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Investment Optimal Portfolio as an Answer for Human Needs and Current Trends

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Abstract. This study examines the influence of digital transformation on human activity and its implications for investment decision-making during the COVID-19 pandemic. The research emphasizes the construction of an optimal investment portfolio that balances profitability and risk, with a focus on emerging trends in technology, education, and gaming. Utilizing the Efficient Frontier method, the study determines optimal portfolio weights, while the Sharpe Ratio is employed to evaluate and compare the risk-adjusted returns of these portfolios. The findings reveal that portfolios aligned with technological, educational, and gaming trends achieve a superior balance between profitability and risk. The Sharpe Ratio results further demonstrate that such portfolios yield enhanced risk-adjusted returns, highlighting the growing impact of digital trends on investment strategies. This research contributes to the academic discourse by elucidating the relationship between digital transformation and investment portfolio performance. It offers a novel perspective by linking human needs and the dynamics of modern digitalization with financial strategies, providing valuable insights for investors navigating the post-pandemic economic landscape.

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JEL Classification: G11; G41; O33; O16; E22.

1. INTRODUCTION. WHAT DO WE REALLY MEAN BY PROGRESS?

The Oxford English Dictionary defines progress as "advancement to a further or higher stage, or to further or higher stages successively; growth; development, usually to a better state or condition; improvement (…) applied especially to manifestations of social and economic change or reform" (Simpson, Weiner, 1989). Xingfu and Siming (2020) supported theoretically with ideas from a Marxian critique of the paradox of progress in capitalist society and a Habermasian reconstruction of social evolution and progress, note that progress shall not be understood as an intrinsic trend of history itself, but a 'historical-practical project' of humanity.

The Conversations on Rethinking Human Development project team tried to reveal the modern meaning of this term. In report of the International Science Council (2020, pp. 75-76) the question appears: "Do we mean progress as a certain mastery of the universe, a mastery of technology or do we mean progress as our capacity to have certain kinds of relationships and solidarities with each other?" The other question is about human. What does it mean to be a human? Is it concentrated around 'Homo economicus' (human as primarily economic animal) or this is a framing in which individual competition and self-interest congealed into a social system where profit ruled over all things? What are our collective responsibilities and "(…) how they are challenged by material provisioning, economic life, technological changes and artificial intelligence"? (International Science Council, 2020, p. 76).

Ruzzeddu (2022) describes modernisation as a process where the ascribed characteristics (gender, religion, and ethnicity) progressively lose their function of rigidly defining a person's identity, on behalf of personal achievements. According to the "Framework for 21st Century Learning" proposed by the US-based Partnership for 21st Century Learning, four main categories of critical skills are: critical thinking, communication, collaboration and creativity (Joynes et al., 2019). "The '4Cs' model is based on the assertion that 21st century challenges will demand a broad set of skills emphasizing the individual's capabilities in core subject skills, social and cross-cultural skills, proficiency in languages, and an understanding of the economic and political forces that affect societies" (Joynes et al., 2019, p. 12). Considering deeper approach, it is about self-improvement, e-learning, new knowledge and other equally important skills. In this research we can also find a note about a Chalkiadaki's model of overarching 21st century competencies such as lifelong learning, problem solving, self-management and team work.

Economic growth is somehow a relevant metric for assessing progress in developed countries. As to Lei Pan and Vinod Mishra (2018, p. 661) "the interplay between the stock market and the real economy is crucial in the various channels through which financial markets drive economic growth". Lazonick (2017) tried to promote a relevant conception of the evolving role of the stock market. He expanded it from only cash gaining to additional functions like 'control', 'creation', 'combination' and 'compensation'. Morck et al. (1990) emphasized a sentiment as a real instrument that affects stock prices and real business activity. To prove this assumption they chose the crash of October 1987. The authors found out these corporate insiders aggressively bought stocks of their own companies during the crises. "The insiders quite correctly saw no change in fundamentals and attributed the crash to a sentiment shift. The thrust of the evidence is that stock prices respond not only to news, but also to sentiment changes" (Morck et al., 1990, p. 160).

So, our aim is to build an investment optimal portfolio, as an optimal balance between profitability and risk coming from human needs and current trends. First of all, we define human needs and current trends. Based on the list of trending tickers we determine the leaders of three consecutive clusters and optimize the investment portfolio. Based on the level of cumulative income, we form three clusters – the best one, the average and the 'catching up'

one. Considering stock market, we assume that investment optimal portfolio – one designed with a perfect balance of risk and return – should be an answer for contemporary human needs. The next step presents our attempt to calculate weights for optimal investment portfolio and the level of Sharpe Ratio based on the Efficient Frontier method. Finally, we compare the Sharpe Ratio for the optimized portfolios, and then construct a joint optimal portfolio of the best options.

2. AN OUTLINE OF THE PROBLEM. RESEARCH

Considering our time, we can definitely state that the digital economy is the defining trend today. Nie and Erbring (2000) offer early insight into how the Internet began to shape the way humans interact, while Kiesler et al. (1984) look beyond the efficiency and technical capabilities of computer communication technologies, providing a deeper understanding of their psychological, social, and cultural significance. These early perspectives foreshadow the profound ways digital transformation has come to influence society, as highlighted by Chesini, who notes that while governments recognize and even nurture humans' need to be a part of an increasingly complex society, many are beginning to realize that digital service providers are gaining power. They are doing so not only by meeting digital needs but by increasingly controlling (directly or indirectly) and provisioning many basic needs, like food, healthcare, education, shelter, clothing, infotainment, and possibly even safety and energy.

The COVID-19 pandemic accelerated the adoption of digital solutions at an unprecedented pace, creating unforeseen opportunities for scaling up alternative approaches to social and economic life (Hantrais et al., 2021). Scientists further demonstrate how the ethics of artificial intelligence became a primary concern for government legislation and how features enabling smart cities to act as productivity drivers did not necessarily offer advantages during the pandemic. These developments underscore the transformative role of digitalization in addressing societal challenges and highlight the need for frameworks to align technological advancements with human well-being.

The "Digital Society Index 2019" provides a model of Maslow's hierarchy for the digital age, illustrating how digitalization intersects with fundamental human needs:

- Basic needs: Access to digital tools and trust in data.
- Psychological needs: Improved health, well-being, and quality of life through digital.
- Self-fulfillment needs: Digital empowerment and utilization.
- Societal needs: A belief in digital's potential to improve society.

Despite this, a global survey of over 43,000 people reveals that less than half (49%) believe their basic digital needs – such as access to quality digital infrastructure and trust in responsible data use – are being met (Digital Society Index, 2019). This finding echoes Manfred Max-Neef's framework of fundamental human needs, which establishes a universal set of needs consistent across cultures and historical periods. Max-Neef highlights how poorly aligned satisfiers – particularly in consumer-driven systems – can alienate societies and hinder meaningful development (Max-Neef, 2010). This perspective offers a foundation for examining how digital transformation, industry shifts, and work adaptations address or fail to address these needs in contemporary contexts.

In alignment with Max-Neef's principles, Lu et al. (2022) propose a human-centric approach to Industry 5.0, where manufacturing systems prioritize worker well-being over system efficiency. Their Industrial Human Needs Pyramid mirrors the hierarchy of needs, advocating for empathy-driven human-machine collaboration. This shift recognizes the interplay between technological advancements and the fulfillment of human needs at cognitive, social, and self-actualization levels.

Similarly, Zhang and Chen (2024) explore the digital transformation of human resource management, emphasizing how digital tools can enhance employee selection, training, and development. However, they caution against potential negative effects when transitioning between old and new systems, reflecting Max-Neef's observation of the risks posed by misaligned satisfiers in systems undergoing rapid change.

The narrative of digital transformation is further advanced in studies focusing on remote and hybrid work models. For example, Sokolic (2022), Grzegorczyk et al. (2021), and Babapour Chafi et al. (2022) highlight how workplace flexibility can enhance autonomy, productivity, and work-life balance. However, these studies also reveal challenges, such as diminished workplace relationships and the need for equitable policies to prevent disparities between remote and on-site workers.

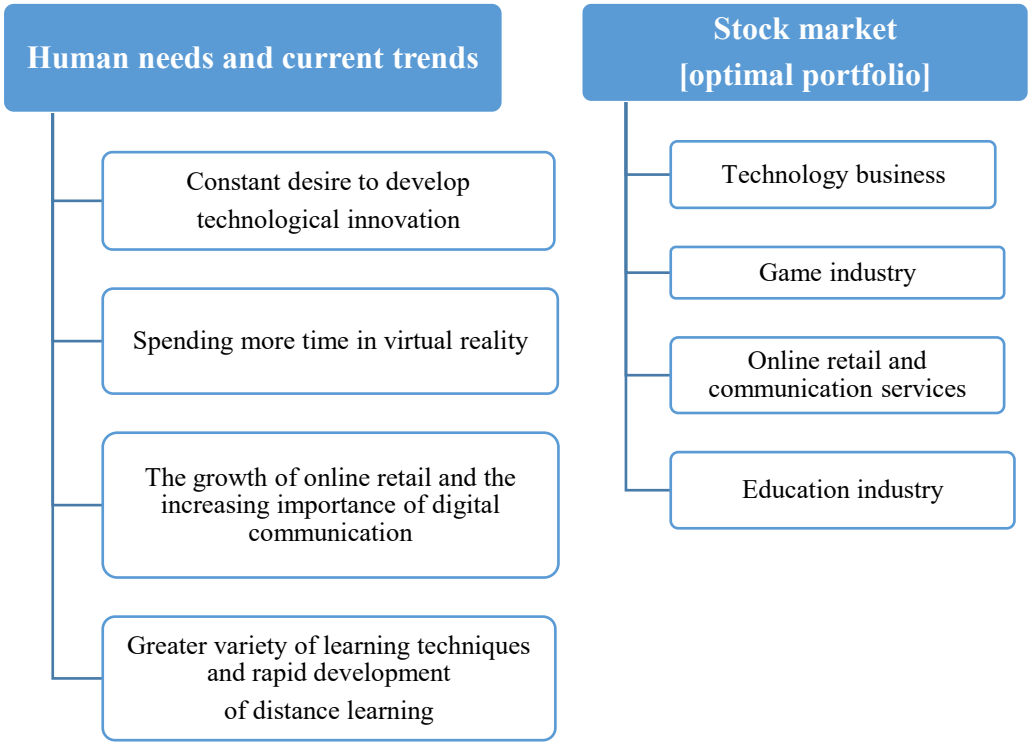
The 'new normal' brought by COVID-19 has reshaped labor markets and work practices. Vyas (2022) identifies trends of acceleration, normalization, and remodeling in flexible work arrangements, underscoring the importance of balancing traditional and innovative practices. Similarly, Juchnowicz and Kinowska (2021) examine the impact of remote work on employee well-being, emphasizing the necessity of digital tools to sustain workplace relationships and maintain work-life balance. Faruque et al. (2024) extend this discussion to small businesses, demonstrating how remote work enhances flexibility, cost-effectiveness, and employee satisfaction, while also presenting challenges in communication and team management.

Dahlke et al. (2021) contextualize these changes in a crisis-driven innovation framework, emphasizing the need for systemic responses to societal challenges. Their analysis of COVID-19 innovations highlights an increased focus on addressing social needs through frugal and social innovations. These findings align with the broader discourse on integrating digitalization and innovation into strategies that fulfill fundamental human needs while ensuring resilience and sustainability.

Therefore, these studies elucidate the multifaceted implications of digital transformation and work adaptations on human needs, emphasizing the importance of aligning technological advancements with well-being and systemic sustainability. However, this raises a critical question: Are human needs currently being met on a global scale? From an economic perspective, the stock market provides a lens through which we can evaluate the alignment between investment strategies and contemporary human needs. In this context, an optimal investment portfolio could potentially serve as a response to these evolving needs, balancing profitability with societal and individual well-being. Figure 1 shows our look for human needs and current trends from the perspective of investment optimal portfolio. Thus, we assume that the following trend became significant for the new human reality. The everyday activity has become highly digitalized, technologically equipped, diversified in educational tools, more in-depth into virtual reality. Among the key recommendations on the recovery measures and policies after the Covid lockdowns we can underline: to develop the competitiveness of the EU industry via investments in R&D and digital re/upskilling; to increase cross-country collaboration in innovative industrial projects, including healthcare; and to ensure transparent and evidence-based communication between government and citizens as well as coordination at EU-level (Tomala, Prokop & Kordonska, 2022).

Figure 1

Human needs and current trends from the perspective of investment optimal portfolio

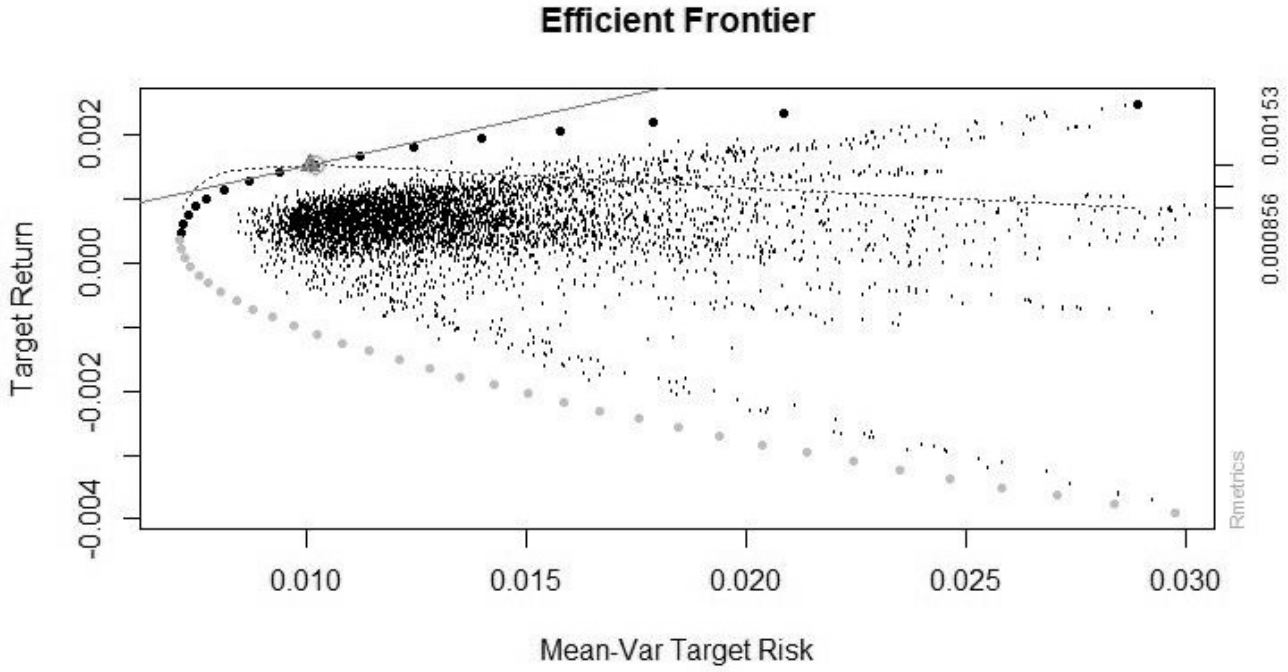


Note. Source: own elaboration.

We build our analysis on the basis of optimal Sharpe ratio, developed by Nobel laureate William F. Sharpe. It is used to help investors understand the return of an investment compared to its risk. The ratio is calculated as an average return earned in excess of the risk-free rate per unit of volatility or total risk. Volatility is a measure of the price fluctuations of an asset or portfolio. We assume that stock market returns are normally distributed. In this way, we deliberately ignore some possible drops or spikes in the share prices. Our actual smoothing of the process is an attempt to investigate a trend. The efficient frontier (Figure 2) measures all possible investments on a scale of risk and return. Practically, we are looking for point of tangency of the Capital Allocation Line (CAL – a line created on a graph of all possible combinations of risk-free and risky assets) and the Efficient Frontier to find an efficient portfolio. In an efficient portfolio, investable assets are combined in a way that produces the best possible expected level of return for their level of risk – or the lowest risk for a target return. In the study we use traditional Python packages like numpy, pandas, matplotlib, etc., but the most useful in our opinion would be: pypfopt, pypfopt.efficient_frontier, yahoo_fin and others and also some instruments of R programming.

Figure 2

The optimal balance between profitability and risk



Note. Source: own elaboration based on PortfolioAnalytics, fPortfolio, PerformanceAnalytics of R programming.

Our study includes several tasks:

- based on the list of trending tickers (increasing or decreasing in value on a defined slope) to determine the leaders of three consecutive clusters and to optimize the investment portfolio;
- to build an investment portfolio of the first 25 companies with the industrial mark 'technology' and to form an optimal investment portfolio;
- to build an investment portfolio of the first 25 companies with the industrial mark 'real estate' and to form an optimal investment portfolio;
- to build an investment portfolio of the first 25 companies with the industrial mark 'energy' and to form an optimal investment portfolio;
- to compare the Sharpe Ratio for the obtained optimized portfolios, and then to construct a joint optimal portfolio #1 of the best options;
- to build an optimal investment portfolio based on the 19 most famous companies in the field of 'education';
- to add the best companies from the portfolio of the firms from education to the joint portfolio #1 (i.e. to create a joint portfolio #2) and to compare the main indicators (i.e. annual return, annual volatility, Sharpe Ratio);
- to build the optimal portfolio of the firms from the game industry and to add its best options to the joint portfolio 2 (i.e. to create a joint portfolio #3),
- to compare the first, second and third joint investment optimal portfolios.

3. RESULTS AND DISCUSSION

Based on the level of cumulative income, we form three clusters – the best one, the average and the 'catching up' one. For the research all data are taken from the https://finance.yahoo.com. The Efficient Frontier method allows us to find the leaders of these clusters – the options with weight coefficients other than '0'. According to Table 1, the leaders in cumulative return are companies in the field of communication services – Roku, Inc. (ROKU), Zoom Video Communications, Inc. (ZM), Alphabet, Inc. (GOOGL) and Microsoft Corporation (MSFT); software infrastructure – MSFT and e-commerce – MercadoLibre, Inc. (MELI) and Meituan (3690.HK).

Table 1

Trending stock clusters based on cumulative return

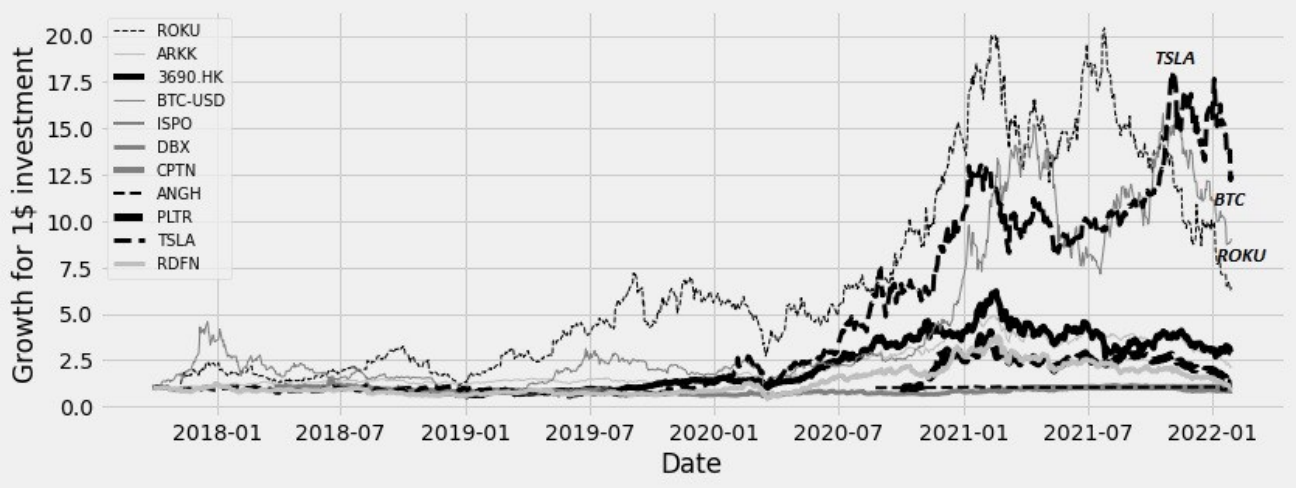
Clusters	I	II	III
Range of firms	ROKU , ARKK, 3690.HK, BTC-USD, ISPO, DBX, CPTN, ANGH, PLTR, TSLA, RDFN	1024.HK, SHAK, PARA, GOOG, FB, ETH-USD, CRM, COST, MELI, 9988.HK, COIN	ZM, MSFT, VRTX, HOOD, INTC, YM=F, LTHM, GOOGL
Leaders	TSLA, BTC-USD, ROKU, 3690.HK	ETH-USD, MELI, COST	MSFT, GOOGL, ZM

Note. Source: own elaboration based on https://finance.yahoo.com/trending-tickers.

It is important to note that there are two cryptocurrencies among the leaders (Bitcoin USD (BTC-USD) and Ethereum USD (ETH-USD)), that reveals an emotional factor in the investment decisions. Figures 3, 4 and 5 demonstrate a graphical presentation of the case in time, so we can observe a change in trend from 2018. Top companies are marked near the corresponding cumulative income curves.

Figure 3

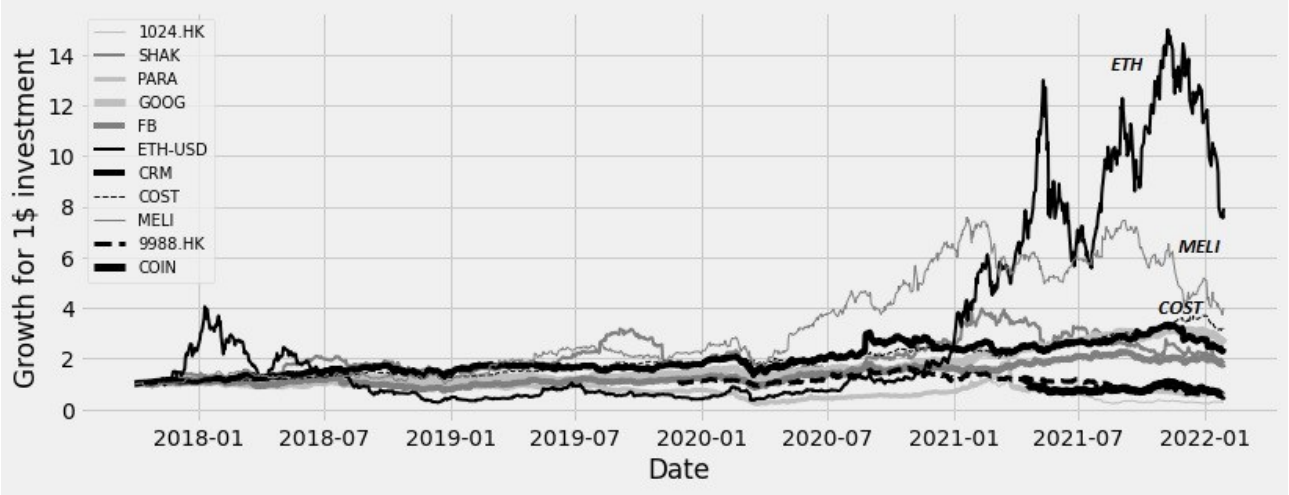
Top companies of the cluster I.



Note. Source: own elaboration based on data from https://finance.yahoo.com/trending-tickers.

Figure 4

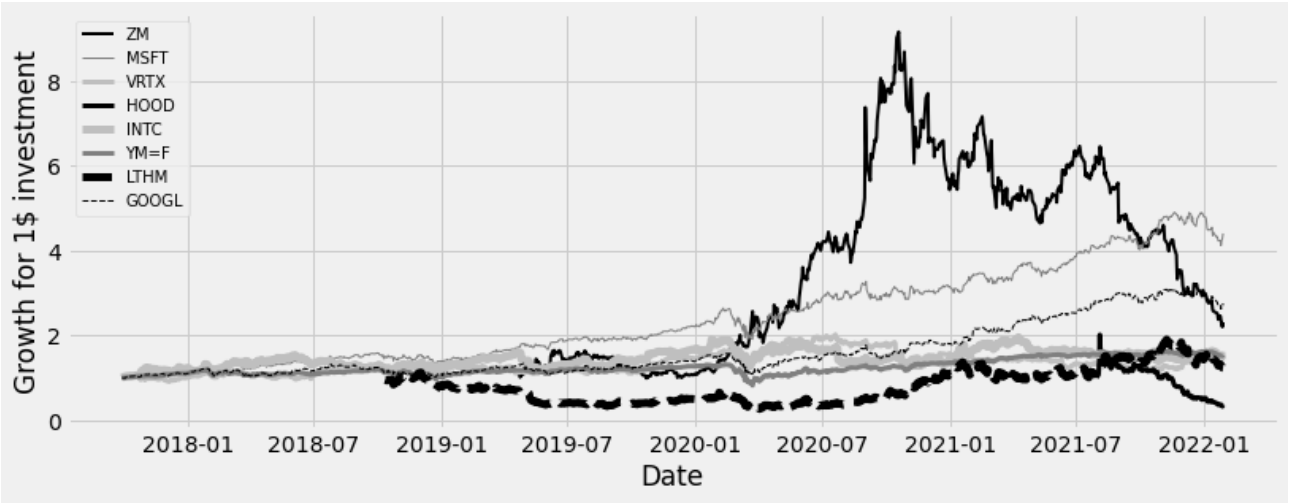
Top companies of the cluster II.



Note. Source: own elaboration based on data from https://finance.yahoo.com/trending-tickers.

Figure 5

Top companies of the cluster III.



Note. Source: own elaboration based on data from https://finance.yahoo.com/trending-tickers.

The next step presents our attempt to calculate weights for optimal investment portfolio and the level of Sharpe Ration as an indicator of the best ratio between annual return and risk based on the Efficient Frontier method (Table 2). All models in the study cover the period of time from 2013-01-01 to 2022-01-30. The Sharpe Ration of 1.9 is absolutely sufficient to conclude that the investment is optimal. So, the following industries are reflected in the portfolio frontier: software application (Cepton Inc. (CPTN)), communication services (ROKU, MSFT, ZM), online retail (Meituan (3690.HK)).

Table 2

Optimal investment portfolio and the level of Sharpe Ration based on the Efficient Frontier method

Stock Symbols = ['ROKU', 'ARKK', '3690.HK','BTC-USD', 'ISPO', 'DBX', 'CPTN', 'ANGH', 'PLTR', 'TSLA', 'RDFN', '1024.HK', 'SHAK', 'PARA', 'GOOG', 'FB', 'ETH-USD', 'CRM', 'COST', 'MELI', '9988.HK', 'COIN', 'ZM', 'MSFT', 'VRTX', 'HOOD', 'INTC', 'YM=F', 'LTHM', 'GOOGL'] Stock Start Date = '2013-01-01' today = '2022-01-30'*
Ordered Dict ([('ROKU', 0.00254), ('ARKK', 0.0), ('3690.HK', 0.0262), ('BTC-USD', 0.02967), ('ISPO', 0.0), ('DBX', 0.0), ('CPTN', 0.68175), ('ANGH', 0.0), ('PLTR', 0.0), ('TSLA', 0.0483), ('RDFN', 0.0), ('1024.HK', 0.0), ('SHAK', 0.0), ('PARA', 0.0), ('GOOG', 0.0), ('FB', 0.0), ('ETH-USD', 0.0), ('CRM', 0.0), ('COST', 0.14991), ('MELI', 0.0), ('9988.HK', 0.0), ('COIN', 0.0), ('ZM', 0.00701), ('MSFT', 0.05457), ('VRTX', 0.0), ('HOOD', 0.0), ('INTC', 0.0), ('YM=F', 0.0), ('LTHM', 0.0), ('GOOGL', 0.0)]) **Expected annual return: 17.6%** **Annual volatility: 8.2%** **Sharpe Ratio: 1.90**

Note. Source: own elaboration based on data from https://finance.yahoo.com.

Let's use a slightly different way of analysis, namely a set of tickers from the https://finance.yahoo.com for three industries: technology, real estate, and energy (Table 3). From the proposed set we will choose the 25 best companies, as we just need the components of the optimal portfolio, which are most likely at the top of the list. As we can see, 'technology' is the best one with a Sharpe Ratio – 1.55; Expected annual return – 45.5% and Annual volatility – 28.0%. This portfolio is also the most homogeneous, and therefore the most competitive among others. For comparison, the optimal portfolio of the energy sector includes only two elements ('CNQ', 0.07873 and 'VLO', 0.92127). We assume that if our portfolio is expended by companies operating in the field of education it may have a positive effect on the ratio of profitability and risk, i.e. the Sharpe Ratio. We select companies not only from the US, but in general from the 250 global education stocks, focusing on originality, range of services and duration of work in the market (Table 3).

Table 3

Portfolios for separated industries

Technology	**Portfolio**	AAPL, MSFT, TSM, NVDA, ASML, CSCO, AVGO, ADBE, ACN, ORCL, CRM, QCOM, INTC, TXN, INTU, 'SAP', AMD, SONY, AMAT, IBM, NOW, MU, INFY, SNOW, ADI	Expected annual return: 45.5%; Annual volatility: 28.0%; **Sharpe Ratio: 1.55**
	Results of optimization	('AAPL', 0.0), ('MSFT', 0.27689), ('TSM', 0.0), ('NVDA', 0.3966), ('ASML', 0.0), ('CSCO', 0.0), ('AVGO', 0.16325), ('ADBE', 0.0), ('ACN', 0.0), ('ORCL', 0.0), ('CRM', 0.0), ('QCOM', 0.0), ('INTC', 0.0), ('TXN', 0.0), ('INTU', 0.0), ('SAP', 0.0), ('AMD', 0.01821), ('SONY', 0.11274), ('AMAT', 0.0), ('IBM', 0.0), ('NOW', 0.02891), ('MU', 0.0), ('INFY', 0.0034), ('SNOW', 0.0), ('ADI', 0.0)	
Real Estate	**Portfolio**	PLO, AMT, CCI, EQIX, PSA, SPG-PJ, SPG, PSA-PH, PSA-PK, DLR, O, WELL, CBRE, EQR, AVB, SBAC, ARE, WY, UDR, DLR-PK, DLR-PJ, EXR, INVH, MAA, BEKE	Expected annual return: 20.3%
	Results of optimization	('PLO', 0.0), ('AMT', 0.0), ('CCI', 0.0), ('EQIX', 0.03965), ('PSA', 0.0), ('SPG-PJ', 0.12615), ('SPG', 0.0), ('PSA-PH', 0.0),	

		('PSA-PK', 0.0), ('DLR', 0.0), ('O', 0.0), ('WELL', 0.0), ('CBRE', 0.06384), ('EQR', 0.0), ('AVB', 0.0), ('SBAC', 0.1763), ('ARE', 0.0), ('WY', 0.0), ('UDR', 0.0), ('DLR-PK', 0.0), ('DLR-PJ', 0.0), ('EXR', 0.59405), ('INVH', 0.0), ('MAA', 0.0), ('BEKE', 0.0)	Annual volatility: 18.0% **Sharpe Ratio: 1.02**
Energy	**Portfolio**	XOM, CVX, PTR, TTE, COP, BP, EQNR, PBR, ENB, SNP, PBR-A, EOG, CNQ, SLB, E, EPD, TRP, MPC, SU, KMI, PSX, OXY, DVN, WMB, VLO	Expected annual return: 14.5%; Annual volatility: 37.9%; Sharpe Ratio: 0.33
	Results of optimization	('XOM', 0.0), ('CVX', 0.0), ('PTR', 0.0), ('TTE', 0.0), ('COP', 0.0), ('BP', 0.0), ('EQNR', 0.0), ('PBR', 0.0), ('ENB', 0.0), ('SNP', 0.0), ('PBR-A', 0.0), ('EOG', 0.0), ('CNQ', 0.07873), ('SLB', 0.0), ('E', 0.0), ('EPD', 0.0), ('TRP', 0.0), ('MPC', 0.0), ('SU', 0.0), ('KMI', 0.0), ('PSX', 0.0), ('OXY', 0.0), ('DVN', 0.0), ('WMB', 0.0), ('VLO', 0.92127)	
Education	**Portfolio**	BHA.F, 0CG.F, GKD.F, LTG.L, 300559.SZ, SEER3.SA, KAH.F, 9470.T, KE0A.F, YDUQ3.SA, PSON.L, 7912.T, BFAM, CHGG,TWOU, LOPE,ATGE,LRN,PRDO	Expected annual return: 17.3%; Annual volatility: 17.3%; **Sharpe Ratio: 0.99**
	Results of optimization	('BHA.F', 0.22054), ('0CG.F', 0.04375), ('GKD.F', 0.12651), ('LTG.L', 0.1567), ('300559.SZ', 0.04868), ('SEER3.SA', 0.0), ('KAH.F', 0.0), ('9470.T', 0.0), ('KE0A.F', 0.0), ('YDUQ3.SA', 0.0), ('PSON.L', 0.0), ('7912.T', 0.14877), ('BFAM', 0.15606), ('CHGG', 0.0065), ('TWOU', 0.0), ('LOPE', 0.09249), ('ATGE', 0.0), ('LRN', 0.0), ('PRDO', 0.0)	
Gaming	**Portfolio**	9697.T, ZNGA.MX, TKE.F, ATVI.MX, T1TW34.SA, AIY.F, 2XY.F, EGLX.TO, CCOEF, ZNGA,TTWO, ATVI, EA, NTDOY, SCPL, OTGLY, ATVI,NCTY,EGLX, SE, ESPO	Expected annual return: 53.4%; Annual volatility: 35.8%; **Sharpe Ratio: 1.44**
	Results of optimization	('9697.T', 0.38768), ('ZNGA.MX', 0.0), ('TKE.F', 0.0), ('ATVI.MX', 0.0), ('T1TW34.SA', 0.06831), ('AIY.F', 0.0), ('2XY.F', 0.0), ('EGLX.TO', 0.08527), ('CCOEF', 0.0), ('ZNGA', 0.02646), ('TTWO', 0.0), ('ATVI', 0.0), ('EA', 0.0), ('NTDOY', 0.0), ('SCPL', 0.0), ('OTGLY', 0.0), ('NCTY', 0.0), ('EGLX', 0.0), ('SE', 0.43228), ('ESPO', 0.0)	

Note. Source: own elaboration based on data from https://finance.yahoo.com/screener/predefined/ms_technology/; https://finance.yahoo.com/screener/predefined/ms_real_estate ; https://finance.yahoo.com/screener/predefined/ms_energy/; https://finance.yahoo.com; https://www.holoniq.com/notes/250-global-education-stocks.

The elements of optimal portfolio became a basis for joint portfolio #1. It includes Microsoft Corporation (MSFT), NVIDIA Corporation (NVDA), Broadcom Inc. (AVGO), Advanced Micro Devices, Inc. (AMD), Sony Group Corporation (SONY), ServiceNow, Inc. (NOW), Infosys Limited (INFY), Equinix, Inc. (EQIX), Simon Property Group, Inc. (SPG-PJ), thus: software applications, software – infrastructure industry, but also a list of semiconductors producers. As we can see, the Sharpe ratio in this case is even better than for the technology industry alone (1.66 compared to 1.55). Besides, such a market is characterized by a significantly lower level of both profitability and risk. At the same time, Sharpe Ratio is close to the level of 'real estate' market and significantly better than the 'energy' one.

The next step is to complete the optimal portfolio #1 with the components of education and to build the joint portfolio # 2 with Sharpe Ratio 1.76 (Table 4). These new elements include: Bright Horizons Family Solutions Inc.

(BHA.F), Grand Canyon Education, Inc. (GKD.F), Learning Technologies Group plc (LTG.L), Chengdu Jiafaantai Education Technology Co. (300559.SZ), and Dai Nippon Printing Co., Ltd (7912.T). These are companies creating new bridges between work and home, making education more accessible in any part of the world. And the market clearly presents that investing in this business is optimal given the ratio of risk and return. Along with technology, this is one of the best solutions that complement each other and form an optimal portfolio.

In our study, we have not yet paid enough attention to the virtualization process. We decide to include this element in our analysis by involving computer game manufacturers. We examine two dozen market leaders to choose among them those who can significantly influence the optimal portfolio (Table 3). We can observe that Sharpe Ratio in case of gaming industry is 1.44 that is even worse than for join portfolio #2. If we add gaming industry (i.e. Japanize Capcom (9697.T) and Singaporean Sea (SE) working in sphere of electronic gaming and multimedia) into join portfolio #2, the Sharpe Ratio increases to the level 1.87 (Table 4).

Table 4

Investment optimal portfolio

Joint portfolio #1	MSFT, NVDA, AVGO, AMD, SONY, NOW, INFY, EQIX, SPG-PJ, CBRE, SBAC, EXR, CNQ, VLO	Expected annual return: 37.4%; Annual volatility: 21.3%; **Sharpe Ratio: 1.66**
Result of optimization	('MSFT', 0.14115), ('NVDA', 0.2903), ('AVGO', 0.08885), ('AMD', 0.01219), ('SONY', 0.05328), ('NOW', 0.01193), ('INFY', 0.0), ('EQIX', 0.0), ('SPG-PJ', 0.06488), ('CBRE', 0.0), ('SBAC', 0.0), ('EXR', 0.33742), ('CNQ', 0.0), ('VLO', 0.0)	
Joint portfolio #2	MSFT, NVDA, AVGO, AMD, SONY, NOW, INFY, EQIX, SPG-PJ, CBRE, SBAC, EXR, CNQ, VLO,BHA.F, 0CG.F, GKD.F, LTG.L, 300559.SZ, 7912.T, BFAM, CHGG, LOPE	Expected annual return: 32.4%; Annual volatility: 17.2%; **Sharpe Ratio: 1.76**
Result of optimization	('MSFT', 0.10016), ('NVDA', 0.22437), ('AVGO', 0.06988), ('AMD', 0.0059), ('SONY', 0.02586), ('NOW', 0.00281), ('INFY', 0.0), ('EQIX', 0.0), ('SPG-PJ', 0.03786), ('CBRE', 0.0), ('SBAC', 0.0), ('EXR', 0.24501), ('CNQ', 0.0), ('VLO', 0.0), ('BHA.F', 0.14165), ('0CG.F', 0.0), ('GKD.F', 0.05298), ('LTG.L', 0.03512), ('300559.SZ', 0.01331), ('7912.T', 0.04509), ('BFAM', 0.0), ('CHGG', 0.0), ('LOPE', 0.0)	
Joint portfolio #3	MSFT, NVDA, AVGO, AMD, SONY, NOW, INFY, EQIX, SPG-PJ, CBRE, SBAC, EXR, CNQ, VLO, BHA.F, 0CG.F, GKD.F, LTG.L, 300559.SZ, 7912.T, BFAM, CHGG,LOPE, 9697.T, T1TW34.SA, EGLX.TO, ZNGA, SE	Expected annual return: 33.7%,; Annual volatility: 17.0%; **Sharpe Ratio: 1.87**
Result of optimization	('MSFT', 0.07537), ('NVDA', 0.19757), ('AVGO', 0.06572), ('AMD', 0.00364), ('SONY', 0.0062), ('NOW', 0.0), ('INFY', 0.0), ('EQIX', 0.0), ('SPG-PJ', 0.03698), ('CBRE', 0.0), ('SBAC', 0.0), ('EXR', 0.22877), ('CNQ', 0.0), ('VLO', 0.0), ('BHA.F', 0.13755), ('0CG.F', 0.0), ('GKD.F', 0.03484), ('LTG.L', 0.02116), ('300559.SZ', 0.00823), ('7912.T', 0.0), ('BFAM', 0.0), ('CHGG', 0.0), ('LOPE', 0.0), ('9697.T', 0.15181), ('T1TW34.SA', 0.0), ('EGLX.TO', 0.0), ('ZNGA', 0.0), ('SE', 0.03218)	

Note. Source: own elaboration based on data from https://finance.yahoo.com.

4. CONCLUSIONS

With physical contacts kept to minimum, it is digital that proves to be a lifeline for many people, companies and organisations. Consumer brands and retailers have grown their online sales and kept their business running through home offices. Based on the list of trending tickers we determined the leaders of three consecutive clusters, optimized the investment portfolio and formed three clusters – the best one, the average and the 'catching up' one. The Efficient Frontier method allowed us to calculate weights for optimal investment portfolio and the level of Sharpe Ratio.

Based on the results of analysis, we found complete confirmation for the assumption that developed stock market is a reflection of the main features of modern personality which is highly digitalized, technologically equipped, diversified in educational tools, more in-depth into virtual reality (Table 5).

Table 5

Human and market priorities

Human	Market
Constant desire to raise the level of technology in everyday life	technology business in the optimal portfolio in any configuration (Table 2, 4) and results of clustering (Table 1)
Spending more time in virtual environment	gaming in optimal portfolio (Table 4)
Greater variety of learning techniques and rapid development of distance learning	education business in optimal portfolios (Table 3, 4)
The growth of online retail and the increasing importance of digital communication	internet retailers and communication services in optimal portfolios among trending companies (Table 3, 4) and results of clustering (Table 1)

Note. Source: own elaboration.

We found that an investment optimal portfolio, as an optimal balance between profitability and risk, coming from human current trends, includes companies in the field of education, gaming (virtualization), technology and communication. At the same time, we would like to emphasize the use of elements of the developed stock market in our research, rejecting the manipulative nature of this instrument in many cases of developing markets.

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