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PORTFOLIO FORMING DECISIONS: THE ROLE OF INTANGIBLES

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PORTFOLIO FORMING DECISIONS: THE ROLE OF INTANGIBLES²

The purpose of this study is to present a tool to categorize companies as potentially profitable on the basis of an analysis of their intangibles. The paper distinguishes two crucial attributes for picking shares: intangibles and the capitalization of intangible-based growth potential in market indicators. By means of these attributes we create a portfolio from a sample of European companies and annually rebalance it. To test its attractiveness we compare it with benchmarks and random portfolios during the period from 2006 to 2013 using the Sharpe coefficient. The comparisons of the portfolio with the benchmarks demonstrate the importance of intangibles and the validity of the proposed tool. The Sharpe coefficient of the portfolio is significantly higher than the mean and median Sharpe ratio of random portfolios. The importance of intangibles for choosing an investment goal increases in crises. The paper contributes to the literature by identifying undervalued shares on the basis of the company's intangibles and developing an algorithm to create an intangible-based investment portfolio.

JEL Classification: J24, G11, G23, M50,

Keywords: Intangibles, portfolio comparisons, Sharpe coefficient, benchmarking, growth potential

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1. Introduction

The idea of forming an investment portfolio on the basis of fundamental factors has been thoroughly investigated. However, the knowledge economy has helped to recognize new intangible value drivers. Therefore, investment attractiveness lies in the influence of tangible and intangible internal factors, as well as external factors. Although the creation of a portfolio using intangibles has been broadly discussed in the literature there is no commonly used method.

Recent research dedicated to intangibles and capital markets concentrate on the influence of intangibles, such as R&D expenditure or R&D stock on market capitalization, market value or return. According to Griliches (1981), high R&D expenditure is recognized by market investors as an influential trigger for the growth of future earnings and returns on shares. Daniel and Titman (2006), Chan et al. (2001), Lev and Sougiannis (1999) empirically show that intangibles influence market indicators and offer different explanations for this phenomenon. Portfolio comparisons are used to show such an influence, e.g. Lev and Sougiannis (1999), Chan et al. (2001), Anagnostopoulou and Levis (2008). However, most of the papers aim to find evidence for intangible recognition by the stock market or to discuss whether indicators of intangibles are useful to investors. Unfortunately, the lack of relevant strategies prevents investors from categorizing companies as potentially profitable on the basis of the analysis of intangibles. Throughout this paper, we come up with a distinctive tool not only to reach the purpose mentioned above but also, to and creates a portfolio of companies worth investing in by means of two crucial attributes for picking shares: intangibles and the capitalization of intangible-based growth potential in market indicators. The first is examined in many papers while the second is usually ignored but seems to be very important since a company with a high intangible value but low market capitalization is undervalued by the stock market and therefore attractive for investors. Another company may also have a high value of intangibles but this value has already been capitalized in the share price, suggesting that the time for investing in this company has passed. In the current research, the market-to-book coefficient is used for determining growth potential according to the findings of Chan et al. (2001), Zeghal and Maaloul (2010), Orens et al. (2009), Youndt et al. (2004).

The remainder of this paper is structured as follows: Section 2 reviews the literature on the recognition of intangibles by the stock market. Section 3 describes the tool to pick companies on the basis of intangibles. Section 4 gives the samples and sub-samples used for the empirical testing. Section 5 presents the main findings; portfolio comparisons results particularly. Section 6 concludes with summary of the main results, their discussion and future research suggestions.

2. Literature review

The literature review is divided into two research areas: capital markets and the analysis of intangibles. All the papers discussed aimed to discover the influence of intangibles on market performance. However, the papers that analyse the problem from a capital market perspective usually concentrate on market performance measures and techniques. Indeed, they refer to intangibles as just another determinant of return or market capitalization and do not analyse them in depth. On the contrary, papers dedicated to intangibles or intellectual capital recognize market performance as one of the possible outcomes and stress the nature, variety and measurement of intangibles. This paper considers both points of view.

2.1. Intangibles

Intangibles have a vague nature and heterogeneous structure. Therefore there is no single definition (Clarke et al., 2010). They are usually interpreted according to the research purpose. This study adopts the definition given by Kristandl and Bontis (2005, p.1518): “strategic firm resources that enable an organization to create sustainable value, but are not available to a large number of firms”. They also mention that such resources are non-physical, non-financial and usually not included in financial statements.

Market indicators are often regarded as an outcome of intangibles. The most popular indicators are market value, Tobin’s q and market-to-book (M/B) ratio. Research usually measures intangibles using a set of proxy indicators. However some also use specially developed indicators like the value added intellectual coefficient (VAIC) (Pulic, 2000; Chen et al., 2005; Chan, 2009; Maditinos et al., 2011) or the calculated intangible value (CIV).

Research on developed markets evidence that intangibles play an important and statistically significant role in a company’s market valuation. Nold (2012) uses a matched sample comparison group approach for US companies to show that intangibles exceed the probability of a company to outperform similar companies. Orens, Aerts and Lybaert (2009) study 267 European companies and reveal that the disclosure of intangibles is positively associated with Tobin’s q. Zeghal and Maaloul (2010) confirm the association between intangibles and stock market performance is only significant for high-tech UK industries.

Research on developing countries does not reveal strong influence of IC on market performance. The results are usually debatable. Some researchers like Chan (2009), Garanina (2009) assume that intangibles have not become a key driver of market performance on developing markets for several reasons such as problems in intangible disclosure or a large number of noise traders.

2.2. Capital markets

The majority of studies related to capital markets concentrate on research and development (R&D) expenses. The value of R&D expenses, stock of R&D, R&D intensity is used to explain market indicators in Lev and Sougiannis (1999), Chan et al. (2001), Hirschey and Richardson (2004), Eberhart et al. (2004), Anagnostopoulou and Levis (2008), Duci et al. (2011). The findings reveal that R&D expenses are usually positively recognized by the stock market.

Few studies concentrate on the other intangibles. Chan et al. (2001) also analyse advertising expenses as a part of the company's intangibles which influence share returns. Fan and Case (2010) also investigate the impact of R&D and advertising expenses on future first, second, and third year buy and hold returns. Hirschey and Richardson (2004) extend the analysis by including the quantity and quality of patents as a measure of research activity. Kallapur and Kwan (2004) examine brand and contracting incentives as determinants of market capitalization and abnormal return. Daniel and Titman (2006) investigate the impact of intangible information measured as "the part of past returns that cannot be explained by tangible information about past performance" on monthly returns. Jagannathan and Wang's research describes the CAPM model which is modified in order to include human capital (1996). They demonstrate that including human capital explains the cross-sectional differences in average return in contrast to classic CAPM. However the other components of company's intangibles are ignored in capital market research.

Portfolio comparisons are often used in this kind of research. Thus Chan et al. (2001) form six portfolios from low to high R&D value and non-R&D portfolio. Fan and Case (2010) divide sample in 10 portfolios according to companies R&D to market value ratio. Lev and Sougiannis (1999) rank sample companies by book-to-market value and form 10 portfolios. Similar methodology is used by Daniel and Titman (2006), Al-Horani et al. (2003), Anagnostopoulou and Levis (2008). However this research uses portfolio comparisons to evidence the influence of intangibles (usually R&D) on excess return, market value, capitalization, etc. Existing papers rarely implement revealed dependence to portfolio construction and management.

3. Research design

According to the previous research, intangibles are regarded by investors as a source of competitive advantage and therefore provoke growth in market capitalization. Investors seek undervalued companies, however, growth potential determined by intangibles could have been already recognized by the market and capitalized into share prices. Therefore, a company is attractive not only if it has a high quality and quantity of intangibles but also if the market

undervalues such a company. That is why we need to focus on the identifying and measuring how much a company might be undervalued.

The literature analysis revealed that M/B ratio determines the effectiveness of intangible implementation. In the process of picking investments the same (M/B ratio) or inverse coefficients (B/M ratio) are often used (e.g. Goyal, Welch, 2008; Lewellen, 2004; Campbell, Thompson, 2008). Fama and French (1992) laid the foundations for the role of B/M ratio in finance. According to their findings, the B/M ratio explains cross-sectional variation in stock returns. There is a growing body of literature verifying the relationship between B/M ratio and stock return e.g. Kothari and Shanken (1997), Pontiff and Schall (1998) who supported the same hypothesis about Dow-Jones Industrial Average (DJIA): B/M of DJIA predicts market return. Fama and French (1998) developed their primary idea and demonstrated that stocks which are characterized by a high B/M ratio have higher returns in the future. Moreover, they found evidence for this hypothesis in different capital markets. Johnson and Soenen (2003) analysed the B/M influence on the other performance indicators. They showed that companies with a high B/M ratio have a higher Jensen's alpha, a higher share of economic value added in material assets, and a lower Sharpe coefficient. However the majority of relevant papers show that the M/B coefficient negatively relates to future returns.

As a result we have determined two attributions that are of crucial importance for picking shares: intangibles and a low M/B ratio. While the first is vital for market value growth potential, the second checks whether the potential has been realized. Both are essential for portfolio forming decisions on the basis of intangibles, otherwise we can pick overvalued or fairly valued shares (Table 1).

Tab. 1. Portfolio forming decisions

	M/B	
Intangible drivers	low	high
Low	fairly estimated	overestimated
High	underestimated	fairly estimated

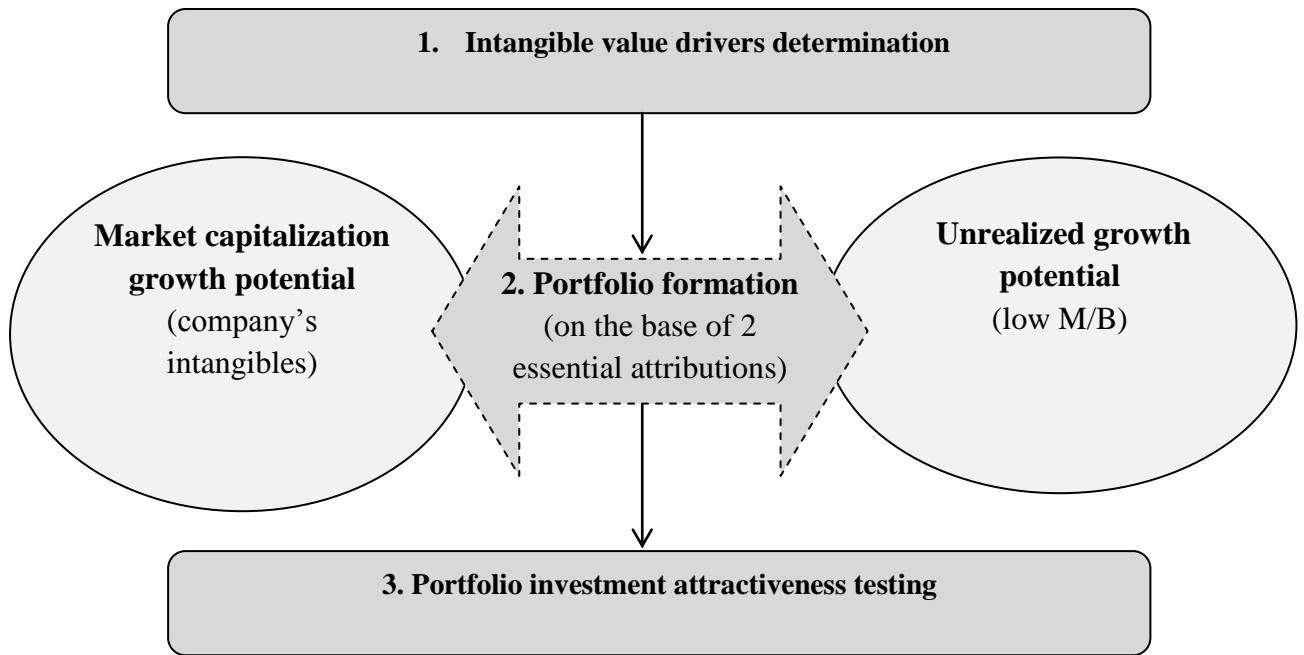


Figure 1. The framework of the research design

The framework of the research is presented in Figure 1 and described below.

1. **Determining the drivers of intangible value.** While each company has a wide range of intangibles we focus on the basic intellectual resources that are significant for value creation. We analyse the literature dedicated to value creation and intangibles in order to identify those factors and validate them. Note that all chosen value drivers should be available for market investors.
2. **Portfolio formation.** Firstly we examine the market capitalization growth potential determined by company intangibles. However the measurement of intangibles and their outcomes are complicated. Therefore we do not propose to measure value growth potential. Instead we determine companies which have higher value growth potential than the average company (regarding a chosen set of companies). We propose to use the median of intangible value driver X to divide companies into two groups: “with relatively high growth potential based on X” and “with relatively low growth potential based on X”. In other words we filter the chosen set of companies. And the number of intangible-based filters is equal to the chosen intangible value drivers. The use of median instead of mean eliminates the influence of outliers. Note that in practice we can use other statistical measures such as quantile to choose companies with intangible-based growth potential.

Secondly we choose companies with unrealized growth potential. We propose to use the median M/B indicator to divide companies into two groups: “with relatively

unrealized growth potential” and “with relatively realized growth potential”. We implement this “MB-filter” after intangible-based filters. The final set of companies can be used to form a portfolio. We use equal weight for shares according to the papers of Chan et al. (2001), Al-Horani et al. (2003) because the choice of weights is debatable.

- 3. Portfolio investment attractiveness testing.** The portfolio is tested in order to prove its investment attractiveness. We use Sharpe coefficient analysis, comparisons with benchmarks, and confidence interval construction. The coefficient was developed by Sharpe (1966) to measure portfolio return weighted by risk. As a measure of risk Sharpe suggested using the volatility of portfolio calculated by standard deviation. The Sharpe coefficient has the following formula:

$$S = \frac{E(r - r_f)}{\sqrt{\text{Var}(r - r_f)}} \quad (1)$$

where r is the return of portfolio calculated using daily returns of shares;

r_f is the return of alternative investments (risk-free return calculated as the return of the US treasury bills converted from dollars to euros using interest rate parity);

$E(r - r_f)$ is average daily return of the portfolio for the period of time. To calculate it we divide the cumulative return for the period by the square root of the number of days;

Var is the dispersion of the portfolio’s daily returns.

We use two benchmarks for portfolio comparisons:

- a. MSCI Europe index. This is a free float-adjusted market capitalization weighted index of large and medium-sized European companies. The index was developed by Morgan Stanley Capital International. According to Morgan Stanley it “covers approximately 85% of the free float-adjusted market capitalization across the European Developed Markets equity universe”. Investment in indexes is usually regarded as a risk-avoiding strategy because it can capture market average return and decrease the volatility of separate shares. MSCI Europe benchmarks intangible-based portfolio with the market average.
- b. M/B-portfolio. We form a set of companies with “relatively unrealized growth potential” based on their M/B ratio and low growth potential based on intangibles. The comparisons with MB-portfolio prove the importance of intangibles for investment attractiveness.

4. Sample and methodology

We investigate this framework based on a sample of European companies. We analyse companies from Great Britain, Germany, France, Italy and Spain. The chosen countries have developed financial markets and aggregate GDP which is 71% of European Union's GDP. We also analysed the development of the knowledge economy in these countries with the help of composite indexes calculated by World Bank: KI (Knowledge index) and KEI (Knowledge economy index). All of the chosen countries are in the 1st quartiles of KI- and KEI-based country ratings. We suggest that institutional innovativeness allows investors to recognize intangible value drivers more easily. Note that each of the sample companies is a public company in order to be available for internal investors.

The sample was formed from such databases as Amadeus (Bureau Van Dijk), QPAT, Datamonitor, company sites, and other sources. The implementation of all the criteria listed above (country affiliation and data availability) allows us to form a sample of 1696 companies. Taking the period from 2004 to 2011, we collected 13 568 observations. 44% of them are related to British companies, 24% to German, 2% to Italian, 5% to Spanish, 25% to French.

In order to implement the proposed method of portfolio formation we determine the intangible-based value drivers. All the existent definitions and decompositions underline intangible heterogeneity on one hand, and the lack of a generally accepted measurement method on the other. The nature of intangibles determines the complication of quantitative valuation. Therefore IC quantity and quality can be expressed only by approximate indicators.

Chosen proxy indicators are enumerated in the Table 2.

Tab. 2. Proxy indicators of intellectual capital

Intangible value driver		Labour force qualification	Labour productivity	Computer resources and infrastructure	R&D intensity	Number of patents	Advertising expenses	Ownership
Proxy indicator		Board of directors' qualification	Earnings per employee	ERP systems implementation	R&D intensity	Number of patents	Advertising expenses	Foreign capital employed
Papers that use the same or similar proxy	Intangibles research	Sullivan, 2000; Edvinsson, Malone, 1997; Roos, Roos, 1997	Huang, Wang, 2008; Sveiby, 1999; DTI, 1998; Molodchik et al., 2012	Mouritzen, 2003; Diez et al., 2010; Garanina, 2009; Edvinsson, Malone, 1997	Diez et al., 2010; Mouritzen, 2003; Sveiby, 2001; Bayburina, Golovko, 2008; Edvinsson, Malone, 1997	DTI, 1998; Sullivan, 2000; Edvinsson, Malone, 1997; Roos, Roos, 1997	Mouritzen, 2003; Garanina, 2009	Mohd et al., 2009; Orens, Aerts, Lybaert, 2009
	Value drivers research	Roper et al., 2008	Roper et al., 2008	Doern, Fey, 2006; Ruivo et al., 2014	Lev, Sougiannis, 1999; Chan et al., 2001; Daniel, Titman, 2006; Anagnostopoulou, Levis, 2008	Coombs, Bierly, 2006; Greenhalgh, Longland, 2005	Johnson, Soenen, 2003; Lev, Sougiannis, 1999	Yoshikawa, Gedajlovic, 2002
Method of estimation		Company's Annual Report, section "Directors' information" If more than one-third of directors have postgraduate level qualifications and more than five years' experience – 2 points. If more than one-third of directors have postgraduate level qualifications or more than five years' experience – 1 point. Otherwise – 0.	Company's Annual Report, section "Financial data" Earnings before interests and taxes (EBIT) divided by number of employees.	Search on company's web site using the following words: "ERP", "Oracle", "NAVISION", "NAV", "SQL", "SAP". If company has news about these as listed above – 1 point, otherwise – 0 points.	Company's Annual Report, section "Financial data" Share of R&D expenses in company's earnings	The number of company patents according to the patents database QPAT	Company's Annual Report, section "Financial data" Advertising expenses	Company's Annual Report, section "Shareholders" If a company has foreign investors – 1 point, otherwise – 0 points.

We discuss the chosen indicators below:

- **Labour force qualification.** The human capital of a company consists of employee knowledge, skills and experience. However it cannot be measured for each employee on the base of publicly available information. Therefore we measure the qualifications of top-management. We expect these qualifications to play a significant role in knowledge and value creation, and to be positively correlated with employee human capital. That assumption is also investigated in papers of Shrader and Siegel (2007), Ugboro and Obeng (2000).
- **Labour productivity.** Revenue and earnings are usually regarded as one of the main results of human capital implementation (Bachhuijs et al., 1999; Johanson et al., 1999; Miller et al., 1999). We suggest that earnings per employee evaluates the average efficiency and productivity of human capital.
- **Computer resources and infrastructure.** Computer resources and information technology implementation can lead to value creation. While each company nowadays uses IT in varying degrees we recognize some outstanding computer-related value drivers which help to range companies. Previous research use expenditure on computers, IT and software (Mouritzen, 2003; Diez et al., 2010), however it is not available for market investors. We analyse the use of ERP (Enterprise Resource Planning) systems. ERP-systems are based on IT and integrate company activity, manage assets and human resources, finance and quality. That is why such systems improve intangible transformation into value.
- **R&D intensity.** R&D expenses are positively recognized by capital markets (as discussed above). R&D related activity can be regarded as the creation of new knowledge and therefore as investment in intangibles.
- **The number of patents.** The more R&D results a company has, the more innovative it is and therefore the higher the value growth potential. While the value created by patents is more important than their number we choose the indicator available to the market investor.
- **Advertising expenses.** The purpose of advertising is to attract new customers and make the company's name more easily recognized. Therefore advertising expenses are an investment in relationships with customers and potentially lead to value creation. However only about 5% of the sample companies report their advertising expenses. In order to keep sample size we exclude the indicator from the analysis.

- **Ownership.** Following Mohd et al. (2009) we assume that foreign capital identifies a company's popularity, attractiveness and recognition in foreign markets.

Much research (e.g. Doern, Fey, 2006; Roper et al., 2008) concentrates on environmental characteristics as a value driver. Therefore we also propose to control for environmental innovativeness through the innovation-related sub-index of Global Competitiveness Index (GCI)³.

The Table 3 represents sample descriptive statistics. Note that we analyse each year independently.

Tab. 3. The sample descriptive statistics

		Board of directors' qualification	Earnings per employee, th.euros	ERP systems implementation	R&D intensity	Number of patents	Foreign capital employed	GCI innovation-related sub-index	M/B value
2004	Mean	1.24	0.07	0.29	-24.7	241	0.88	4.83	5.76
	Median	1	0.01	0	0.04	0	1	4.78	1.25
	SD	0.71	1.18	0.45	599.20	2650.50	0.32	0.43	85.29
2005	Mean	1.25	0.13	0.29	0.75	243.81	0.88	4.83	7.87
	Median	1.00	0.01	0.00	0.04	0.00	1.00	4.78	1.44
	SD	0.71	1.65	0.45	8.77	2 687.23	0.32	0.43	115.53
2006	Mean	1.25	0.12	0.30	-0.10	255.76	0.89	4.83	9.79
	Median	1.00	0.01	0.00	0.05	0.00	1.00	4.78	1.53
	SD	0.71	0.95	0.46	6.69	2 749.35	0.32	0.43	171.64
2007	Mean	1.25	0.57	0.30	-0.08	267.85	0.89	4.83	5.55
	Median	1.00	0.01	0.00	0.06	0.00	1.00	4.79	1.39
	SD	0.71	14.66	0.46	27.89	2 814.84	0.32	0.47	65.20
2008	Mean	1.26	-0.16	0.31	0.25	279.69	0.89	4.71	2.91
	Median	1.00	0.01	0.00	0.05	0.00	1.00	4.66	0.96
	SD	0.71	4.76	0.46	4.38	2 874.11	0.31	0.41	32.26
2009	Mean	1.26	0.05	0.32	0.20	291.32	0.89	4.61	4.03
	Median	1.00	0.01	0.00	0.03	0.00	1.00	4.60	1.11
	SD	0.71	1.50	0.47	10.24	2 930.99	0.31	0.39	37.60
2010	Mean	1.27	0.16	0.33	0.24	302.15	0.89	4.64	6.98
	Median	1.00	0.01	0.00	0.07	0.00	1.00	4.65	1.21
	SD	0.71	1.21	0.47	2.73	2 986.85	0.31	0.43	84.09
2011	Mean	1.26	0.15	0.34	0.30	312.00	0.89	4.89	8.62
	Median	1.00	0.01	0.00	0.08	0.00	1.00	4.94	1.08
	SD	0.71	1.24	0.47	8.69	3 046.24	0.31	0.45	172.33

Since some of these indicators changes quarterly or annually, we rebalance the portfolio annually. Following Duci et al. (2011) we rebalance in the middle of the year in order to control for the time of company reporting. They argue that the proposed methodology guarantees the availability of financial statements for market investors. However different companies report at different times therefore investors at a given moment have different information about sample companies.

³ GCI proposed and calculated by World Economic Forum as a part of the annual Global Competitiveness Report

Sharpe coefficients of the intangibles-based portfolio and chosen benchmarks are analysed by a daily expanding window. Sharpe coefficients are compared every day to determine the most attractive portfolio. Note that expanding window determines that the Sharpe ratio comparisons of the same portfolio at different periods of time are impossible.

5. Results

Portfolio formation

Using the M/B data and the value drivers, we chose sets of companies to invest in (our intangibles based portfolio). We also chose the companies with low M/B ratio and low value of intangibles (M/B portfolio) for benchmarking. The results are presented in Table 4.

Tab. 4. The chosen sets of companies

Year	Number of companies	
	Intangible-based portfolio	MB-portfolio
2004	15	128
2005	28	30
2006	25	28
2007	22	24
2008	30	25
2009	20	30
2010	20	34
2011	19	24

Note that the majority of the companies included in the intangibles-based portfolio are German and the rest of the companies are British. Only the portfolio formed on the basis of 2008 data contains one French company. Despite that the M/B-portfolio has companies from all five countries.

Further we construct equal-weighted portfolios annually. To evaluate the returns and Sharpe coefficients the sample is supplemented with daily share price data from the Bloomberg database. We analyse the time period from the 1st of July, 2005 to 30th of June, 2013.

Portfolio returns

The portfolios returns are shown in Figure 2. The returns of the intangibles-based portfolio and the benchmarks before annual rebalancing are reported in Table 5.

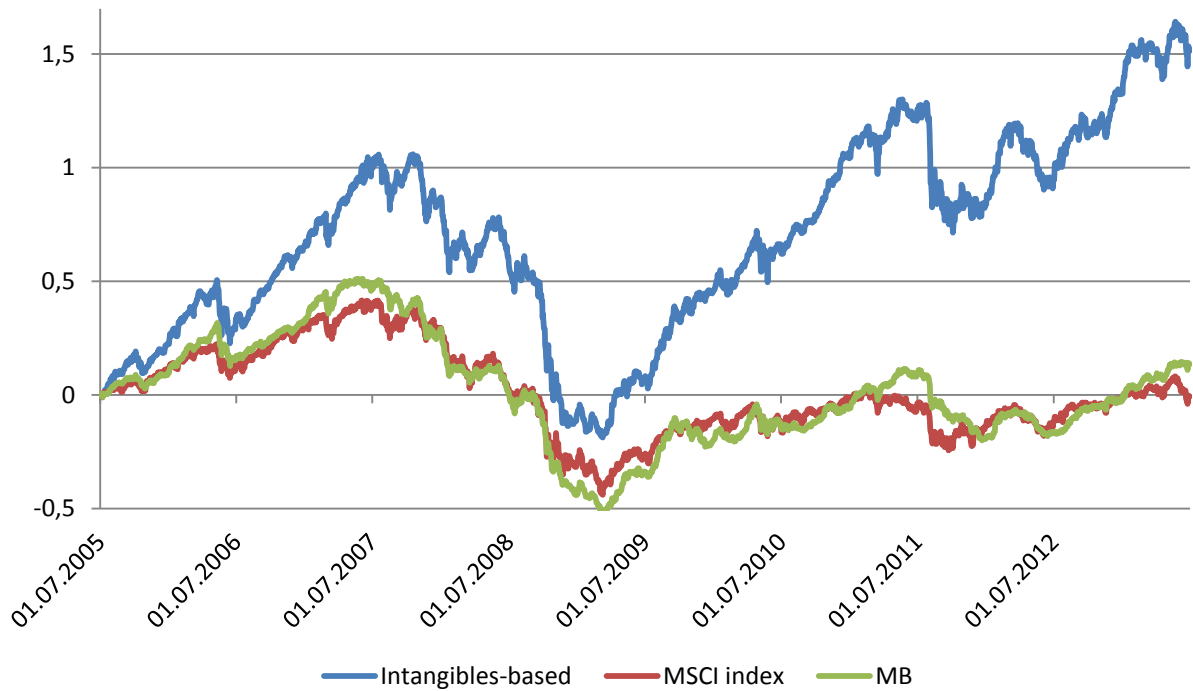


Figure 2. The returns of intangibles-based portfolio and benchmarks

We assume that intangibles help to pick the most profitable companies compared to the benchmarks. The intangibles-based portfolio performs better in the pre-crisis period, has lower drawdown during the crisis and recovers fast afterwards. However it has high volatility. That is why we analyse Sharpe ratios.

Sharpe ratios

The analysis started on 1st of January, 2006 in order to collect enough data for standard deviation calculation. The dynamics of the Sharpe ratios are presented in Figure 3. The value of Sharpe coefficients of the intangibles-based portfolio and the benchmarks before annual rebalancing are reported in Table 5.

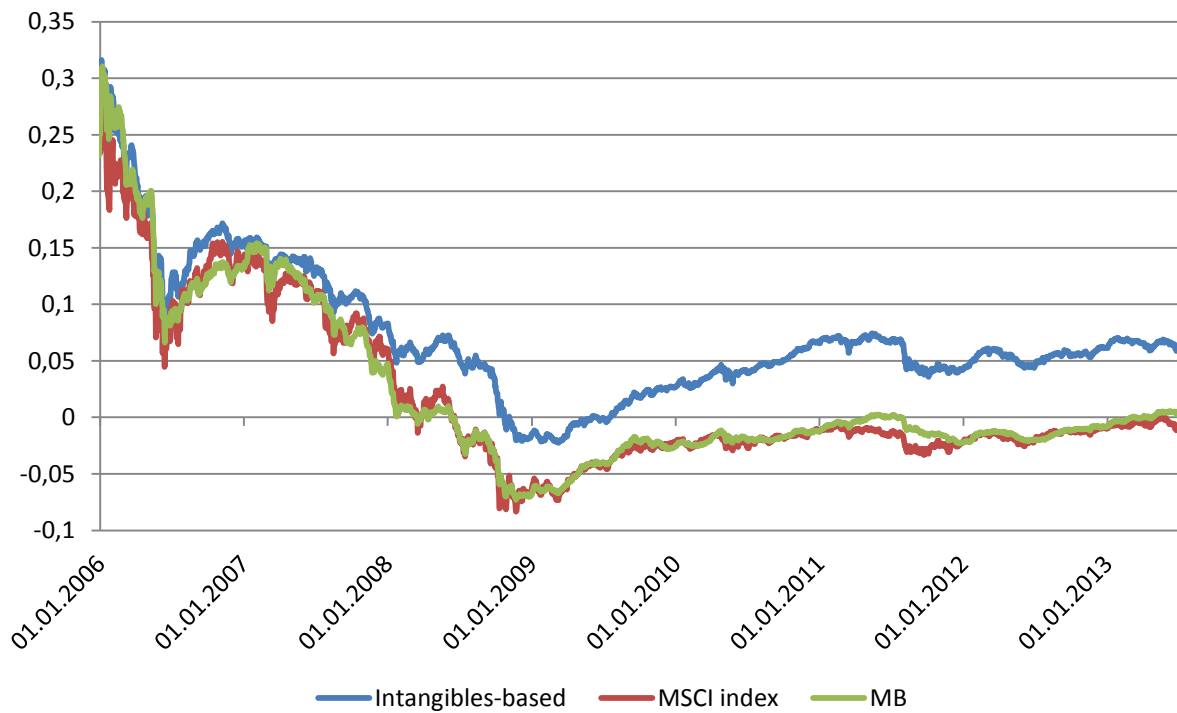


Figure 3. The Sharpe ratios of intangibles-based portfolio and benchmarks

Tab. 5. The Sharpe ratios of intangibles-based portfolio and benchmarks at the chosen date

Returns								
Date	30.06.2006	30.06.2007	30.06.2008	30.06.2009	30.06.2010	30.06.2011	30.06.2012	30.06.2013
Intangibles-based portfolio	0.3367	1.0058	0.5931	0.0747	0.6376	1.235	0.9467	1.5142
MSCI index	0.1416	0.3943	0.0277	-0.2712	-0.1429	-0.0436	-0.1186	-0.0079
MB-portfolio	0.1702	0.4696	0.0123	-0.34	-0.1439	0.1003	-0.1646	0.1350
Sharpe coefficients								
Date	30.06.2006	30.06.2007	30.06.2008	30.06.2009	30.06.2010	30.06.2011	30.06.2012	30.06.2013
Intangibles-based portfolio	0.1225	0.1299	0.0530	-0.0011	0.0401	0.0675	0.0459	0.0614
MSCI index	0.0971	0.1088	-0.0142	-0.0425	-0.0249	-0.0132	-0.0195	-0.0085
MB-portfolio	0.0927	0.1036	-0.0141	-0.0399	-0.0199	0.0014	-0.0197	0.0046

The analysis evidences that the intangibles-based portfolio contains the most attractive companies in terms of return and risk-adjusted return. The M/B portfolio demonstrates results that are close to the index or slightly better. It underlines the crucial role of intangibles in portfolio formation.

The Sharpe ratios of the intangibles-based portfolio and the benchmarks are also analysed daily to choose a “leader”. The leading portfolio is characterized by the highest Sharpe ratio (between the intangibles-based portfolio and the benchmarks). We analysed both the

absolute values and 95% confidence intervals of the Sharpe ratios. If the lower confidence interval of the intangibles-based portfolio is higher than the upper confidence interval of MSCI Europe index or upper confidence interval of MB portfolio at the same period of time, it is the “leader” at a 5% level of significance. Table 6 shows the percentage of days in which the intangibles-based portfolio leads. We analyse the whole period (01.07.2005–30.06.2013) and the crisis period (01.01.2008–31.12.2009) because some relations between intangibles and market value existed before the crisis could be unstable to exogenous shocks.

Tab. 6. The results of statistical portfolio comparisons

	Absolute values	5% level of significance
Leadership of intangibles-based portfolio, percentage (01.07.2005-30.06.2013)	96.09%	91.21%
Leadership of intangibles-based portfolio, percentage (crisis period, 01.01.2008-31.12.2009)	100%	100%

The results still show the attractiveness of the intangibles-based portfolio—it is the leader throughout the crisis and recovery periods. This finding supports the idea that a company’s intangibles are of great importance during an economic recession.

Comparisons with random portfolios

Although we compare the intangibles-based portfolio with the benchmarks, an analysis of risk-adjusted return, confidence intervals, some additional verification should be conducted. In order to check the robustness of results we compare the intangibles-based portfolio with a number of random portfolios. This procedure checks whether the high returns and the Sharpe coefficients of the intangibles-based portfolio are non-random and can be explained by company intangibles.

Each random portfolio includes twenty randomly selected shares of companies from the whole sample of 1696 companies. The number of shares is chosen as the median value of shares in the intangibles-based portfolio. The random portfolio is also equal-weighted and rebalanced annually in the middle of year.

After each simulation we evaluate the random portfolio leadership over the benchmarks and the intangibles-based portfolio (on the basis of Sharpe coefficients). The mean and median values, maximum and minimum of the leader percentages are evaluated after 100 simulations and reported in the Table 7.

Tab. 7. The results of random portfolios comparisons

	Comparisons with benchmarks		Comparisons with intangibles-based portfolio	
	Absolute values	5% level of significance	Absolute values	5% level of significance
mean	64.95%	53.62%	8.20%	7.65%
median	74.99%	64.37%	5.15%	4.34%
max	96.51%	92.84%	62.47%	60.82%
min	3.84%	0.52%	0.03%	0.00%

The results indicate that on average random portfolios lead the benchmarks by 53,62% (64,95% in absolute terms) of analysed interval. The median value of the leader is slightly higher, 64,37% (74,99%). While there is an absence of a steady leader, investing in random portfolios is not preferable in comparison with the benchmarks. The comparisons with the intangibles-based portfolio show that random portfolios have less value of risk-adjusted return during the larger part of analysed time period: the average percentage of random portfolios leadership is 7,65 (8,20% in absolute terms), the median is 4,34% (5,15%).

7. Conclusion and discussion

The literature exploring the influence of intangibles on market returns is limited as it takes into account only one component of intangibles, usually human capital, R&D expenses or advertising expenses. While intangibles are heterogeneous we believe that a simultaneous analysis of several components allows better identification of profitable companies. More important, the growth of market value is possible only if the market has not capitalized the information about intangibles. Investments in intangibles are usually not transparent and sometimes even not reported, so the market needs to wait for the output of these investments to get any information. In other words we believe that some market inefficiencies concerning intangibles exist. That is why the current paper presents a tool to categorize companies as potentially profitable on the basis of the analysis of intangibles. The tool distinguishes two attributes which are important to identify companies worth investing in: the intangibles themselves, and the capitalization of intangible-based growth potential in market indicators. To determine the capitalization we adapt the M/B ratio. According to Stewart (1997), Sveiby (1997), Nold (2012), companies which create intangibles raise the M/B ratio and, therefore, are attractive for investors. The paper shows that a relatively low M/B value and a high value of intangibles characterize undervalued companies. The proposed tool was tested using a sample of European companies to recognize potentially profitable ones. To test the investment

attractiveness we compare the intangibles-based portfolio with benchmarks and random portfolios.

Portfolio comparisons show the ability and validity of the proposed method for picking investment goals. The intangibles-based portfolio demonstrates higher cumulative returns and Sharpe ratios than the benchmarks and random portfolios. It also confirms the existence of market inefficiencies concerning intangibles. The components of intangibles, which are not reported directly, reflect future earnings, value and growth with a time lag. That is why it is important to search for the components of intangibles that determine competitive advantages and invest in companies which have a high quantity and/or quality of those components before stock market acquires the information about them.

The current research extends the understanding of the role of intangibles during a crisis. The idea that company intangibles are of great importance during an economic recession is widespread. We show that in exogenous shocks, intangibles are not only significant for the survival of a company and its economic results, but also allow a lower drop in the market value and faster recovery. While exogenous shocks influence all companies in the market, we find that intangibles prevent a significant drop of company market value. The portfolio comparisons justify not only the increasing importance of intangibles for investors but also the ability of the proposed tool to choose between low valued companies which will grow in future, despite the fact that during the financial crisis the M/B ratios of the majority of companies drop.

The proposed tool allows market investors to categorize companies as potentially profitable on the basis of publicly available information about intangibles, in other words, it represents a kind of simple screening. Company management can apply the tool to diagnose their company's position in the stock markets. The results also can be used to develop empirical research on the market recognition of intangibles, to test and explain market inefficiency and develop trading strategies.

While the current research develops a tool to determine undervalued companies on the basis of intangibles, the future development of this topic can be a deeper analysis of intangibles. Intangibles are heterogeneous and are evaluated and defined differently by different investors. In this work we do not analyse the indicators separately. However we believe that the interaction between intangibles can lead to synergetic effects that should be taken into account when making investment decisions. We also ignore the probability of overinvestment in intangibles, when their high value is connected only with high expenditure which does not lead to the value growth of the company. The proposed tool should be improved to take into account such cases.

We rebalance the intangibles-based portfolio annually in the middle of the year to guarantee the availability of financial statements for market investors. While the Sharpe

coefficient of the portfolio is higher than the Sharpe coefficients of benchmarks we conclude that the value growth potential is realized quickly. Nevertheless, finding the optimal frequency for portfolio rebalancing will increase the return of portfolio and needs further research.

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