differences are most apparent. It is also interesting which ratios or groups of ratios best reflect these differences. Consequently, one of the subordinate

objectives can be formulated as the identification of the ratios with the best discriminatory properties, i.e. the most differentiated in the analysed sections.

Because of the relatively wide range of data characterising many objects, a natural procedure is to organise the elements of the analysed population, i.e. to classify them according to certain criteria. Thus, grouping the objects into categories characterised by a greater within-group similarity is another secondary objective of the analysis.

The final research goal is to simplify the data structure by identifying the major factors determining the corporate performance in the individual countries and industries. The identified factors will then be compared across countries and across industries.

The source of the analytical data is the BACH (Bank for the Accounts of Companies Harmonised) database. The Directorate General for Economic and Financial Affairs of the European Commission collects and harmonises the statistical data of company annual accounting for European countries. The information is published in the BACH database. The data is provided by the institutions that form part of the ECCB (European Committee of Central Balance Sheet Data Offices).

The BACH database is a rich source of information organised by years, countries, industries and size of firm. The harmonised and aggregated data from the annual accounts of non-financial companies was used to calculate 32 financial ratios for each country and industry in each year of a 7-year period 1999–2005. The data from more recent years were not included due to a significant number of missing data at the time of the analysis. The analysed ratios were grouped into three categories, shown in Table 2.1.

The above list of ratios is broader than in the hitherto studies based on the BACH database, but it includes most of the ratios analysed previously. Extending the range of variables is meant to perform a more comprehensive analysis of companies across industries and internationally. The variables in question are all ratios of means and not means of ratios, as only the aggregated data is available (McLeay, 1986). This means that for example the ratio P_1 (gross operating profit / turnover) in the Polish agriculture is calculated as the relation of the total of gross operating profits in Polish enterprises for this industry to the total of their turnover, and not as an average value of this ratio for this group of companies. The value of the ratio for Poland should be understood as the aggregated gross operating profits of all enterprises in the country in relation to the turnover of all companies. This is not, however, the mean of ratios P_1 for all industries in Poland.

Most of the ratios are stimulants, with the exception of the ratios P_7 , P_{11} , P_{12} , P_{13} , L_9 , L_{10} , D_2 , D_3 , D_6 , D_7 and D_8 , which were considered as anti-stimulants. Although some of the ratios, e.g. liquidity ratios should not formally be considered as stimulants, 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 analysed population includes ten European Union countries: Austria, Belgium, Finland, France, Spain, Holland, Germany, Poland, Portugal and Italy. Nine of them belong to the euro zone, which makes them a group of highly

Table 2.1 Financial ratios used in the study

Profitability and turnover ratios		Liquidity ratios		Debt ratios	
P ₁	$\frac{\text{Gross operating profit}}{\text{Profit turnover}}$	L ₁	$\frac{\text{Current assets}}{\text{Short-term liabilities}}$	D ₁	$\frac{\text{Gross operating profit}}{\text{Interest}}$
P ₂	$\frac{\text{Net operating profit}}{\text{Turnover}}$	L ₂	$\frac{(\text{Current assets} - \text{stocks})}{\text{Short-term liabilities}}$	D ₂	$\frac{\text{Long-term debt}}{\text{Assets}}$
P ₃	$\frac{\text{Net profit}}{\text{Turnover}}$	L ₃	$\frac{(\text{Cash and cash equivalents})}{\text{Short-term liabilities}}$	D ₃	$\frac{\text{Long-term debt}}{\text{Equity}}$
P ₄	$\frac{\text{Net profit}}{\text{Equity}}$	L ₄	$\frac{\text{Costs of goods sold}}{\text{stocks}}$	D ₄	$\frac{\text{Equity}}{\text{Assets}}$
P ₅	$\frac{\text{Net profit}}{\text{Assets}}$	L ₅	$\frac{\text{Turnover}}{\text{Debtors}}$	D ₅	$\frac{\text{Long-term debt}}{\text{Net working capital}}$
P ₆	$\frac{\text{Net profit}}{\text{Net working capital}}$	L ₆	$\frac{\text{Cash}}{\text{Assets}}$	D ₆	$\frac{\text{Interest}}{\text{Turnover}}$
P ₇	$\frac{\text{Costs of materials and consumables}}{\text{Turnover}}$	L ₇	$\frac{\text{Current assets}}{\text{Assets}}$	D ₇	$\frac{\text{Interest}}{\text{Financial debt}}$
P ₈	$\frac{\text{Turnover}}{\text{Assets}}$	L ₈	$\frac{(\text{Current assets} - \text{stocks})}{\text{Assets}}$	D ₈	$\frac{\text{Provisions}}{\text{Assets}}$
P ₉	$\frac{\text{Turnover}}{\text{Fixed assets}}$	L ₉	$\frac{\text{Stocks}}{\text{Net working capital}}$		
P ₁₀	$\frac{\text{Value added}}{\text{Turnover}}$	L ₁₀	$\frac{\text{Stocks}}{\text{Current assets}}$		
P ₁₁	$\frac{\text{Staff costs}}{\text{Turnover}}$	L ₁₁	$\frac{\text{Turnover}}{\text{Net working capital}}$		
P ₁₂	$\frac{\text{Wages and salaries}}{\text{Value added}}$				
P ₁₃	$\frac{\text{Financial income}}{\text{Turnover}}$				

Source: Author's own compilation

advanced countries in terms of the integration process. The territorial range of the study was deliberately limited to the fairly homogeneous area in order to avoid the possibility of exaggerating the country effect, which could happen if the study covered a wider group of countries, with more diverse levels of development. Including Poland in the study – as the only country excluded from the monetary integration – was meant to compare our country with other countries in the euro area. Accessing the euro zone by Poland is probably a near prospect, so it is purposeful to show the likely gap dividing our country and the partners from the common currency area.

The industrial diversity analysis is performed on the objects, which constitute the economic sectors according to the European Classification of Business Activities (NACE)¹ used in the BACH database. The NACE, developed on the basis of a publication of the European Statistical Office EUROSTAT, provides a structured set of types of socio-economic activities in the national economy. It is used, among others, for the following purposes:

- Collecting and presenting data by type of economic activities in the area of population statistics, production, employment, wages, national income, and other areas of statistics,
- Making international comparisons of uniform categories of activities,
- Classifying businesses for the needs of national register of economic entities – according to the nature of their predominant activity.

¹ *Nomenclatures des Activites de Communité Europeenne*.

Table 2.2 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

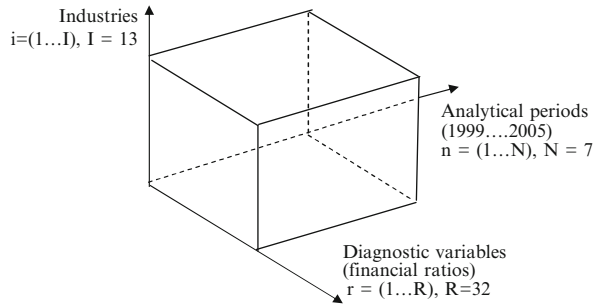
There are four levels of activities in the NACE systematics. The types of activities are classified as: sections, divisions, groups and classes. The first level (sections) is embodied in the NACE as an alphabetical code, A to Q, and is further disaggregated in some areas into subsections indicated by 2-digit alphabetical codes. The lowest level comprises four digits. The study includes 13 of the 13 basic sections (one-digit classification). These are the industries where there is the three-letter symbol in the last column of Table 2.2. These symbols are used later in the study in order to facilitate the identification of industries.

Due to the specific nature of the financial statements of enterprises in the financial sector, which largely hinders the direct comparability of common ratios used to diagnose non-financial companies, they were excluded from the study. Several other industries (labelled in NACE as L, P, Q) were also excluded from the analysis due to the very limited data availability.

Summing up, it should be stated that the subject of the empirical research is constituted by the industries in each country, which are described by a variety of financial ratios in a 7-year period. The study involves 32 financial ratios in 13 industries and in 10 countries, which after taking into account the missing observations gives a total of 26,204 data items.

The range of data is four-dimensional including: industries, countries, financial ratios and years. For each country, the range of data thus forms the so called data cube, i.e. the three-dimensional matrix of observation, where the individual dimensions correspond to the industries, annual periods and variables in the form of financial ratios. The scope of the study can therefore be represented as a ten-item series of three-dimensional matrixes, representing individual countries, one of which is shown in Fig. 2.1.

Fig. 2.1 Data cube analysed in the research (Source: Author's own compilation)



In the above situation, the observational unit is an industry in a country and a given year. The analysis allows identifying the following systems of effects:

- Country and time – when industries are aggregated,
- Industry and time – when countries are aggregated,
- Country and industry – when years are aggregated.

From the above pairs of effects, the last one seems the most interesting, which is why it also constitutes the main object of the study.

The database used in the research provides international and cross-industry comparability of the ratios, as the data available is harmonised and aggregated. On the one hand, the aggregation of data makes it easier to detect certain regularities within the analysed population. On the other hand, however, it causes substantial loss of information, as well as generates some inevitable errors resulting from data generalisation. Inference based on the analyses with the use of the data may also be subject to errors arising from random sampling of enterprises in each industry and country. Although the coverage of the population by the sample size is usually quite high – more than 60 % on average (the detailed data is presented in Table 2.3.), for some objects the rate is much lower, and for others, including Poland – unknown. Therefore, it can certainly be stated that the analyses based on the data are not fully comprehensive and exhaustive.

Consequently, it can be assumed that the variable x_{ij} is a random variable of a given financial ratio for the i -th country and j -th industry, of normal distribution $x_{ij} \sim N(\mu_{ij}, \sigma_{ij}^2)$ or at least close to normal to the extent enabling multivariate analyses.

2.4 Methodology of Corporate Performance Diversity Analysis

The scope of research, both due to the abundance of the data and its multidimensionality, to some extent determines the type of analytical tools employed in the study, i.e. mainly the taxonomic methods. The first part of the name “taxonomic” comes from the Greek word: *taxis* – arrangement, order, while the other part *nomos*

Table 2.3 Number and share of the companies aggregated in the BACH database (average for 1999–2005)

Industry		Country									
		NL	B	FR	ES	I	A	D	P	FIN	PL
AGR	n.	3509	4893	2199	143	325	262	–	482	3131	1959
	%	89	100	62	–	42	–	–	26	43	–
FSH	n.	196	154	116	31	14	–	–	62	233	58
	%	90	100	55	–	31	–	–	47	57	–
MIN	n.	90	219	808	51	137	4854	146	170	559	235
	%	98	100	68	29	59	39	90	50	86	–
MNF	n.	11840	22064	39028	2698	17947	–	9630	5519	16326	14546
	%	93	100	77	21	79	–	79	63	97	–
ELE	n.	89	154	241	171	296	60	527	126	543	870
	%	100	100	89	76	77	38	62	73	93	–
CST	n.	10350	25733	19734	798	1925	3087	3092	1839	17917	4686
	%	91	100	68	9	41	29	37	39	85	–
TRD	n.	31706	72103	59285	1754	10860	6900	9500	4587	28913	14221
	%	88	100	73	21	77	23	56	41	90	–
HOT	n.	3146	14131	5630	315	323	2626	–	305	6180	660
	%	84	100	59	12	47	15	–	21	81	–
TRS	n.	5130	10521	9293	425	1634	1330	1499	1078	12771	2029
	%	92	100	69	47	85	17	80	58	90	–
RLE	n.	34020	79516	26867	1789	1601	2034	5739	1777	25074	4904
	%	88	100	67	21	46	11	42	34	80	–
EDU	n.	786	626	499	35	–	65	–	125	998	162
	%	84	100	29	2	–	–	–	37	71	–
HLT	n.	3482	9359	2589	50	–	181	–	165	4699	708
	%	85	100	66	8	–	–	–	29	63	–
COM	n.	3659	8630	2826	196	522	779	–	226	9746	880
	%	87	100	47	19	63	–	–	46	85	–

Source: Author's own compilation based on BACH database

means law, rule. Initially, the term 'taxonomy' was introduced by biologists for the classification of plants and animals. The idea of taxonomy was particularly intensively developed in the eighteenth century through the work of a botanist Adanson. In the second half of the nineteenth century numerical methods were used to solve classification problems. The initiator of taxonomic research and application of numerical methods in anthropology was a Polish scientist Czekanowski (1913). The work of Steinhaus (1956) and his team of mathematicians in Wroclaw was also of great importance for the development of the taxonomic methods. The method known as Wroclaw taxonomy is still widely used not only in Poland, but in the world. A commonly used term for numerical taxonomy in Poland is 'taxonometry', which is a scientific discipline dedicated to the principles and procedures of classification (Borys, 1984; Grabiński, 1992; Hellwig, 1988). Further and ongoing development of new taxonomic techniques makes them more and more commonly used in various fields, such as astronomy, geography, linguistics, agriculture,

psychology and economics (Siudek, 2006). Hellwig's works were also of crucial importance in the development of the theory of taxonomy in the socio-economic research. They inspired researchers who used quantitative methods in economics (Hellwig, 1968). A taxonomic method with a standard object developed by the same author has created fundamentals for the discipline referred to as multidimensional comparative analysis.

Factor analysis and cluster analysis, applied further in this study, are also the examples of taxonomic methods. Factor analysis, in brief, is to replace a set of independent variables which describe an object, with a less numerous set of new variables, making it easier to characterise this object. Cluster analysis is based on the division of observations into groups with similar objects, where the number of these groups might not be pre-determined. This problem is known in the literature as the taxonomic task or the automatic classification.

The choice of the research methodology can be justified – as mentioned – by the nature of the data, which is a relatively large set of objects (industries, countries and industries in countries) described by a number of diagnostic variables. The methods of multivariate analysis are therefore a natural tool for simplifying the structure of the data and identifying the most important regularities. This does not mean, however, that the application of the taxonomic methods is the only possible approach in this case. The review of the hitherto studies, however, shows that the multivariate statistical analysis often provides an effective solution to similar research problems (Boillat, de Skowronsky, & Tuchschnid, 2002; Cinca et al., 2005; Gupta & Huefner, 1972; Helg, Manasse, Monacelli, & Rovelli, 1995; Leal & Powers, 1997; Sell, 2005).

Due to the fact that the diagnostic variables selected for study are measured with different scales of reference (the ratios vary within different ranges), it is necessary to make them comparable. Eliminating the dimensionality of the variables enables further aggregation of the data. One of the methods of standardising diagnostic variables is the method described by Borys (1978), which makes variables comparable with the use of their spread. One of the attributes of this method is its versatility, thanks to which it can be used for normalisation of variables of any kind, sign, character, size and unit. This kind of transformation of variables brings their values to a fixed range of variation (Domański, Pruska, & Wagner, 1998) – in this case [0,1]. The details of the normalisation procedure are presented in Appendix 1.

Then the classically normalised variables were further analysed. The first stage of the research was to analyse the basic statistics of the financial ratios across industries and across countries. It was meant to initially diagnose the diversity of ratios and detect the basic regularities within the analysed population.

In the case of differences in means of ratios between countries and (or) industries, it is necessary to clarify whether the observed differences are statistically significant, or result from an incidental variation of ratios. For this purpose, the one-way analysis of variance ANOVA was used as a method to test observations, which depend on one or more simultaneous factors. These factors are also known as grouping or classifying factors, or manipulative variables. The analysis of variance,

developed in the twenties by Fisher (1954), allows evaluating the significance of differences between many means and explains the probability with which the extracted factors may be the reason for the observed differences between group means. The hypotheses then are as follows: $H_0 : \bigwedge_{i,j} \mu_1 = \mu_2 = \dots = \mu_t$, against the alternative hypothesis $H_1 : \bigvee_{i,j} \mu_i \neq \mu_j, i \neq j$. If the means differ significantly, it can be intuitively concluded that the analysed factors affect the dependent variable. The essence of the analysis of variance is thus the simultaneous examination of the significance of differences between means from multiple groups (populations). The use of ANOVA method involves the fulfilment of assumptions about the measurability of the dependent variables, the normality of their distribution: $N(\mu_i, \sigma_i)$, $i = 1, 2, \dots, k$, and the homogeneity of variance: $\sigma_1^2 = \sigma_2^2 = \dots = \sigma_t^2$. However, meeting the assumption of normality usually is not indispensable, as the significance tests remain valid. Many empirical examples show that the deviations from normality have little effect on the results of the analysis of variance. In practice, therefore, even significant deviations do not cause large inference errors (see also Domański, 1990, pp. 117–118). Similarly, it can be assumed that some deviations from variance homogeneity are also permissible.

The heterogeneity of the elements of the analysed population, as well as certain similarities detected between them, create a natural need to organise the objects, i.e. to classify them. The classification of objects results from the following premises (Grabiński, Wydymus, & Zeliaś, 1989, p. 10):

- Reducing the accumulated information into just several basic categories, which facilitates the understanding of the variety of phenomena, formulating general conclusions and determining the typology of the analysed items,
- Defining the homogeneous objects of analysis, which facilitates the extraction of the systematic factors and possible cause-result relationships,
- Reducing the time-consumption of the research by limiting the discussion to just a few most common facts, phenomena and objects with relatively low losses of information and not much higher probability of obtaining distorted results of the analysis.

The concept of classification can be interpreted as linking objects into sets or categories based on their properties. This grouping process is the next stage of analysis. One of the many grouping methods, which allows distinguishing the internally coherent groups of objects is the cluster analysis (Borkowski, Dudek, & Szczesny, 2004; Hartigan, 1975; Jajuga, 1993; Ostasiewicz, 1999; Stanisz, 2000). It aims at classifying the observed data by combining similar objects represented by vectors into certain groups. The higher the level of aggregation, the less similar the objects from different classes of the organised structure.

The need to develop classification schemes, as the first stage necessary for understanding phenomena, is being increasingly recognised in a variety of scientific disciplines, including biology, medicine and marketing (Varadarajan, 1986). As noted by Hunt (1983), categorising elements of a population into mutually

exclusive and exhaustive groups can provide the key to the development of the theory. Classification scheme makes it possible to identify the hidden causes of the formation of different categories, as well as to find the characteristic features common for the objects from the same group (Leal & Powers, 1997).

Classification of objects can be based on various characteristics. In this analysis, the criterion is the corporate performance described with the use of ratios. In the applied cluster analysis the following sets of objects are examined: industries, countries and industries in countries. The corporate performance can be compared, if an appropriate measure of similarity or dissimilarity between objects is defined. The algorithm of the agglomeration method used in this case groups the objects according to the square Euclidean distance,² which requires prior standardisation of all variables. A characteristic feature of this metric is that it assigns more weight to more distant objects. In order to determine the distances between new clusters formed by the linked objects, i.e. the amalgamation procedure, which determines the degree of similarity of these clusters, the hierarchical Ward's method was chosen (Ward, 1963). It is distinguished by the fact that it uses methods characteristic for the analysis of variance in order to estimate the distances between clusters (Milligan, 1996) and that it tends to form less numerous clusters (Boillat et al., 2002). The method aims at minimising the sum of squares of any two (hypothetical) clusters that can be formed at each stage of the amalgamation. The effectiveness of the Ward's method in detecting data structure is better in comparison with other methods, although it tends to create clusters of small size (Orłowski, 2001; Ward, 1963). Applying Ward's method³ determined the use of square Euclidean distance as the metric defining the distance between objects.

The variables selected for the cluster analysis should be characterised with large variability and independence. These conditions mean that the variables that do not differentiate the examined objects (industries and countries) should be removed from the initially accepted set of potential characteristics. The possible duplication of the information carried by individual variables should also be eliminated.

The variability of ratios was examined with the use of the variation coefficient.⁴ None of the selected variables is a constant one; the standard deviation varies from more than 10 to about a 100 % of the mean. As for the correlation of variables, it is recommended in the literature to leave the smallest possible number of representative variables. However, if the objective of the study is the comprehensive analysis of the corporate performance, it is purposeful to consider many ratios carrying a wide range of information, provided that they meet the statistical requirements for the selection of diagnostic variables (Hellwig, 1981; Nowak, 1990).

² $d_{(x,y)} = \sum_i (x_i - y_i)^2$.

³ $D(X,Y) = \frac{m \cdot k}{m+k} \cdot (d(\bar{x}, \bar{y}))^2$, where m, k – numbers of objects in clusters X and Y.

⁴ $V = \frac{\sigma}{\mu}$, where σ – standard deviation, μ – mean.

The simplest measure to verify the correlation of the characteristics is the Pearson's correlation coefficient,⁵ which measures the strength and direction of the linear relationship between the pairs of variables. The values of the correlation coefficient for all pairs of variables are presented in Appendix 2. The table shows that the pair of the most correlated variables is P_8 and P_9 ($r = 0.910$). One variable is dependent on the other in 83 % (r^2), which means that only 17 % of the information carried by them is different. Usually the variable which is less correlated with other variables should be involved in the study. Since both ratios are related with other variables to a similar extent, it was the ratio P_8 , which was selected for further analyses, as a more synthetic variable, characterising the turnover of total assets, and not just current assets (P_9).

Another pair of highly correlated variables is a pair of liquidity ratios L_1 , L_2 ($r = 0.862$). Since none of the two variables shows a strong relationship with other ratios, the information capacity and analytical usefulness of the ratios were used as the criteria for deciding which of them should be retained in the data set. From this point of view the short-term liquidity ratio (L_1) was considered as more important, as it characterises a company's ability to repay creditors in 1 year's time, and not only within about 3 months (L_2).

Another value of the correlation coefficient, indicating a relatively strong correlation of variables ($r = 0.835$) was observed in the case of ratios L_{11} and D_5 . Due to the stronger correlation of the variable D_5 with the other ratios, it was removed from the data set. In the case of another pair of highly correlated variables: P_8 and D_6 ($r = 0.830$) the later of them was eliminated not because of high correlation with the variable P_9 , which had been previously removed, but due to the similar information content to the ratio D_7 which was selected for further analyses.

A similar economic meaning is also carried by the ratios P_1 and P_2 , which is reflected in their high correlation ($r = 0.828$). From this pair of variables, again due to the similar levels of the correlation with other variables, the ratio P_2 was selected for further analyses. It was because of the information capacity of this profitability ratio, which takes into account not only the sales, but the total of business operations.

A strong, but inverse relationship can be observed in the case of pairs of profitability ratios P_{10} and P_{11} ($r = -0.824$). The removal of the ratio of staff costs in relation to turnover (P_{11}) was determined by a similar content of another ratio (P_{12}), which involves the cost of wages and salaries.

Another pair of correlated variables was formed by the ratios P_3 and P_5 ($r = 0.811$). Despite the slightly higher correlation of the ratio P_3 with other ratios, it was retained in the set of diagnostic variables. It was justified by the substantial analysis of the construction of these ratios. In terms of versatility of the analysis, it seems more appropriate to apply a variable measuring the profitability of the total assets, instead of another variable characterising the profitability of turnover.

⁵ $r_{xy} = \frac{\text{cov}(x,y)}{\sigma_x \sigma_y}$.

Again, a fairly strong inverse relationship can be observed in the case of a pair of liquidity ratios L_4 and L_{10} ($r = -0.744$). As none of the two ratios showed significant relationship with the others, the ratio of inventory turnover (L_4) was selected for the study instead of the ratio measuring the share of inventory in the current assets. The relative size of the inventory is illustrated by another ratio left for the analysis (L_9), which relates inventory to the working capital.

From the last pair of highly correlated variables L_3 and L_6 ($r = 0.727$) the first one, characterising immediate liquidity (cash solvency ratio), was retained in the target set of variables. It can be assumed that the ratio L_6 , which is a relation of cash to assets, is much less informative, because, in contrast to the ratio L_3 , it does not include short-term investments. The balance sheet item 'cash' may often prove quite incidental in terms of value, especially when the cash level is the one from the end of the year.

The remaining ratios were much less correlated with each other ($|r| < 0.68$), so the process of reducing the number of variables was considered as completed. Consequently, ten variables were removed from the initial data set: P_1 , P_3 , P_9 , P_{11} , L_2 , L_6 , L_8 , L_{10} , D_5 and D_6 , which resulted in reducing the number of diagnostic variables to twenty-two. A detailed list of the variables selected for the cluster analysis is presented in Table 2.4.

Apart from the appropriate selection of variables, the use of cluster analysis in the segmentation research is associated with a decision about the optimum number of the identified clusters. Deciding how many groups to distinguish when dividing an analysed population is one of the fundamental problems that arise in this type of analyses (Migdał-Najman & Najman, 2005). Usually, the knowledge and experience of a researcher allow for such a grouping of objects, that those belonging to a given cluster have as much in common as possible and at the same time bear little resemblance to the objects from outside the group. In many empirical cases, the objects of the analysed populations have certain natural tendencies to be grouped together in relatively homogeneous classes, which greatly facilitates their analysis. When the clusters of objects are intrinsically similar, and there are also clear differences between groups noticeable, it is not difficult to separate these groups and to determine their number (Migdał-Najman & Najman, 2006).

The same applies to the analysed population, where the distinction between internally homogeneous groups of objects is intuitively observable, and therefore relatively easy. In practice, in order to reduce the subjectivity in this area, the graph of linkage distance versus linkage stages can be used. It shows the distances between groups at the moment of their linking. A clear surge of the curve usually indicates the optimal choice of the number of clusters (Dobosz, 2001).

Another, more objective, solution of the problem applied in this study is to determine the number of clusters according to the criterion which is independent from the grouping method. A method called *silhouette index* (SI), proposed by Rousseeuw (1987) is considered as one of the most versatile, simple and effective. The detailed algorithm for calculating the index is presented in Appendix 3.

The silhouette index is a measure that allows determining the optimal number of clusters, i.e. such a configuration which maximises the value of SI (Bolshakova &

Table 2.4 Financial ratios selected for the study after removal of the correlated variables

Profitability and turnover ratios		Liquidity ratios		Debt ratios	
P ₂	$\frac{\text{Net operating profit}}{\text{Turnover}}$	L ₁	$\frac{\text{Current assets}}{\text{Short-term liabilities}}$	D ₁	$\frac{\text{Gross operating profit}}{\text{Interest}}$
P ₄	$\frac{\text{Net profit}}{\text{Equity}}$	L ₃	$\frac{(\text{Cash and cash equivalents})}{\text{Short-term liabilities}}$	D ₂	$\frac{\text{Long-term debt}}{\text{Assets}}$
P ₅	$\frac{\text{Net profit}}{\text{Assets}}$	L ₄	$\frac{\text{Costs of goods sold}}{\text{stocks}}$	D ₃	$\frac{\text{Long-term debt}}{\text{Equity}}$
P ₆	$\frac{\text{Net profit}}{\text{Net working capital}}$	L ₅	$\frac{\text{Turnover}}{\text{Debtors}}$	D ₄	$\frac{\text{Equity}}{\text{Assets}}$
P ₇	$\frac{\text{Costs of materials and consumables}}{\text{Turnover}}$	L ₇	$\frac{\text{Current assets}}{\text{Assets}}$	D ₇	$\frac{\text{Interest}}{\text{Financial debt}}$
P ₈	$\frac{\text{Turnover}}{\text{Assets}}$	L ₉	$\frac{\text{Stocks}}{\text{Net working capital}}$	D ₈	$\frac{\text{Provisions}}{\text{Assets}}$
P ₁₀	$\frac{\text{Value added}}{\text{Turnover}}$	L ₁₁	$\frac{\text{Turnover}}{\text{Net working capital}}$		
P ₁₂	$\frac{\text{Wages and salaries}}{\text{Value added}}$				
P ₁₃	$\frac{\text{Financial income}}{\text{Turnover}}$				

Source: Author's own compilation

Azuaje, 2003). The value of SI provides information about the quality of the resulting group structure. The higher the value of the indicator, the clearer the structure and better grouping (Kauffman & Rousseeuw, 1990).

In cluster analysis, carried out separately for each country and industry, it will be important to compare the results of clustering and to evaluate the similarity of groupings. In order to find out how much alike or how different the groupings of industries are between countries or the groupings of countries between industries, a similarity measure of grouping results can be applied. One of the most common measures used for evaluating similarity of groupings from the many different measures proposed in the literature (Arabie & Boorman, 1973; Fowles & Mallows, 1983; Goodman & Kruskal, 1979; Gordon, 1987; Rand, 1971; Rohlf, 1974; Wallace, 1983) is the Rand's measure (Najman, 2007), which takes a value of 0 when the two compared groupings are completely dissimilar (in one grouping all objects belong to one group, and in the other, every object is a separate group), and a value of 1 when the groupings are identical. This measure defines the share of pairs of objects convergent between the two groupings in the total number of pairs of objects. The value of this measure tends to increase with the number of groups, whereas the adjusted Rand's measure (R_{AD}), applied in this study, is free from this defect (Hubert & Arabie, 1985; Najman, 2007). The calculation method of the measure is presented in Appendix 4.

In order to identify the main factors determining corporate performance in countries and industries, the factor analysis was used. Factor analysis as a statistical method based on examining the interrelationships between variables in a multidimensional space and aims at explaining the reasons for the total variation (for more about factor analysis see e.g. Aczel, 2000; Bolch & Huang, 1974; Dobosz, 2001; Harman, 1967; Morrison, 1990; Tadeusiewicz, 1993).

The factor analysis is based on a linear transformation of variables into new uncorrelated variables (factors), where the sum of variance of the factors is equal to the sum of variance of the original variables. The variance of each new factor explains a number of primary variables and the variation is represented by the

eigenvalue. Each consecutive factor (principal component) explains less and less volatility.

Deciding when to stop extracting the factors depends largely on how much random variation remains unexplained by the new factors. The nature of this decision is arbitrary. However, there are several methods which can be used to establish the number of factors, e.g. the Kaiser criterion (Kaiser, 1960), which says that only factors with eigenvalues greater than 1 can be retained, or a graphical method called the scree test proposed by Cattell (1966).

In the context of the main purpose of the study, which is to answer the question about how the country and industry effects influence the corporate performance, the factor analysis will determine whether the extracted factors are the same for countries and industries or whether they differ due to the national and industrial specificity. It should be noted, however, that the factors extracted in the factor analysis are interpreted differently than the country and industry factors. In the case of corporate performance analysis, they are some aspects of the condition of an enterprise, such as liquidity or assets efficiency, characterised by specific ratios. Comparison of the principal components responsible for corporate performance in countries and industries will indicate which groups of variables most affect the efficiency of companies in these two sections and what the similarity is of the factors between countries and industries.

Regardless of the research methodology, aiming to extract the factors specific for countries and industries is greatly hampered by the confluence of these two specificities. The problem with isolating the so-called 'pure' country effect and the 'pure' industry effect is related to the fact that the differences between the mean values of ratios for individual countries may be partly a consequence of the different industrial structures of the economies, and the differences between the mean values of ratios in industries may partly be due to the fact that companies included in an industry are located in different countries.

In the multivariate analysis, where the objects are, by definition, characterised by a large number of variables, it becomes essential to simplify the data structure in order to interpret the relationships within the research area. Apart from the factor analysis (Pluta, 1977, p. 51), a method aiming to extract the underlying factors, which explain the observed similarities or dissimilarities between objects, is the multi-dimensional scaling. The objects are located in a space of a declared number of dimensions in such a way, that the obtained configuration provides the best approximation of the observed distances.

<http://www.springer.com/978-3-319-00344-3>

Corporate Performance
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Analyses

Koralun-Bereźnicka, J.

2013, XX, 194 p., Hardcover

ISBN: 978-3-319-00344-3