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The Impact of the Covid-19 Pandemic on Changes in the Cost of Capital on the U.S. Market

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Abstract:

Purpose: *The authors analyze the impact of extraordinary events, i.e., the Covid-19 pandemic on changes in the investor's cost of capital in the U.S. market.*
Design/Methodology/Approach: *The cost of capital for 25 Fama-French quintile portfolios formed on book value to market value and on capitalization is estimated. The portfolios are formed from stocks listed on the U.S. market. In order to accurately assess the impact of Covid-19 conditions on changes in the cost of capital the confidence intervals of the estimated values of the cost of capital are determined. The bootstrap method to estimate the confidence interval of the cost of capital is used.*
Findings: *The authors show that Covid-19 had an impact on the value of the cost of capital in U.S. market, but at a relatively low level of significance, about 10%.*
Practical Implications: *Extraordinary events occurring on the global financial market can significantly affect the decisions of investment portfolio managers. These decisions are determined by changes in the cost of capital perceived by investors. Therefore, correctly estimating the cost of capital in relation to changing economic states is of crucial importance in practice.*
Originality/Value: *Common methods of estimating the cost of capital are based on the use of the classic CAPM model. The use of the five-factor Fama-French model allows for taking into account the multidimensional risk vector. The use of the bootstrap method allows for determining the errors of the cost of capital estimated on the basis of available short time series.*

Keywords: *ICAPM, Cost of capital, Bootstrap method, five factors Fama and French model, U.S. market, cost of capital estimation.*

JEL codes: *G11, G12, G14, G15.*

Paper type: *Research paper.*

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1. Introduction

The cost of capital is the basis for making investment decisions. It is used both in the process of assessing the profitability of investment projects and in the pricing of companies. That is why it is so important to estimate it correctly. However, it is not easy due to the multitude of factors that affect it.

The literature lists many methods for estimating the cost of capital, i.e., CAPM (Capital Asset Pricing Model), ICAPM (Intertemporal Capital Asset Pricing Model), CCAPM (Consumption-based Capital Asset Pricing Model), APM (Arbitrage Asset Pricing Model), DMG (Dividended Growth Model), DCF (Discounted Cash Flow Method), BPM (Butler-Pinkerton Model) and the build-up approach.

The CAPM model is most often used in practice, but it is characterized by many imperfections. The most important of them is that it takes into account only one factor - the market factor, which is a significant simplification that does not fully reflect the economic reality. It should also be pointed out that the cost of capital is not constant.

It is subject to constant changes over time, therefore it is necessary to update it. Extraordinary events, and in particular economic crises, have a significant impact on the financial market. It seems that they should also have an impact on the cost of capital.

The last few years have brought many extraordinary events, such as the financial crisis (2007), the annexation of Crimea (2014), the Covid-19 pandemic (2020-2021) and the outbreak of war in Ukraine (2022). The question arises how such events affect the cost of capital (Hakim and Thalassinos, 2024).

The main aim of our study is to evaluate the global changes in the cost of capital in the world of the COVID-19 pandemic. In our work we estimate the cost of capital for 25 Fama-French quintile portfolios formed on book value to market value (BM) and on capitalization (CAP). The portfolios are formed from stocks listed on the U.S. market. We formulate our research question as follows:

What is the impact of Covid-19 conditions on changes in the cost of capital?

In order to accurately assess the impact of Covid-19 conditions on changes in the cost of capital, we determine confidence intervals of the estimated values of the cost of capital. The cost of capital is the product of the estimated risk premium components and the estimated systematic risk components. The distribution of the cost of capital is unknown and cannot be considered normal. Therefore, we use the bootstrap method to estimate the confidence interval of the cost of capital.

In Section 2, we present a review of the literature on the estimation of the cost of capital and research on the impact of Covid-19 on it. In Section 3, we present the data, procedures of the portfolio construction, and the adopted research hypotheses. Section 4 includes a discussion of the obtained results. In Section 5, we present conclusions regarding the obtained results, as well as limitations of the study.

2. Literature Review

The investment decision-making process is complex and requires taking into account many factors, such as investment time, risk, future cash flows, etc. The cost of capital, illustrated by an appropriate rate of interest to arrive at a present value (Ward, 1999, p. 287), is of particular importance. It is 'the return that investors require on their investment in a firm's securities to persuade them to invest' (Weiyi Cai, 2023, p. 132). It is closely related to the risk taken by a risk-averse investor.

Obtaining a higher expected return is possible by taking on additional risk. This additional profit is a risk premium. According to classical theories, the market presents two prices – the pure interest rate (time price), illustrated by the intersection of the Capital Market Line (CML) with the axis describing the expected return, and the additional expected return per unit of risk taken (risk price), illustrated as the inverse of the CLM slope (Sharpe, 1965, p. 425).

As Lintner (1965, p. 14) points out, the minimum expected return depends on five factors: the risk-free rate of return, the market price of risk, the variance in the project's own present value, the project's aggregate present value return-covariance with assets already held by the company, and its total covariance with other concurrently projects.

A large number of literature studies indicate the possibility of using explicit CAPM/ICAPM implementations to estimate the cost of capital. Such procedures continue to be used despite discrepancies between realized and simulated returns. The reason for these incompatibilities may result from anomalies found, among others, by Banz (1981), Basu (1983), Rosenberg *et al.* (1985), DeBondt and Thaler (1985), Bhandari (1988), Jegadeesh and Titman (1993), Lakonishok *et al.* (1994), or Fama and French (1992).

Fama and French (1993) indicate that the basic factors influencing the cost of equity capital are risk, growth and size.

On the other hand, Fama and French (1995) state that the factors generating future returns, and thus the cost of capital, are the structure of the company's past financial results in relation to equity capital. The modifications of the Fama and French (1993) model are presented by Urbański (2012), and Urbański and

Zarzecki (2022). In turn, in the five-factor model, Fama and French (2015) add two more factors, i.e., operating profitability and investment policy.

As shown in numerous studies, the level of the cost of capital depends, among others, on the size of the company. Companies with smaller capitalization are characterized by a higher cost of capital (Brigham and Smith, 1967; Alberts and Archer, 1973; Peek, 2019; Harrington *et al.,* 2022).

The study analyses one of the most important events in recent years that had an impact on the financial market, namely the SARS-CoV-2 virus pandemic and the accompanying restrictions and limitations (Grima *et al.,* 2020). This event has an above-average impact on financial markets. It started at the end of 2019, but its most serious effects occurred in 2020-2021 (Nguyen *et al.,* 2022).

Numerous restrictions introduced by governments, especially those related to lockdowns and movement restrictions, had a strongly negative impact on the entire global economy (Ji *et al.,* 2025). It led to the disruption of supply chains and, consequently, the collapse of some sectors of the economy. The sudden occurrence of this negative phenomenon led to the emergence of an unprecedented level of risk (Zhang *et al.,* 2020), in particular by significantly increasing volatility on global financial markets (Haroon and Rizvi 2020). The Covid-19 crisis had a significantly negative impact on stock returns (Liu *et al.,* 2022; Bannigidadmath *et al.,* 2022).

The problem of the impact of extraordinary events, in particular the Covid-19 pandemic on the cost of capital has not been sufficiently discussed in the literature so far.

Ke (2022) analyzes the impact of the Covid-19 pandemic on the cost of equity of US public companies from August 2019 to August 2020. Based on the regression analysis, it is shown that the cost of equity increased by an average of 172 basis points as a result of the Covid-19 pandemic.

In turn, Arianpoor and Naeimi Tajdar (2024) showed that during the Covid-19 pandemic companies listed on the Tehran Stock Exchange with a low level of financial leverage had a lower total risk, while companies with a higher level of financial leverage did not have a higher risk at that time. At the same time, during the Covid-19 pandemic, companies with a high level of financial leverage had a lower cost of equity.

Hatane *et al.* (2024) show that the impact of ESG performance on the cost of equity was reduced for Indonesian non-banking and financial public companies disclosing full ESG (Environmental, Social and Governance) information during the Covid-19 period. Therefore, ESG disclosures were not effective in mitigating the negative impact of Covid-19 on the cost of equity.

Pęksyk *et al.* (2023) conduct a study of the impact of three periods of uncertainty: subprime (2008-2012), Covid-19 (2020-2021) and high inflation caused by Russia's aggression against Ukraine (2022-2023) on parameters important for determining the cost of equity capital of companies on the U.S. market. The authors estimate the cost of equity capital based on alternative methods, modifying the classic CAPM model.

They show the decreasing dependence of government bond interest rates on the cost of equity capital. They also indicate that the level of the cost of equity capital during the Covid-19 crisis is similar to the cost of capital recorded during the financial crisis of 2008 and is significantly higher than the level considered correct, i.e., 3.5-6%.

A flattening of the cost of equity capital level to the range of 6.5-7% is also observed in the period 1962-2020, which, according to the authors, may be due to the discounting of emerging uncertainty and thus decreasing expectations as to the cost of equity capital level in the long term.

3. Research Methodology

We use the ICAPM theory (see: Merton, 1973) to estimate the cost of capital. The return on investment can be presented as follow:

$$E(r_i) = E(RF) + \sum_{k=1}^{K} E(F_k)\,\beta_{ik}, \tag{1}$$

where $E(F_k)$ is the component of the risk premium vector of factor F_k of the tested market, β_{ik} is the components of the systematic risk vector of asset i, $E(RF)$ is the expected return on a risk free asset, and $E(r_i)$ is the expected return of an analyzed asset.

Consequently, the cost of capital ($Ccap_i$) is estimated according to relation (2).

$$\widehat{Ccap_i} = E(RF) + \sum_{k=1}^{K} \widehat{\gamma_k}\widehat{\beta_{ik}^{T'}}; \quad \forall\, i=1,\ldots,m. \tag{2}$$

$E(RF)$ is estimated as follows: $E(RF) = \frac{1}{T}\sum_{t=1}^{T} RF_t$. γ_0 corresponds to the return for which the systematic risk vector β_{ik} is zero.

$\widehat{\beta_{ik}^{T'}}$ are estimated using regression (3) for the assumed period T'.

$$r_{it} = \beta_{i0}^{T'} + \sum_{k=1}^{K} \beta_{ik}^{T'} F_{kt} + s_{it};\ t=1,\ldots,T';\ \forall\, i=1,\ldots,m. \tag{3}$$

The $Ccap_i$ is a nonlinear function of $\widehat{\gamma_k}$ and $\widehat{\beta_{ik}^{T'}}$. Therefore, we use bootstrap estimates of the cost of capital error.

We estimate the risk premium components (γ_k) using the five-factor Fama-French (2015) model. In this case, the factors in equation (1) are defined as follows:

$$F_{1t} = RM_t - RF_t,\ F_{2t} = HML_t, F_{3t} = SMB_t, F_{4t} = RMW_t, F_{5t} = CMA_t, \quad (4)$$

where *HML, SMB, RMW* and *CMA* are well known Fama-French factors.[3]

Considering (4), pricing model (1) can be written as follows:

$$E(r_i) = E(RF) + \beta_{iM}E(RM - RF) + \beta_{i,HML}E(HML) + \beta_{i,SMB}E(SMB) + \beta_{i,RMW}E(RMW) + \beta_{i,CMA}E(CMA). \quad (5)$$

Consequently, we estimate the cost of capital of asset *i* according to Equation (6) below:

$$\widehat{Ccap_i} = E(RF) + \widehat{\gamma_M}\widehat{\beta_{iM}^{T\prime}} + \widehat{\gamma_{HML}}\widehat{\beta_{i,HML}^{T\prime}} + \widehat{\gamma_{SMB}}\widehat{\beta_{i,SMB}^{T\prime}} + \widehat{\gamma_{RMW}}\widehat{\beta_{i,RMW}^{T\prime}} + \widehat{\gamma_{CMA}}\widehat{\beta_{i,CMA}^{T\prime}} \quad \forall i=1,\ldots,m. \quad (6)$$

We calculate the cost of capital for 25 Fama-French quintile portfolios formed in two directions on BM and CAP. BM and CAP for portfolios constitute average arithmetical values of these functions of various securities of the portfolio. Returns on given portfolios are average stock returns weighted by market capitalizations.

The calculations and analysis are performed on the basis of 336 monthly returns (from January 1996 to December 2023) of the audited stocks and are characterized by their positive book value.

We analyze stock portfolios of the U.S. market. The monthly value-weight portfolio returns are taken from the Kenneth R. French - Data Library.[4]

All returns are calculated on the basis of prices in U.S. dollars, and include dividends and capital gains. Market return *RM-RF* is the return on a region's value-weight market portfolio minus the U.S. one month T-bill rate.

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[3]*The Fama-French factor values downloaded for calculations are defined on the Fama website: https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.*

[4]*The developed portfolios use developed size breaks, but we use the BM breakpoints for each region to allocate the region's stocks to the developed portfolios. The 25 value-weight size-BM portfolios for a region are the intersections of the independent 5x5 size and BM sorts. (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/tw_5_ports_developed.html).*

We estimate the cost of capital on the basis of betas $\widehat{\beta_{ik}^{T'}}$ estimated from *T'*=24 monthly periods, for six 24-month rolling windows with a delayed step of 24 months. The first time window corresponds to the period 2022-2023. The last time window is for the period 2012-2013. The risk premium components ($\widehat{\gamma_k}$) are estimated on the basis of the entire analyzed history of 336 months.

Based on the above considerations, we expect that the following conjecture is true: The ongoing period of the Covid-19 pandemic on the examined market affects the value of the cost of capital of the examined stock portfolios.

4. Research Results and Discussion

The portfolios for July of year *t* to June of *t+1* include all NYSE, AMEX, and NASDAQ stocks for which we have market equity data for December of *t-1* and June of *t*, and (positive) book equity data for *t-1*.

Tables 1 and 2 present detailed results of the cost of capital for individual BM quintiles of companies with the smallest and largest capitalization, respectively. These tables also show the lower and upper values of the confidence interval estimated on the basis of bootstrap method.

Table 1. *Cost of capital of the U.S. market portfolios formed on the minimum capitalization quintiles*

	BM_min	**BM_2**	**BM_3**	**BM_4**	**BM_max**
2022-2023					
Ccp_ZER	0.94%	0.95%	0.97%	1.01%	1.04%
90%	1.12%	1.08%	1.10%	1.10%	1.16%
10%	0.74%	0.82%	0.83%	0.91%	0.91%
2020-2021					
Ccp_ZER	0.94%	0.98%	1.02%	1.07%	1.12%
90%	1.18%	1.18%	1.14%	1.20%	1.80%
10%	0.64%	0.75%	0.90%	0.95%	0.38%
	2018-2019				
Ccp_ZER	1.03%	0.87%	1.06%	1.11%	1.32%
90%	1.24%	1.19%	1.17%	1.25%	1.55%
10%	0.80%	0.54%	0.94%	0.96%	1.10%

Notes: *Ccp_ZER is the value of cost of capital estimated by equation (6). 10% and 90% means 10% lower bound and 90% upper bound of the confidence intervals of cost of capital estimation. BM_min and BM_max applies to quintiles with minimum and maximum values of book to market.*
Source: *Own study.*

Figure1 presents distributions of the cost of capital for individual BM quintiles of companies with the smallest capitalization a) and aa), and largest capitalization b) and bb).

Table 2. *Cost of capital of the U.S. market portfolios formed on the maximum capitalization quintiles*

	BM_min	**BM_2**	**BM_3**	**BM_4**	**BM_max**
2022-2023					
Ccp_ZER	0.78%	0.98%	0.97%	0.91%	0.79%
90%	0.87%	1.12%	1.09%	1.03%	0.97%
10%	0.69%	0.84%	0.85%	0.77%	0.62%
2020-2021					
Ccp_ZER	0.94%	0.98%	1.02%	1.07%	1.12%
90%	1.18%	1.18%	1.14%	1.20%	1.80%
10%	0.64%	0.75%	0.90%	0.95%	0.38%
2018-2019					
Ccp_ZER	0.83%	0.82%	0.94%	0.10%	0.77%
90%	0.96%	0.97%	1.08%	1.11%	1.05%
10%	0.70%	0.65%	0.77%	0.87%	0.48%

Notes: *Ccp_ZER is the value of cost of capital estimated by equation (6). 10% and 90% means 10% lower bound and 90% upper bound of the confidence intervals of cost of capital estimation. BM_min and BM_max applies to quintiles with minimum and maximum values of book to market.*
Source: *Own study.*

The period of the SARS-CoV-2 virus pandemic brought in most cases a decrease in the cost of capital for small-capitalization companies (BM_min; BM_3; BM_4; BM_max) (Figure 1a). The highest decrease is recorded in the case of companies with the highest BM ratio, i.e., undervalued companies (change by 0.2 percentage points).

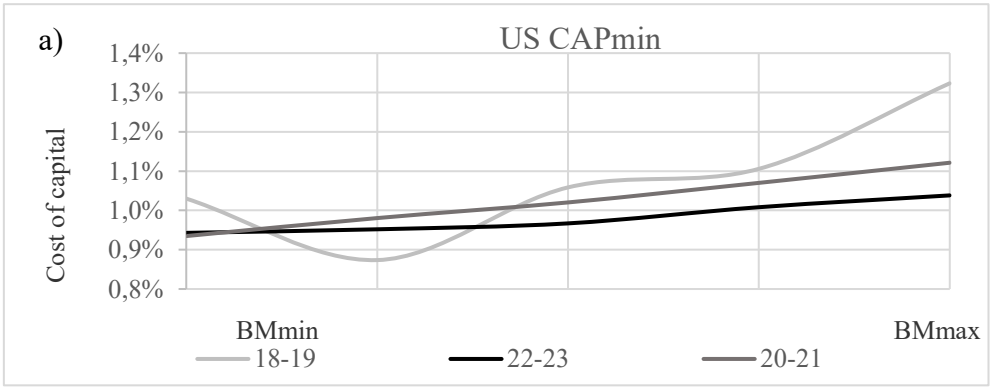
The estimated confidence intervals of the cost of capital in the pre- and post-Covid-19 periods for the first four BM quintiles (BMmin, BM2, BM3 and BM4) differ at a low significance level exceeding 10%. It is worth noting that in the case of the smallest companies, the decrease in the cost of capital is also continued in the period immediately following the end of the pandemic.

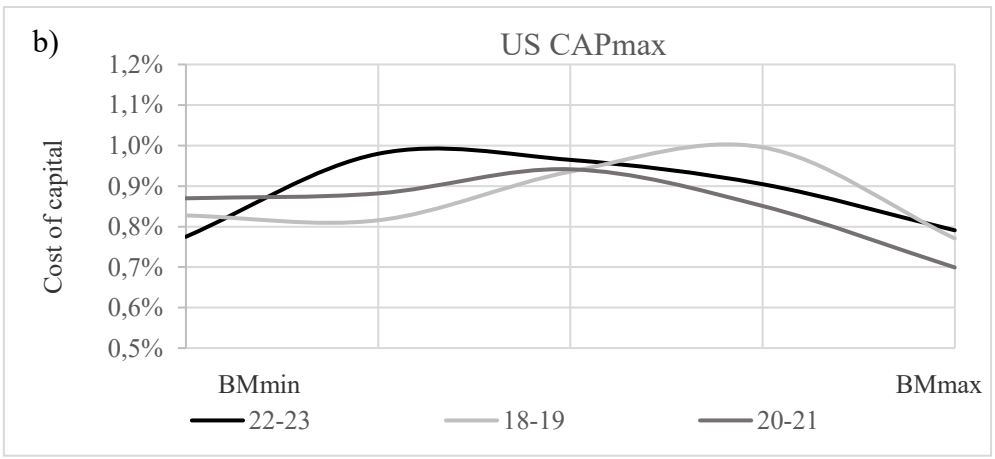
The decrease in the cost of capital may result from the small business support program - Paycheck Protection Program (PPP) adopted by the US authorities under the Coronavirus Aid, Relief, and Economic Security (CARES) Act.

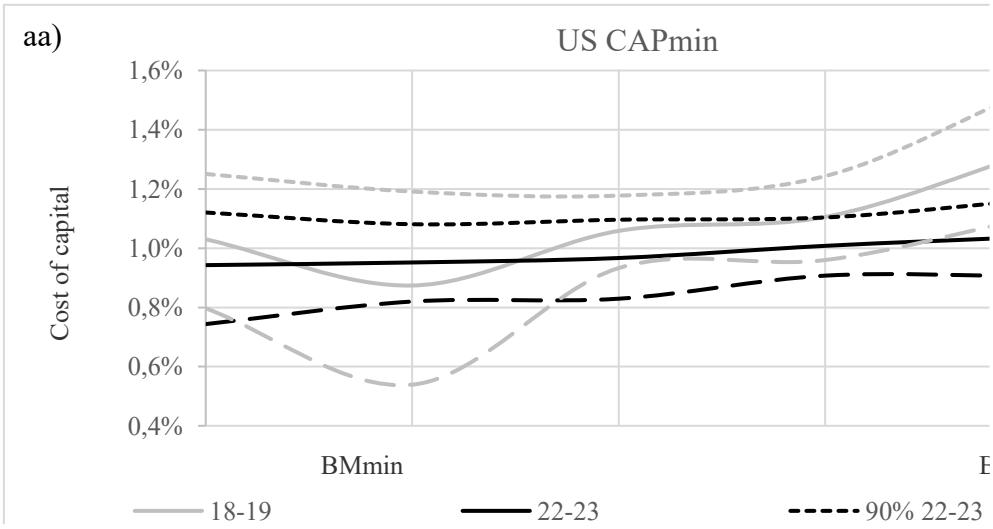
The value of the program amounted to USD 669 billion (in 2021 the amount was increased by another USD 284 billion based on the Consolidated Appropriations Act), which were to be allocated to uncollateralized, low-interest loans during the pandemic.

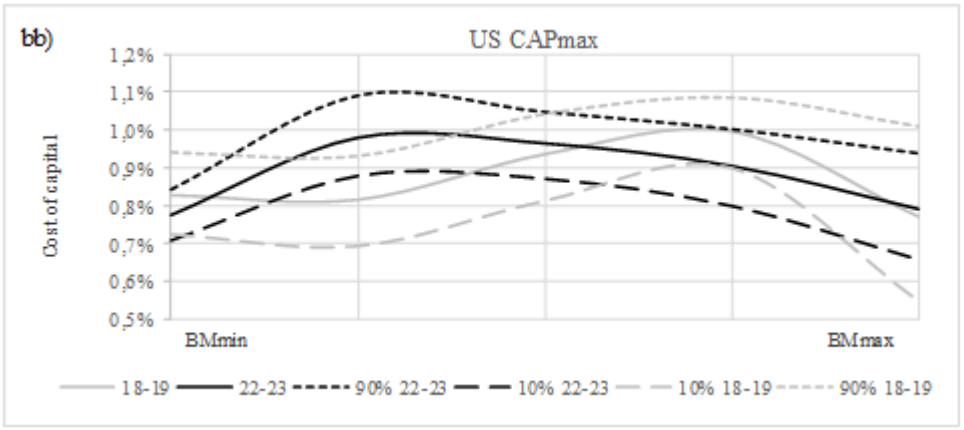
On its basis, three-quarters of small businesses in the US received a loan, most of which were ultimately written off (Autor *et al.,* 2022; di Nola *et al.,* 2023; Schweitzer and Borawski, 2021).

Figure 1. *Cost of capital for portfolios formed on the U.S. market estimated in 2018-2019, 2020-2021 and 2022-2023.*









Notes: *25 Fama-French portfolios formed on BM and capitalization (CAP) are analyzed. CAPmin, CAPmax mean quintiles of minimum and maximum capitalization value. BMmin. BMmax mean quintiles of minimum and maximum book to market values. 18-19 means cost of capital estimated in 2018-2019. 20-21 means cost of capital estimated in 2020-2021. 22-23 means cost of capital estimated in 2022-2023. 10% means 10% lower bound of the confidence interval. 90% means 90% upper bound of the confidence interval. Confidence intervals are determined using the bootstrap method, assuming 3,000 bootstrap iterations.*
Source: *Own study.*

The recapitalization of small companies allowed them to maintain liquidity in times of restrictions, and from the point of view of investors, the risk of their bankruptcy decreased. Access to low-interest loans translated into a reduction in the cost of raising capital for small enterprises. Importantly, the program was intended not only for companies at risk of bankruptcy, but also those in good financial condition.

The lack of major restrictions with regard to small companies may explain the decrease in the cost of capital, practically regardless of the BM ratio. The possibility of loan forgiveness after meeting certain conditions, as well as the improvement in market sentiment caused by the containment of the effects of the pandemic, could in turn contribute to the continuation or even further decrease in the cost of capital in 2022-2023.

In the case of companies with the highest capitalization, it can be seen that the pandemic period caused a decrease in the cost of capital among companies with a high (BM_4) and very high BM ratio (BM_max), while it increased in companies with a low (BM_2) and very low (BM_min) ratio (Figure 1b).

The estimated confidence intervals of the cost of capital in the pre- and post-Covid-19 periods differ at a low significance level exceeding 10%. This means that the restrictions resulting from the SARS-CoV-2 virus pandemic and the actions taken by the U.S. authorities resulted in a decrease in the cost of capital in the case of undervalued largest companies. In turn, in the case of the largest growth companies,

it led to its increase. This may be due to the lack of support tools aimed at large enterprises in a good financial situation, which were less affected by the restrictions related to the Covid-19 pandemic. Additionally, the state's actions related to the negative tax changes resulting from The American Rescue Plan Act of 2021 could have had a negative impact.

Nevertheless, the difficult general situation on the market could have contributed to an increase in expectations regarding the return on capital employed. It can be assumed that companies lowly priced by the market are companies from the industries most affected by the restrictions resulting from the Covid-19 pandemic, i.e., transport, hotel industry, aviation.

Grant programs have been provided for this type of business, i.e., the Coronavirus Economic Relief for Transportation Services (CERTS) program and Restaurant Revitalization Fund (U.S. Department of the Treasury, 2021), which allowed them to obtain much-needed capital and at the same time led to a decrease in the cost of capital.

It should be noted that the estimated values of the cost of capital during the period of the pandemic and after the end of the pandemic show differences at a relatively low level of significance, exceeding 10% (Figures 1aa and 1bb).

5. Conclusions, Proposals, Recommendations

This paper presents the possibilities of using the five-factor Fama-French (2015) model to estimate changes in the cost of capital. The investor's cost of capital in the last decade of the 21st century is examined on the U.S. market during the periods of the Covid-19 pandemic.

To investigate the impact of the Covid-19 pandemic on changes in the cost of capital, we estimated the cost of capital in two-year time windows before and after the occurrence of these extraordinary events.

In order to assess the significance of changes in the estimated cost of capital as a result of the examined non-market influences (Covid-19), we estimated the changes in confidence intervals using the bootstrap method.

Changes in the cost of capital in the examined markets can be summarized as follows:

1) U.S. market - small-capitalization companies.
   The period of the Covid-19 pandemic brought a decrease in the cost of capital. The highest decrease is recorded in the case of companies with the highest BM ratio, i.e., undervalued companies. The decrease in the cost of capital is also continued in the period following the end of the pandemic.

The estimated confidence intervals of the cost of capital in the pre- and post-Covid-19 periods for the first four BM quintiles (BM_min, BM2, BM3 and BM4) differ at a low significance level exceeding 10%. This means that assumed Conjecture can be accepted at a level exceeding 10%. Only for the BM_max quintile Conjecture can be accepted at a level about of 10%.

2) U.S. market - high-capitalization companies.
The pandemic period caused a decrease in the cost of capital among companies with a high BM ratio, while it increased in companies with a low BM. In the case of the largest growth companies, it led to its increase. The estimated confidence intervals of the cost of capital in the pre- and post-Covid-19 periods differ at a low significance level exceeding 10%. This means that assumed Conjecture can be accepted at a level exceeding 10%.

It should be noted that the conducted study is associated with certain limitations. Firstly, the five-factor model of Fama and French is used to estimate the investor's cost of capital. However, it should be noted that this model does not fully describe reality.

As Fama and French (2015) point out, this model is unable to capture 'the low average returns on small stocks whose returns behave like those of firms that invest a lot despite low profitability'. Secondly, it cannot be ruled out that other models based on ICAPM will give more reliable results. Thirdly, it cannot be ruled out that other factors (events) than those analyzed in the study could have also had an impact on changes in the cost of capital. Fourthly, the obtained results are characterized by a significance level of approx. 10%.

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