Acta Montanistica Slovaca
ISSN 1335-1788
actamont.tuke.sk

Relationship between Variations in Valuation Methodologies: Evidence from Polish Construction Market

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How to cite this article:
Vrbka, J., Krulický, T. and Šanderová, V. (2023). Relationship between Variations in Valuation Methodologies: Evidence from Polish Construction Market. *Acta Montanistica Slovaca,* Volume 28 (2), 314-324

DOI:
https://doi.org/10.46544/AMS.v28i2.05

Abstract
Making investment decisions in modern conditions is quite complicated. On the example of the construction industry, the article tests the approach based on WACC and WARA analyses. The risk and profitability of the specified markets were analyzed based on the Efficient Frontier method. The Polish market and the group of Euronext markets were selected for comparison. The necessity of calculation of WARA based on only significant assets was determined. The differentiation between WARA and WACC in the Polish construction market can be overcome by maximizing goodwill and intangible assets and minimizing tangible assets. It reveals problems not in the stock market, but in the industry and the economy as a whole, particularly the lack of functioning markets such as the stock market for individual assets. The role of intangibles is different for Euronext markets. On the other hand, the requirement of the international accounting standards to transfer goodwill from assets to "other income" in case of a negative value (bad will) makes adequate consideration of goodwill in the WARA model virtually impossible. Another problem is a calculation of relative weights of assets in conditions of occurrence of both positive and negative values, which creates prerequisites for different approaches and interpretations. Building material that is used in the construction industry tries to improve the environment. the source of building materials are natural resources such as sandstone.

Keywords
WACC, WARA, asset return, construction, natural, environment

Introduction

The construction industry in Poland started to expand gradually in 2022. The increase is probably also due to the fact that European construction companies started to notice promising opportunities in this market. Poland has also seen a rapid and predictable increase in building permits. The example of the number of dwellings per thousand inhabitants for which building permits were issued was used for comparison. For example, this was almost ten times less in the Czech Republic than in Poland. While in Poland, the average number of flats is 13, in Prague, on the other hand, it has been approximately 3.4 per year for the last five years (Rudy, 2022).

A similar boom in construction growth in Poland was already recorded in 2018. The overheated economy in Poland started to cause some difficulties for larger construction companies, but the construction materials manufacturers were waiting for the conjuncture in 2019 (CzechTrade, 2018).

Next year, the Polish government decided to prepare an amendment to the law that would allow the construction of houses without a building permit. The amendment to the law builds on the basic needs of a person, to live, and tries to prioritize it over the needs of the developer. To meet the needs of the developer, the government is preparing other possible solutions. Available data obtained from the Polish Central Statistical Office show that in the first quarter of 2020, over 25,000 building permits were issued (Charvát, 2022).

Since the Polish stock market recently received the status of a developed market, an important task is to compare this market with Euronext markets, especially in the construction sector, under the conditions of permanent crises in the recent period. A similar topic was also dealt with by Kabourková et al. (2020).

Compared to Poland, the neighbour Czech Republic is among the countries that are characterized by very complex construction procedures. The new construction law should change this problem. However, the Czech Republic will still lag behind the West in environmental and nature protection issues (Kézl, 2021).

A similar topic to Matveev was also dealt with by Marousek et al. (2015). Under such conditions, the assessment of the value of the business in the construction sector acquires special importance and relevance. The aggregate rate of return on different types of tangible and intangible assets is called WARA or weighted average return on assets. This issue will be addressed in the paper from theoretical and practical perspectives. A similar topic was also dealt with by Matveev et al. (2016).

Since WARA deals with a weighted average return on assets, and bulk assets have a lower rate of return than intangible assets, averaging these returns will produce a result as a percentage of total assets. In theory, the WARA result should be the same as the WACC or a weighted average cost of capital.

However, in practice, there is a difference between these two indicators caused by approaches to the calculation of premiums, the special status of goodwill, and behavioural models.

Review

Based on the latest research, the value of a company today consists mainly of intangible assets instead of traditional tangible assets (Volkov & Garanina, 2007). The American economist Janice Eberly sees the advantage of intangible assets as the fact that they are not so sensitive to monetary policy. However, intangible assets can include both measurable and non-measurable assets (Mrazkova, 2019; Luis Gil-Alana et al., 2020; Mahdiraji et al., 2020). According to Osinski et al. (2017), today's economy is primarily based on intangible assets, namely knowledge. A similar topic was also dealt with by Kasych et al. (2019).

According to Petković, Krstić and Radenović (2020), defining intangible resources is very difficult. However, according to them, intangible resources determine a company's success. It must be added that their actual measurement and valuation are also difficult. Given the rapid development of intangible assets and the economy itself, their valuation is becoming increasingly important (Škare and Riberio Soriano, 2022; Wang et al., 2022). Hence, their valuation is often the subject of research (Chiu & Chen, 2007). In order to value them, information about the object of valuation is needed. Whether the information reported in the accounting records is relevant to the valuation of intangible assets is often a topic of interest to accounting policymakers and researchers (Choi et al., 2000). Macek (2010) also addressed a similar topic.

WARA, or weighted average return on assets, refers to the overall rate of return on different types of tangible and intangible assets in a firm, the assumption of which is that each specific type of asset has its own rate of return and its own unique appearance. Lee (2012) argues that investors' returns are determined by the returns of the underlying assets and their capital flows. The author Wu (2019) addressed the value-weighted average return from the perspective of equities. He found that stocks with high beta risk scored higher than stocks with low beta risk. Lin (2017) also addresses a similar issue in his study. A similar topic was also dealt with by Stehel et al. (2019).

The rate of return on unidentifiable intangible assets or goodwill is usually calculated using the so-called implied rate of return, for which there are two possible approaches to calculate it, namely the weighted average return on assets (WARA) or the adjusted present value approach (Pratt et al., 2022).

An interesting study on the issue of goodwill was conducted by Sun Li (2016), who investigated the relationship between goodwill valuation and managerial skills. However, the main problem of goodwill is its

quantification (Dohnal, Hanusová & Lipovská, 2019). Nowadays, there are many ways to value goodwill, but the question remains, which method is correct and applicable to all industries. Podhorska et al. (2019) sought to identify the different indicators of goodwill since the key indicators of goodwill value can contribute to the effective management and growth of the company's market value. Domanižová et al. (2020) also addressed a similar topic.

Daitchman (2017) argues that consistency can be expected between three different measures of return: weighted average cost of capital, internal rate of return, and a weighted average return on assets. In a bargain purchase scenario, however, these measures would often not initially be consistent without additional effort. As a result, we can establish the following relationship: IRR > WACC > WARA. IRR tends to be highest because the buyer is demanding a higher than the market rate of return on investment. The WACC is in the middle because it is calculated regardless of the purchase price and reflects the market participants' demands for a return. WARA tends to be the lowest rate of return because there is no goodwill in a bargain purchase, which typically has the highest required rate of return on the acquired asset due to its inherent riskiness. A similar topic is also addressed by Hromada (2019).

To provide a fair value of intangibles, there was a need to document and defend the cost of capital estimates used in valuing assets, including intangibles (Pan et al., 2022). Pratt and Grabowski (2014) focus on intangible assets and discuss the rate of return on unidentifiable intangible assets or goodwill that can be used to derive implied rates of return, including weighted average return on assets (WARA). Marecek et al. (2017) also address a similar issue.

Schüler (2020) discusses the valuation of intangible assets using the income approach. When using data on comparable companies, comparability must be stated with respect to investment risk and estimating the cost of equity without asset-specific leverage. A similar topic was also dealt with by Junga (2020). Other solutions, such as WACC or the WARA approach, are critically evaluated in terms of implied capital structure, value allocation and compliance with the market value-added principle. Hašková et al. (2020) address a similar topic. Investment decision-making also takes into account the evaluation of projects for sustainable and healthy regions (Kelemen et al., 2022) or the development of components of smart city concepts (Gavurova et al., 2022).

Tworek (2009) focused on the conditions of survival of Polish construction firms during the crisis. In 2009, these companies did not invest at all or invested only in cases of absolute necessity, implying a strategy of stagnation. In Poland, the majority of contractors adopted such an approach. Under these conditions, the internal rate of return (IRR) was chosen as a basic measure of the efficiency of such projects. Marecek (2016) views a similar problem from a similar perspective.

Veselinovic and Drobnjakovic (2015) emphasized that there is a significant difference between the business philosophy of economically developed countries and countries in transition, especially in terms of understanding the role of intangible assets in the profit generation process. On the one hand, we observe the increasing power of intangible assets in generating profit or loss for a business and also the importance of quantifying them. But on the other hand, we see some gaps in the policy on intangible assets in CEE (Veselinovic & Drobnjakovic, 2015; Olah et al., 2021). Other findings are presented by researchers who investigated the interdependence between financial development, fiscal instruments, and environmental degradation in developed and converging EU countries (Ziolo et al., 2020; Simionescu et al., 2021, 2022; Can et al., 2022), which are also reflected in security aspects (Kelemen et al., 2018; Kelemen et al. 2021, 2022).

Crane (2019) proposed to abandon the suggestion-based establishment of premiums for individual assets in the calculation of WARA. He considers it necessary to determine the statistical significance of the impact of relative weights of individual assets on the WACC - coefficient and to calculate standard deviations of these relative weights in order to establish risk (premiums). The calculation of WARA is based only on significant relative weights of assets and their rates of return. Risk-based premiums (discounts) are added (subtracted) to the WACC - coefficient. According to his approach, significant assets are: in the case of agriculture - TCA, NC, mining – NC, construction – TCA, TA, manufacturing – TCA, CR, TN, GW, services – CR, T, NC, GW, etc. He used traditional notation: Total Current Assets (TCA), Tangible Assets (TA), Customer Relationships (CR), Technology (T), Non-Competes (NC), and Goodwill (GW).

Zaremba and Konieczka (2014) examined the suitability of four popular factor pricing models: the capital asset pricing model, the Fama and French three-factor model, Carhart's four-factor model, and the five-factor model of Fama and French. They tried to analyze which of these models is most applicable to the Polish stock market. They proved that the four-factor model outperforms the other models. In fact, for this market, this result means that it is insufficient to use the CAPM model when calculating the WACC – coefficient (Zaremba & Konieczka, 2014).

Material and Methods

For our analysis, we used data from financial statements of public companies in Poland and stock markets merged in Euronext (markets in Paris, Brussels, Dublin, Lisbon, Milan, and Oslo). Yahoo Finance allows us to get

both financial statement data, market indicators such as risk level (beta), and monthly stock price data using python tools (packages yahoo_fin and pandas_datareader).

Statistically significant assets with respect to the impact on the WACC - coefficient have been found using linear regression methods. At the same time, the premiums needed to calculate assets rates of return are represented by the standard deviation of the corresponding variables.

Both residual goodwill (because of impairment) and the one based on restatement may be used to calculate WARA. To do this, we have used the current value of companies' free cash flows (FCF) for the previous 3 years and the WACC coefficient calculated from the CAPM model. We have obtained goodwill based on the acquisition method (earlier purchase method) provided by international accounting standards (IFRS).

In order to preserve the comparability of the models, the negative goodwill losing its status as an asset remains in the model for calculating WARA.

Research

Market description

Despite the recently acquired status of a developed market, the Polish stock market is quite young. Nevertheless, we managed to find data on 27 Polish public companies operating in the construction market. The period from 2013 to 2022 for some models and from 2018 to 2022 for other models was selected for the study. In a similar way, 22 companies from the markets united by the Euronext network were selected. Since our interest in this study is the construction sector, the selection was also arbitrarily limited. We should immediately note that the similarity of the selected objects for comparison in terms of risk and profitability should confirm the recently obtained status for the Polish market. Since our analysis does not focus on the problems or achievements of individual companies, we have every right to limit ourselves to their tickers.

Table 1 Separated optimal portfolios for Poland and Euronext in the construction market

Polish construction public companies	Euronext construction companies
[('DG.PA', 0.02364), ('AFG.OL', 0.32109), ('VEI.OL', 0.14447), ('EN.PA', 0.0), ('FGR.PA', 0.05758), ('BOKA.AS', 0.0), ('MULTI.OL', 0.0), ('SPIE.PA', 0.0), ('ARCAD.AS', 0.0), ('CFEB.BR', 0.00137), ('BAMNB.AS', 0.0), ('BWIDL.OL', 0.0), ('ASY.PA', 0.09027), ('EGL.LS', 0.0), ('MAR.LS', 0.0), ('MOUR.BR', 0.2802), ('TVRB.PA', 0.0), ('INFE.PA', 0.02242), ('CDU.LS', 0.00952), ('TDSA.LS', 0.0), ('MLHYE.PA', 0.04943), ('SEC.PA', 0.0)] Expected annual return: 14.8% Annual volatility: 12.6% Sharpe Ratio: 1.01	[('BDX.WA', 0.24824), ('TOR.WA', 0.03188), ('MSW.WA', 0.0), ('TRK.WA', 0.0), ('PXM.WA', 0.0), ('ERB.WA', 0.02769), ('UNI.WA', 0.0), ('PBG.WA', 0.0), ('ZUE.WA', 0.0), ('RFK.WA', 0.0), ('CNT.WA', 0.14218), ('DEK.WA', 0.11502), ('EKP.WA', 0.0), ('ELT.WA', 0.0), ('ENP.WA', 0.08278), ('NPA.F', 0.0), ('STX.WA', 0.28171), ('SHG.WA', 0.0), ('RES.WA', 0.0), ('RMK.WA', 0.0), ('INK.WA', 0.07049), ('JWW.WA', 0.0), ('MRB.WA', 0.0), ('MSP.WA', 0.0), ('MSZ.WA', 0.0), ('NVA.WA', 0.0), ('OND.WA', 0.0)] Expected annual return: 15.1% Annual volatility: 14.9% Sharpe Ratio: 0.88

Note: Euronext is the largest stock exchange group in Europe and one of the largest in the world. It was originally created via the mergers of the Amsterdam, Paris, and Brussels stock exchanges. Now this group is gradually expanding. Source: Own processing.

Table 2 Joint optimal portfolio. Source: Own processing.

Poland – Euronext optimal portfolio
([('BDX.WA', 0.11698), ('TOR.WA', 0.0), ('MSW.WA', 0.0), ('TRK.WA', 0.0), ('PXM.WA', 0.0), ('ERB.WA', 0.0), ('UNI.WA', 0.0), ('PBG.WA', 0.0), ('ZUE.WA', 0.0), ('RFK.WA', 0.0), ('CNT.WA', 0.06297), ('DEK.WA', 0.0476), ('EKP.WA', 0.0), ('ELT.WA', 0.0), ('ENP.WA', 0.03235), ('NPA.F', 0.0), ('STX.WA', 0.11178), ('SHG.WA', 0.0), ('RES.WA', 0.0), ('RMK.WA', 0.0), ('INK.WA', 0.02468), ('JWW.WA', 0.0), ('MRB.WA', 0.0), ('MSP.WA', 0.0), ('MSZ.WA', 0.0), ('NVA.WA', 0.0), ('OND.WA', 0.0), ('DG.PA', 0.0), ('AFG.OL', 0.22093), ('VEI.OL', 0.08067), ('EN.PA', 0.0), ('FGR.PA', 0.0172), ('BOKA.AS', 0.0), ('MULTI.OL', 0.0), ('SPIE.PA', 0.0), ('ARCAD.AS', 0.0), ('CFEB.BR', 0.0), ('BAMNB.AS', 0.0), ('BWIDL.OL', 0.0), ('ASY.PA', 0.048), ('EGL.LS', 0.0), ('MAR.LS', 0.0), ('MOUR.BR', 0.17991), ('TVRB.PA', 0.0), ('INFE.PA', 0.01027), ('CDU.LS', 0.00688), ('TDSA.LS', 0.0), ('MLHYE.PA', 0.03979), ('SEC.PA', 0.0)]) Expected annual return: 15.4% Annual volatility: 10.9% Sharpe Ratio: 1.23

Note: estimated by an Efficient Frontier method using the Python package EfficientFrontier. Source: Own processing.

Based on annual return and volatility, we observe even some advantages of the Polish construction market over the markets united in Euronext (Sharpe ratios 1.01 and 0.88, respectively). At the same time, in the optimal joint portfolio, we see representatives of both the Polish market and Euronext in approximately equal proportions (40% and 60%, respectively). We should note that the level of risk in all specified construction markets is quite high, which may be partly explained by the inclusion of the pandemic period in the studied years 2013-2022.

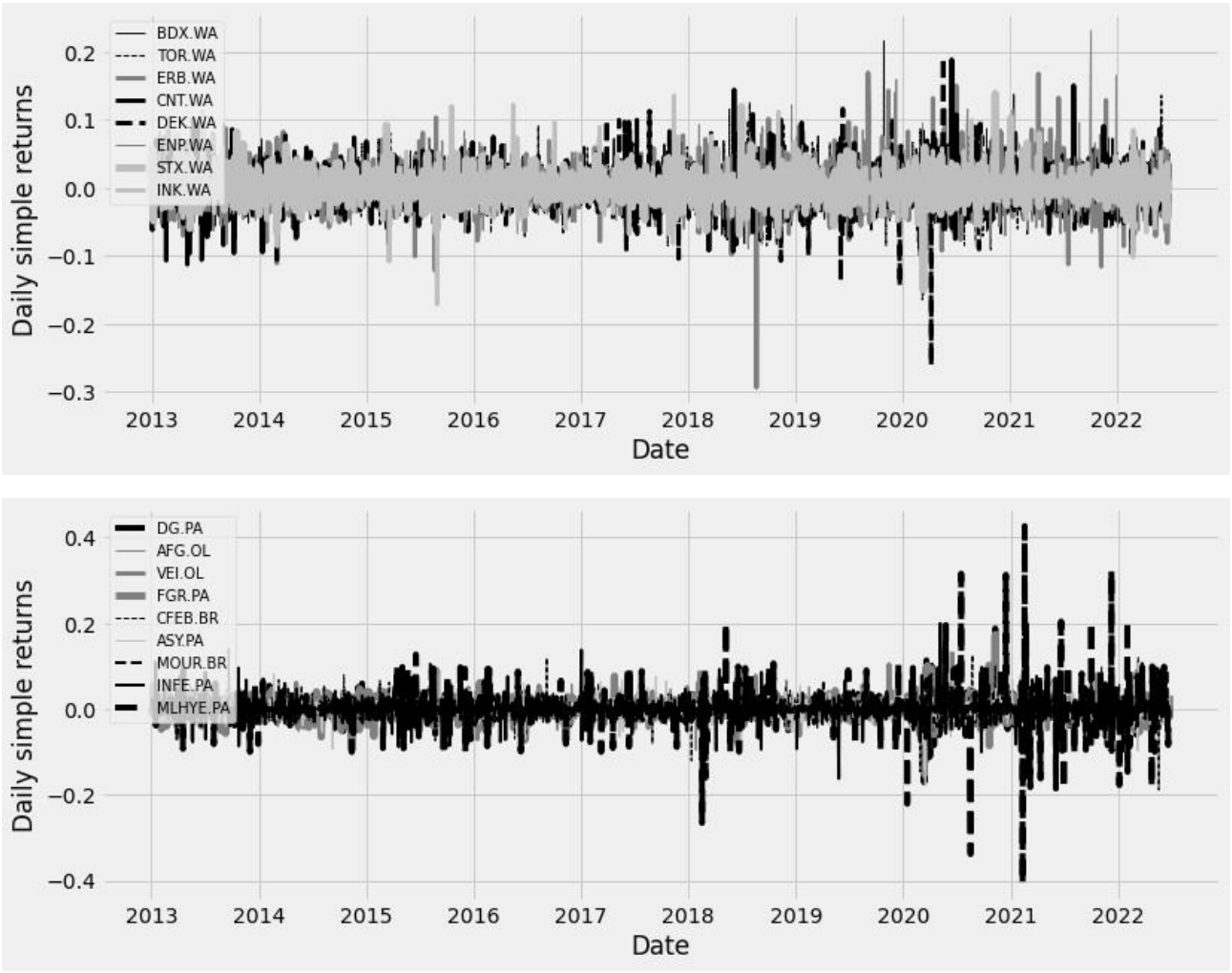

Fig. 1 Risk in the market (Note: Upper part – Polish market, lower part – Euronext). Source: Own processing

As Fig. 1 shows, although for some companies the risk occasionally reached a level above 40%, for most companies, it remained within 10-20%.

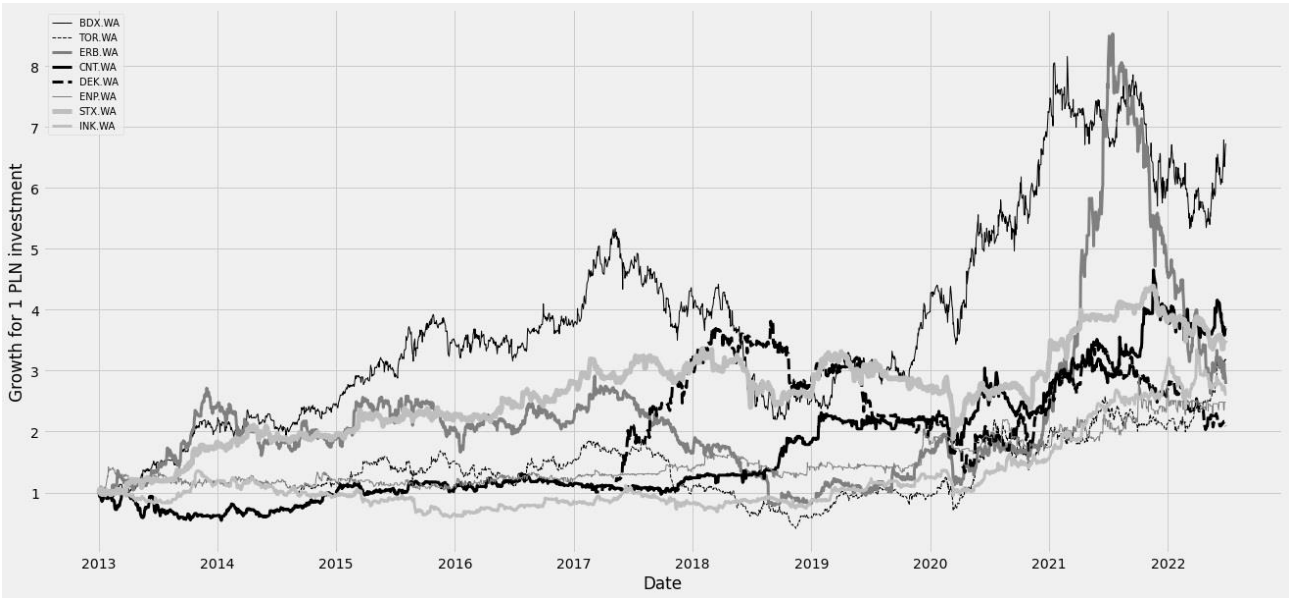

Fig. 2 Growth of investment in the Polish market. Source: Own processing

The shares of Budimex (BRD.WA) and Erbud (ERB.WA) demonstrate the highest rates of return on investment. The graphs of these companies crossed the line of 8-times growth (>700%) in 2021 (Fig. 2).

The companies AF Gruppen (AFG.OL) and Veidekke (VEI.OL), as representatives of chosen Euronext portfolio, have secured almost 6-times (almost 500%) growth of investment for their shareholders (Fig. 3).

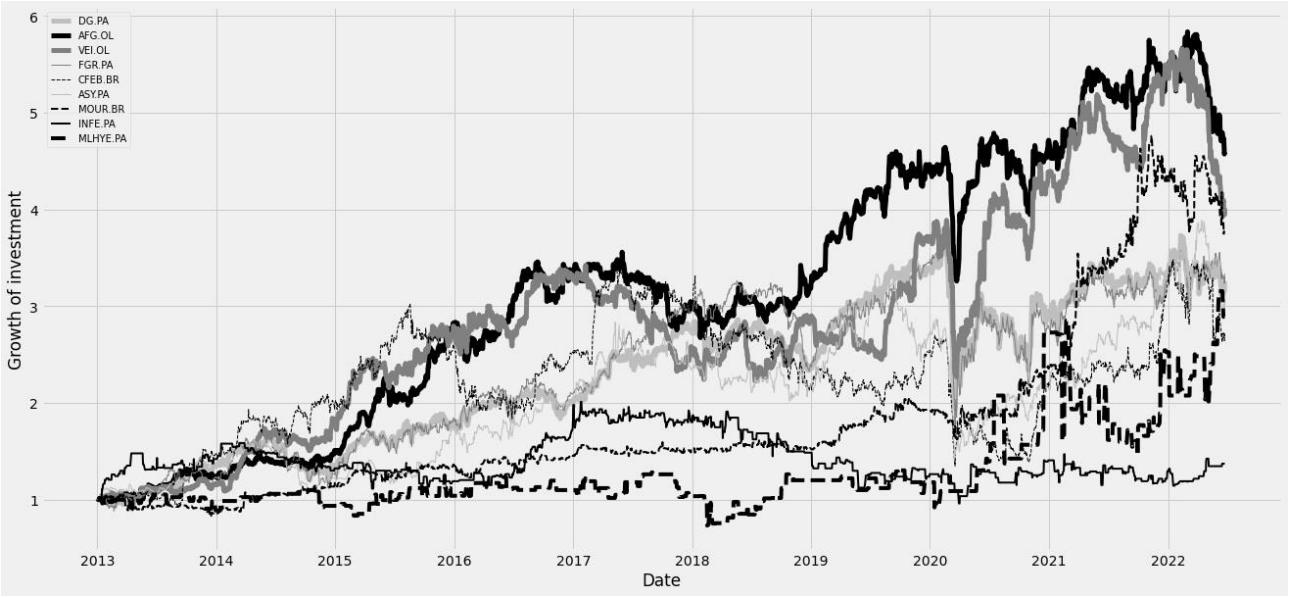

Fig. 3 Growth of investment on Euronext (Note: calculations made for the ingredients of the optimal portfolio). Source: Own processing

Several important aspects were identified in the process of research. Results of the 5-factor Fama-French model for Polish construction companies show that not all companies could be involved in our analysis.

***Table** 3 Fama-French analysis of the Polish construction industry*

Ticker	Adj R^2	F(Prob)	Mkt-RF (Prob)	SMB(Prob)	HML(Prob)	RMW(Prob)	CMA(Prob)
BDX.WA	0.090	2.13(0.07)	0.003(0.4)	0.012(0.08)	-0.01(0.01)	0.017(0.05)	0.02(0.03)
PXM.WA	0.201	3.87(0.004)	0.006(0.2)	0.027(0.01)	-0.02(0.01)	0.006(0.64)	0.046(0.001)
ERB.WA	0.152	3.04(0.01)	0.004(0.47)	0.025(0.01)	-0.001(0.8)	0.023(0.07)	0.097(0.01)
ZUE.WA	0.25	4.8(0.001)	0.01(0.01)	0.0182(0.01)	-0.006(0.3)	0.009(0.30)	0.018(0.06)
RFK.WA	0.099	2.3(0.06)	0.04(0.61)	0.024(0.07)	-0.004(0.6)	0.033(0.05)	0.026(0.13)
DEK.WA	0.22	4.2(0.002)	0.002(0.58)	0.021(0.01)	0.004(0.49)	0.026(0.01)	-0.001(0.9)
EKP.WA	0.33	6.62(0.00)	-0.042(0.02)	0.022(0.49)	-0.1(0.00)	0.015(0.7)	0.127(0.004)
INK.WA	0.10	2.14(0.07)	0.0004(0.9)	0.017(0.02)	-0.004(0.3)	0.017(0.06)	0.013(0.1)
MSP.WA	0.076	1.94(0.1)	0.01(0.07)	0.009(0.5)	-0.03(0.02)	0.006(0.7)	0.04(0.02)
SHG.WA	0.08	2.07(0.08)	0.007(0.18)	0.017(0.07)	-0.087(0.2)	0.009(0.41)	0.022(0.07)
PJP.WA	0.09	2.2(0.06)	0.001(0.75)	0.02(0.01)	-0.006(0.3)	0.018(0.07)	0.011(0.29)
RES.WA	0.252	4.8(0.001)	0.017(0.002)	0.014(0.1)	-0.01(0.06)	0.0167(0.2)	0.031(0.01)
RMK.WA	0.076	1.94(0.1)	-0.001(0.88)	0.02(0.02)	-0.001(0.8)	0.004(0.7)	0.013(0.3)
ARH.WA	0.189	3.6(0.006)	0.003(0.42)	0.019(0.008)	-0.004(0.4)	0.02(0.02)	0.013(0.01)

Notes: Python packages: pandas_datareader.data, pandas, statsmodels.api were used. Data for independent variables were obtained from https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html, daily data for dependent variables for the last 5 years were obtained from yahoo.finance. Source: Own processing.

The estimates presented in Table 3 allow us to determine the main trends in the Polish construction market:

1) The risk of such companies is significantly lower than the market risk.

2) They are predominantly small businesses.
3) Their securities are predominantly growth stocks.
4) Profitability of the Polish construction companies is higher than the average level.
5) These companies predominantly adopt conservative strategies.

At the same time, we should note that these conclusions are suitable only for the companies to which the Fama-French analysis is applied. Control is carried out based on the F - criterion.

Our main idea is that the sample should be reduced to the subsample of companies that the Fama French model is generally significant for. In our case, the further analysis includes almost half of the database.

Table** 4 Determination of significant assets **for the Polish market

Model/factors and indicators	Adj R^2	F(Sig.)	Goodwill t (Sig.)	NTA t (Sig.)	Other INT t (Sig.)	WC t (Sig.)
1. No corrections	0.10	13.7 (0.00)	-0.61 (0.53)	4.8 (0.00)	-0.72 (0.46)	3.2 (0.00)
2. Only Fama-French approach friendly	0.08	5.3 (0.03)	-	2,3 (0.03)	-	-
3. Goodwill recalculation	0.20	4.0 (0.01)	2.14 (0.04)	-1.93 (0.06)	-0.62 (0.54)	1.33 (0.19)

Notes: model1 - 114, model 2 – 49 (Backward Stepwise Regression), model 3 - 51 observations. WACC is a dependent variable. Source: Own processing.

Table 4 shows the estimates of three regression models. Model 1 is a search for significant weights of specific assets whose rates of return could be used in the WARA method. The model shows that in the WARA analysis, it is advisable to use only two assets, namely working capital (WC) and tangible assets (NTA), that significantly impact the WACC.

Despite the recently received motivational status of a 'developed market', the Polish stock market is still in the process of development. It means that the analysis tools available for the developed stock market will only partially work for some sectors of the Polish market. Among all analyzed construction companies represented on the stock market, 5 - factor model Fama – French (with factors for developed markets) for the period 2018-2021 was significant for only 14 companies.

Model 2 included data for these 14 companies and revealed only one significant factor – the relative weight of tangible assets.

Model 3 involves the amount of goodwill recalculated by an alternative method. We have calculated the NPV of FCF as the potential purchase price of a company. The database was reduced by half but remained sufficient for estimation. Although negative goodwill loses its asset status and should be included in "other incomes" in the Statement of Comprehensive Income according to IFRS, in order to use the WARA method, we still interpret goodwill as an asset in these cases and use absolute values for the calculation of its relative weight. Goodwill, calculated by this method, becomes significant in Model 3, as well as tangible assets.

Next, to calculate WARA, we needed to calculate premiums to the WACC for significant assets. Many authors use expert estimates and apply, for example, a premium of 10% to goodwill and a discount of 7.9% to tangible assets (Crane, 2019). Another method suggests the calculation of standard deviations for specific weights and considering it as an additional discount or premium.

Standard deviation of goodwill relative weight from model 2 (s=7.6%) is significantly lower than expert estimate of 10% (*chi-squared*=77.9, p=0.0041), while standard deviation of tangible assets' relative weight (s=14.7%) is significantly higher than expert estimate of 7.9% (*chi-squared*=211.0469, p-value=0.00).

***Table** 5 Descriptive statistics*

Share of the asset	Mean	Std. deviation
nta	0,59	0.14
goodwill	0.06	0.07
intangibles	0.03	0.03
wc	0.31	0.31

Notes: notations used: nta – net tangible assets, wc – working capital, etc. Source: Own processing.

Since goodwill may be both positive and negative (bad will), we decided to use its absolute values when calculating its share and share's standard deviation, which did not significantly deform the final result. Figure 4 shows WACC (wacc) and goodwill (g_wacc) recalculated by methodology close to international accounting standards (without reassessment) together with linear, cubic and quadratic regression trends. Under such

circumstances, it is also applicable to use absolute levels of assets instead of shares, but our purpose was to find significant effects of assets without particular interest to values of coefficients.

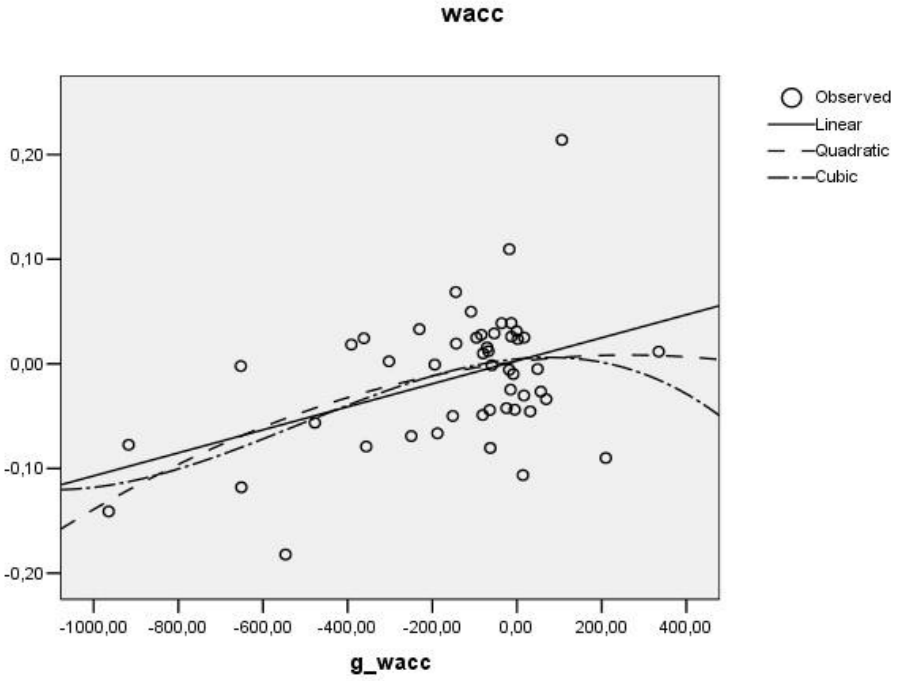

Fig. 4 WACC and recalculated Goodwill. Source: Own processing

It is obvious that the WARA methodology for markets experiencing crises requires additional tools and diversification of approaches. We have additionally tested our approach for Euronext members. We have chosen 25 companies for the period 2018 – 2021. After clearing the data, we obtained 79 satisfactory observations.

***Table** 6 Significant factors for construction markets of Euronext*

Dependent variable/ Factors	goodwill weight Beta (t, sign.)	intangibles weight Beta (t, sign.)	wc weight Beta (t, sign.)	nta weight Beta (t, sign.)
WACC	-0.22(-1.4, 0.17)	excluded	-0.4(-2.7, 0.01)	0.2 (1.2, 0.21)

Notes: R^2=0.15, F = 3.33 (Sign. = 0.03). In fact, results differ from the ones obtained for Polish companies. We used the list of tickers from table 1. Source: Own processing.

The results show that working capital itself is the only significant factor for Euronext members from the construction industry. These companies have much more opportunities to work flexibly with current assets and liabilities because the serving banking system is more flexible, automation of the supply process is more developed, lease relationships are more competitive, and the institution of entrepreneurship did not experience the consequences of a long stay in the administrative system.

***Table** 7 Pearson correlation matrix (p-values in parentheses)*

Indicator	WACC_POL	WACC_EURONEXT
WARA_POL	0.908(0,000)	-
WARA_EURONEXT	-	0.904(0,000)

Note: calculation based on two assets: NTA and Goodwill (premiums -0.14 and +0.07). Source: Own processing

WACC and WARA values should not be identical, but such a strong positive relationship indicates that these values may be mutually agreed (Table 7).

Notes: model 1 - value by modulus for Euronext, model 2 – no correction for Euronext, model 3 – no corrections for Poland

We have also calculated the differences between WACC and WARA (calculated by two different methods). WARA_N was calculated using only significant assets, while WARA_B was calculated using all analyzed assets. An average WACC is significantly higher than an average WARA_N. An average difference is 4.58% (95% CI from 2.93% to 6.22%, *p*-value=0.0000004). At the same time, the average WACC is significantly lower than the average WARA_B. An average difference is -17.59% (95% CI from -21.51% to -13.67%, *p*-value=0.0000000000001). Thus WARA_N seems to be a better method for calculating WARA, as WARA should be lower than WACC, as suggested by several authors (for instance, Daitchman, 2017).

The difference between WARA and WACC may be decreased by increasing goodwill in the case of the Polish market and the markets of Euronext. Additional tools for Euronext may include a decrease of tangibles and intangibles, while for Poland, they include a decrease of tangibles and an increase of intangibles. This difference may be explained by worse conditions of patent and other intangibles markets in Poland.

Discussion

Nowadays, the application of WARA, in the construction industry, in particular, faces numerous problems, which is an obvious obstacle for investors. First, there is no unified methodology for the calculation of relative weights, which creates substantial problems in the case of the occurrence of both positive and negative values. A possible solution may include a calculation based on absolute values.

Second, WARA calculation based on external expert estimates is unacceptable. Contrary to markets for shares and bonds, there are no developed markets for patents or other intangible assets. Such subjective estimates may lead to substantial "errors" in WACC and WARA values.

Finally, since negative goodwill should be transferred from the composition of assets to the statement of financial results, including it in the calculation, it violates international accounting standards.

Conclusions

Today, when markets are exhausted by the pandemic and the war in the region, the valuation of individual assets of a company is especially important. We should add that some markets still lack developed institutions. Expert determination of the value of individual assets under such conditions may be an option. However, it does not satisfy the criterion of critical analysis.

A significant difference between WARA and WACC indicates, on the other hand, the need for a market revaluation of an asset value, which becomes a complicated task in the case of intangible assets.

As in many other areas, combining the application of accounting statements with market assessments requires new unconventional approaches and a rethinking of old models. In this case, the problem of determination of premiums (discounts) for individual assets may be solved based on standard deviations, while the problem of a particular list of assets used in the WARA analysis may be solved by conducting regression analysis with the WACC - coefficient as a dependent variable.

This article uses the above-mentioned approach for a sample of public companies from the Polish construction industry and compares the results with the Euronext markets. The conducted analysis shows an excessive concentration of Polish construction companies on tangible assets and an excessive concentration of Euronext markets on working capital. The development of markets for other assets necessary for the proper calculation of WARA is unsatisfactory. Building material that is used in the construction industry tries to improve the environment.

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