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CONTENT

PREFACE

Dear Readers,

You are holding the 4th issue in 2023 of the Tér-Gazdaság-Ember Journal. The issue consists of six scientific studies.

The first study illustrates the relationship between the level of interdisciplinarity of journals and scientific impact based on a Hungarian case study. We continue with an analyses about job rotation in management at Automobili Lamborghini and Audi Hungary. The next study gives a description about the factors influencing the survival of COVID-19-infected patients in Győr-Moson-Sopron County.

The following paper gives an overview about the impact of inflation on sports consumption based on fitness facilities in Debrecen. The next paper shows the neutral space in norm recovery: cultivating a norm-compliant HR system amidst multicultural economic shifts. Then we present a paper about how pandemic and sustainability concerns transform the office market based on a case study of Budapest.

Győr, 14 March 2024

Adrienn Reisinger
Editor in Chief

STUDIES

ZSOLT KOHUS – MÁRTON DEMETER – ZOLTÁN BARACSKAI
– ESZTER LUKÁCS – KATALIN CZAKÓ

The relationship between the level of interdisciplinarity of journals and scientific impact – a Hungarian case study

Abstract

The evaluation of interdisciplinarity and its effect on research impact is prevalent in modern science. However, the evaluation of interdisciplinarity at the level of individual research papers is inconsistent with several different indicators used and is based predominantly on examinations of paper citations. Moreover, without considering the limitations of individual scientific disciplines, examinations of interdisciplinarity can present a distorted understanding of the research impact of a given paper or field. To overcome this issue, the paper established three different Levels of Interdisciplinarity based on the Web of Science Schema of research categories and assigned research areas at the level of individual journals where research papers were published. The relation of journals' Level of Interdisciplinarity to the research impact at the level of individual research papers (Impact Factor, Field Normalized Citation Impact) in a research area-dependent manner were analysed. Results demonstrate that the relationship between the Level of Interdisciplinarity and research impact varies by scientific field. Moreover, the study shows that the analysis of interdisciplinarity and research impact is less effective at an aggregated, institutional level and highlights the importance of disciplinary specialisations. The major advantage of this approach is that the measurement is independent of the changing number of citing papers and temporally changing citation categories.

Keywords: interdisciplinarity, journal level, research impact, disciplinary differences

JEL classification: I23

INTRODUCTION

The integration of different scientific fields into a complex problem-solving system is a well-known strategy at organizational (Sá, 2008), national (Lepori et al., 2007), and international levels (Bruce et al., 2004). These strategies both foster scientific collaboration among individual researchers and facilitate the creation of new knowledge by bringing together diverse research skills, techniques, and concepts originating from scholars representing different scientific areas (van Rijnsoever–Hessels, 2011). The concept of *interdisciplinarity* lies in the synthesis of theoretical and methodological activities from different scientific disciplines or research fields (Wang–Schneider, 2020). According to Porter et al. (2007), interdisciplinary research is a mode of scientific inquiry performed by teams or individuals that integrate two or more bodies of specialized knowledge or

research practices. Therefore, interdisciplinary research is characterized by the combination of different perspectives/concepts/theories, tools/techniques, and information/data (Leydesdorff et al., 2019). Accordingly, the interdisciplinarity of a research project should be also captured on the level of the research output, crucial for the understanding and assessment of interdisciplinarity.

In analysing interdisciplinary research, various approaches are used; the most frequent among them being the analysis of scientometric data. However, empirical analyses of interdisciplinarity measures show remarkable differences, as the units of analysis and the mode of measurement are not identical. In their recent paper, Wang and Schneider (2020) outlined 16 interdisciplinary measures in four categories: (1) measures depending on a multi-classification system, (2) measures borrowed from other fields, (3) measures considering the similarity of research fields, and (4) measures that rely on networks. While these measures show remarkable differences, the aspect which all the above-mentioned features share is their tendency to capture the diversity or the differences in the body of knowledge. In addition, Zwanenburg et al. (2022) found 25 definitions and 21 different strands of interdisciplinarity and interdisciplinarity measures. To this end, the understanding of interdisciplinarity and its effect on scientific impact is still confusing and unsatisfying (Wang–Schneider, 2020). This study aims to fill this gap.

1. ASSESSING AND QUANTIFYING INTERDISCIPLINARITY: A REVIEW OF THE LITERATURE

The quantitative measurement of interdisciplinarity is a challenging issue, and several indicators and matrices have been developed to capture the interdisciplinary nature of research. At the level of individual journals, Morillo et al. (2003) measured interdisciplinarity through indicators based on the Institute for Scientific Information (ISI) multi-assignation of journals into subject categories. Through their cluster analysis, they differentiated between "big" and "small" interdisciplinarity, based on the interrelations between the categories identified. As a qualitative indicator, they introduced the percentage of multi-assigned papers, the pattern of multi-assignation, the diversity of relationship categories that journals share, and the strength of relationships between the two categories. The use of ISI categories as a proxy of interdisciplinarity was also used by Soós and Kampis (2011) revealing that this type of science overlay map can characterize the extent of interdisciplinarity. Although these studies are fundamental in terms of understanding interdisciplinarity at the level of individual journals through published papers, they did not analyse the relationship of the observed degree of interdisciplinarity to scientific impact.

To go a step further, Porter et al. (2007) used Web of Science Subject Categories (WoS SCs) instead of ISI as key units, and extended the analysis to include research article citations. To this end, they introduced "integration," which measures the extent to

which a research paper cites diverse WoS SCs; and "specialization," which captures the spread of references that publications on a given WoS SC have cited compared to other WoS SCs. The citation-based indicators were also calculated at the level of individual research papers, journals, and their references, to capture the diversity of research fields. To this end, Zhang et al. (2016) used the Leuven-Budapest (ECOOM) subject-classification scheme and measure the disciplinary diversity considering variety (the evenness of the distribution of the subject field classification), balance (the distance between subject fields of references), disparity, and Hill-type diversity. While they found that the most interdisciplinary articles received the most citations, they also found scientific field-dependent differences.

Leydesdorff et al. (2018) used *betweenness centrality* and *diversity* to distinguish and rank journals in terms of interdisciplinarity, where betweenness centrality is considered as a measure of multi-disciplinarity and diversity as an indicator of co-citation in the citing documents. Contrary to Zhang et al. (2016), Leydesdorff et al. (2018) performed their analysis among journals instead of publications assessed by individual researchers. The authors concluded that, without the operational definition of disciplines, interdisciplinarity is difficult to define. Moreover, the citing dimension is independent from betweenness centrality, and diversity as interdisciplinarity remains a problem. In order to reveal the interrelations between different interdisciplinary measures, Wang and Schneider (2020) reviewed 23 different measures and found that they can be classified into two groups based on their dependence on a dissimilarity matrix. More importantly, the authors highlighted that the unit of analysis regarding interdisciplinarity is strongly dependent on the choice of measures and can result in conflicted findings. Their results are in line with the findings of Abramo et al. (2017), who highlighted that the literature analysing interdisciplinary research by bibliometric approaches shows distinct dimensions.

Similar to interdisciplinarity, the relationship between interdisciplinarity and research performance was also investigated using different data sources and methodologies, resulting in different, often controversial results. For example, while Okamura (2019)and interdisciplinary research (IDR showed that increasing the number of effective disciplines by one can increase the field-normalized citation-based research impact by 20%, Yegros-Yegros et al. (2015) concluded that scholars give less credit to those publications which are heterodox in terms of interdisciplinarity (measured as the relationship between interdisciplinarity and the Normalized Citation Score for each publication). Wang et al. (2015) analysed the relationship between the indicators of interdisciplinarity and research impact showing that the long-term increase in citations grows with variety and decreases with rate disparity; however, the long-term decrease of citations is associated with decreasing balance. During their analysis, Chen et al. (2015a) found that the top 1% most cited papers are characterized by higher levels of interdisciplinarity than papers in other citation rank classes. However, they also found that citation rates as a function of interdisciplinarity are higher for research areas with lower citation rates. In contrast, Rinia et al. (2001) identified a significantly negative relation between interdisciplinarity and

the total number of citations, as well as the average number of citations by paper in the physical sciences. When these bibliometric indicators were corrected by the world-average citation rates of journals or fields, the correlations lost their significance. Van Noorden (2015) pointed out that interdisciplinary research takes time to have an impact (more than three years), and the results of Rinia et al. (2001) suggest that citation rates can show remarkable differences within the same research field and interdisciplinarity should be interpreted cautiously.

The common feature of studies analysing interdisciplinarity and its impact is the application of bibliometric data on a set of publications obtained from publication databases. While the use of co-authorship and/or citation coupling to calculate interdisciplinarity is widespread, this method is not ideal. For example, as highlighted by Porter et al. (2007) and Abramo et al. (2017), the examination of the research interest and specialization of a given researcher, as well as the identification of the research field is extremely time-consuming. The analysis of references as an indicator of the interdisciplinarity of journals could partially overcome this problem, however, further research is still needed to cover a large range of interdisciplinarity and discipline-dependent differences (Zhang et al., 2016).

The present study addresses the issue of measuring interdisciplinarity and its effect on research impact. While former studies scrutinized interdisciplinarity by introducing and analysing several quantitative indicators (Leydesdorff et al., 2018; Leydesdorff–Rafols, 2011; Rinia et al., 2001; Yegros-Yegros et al., 2015; Zhang et al., 2016), we have limited knowledge on the disciplinary differences of interdisciplinarity as well as on its effect on scientific impact. To overcome the problem of constantly changing citation patterns influencing the extent of interdisciplinarity indicators, similarly to Morillo et al. (2003) and Soós and Kampis (2011), we used as a proxy of interdisciplinarity the scientific coverage of journals. The assignment of research/subject categories and research areas of the Web of Science Core Collection (WoS) at the level of journals has several advantages: first, the number and type of WoS research categories and research areas at the level of individual journals, where research papers were published, can be calculated independently on the number of citations. Second, the WoS research category-based and research area-based designation of the level of interdisciplinarity is stable, thus the level of interdisciplinarity can be used as a permanent indicator without temporal change. Third, the level of interdisciplinarity can be calculated in a research category-dependent manner, making it possible to analyse discipline-dependent characteristics of the interplay between interdisciplinarity and research outputs.

Until recently, interdisciplinarity has been analysed predominantly on the level of given research fields at the global or national level, ignoring the contribution of individual research facilities (Chen et al., 2015b; Craven et al., 2019; Pan et al., 2012; Porter–Rafols, 2009). To fill this gap, our measures focus on the Eötvös Loránd University in Budapest, which has a diverse teaching and research portfolio, and is also the oldest continuously operating university in Hungary. With nearly 30,000 students, the institution is organized into eight departments (the Department of Law and Political Sciences, the Bárczi

Gusztáv Department of Special Education, the Department of Humanities, the Department of Informatics, the Department of Education and Psychology, the Department of Social Sciences, the Department of Elementary and Nursery School Teacher Training, and the Department of Sciences), in addition to the Institute of Business Economics. According to the Quacquarelly Symond Ranking 2020, Eötvös Loránd University is the best Hungarian university with its 28th place ranking, based on academic and employer reputation, faculty/student ratio, the number of papers published and their online appearances, the proportion of academic staff holding PhDs, the citation of publications, web impact, as well as the proportion of international members and international students. Based on the 2020 Times Higher Education World University Rankings by subject, Eötvös Loránd University has proved to be the best higher education institution in Hungary in the fields of the arts, humanities and psychology, as well as in life and natural sciences. Taking into account their proportion of international collaborations, education and research portfolio, the ranking of Eötvös Loránd University in national and international rankings, as well as its number of publications, we determined Eötvös Loránd University to be a model university.

The diverse examination approaches found in the literature led us to formulate a demand for a stable, implementable, and reproducible methodology able to describe the relationship between interdisciplinarity and research impact. The assignment of individual research articles into one or more WoS research categories and research areas can overcome this problem. The use of this measure of interdisciplinary allowed us to ask and answer how interdisciplinarity can influence scientific impact at the level of a whole institution, and how this relationship is dependent on scientific categories.

2. METHODOLOGY

Data collection: Research articles for the Eötvös Loránd University in Budapest (Hungary), including the journal name, the category normalized citation impact (CNCI) and impact factor (IF) were collected for five years between 2015 and 2019 from the WoS. To identify research categories and research areas we used the Web of Science Schema. Data collection was conducted in July 2020, resulting in 5,315 original research articles.

Based on the 2020 Times Higher Education World University Rankings by subject, Eötvös Loránd University has proved to be the best higher education institution in Hungary in the fields of the arts, humanities and psychology, as well as in life and natural sciences. Taking into account their proportion of international collaborations, education and research portfolio, the ranking of Eötvös Loránd University in national and international rankings, as well as its number of publications, we chose Eötvös Loránd University as a model university.

Level of IDR-calculation, temporal evolution: To establish the level of IDR, we first had to identify the main scientific disciplines for each research paper. To this end, we used the Web of Science Schema, which is comprised of five main research categories (1) Arts and Humanities, (2) Life Sciences and Biomedicine, (3) Physical Sciences,

(4) Social Sciences, and (5) Technology), subdivided into 228 research areas. Thus, for each research article, based on the journal where it was published, the research category/categories and subsequent research area/s were identified. This enabled us to assign research articles to one of the three Levels of IDR. The Single Area group corresponds to those journals where only one main research category, and within that main category, only one research area was present. The Same Category group contains those journals which are characterized by two or more research areas within the same main research category. The Different Categories group is made up of research journals which contain two or more research areas within two or more main research categories (Table 1).

Table 1 The Three Different Levels of IDR

Level of Interdisciplinarity	Number of Research Categories	Number of Research Areas
Single Area (N*=3,054)	1	1
Same Category (N=1,478)	1	2 or more
Different Categories (N=741)	2	2 or more

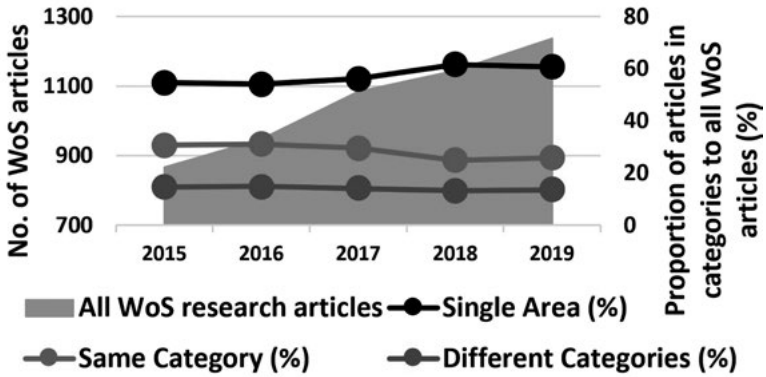
Source: Own table (from Web of Science Schema)
Note: N corresponds to the number of research articles in individual groups.

3. RESULTS

3.1 THE LEVEL OF IDR AND ITS EVOLUTION FROM 2015 TO 2016

To analyse how IDR changes over time, we established the Levels of IDR for each year between 2015 and 2019. We found that the total number of WoS research articles increased from 2015 to 2019, reaching 1,237 research articles in 2019, compared to 867 in 2015 (Figure 1 and Table 2). However, the proportion of papers based on the type of collaboration to all WoS research articles showed remarkable differences among the three Levels of IDR. While Single Area revealed an increasing tendency, the Same Category and Different Categories were characterized by a slight decrease. This contrast of temporal trends for all three Levels of IDR was strengthened by the results of linear correlation analysis between the year of publication and the number of research papers in individual groups (Table 2). Although the total number of all WoS articles increased over time, our results showed that this growth has predominantly been generated by papers from the Single Area group.

Figure 1 Temporal Evolution of WoS Research Articles between 2015 and 2019



Source: Own figure based on Web of Science data

Table 2 Number of WoS Research Articles and Research Articles with Different Levels of Interdisciplinarity

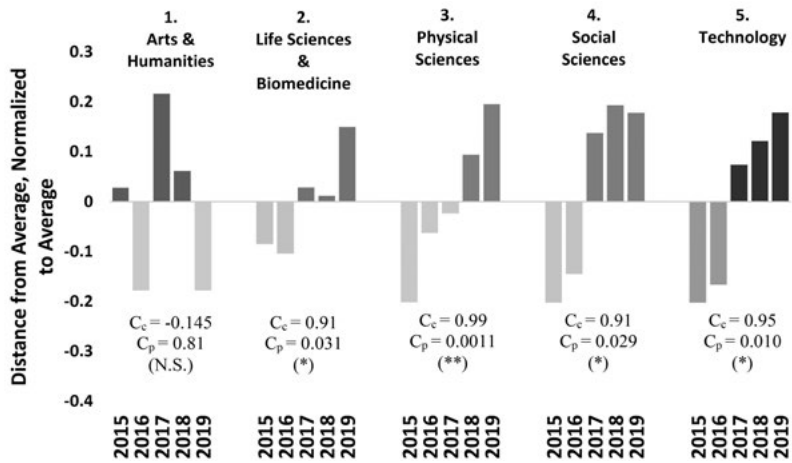
Year	2015	2016	2017	2018	2019	C_c	C_p
All WoS research articles	867	948	1,085	1,145	1,237	0.99	< 0.0001 ***
Single Area	474	513	610	706	751	0.98	0.0013 **
Same Category	266	294	322	286	319	0.66	N.S.
Different Categories	127	141	153	152	167	0.96	0.0089 **

Source: Own table based on Web of Science data

3.2 THE LEVEL OF IDR IN INDIVIDUAL RESEARCH CATEGORIES BETWEEN 2015 AND 2019

To explore individual research categories' contribution to the increase of all WoS research articles, we conducted a second analysis of research articles focusing on the five major WoS-based scientific categories. In terms of research article publication, the most productive scientific area between 2015-2019 was (3) Physical Sciences, followed by (2) Life Sciences & Biomedicine, (5) Technology, (4) Social Sciences, and (1) Arts & Humanities. We also found a significant positive correlation between the year of publication and the number of research articles published for (2) Life Sciences & Biomedicine, (3) Physical Sciences, (4) Social Sciences and (5) Technology. The major increase in research papers, as well as their strongest growth, was observed in the case of (3) Physical Sciences, followed by (2) Life Sciences & Biomedicine, (4) Social Sciences, and (5) Technology. Furthermore, (1) Arts & Humanities is characterized not only by the smallest number of research articles but also by a negative tendency in terms of their quantitative evolution (Figure 2).

Figure 2 Temporal Evolution of WoS Research Articles by Research Category, 2015–2019



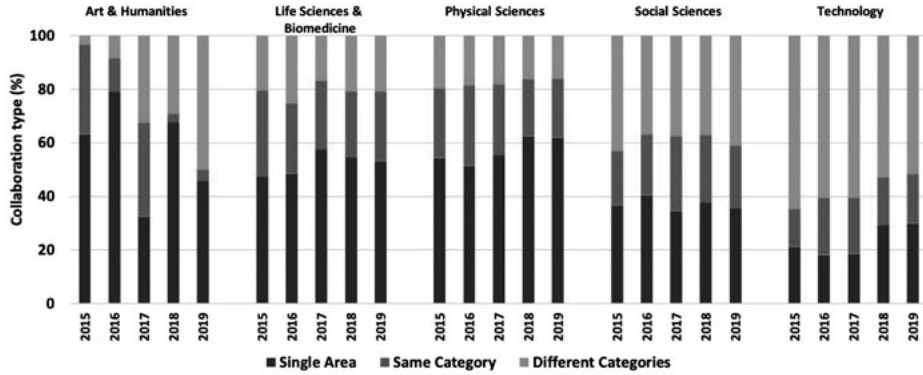
Source: Own figure based on Web of Science data

Note: The number of articles for each year was normalized by the five-year average of all the research articles in the same research category. Consequently, the distance from the average (after normalization, the average was equal to 1) was calculated by the extraction of the average (1) from the normalized value for each year. C_c = correlation coefficient, C_p = correlation probability; *p < 0.05; **p< 0.01; ***P< 0.001; N.S. = not significant

3.3 RESEARCH CATEGORIES AND PROPORTIONS OF THREE LEVELS OF IDR

When looking at the Level of IDR of research articles at the Research category level, we found that the (5) Technology group showed the highest average proportion of research papers operating with two or more research areas, accounting for 76.52% of all the published research articles in this group. This was followed by (4) Social Sciences (62.9%), (2) Life Sciences & Biomedicine (47.66%), (3) Physical Sciences (42.7%), and (1) Arts & Humanities (42.29%) (Figure 3). Thus, in the case of (2) Life Sciences & Biomedicine, (3) Physical Sciences, and (1) Arts & Humanities, the majority of research articles (more than 50% on average) are in the Single Area group. Moreover, the correlation between the year of publication and the number of research articles (Table 3) for the Single Area was positive, except for (1) Arts & Humanities, these correlations were significant. On the other hand, no significant correlation was found within the Single Category, and only the (3) Physical Sciences and (4) Social Sciences showed a significantly positive correlation in the Different Categories group. The prevalence of the Single Area cooperation type in (1) Arts & Humanities, (4) Social Sciences, and (5) Technology and consequent correlation analysis showed that on the Research category level, the increase in annual research performance is predominantly driven by research activities that operate within a single research area. However, the predominance of a Single Area is research category dependent.

Figure 3 Proportion of Levels of IDR for Each Research Category, 2015–2019



Source: Own figure based on Web of Science data
Note the prevalence of Single Area cooperation type at (2) Life Sciences & Biomedicine, and (3) Physical Sciences in Figure 3.

Table 3 Correlation Between Year of Publication and IDR for Each Research Category

	Single Area		Same Category		Different Categories	
	C_c	C_p	C_c	C_p	C_c	C_p
(1) Arts & Humanities	0.44	N.S.	-0.56	N.S.	0.85	N.S.
(2) Life Sciences & Biomedicine	0.91	0.03 (*)	0.1	N.S.	0.52	N.S.
(3) Physical Sciences	0.95	0.01 (*)	0.34	N.S.	0.93	0.02 (*)
(4) Social Sciences	0.89	0.04 (*)	0.79	N.S.	0.96	0.007 (**)
(5) Technology	0.89	0.04 (*)	0.81	N.S.	0.7	N.S.

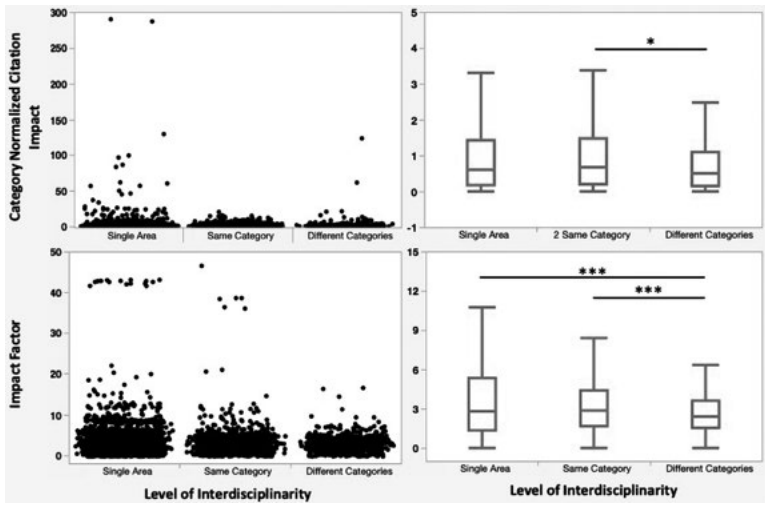
Source: Own table from analysis described above
Note: C_c = correlation coefficient, C_p = correlation probability; the level of significance is marked by asterisks: *p < 0.05; **p< 0.01; ***P< 0.001; N.S. = not significant

3.4 THE RELATIONSHIP BETWEEN THE LEVEL OF IDR AND SCIENTIFIC IMPACT

To reveal the relationship between IDR and research impact, we started by performing our analysis on all research papers without differentiating between scientific categories. This was done by comparing the CNCI and IF for each Level of IDR. We suggested that research impact correlates with an increase in IDR. To verify this, we used the following quantification of IDR: (1) Single Area = non-interdisciplinary, (2) Same Category = low level of IDR, and (3) Different Categories = high level of IDR (Abramo et al., 2017; Chen et al., 2015; Rinia, 2007). The aggregated results at the institutional level, without distinction between Scientific categories, did not support this hypothesis. As it is shown in Figure 4, the (3) Different Categories had the lowest CNCI, and this was significantly lower than the (2)

Same Category. Moreover, the IF of the (3) Different Categories was significantly lower compared to (2) Same Category and (1) Single Area. Furthermore, the correlation analysis between the Level of IDR and CNCI, as well as between the type Level of IDR and IF was significantly negative (C_c = -0.03, C_p = 0.01 for CNCI; Cc = -0.09, Cp < 0.001 for IF). Thus, on the institutional level, the Level of IDR is not increasing the scientific impact of papers.

Figure 4 Scientific Impact of All Research Papers by Type of Collaboration



Source: Own figure based on Web of Science data and own analysis
Note: Left panel: each black dot represents a research article. Right panel: the box plot visualization of data points on the left panel. * P < 0.05; ** P < 0.01; *** P < 0.001

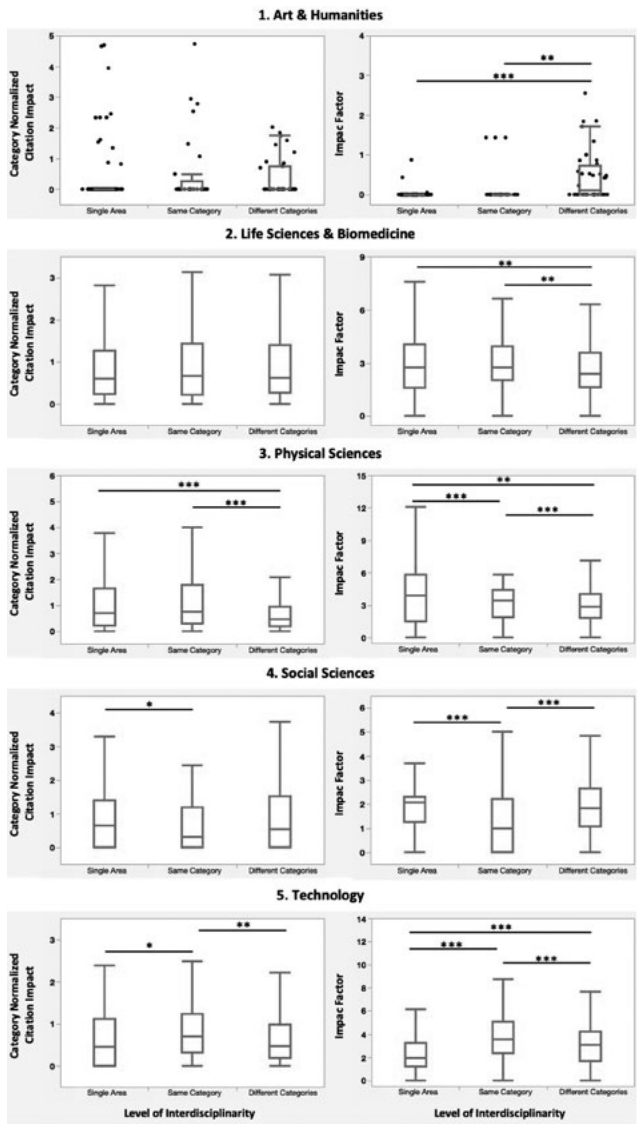
We are aware that the scientific impact is not comparable among scientific fields due to substantial differences between subject categories (Bordons et al., 2002; Bornmann–Marx, 2015; Dorta-González–Dorta-González, 2013). Therefore, the use of aggregated data without distinguishing between different research fields may distort the understanding of the scientific impact of Eötvös Loránd University. To overcome this problem, we reduplicated the statistical and correlation analysis between the Levels of IDR and the scientific impact for each of the five WoS scientific categories.

As expected, the plotting of the CNCI and IF against the Level of IDR (Figure 5), as well as the correlation analysis showed scientific category-dependent differences. The research papers in (1) Arts & Humanities were characterized by an increasing CNCI and IF with an increasing Level of IDR. However, this scientific category has the highest proportion of papers with 0 citations and journals without impact factors. This was also corroborated by the correlation analysis, where we found a positive correlation between the Level of IDR and the CNCI and a significantly positive correlation between the Level of IDR and the IF.

On the other hand, in the case of (2) Life Sciences & Biomedicine and (3) Physical Sciences we observed a tendency that was the reverse of the one seen in (1) Arts &

Humanities: in both scientific categories, the correlation between the Level of IDR and the analysed indicators of research impact were negative, moreover, this negative correlation was significant for both indicators within the (3) Physical Sciences group, and between the Level of IDR and the IF for (2) Life Sciences & Biomedicine.

Figure 5 The Scientific Impact of Research Papers as a Function of the Level of Interdisciplinarity, for All Five Research Categories



Source: Own figure based on Web of Science data and own analysis for Levels of IDR and WoS categories
Note: * P < 0.05; ** P < 0.01; *** P < 0.001

For (4) Social Sciences, the correlation coefficient between the Level of IDR and the CNCI was positive, and no correlation was found between the Level of IDR and the IF. On the other hand, for the (5) Technology scientific category, we identified a negative correlation between the Level of IDR and the CNCI and a weak positive correlation between the Level of IDR and the IF of the journals.

Thus, based on these results, the relationship between Level of IDR and research impact is highly dependent on the scientific category, as it is positive for (1) Arts & Humanities, negative for (2) Life Sciences and Biomedicine and (3) Physical Sciences, and showing a mixed character for (4) Social Sciences and (5) Technology.

4. CONCLUSIONS

The measurement of IDR is a challenging issue in qualitative and quantitative sciences (Greckhamer et al., 2008; Wang–Schneider, 2020). Studies focusing on citation research have found significant differences across and within scientific fields (Guerrero-Bote et al., 2007; Lillquist–Green, 2010). Thus, the analysis of IDR at the level of organizations with different structural and disciplinary representations is still needed. Our study fills this gap. The unique contribution of this paper lies in its use of the Web of Science Schema of research categories and research areas at the level of individual journals as a tool to characterize the Level of IDR.

In contrast to previous studies (Leahey et al., 2016; Porter–Rafols, 2009; Yegros-Yegros et al., 2015), the Level of IDR is not measured through the proportion of references from different scientific disciplines but as the interplay between different scientific research areas within the five main research categories at the level of individual journals. The advantage of this method is that IDR is measured independently from the properties of citations and co-authorship. Thus, the Level of IDR does not change over time (as it does not depend on the number of citations and the research area of the citing papers). Regardless of the IF of the publishing journal or the number of citations, the Level of IDR can be measured for all WoS research journals.

Based on the type of collaboration between the five major scientific categories and subsequent research areas, we derived three Levels of IDR: Single Area (one scientific category and one research area), Same Category (one scientific category with two or more research areas), and Different Categories (two or more scientific categories with two or more research areas). The proposed measure for the Level of IDR is scalable from the journal where the paper was published and can be applied in a scientific category-dependent manner. We have shown that the Level of IDR should be studied at the level of scientific categories, as neglecting scientific category-dependent contributions can distort the understanding of IDR at the level of a given organization. This approach establishes a suitable framework to investigate IDR at an institution's level, focusing on multifield teaching and research. Most importantly, we have shown that instead of a global evaluation of higher education institutions with multiple teaching and research focus, we should consider "dividing" research output (in this case, research articles) according to their assessment of research discipline (research category) and perform

the analysis on that level. These results support the finding of Bornmann (2019), revealing that the possible influence of citations is less effective on an aggregated level of an institution.

However, our methodology limited the impact and reach of our results. First, the WoS provides several schemas of research areas. The use of different research schemas (for example, the use of WoS with five scientific categories and 228 research areas instead of the OECD Category Scheme of 6 major codes and 42 minor codes corresponding to the scientific categories and research areas of the WoS Schema) could result in different assignments of research articles to one of the three cooperation types correlating with the Level of IDR. Second, the Level of IDR reflects the interplay between research areas at the journal level, not at the level of individual research papers. The interplay between research areas at the level of a journal does not necessarily mean that the Level of IDR of a research paper reflects the IDR of the journal. Third, using IF and citation-based methods to reveal scientific impact also entails limitations. IF varies greatly between academic disciplines (Castellano-Radicchi, 2009). Moreover, compiling citations by journal can mask an asymmetric distribution of citations by published papers within the same journal (Kiesslich et al., 2020)the three highest-ranking journals from each JCR category were included in order to extend the analyses to non-medical journals. For the journals in these cohorts, the citation data (2018. There are also disciplinary differences in the number of citations attributed to individual research papers (Vaughan et al., 2017). Moreover, the citation time window also influences the citation impact (Clermont et al., 2020; Wang, 2013), and the research impact of IDR research also tends to gain more citations in the long term (van Noorden, 2015). We took two approaches to overcome these limitations: first, we did not compare the research impact of scientific disciplines; and second, we used CNCI instead of the citation count.

We have demonstrated that the analysis of the Level of IDR and consequent research impact of a multifield higher education institution at the research category level is relevant. However, we do not have a sufficiently long time window available to study the research impact of IDR on the most recent research articles.

We have convincing evidence that the Level of IDR can be captured at the level of individual journals, but the evolution of the relationship between the Level of IDR and research impact was not tested in this paper. Regarding further research, the analysis could be expanded to include a broader time window to analyse the temporal evaluation of research impact as a function of the Level of IDR. Moreover, it would be of interest to compare the similarity of IDR of a given journal and published research paper, as well as to compare the effect of IDR on research impact with other Hungarian higher education institutions and elaborate a method that could be used to compare Hungary with other countries.

It should be mentioned that we did not include any evaluation or consideration of the research fields of the papers citing the assessed interdisciplinary journals. For example, the most powerful relationship between the level of IDR and CNCI was observed for Art & Humanities. However, it is unknown, whether this is caused by the increased interdisciplinarity or by the higher score on the Science Citation Index.

We are aware that our study contains controversial results and could not solve the problem regarding the need for an indicator suitable to capture interdisciplinarity and its effect of scientific impact. There is still a need to measure interdisciplinarity on different bases, such as citation patterns and the origin of citations, or the relative share of references reflecting the knowledge integration. This should be analysed in more detail and with a more complex theoretical approach in the future.

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GÁBOR GUBICZA – SÁNDOR REMSEI

Job rotation in management at Automobili Lamborghini and Audi Hungary

Abstract

This research has two main aims: First, to establish how sense-making/meaning-making facilitates job rotation success, and second, to determine whether there is a universally acceptable rotation interval for automotive management. This paper intends to examine and explore both research objectives and help to understand the management rotation phenomenon. Moreover, the researchers have collected and analyzed negative experiences (e.g., loss of specialized skills, decrease in productivity, or stress and anxiety) and ways of learning from them. Ideally, this research will lead to a better understanding of the job rotation process and better HR models and plans for job rotation. The researchers provided questionnaires about job rotation to staff at Automobili Lamborghini and Audi Hungary, with the survey paying particular attention to the second research question. Based on their research, the authors have not found an optimal rotation interval, but the questionnaire results suggest that this number is between three and six years. The research also provides detailed information on the average rotation time at two companies and a thorough analysis of the background and different aspects of managerial job rotation.

Keywords: job rotation, management, automotive companies, rotation interval

INTRODUCTION

Diverse segments within the automotive industry, including the compact, premium, sport, and super-premium segments, exhibit substantial disparities in implementing management job rotation strategies. These discrepancies arise from variations in the unique requirements and dynamics of these market segments, which are continually influenced by changing market conditions (Weick, 2015). The ability of managers to swiftly adapt to novel workplace terminologies and evolving market demands significantly impacts the execution of job rotation strategies (Matilis–Christianson, 2014). To navigate this complex landscape, managers within automotive companies employ sense-making processes to comprehend and respond to evolving market conditions (Matilis–Christianson, 2014). Furthermore, the importance of generational collaboration in managing automotive companies cannot be overstated (Singh, 2014). Generation Z employees' engagement and effective utilization necessitates providing suitable human resources, motivation, and management tools to accommodate their needs and expectations. (Smith, 2013). The researchers found it essential to see how each generation of managers (Baby Boomers, X, Y) experiences and views job rotation. These generational differences considerably influence the implementation of labor and management rotation practices within the automo-

tive sector. Additionally, job rotation strategies in automotive companies are influenced by the nationalities of their founders and executives (Boone–Hendriks, 2009).

The leaders' cultural perspectives and values shape the organization's strategic decisions related to job rotation. Economic considerations also play a pivotal role in shaping job rotation practices within automotive companies, as certain rotational elements can incur substantial costs (Ortega, 2001). Economic factors are a crucial determinant in the design and execution of job rotation programs, particularly in the automotive sector. In this context, Cost-Benefit Analyses (CBAs) emerge as essential tools for evaluating the feasibility and impact of job rotation strategies. A comprehensive examination of the existing literature in this domain reveals the need for a systematic and comprehensive approach to understanding job rotation within the automotive industry.

However, it is imperative to acknowledge that job rotation within automotive company management remains relatively rare, which makes the need for comprehensive research and analysis of its effects all the greater. This paper will present our research on job rotation at two luxury automotive manufacturers.

Automobili Lamborghini (AL) is an Italian manufacturer of luxury sports cars and SUVs. The company was founded in 1963 by Ferruccio Lamborghini, a successful tractor manufacturer who wanted to create a high-performance car to rival Ferrari. It is a subsidiary of Audi Hungary.

This paper investigates managers' job rotation at Automobili Lamborghini and Audi Hungary, which, despite their corporate relationship, are run differently by managers with different backgrounds.

The COVID-19 pandemic has significantly impacted job rotation practices in the automotive industry. The pandemic has led to many challenges, including suspending international rotations. This disruption to employee rotation was due to the risk of infection and difficulty obtaining travel visas. The disruption of home-office arrangements made it difficult for managers to contact their colleagues and learn about the local culture. The increased risk of quarantine made it difficult for managers to travel home for holidays or to visit their families. Finally, the decline in production led to decreased demand for job rotation, as companies were reluctant to send employees to new locations. The need to relax promotion criteria was due to many talented candidates being unable to meet the traditional requirement of two to three years of international experience. In cases where a rotation had occurred, the lack of opportunities for new managers to get to know their team members led to ongoing difficulties between some managers and their staff.

These challenges have significantly impacted companies' ability to rotate employees effectively. The industry is still recovering from the effects of COVID-19 restrictions. As a result, job rotation practices will likely be slower and less efficient in the coming months and years.

In addition to the challenges mentioned above, the pandemic has highlighted the importance of job rotation. Job rotation can help companies develop their employees' skills and knowledge, improve communication and collaboration, and promote diversity and inclusion. As the automotive industry recovers from the pandemic, companies will likely place an even greater emphasis on job rotation.

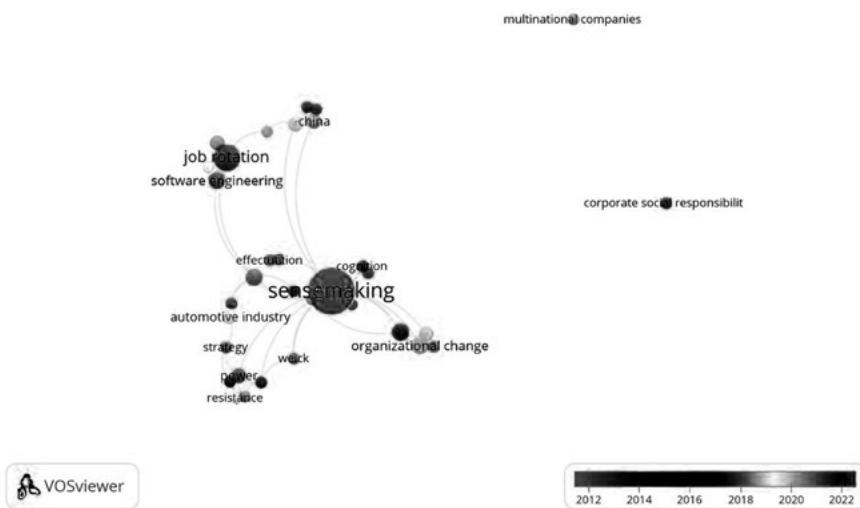
The following literature overview was made to understand this topic's state of the art of science. The methodology will be introduced, and then the results. Finally, the conclusion will be presented.

1. LITERATURE REVIEW

We performed a digital (using VOS View software) and a traditional systematic literature review (SLR) to understand how reasoning/sense-making helps in successful job rotation. We also asked if there is an optimal rotation interval for everyone in automotive management. A set of keywords based on the internet databases Scopus and Web of Science was used to perform the SLR. In traditional SLR, 174 articles were subjected to content analysis by the authors. These 174 publications were categorized into four sections based on their content: job rotation, sense-making, management, organizational culture, and terminus technicus (jargon). The procedure was used to evaluate each group's articles to find an answer to the research questions. The publication dates of the literature examined were between 1973 and 2022.

Over 4,500 articles and books were searched in the digital SLR using the above search terms or keywords. The publication date of the digitally surveyed literature was between 2012 and 2022.

Figure 1 Results of digital SLR research, with a web of relationships among keywords



Source: Authors' survey with VOSviewer

Ortega (2001) conducted similar research on the effects of job rotation, but only from the non-managerial employees' perspective. Ortega claims that the results of his research do not fully align with the *employee learning* and *employee motivation* theories; therefore, the effect of rotation "on the effectiveness with which the employer learns

about its employees" is unknown (2001, 9). Ortega argues that his *firm learning theory* conforms more to the empirical facts and aims to compare job rotation and specialization theories related to employees. These efforts are worthwhile but incomplete. The effects of job rotation on companies should be placed at the center of an investigation, as firms can receive valuable information about job rotation and from studies of the job rotation process, e.g., job-employee matches and the profitability of jobs.

Ortega contrasts his work with the job-matching article of Jovanovic (1979) and Miller (1984). Ortega states that his model focuses on intra-firm mobility – the most typical kind of mobility in the automotive industry – and cases in which employees change jobs in a predetermined way. His research allows forms to gain valuable information that can be used to improve job assignments. This emphasis sets his research apparent from the job-matching literature.

Ortega concludes that based on his model, job rotation is a better learning mechanism than specialization – an assertion supported by empirical evidence. As regards the two other job rotation theories, he claims that while the employee motivation theory suggests that firms rotate employees to fight boredom, empirical evidence suggests a negative correlation between tenure at the organisation and rotation. According to the employee learning theory, firms rotate employees to make them acquire new skills. However, if that were true, there would be a negative correlation between tenure at the organisation and rotation in innovative firms or innovation and rotation in a company that has just introduced a new technology. Unlike these explanations, the theory of firm learning seems to reconcile with all empirical evidence. The literature discusses and analyses rotation processes to prevent line workers' burnout and maintain their ergonomic health. It does not pay enough attention to the rotation of managers and leaders. There is a significant gap in the existing literature. Most of the literature (Ortega, 2001; Osterman, 2000) does not deal with managers but rather the workers in job rotation. Also, no theories in the broader literature relate specifically to the automotive branch. Attention is mainly directed to healthcare, production lines, and jobs in the social care sector (e. g., Rhodes et al., 2016). Ortega defines job rotation as a mechanism that helps firms learn about employee productivity and the profitability of different jobs or activities, including their costs and benefits. When comparing job rotation and assignment policy, he argues that existing evidence on rotation supports the firm learning theory rather than theories of employee motivation and learning.

No other studies on this topic can be found, except for some references to generational differences, which are irrelevant to this research.

2. METHODOLOGY

This research aims to define an optimal rotation interval for everyone in automotive management. The secondary aim is to accumulate and analyze the best job rotation practices. It could be extended into exploring job rotation and job rotation strategies, which is the research's long-term goal.

The primary target group of the questionnaire consisted of Hungarian managers (Audi Hungary). The researchers also had the opportunity to research another subsidiary of the Audi Group, Automobili Lamborghini, which employs Italian managers. The data collection was primarily quantitative, followed by in-depth qualitative research and focus group (segment-focused) interviews. Here, the meta-data analysis approach, which analyzes the results of an extensive collection of studies, was chosen. The reliability and validity of the measures used were ensured using several methods.

The first round of research was conducted in 2022 from October to December. Two hundred seventy-eight managers were surveyed, including middle and upper management and executives. The Lamborghini research was subsequently carried out in March 2023. The total management team consisted of 97 individuals at Automobili Lamborghini (out of a total workforce of 2,290 employees), and 23 of them were surveyed. The questionnaire was the same for both companies. It can be found in the Appendix.

This research has the benefit of a large sample size. These are two separate surveys with identical questionnaires conducted at different times. The objective was to compare managers' opinions within a specific corporate group internationally, conducting a comprehensive sample survey to find and establish a general rotation interval. In the case of Audi, the Easy feedback system was used. The Easy feedback system is Audi's GDPR-compliant questionnaire system and an approved platform for corporate scientific research. At the same time, for Lamborghini, the questionnaire was sent to randomly selected CEOs, upper management, and middle management, with complete anonymity ensured with the support of the HR Director. The Győr pilot project, the GDPR officer, the IT Security manager, and the Compliance department ensured the validation of the questionnaire. The questionnaire was finalized after a pilot survey involving two segments and five middle managers.

The surveys examine the speed with which terminus technicus (jargon) is mastered as a possible measure of the speed of integration. It also offers different rotation period proposals, i.e., after how many years some managers see the need for rotation and where they see signs of burnout. It should be noted that in informal conversations, several managers have already indicated that they do not consider job rotation important. Additionally, they feel that the obligation of changing areas is harmful. Thus, the questionnaire takers will likely offer various responses and opinions.

From the questionnaire, an approximate ideal rotation time interval can be assumed. From the speed of acquisition of the terminus technicus, the speed of the sense-making process can be estimated. The questionnaire results may also provide answers about the attitudes of different manager generations (Baby Boomer, X, Y) toward job rotation.

3. RESULTS

In this nascent phase of the research inquiry, the primary aim is to garner empirical evidence that substantiates the conjectured hypotheses. The researchers have determined that a considerable gap in the research exists concerning the effects of job rotation on managers. However, there is a strong demand to create a standard plan that

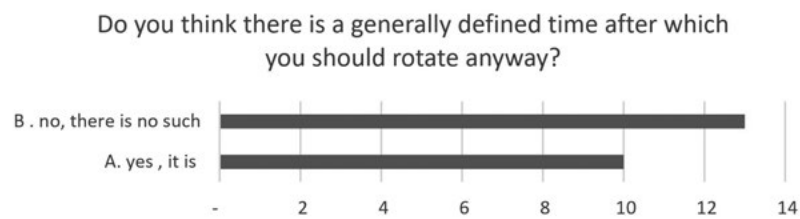
shows how to move workers around different jobs in the car industry. Big companies in this industry face similar needs, which creates a good reason for making consistent rules for rotating workers.

The quantitative data derived from the outcomes of the Lamborghini Management Questionnaire are comprehensively documented within the supplementary section of this research document. This section provides the empirical foundation for our investigative endeavor, incorporating statistical data to enhance transparency and scholarly rigor.

The Appendix contains the statistical results of our research. This placement allows us to focus on theoretical explication, hypothesis formulation, methodological delineation, and broader interpretation of findings, allowing for a more detailed narrative without distracting the reader. We invite readers to assess this data for themselves critically.

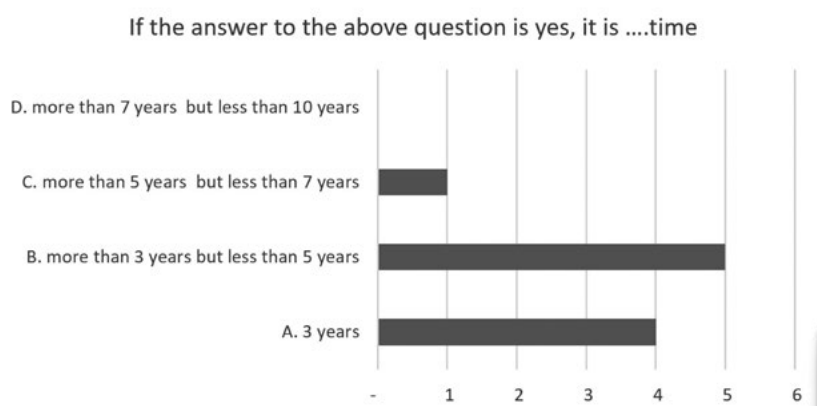
The 2022 Lamborghini Pilot Project found that the average rotation cycle in automotive management is approximately four years, with a quadrennial span being the optimal threshold, based on preliminary interviews and questionnaire assessments with seven top management senior members.

Figure 2 Management Questionnaire Results of Lamborghini 1, n = 23



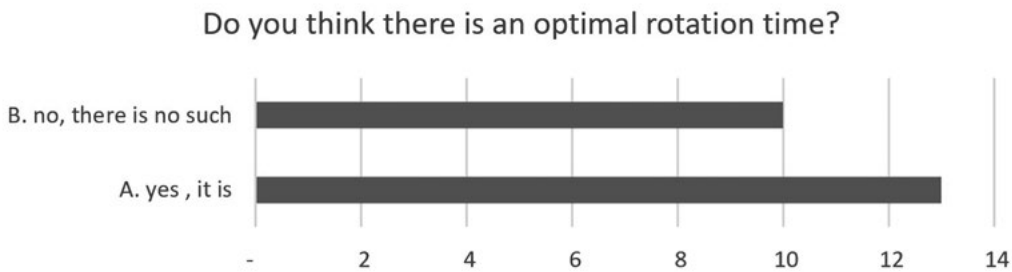
Source: Authors' figure based on survey

Figure 3 Management Questionnaire Results of Lamborghini 2, n = 10



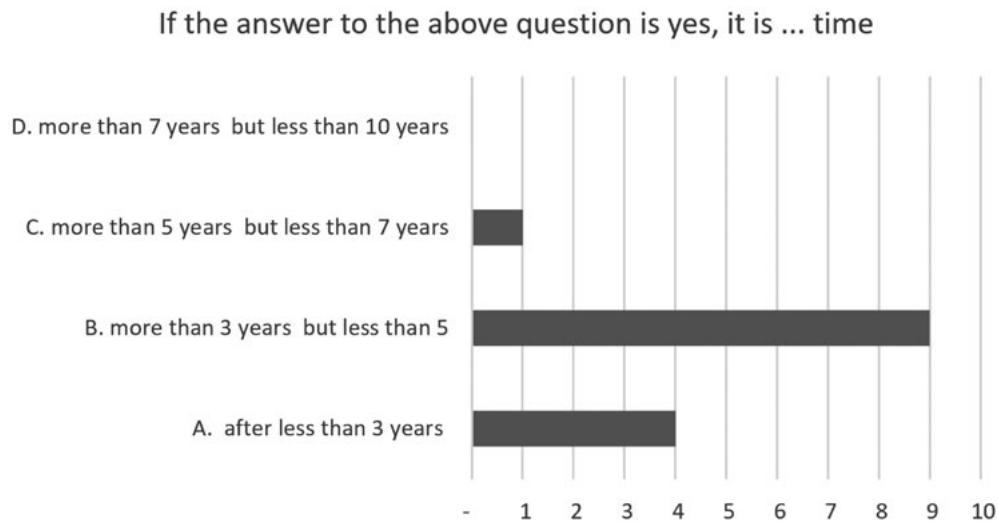
Source: Authors' figure based on survey

Figure 4 Management Questionnaire Results of Lamborghini 3, n = 23



Source: Authors' figure based on survey

Figure 5 Management Questionnaire Results of Lamborghini 4, n =14

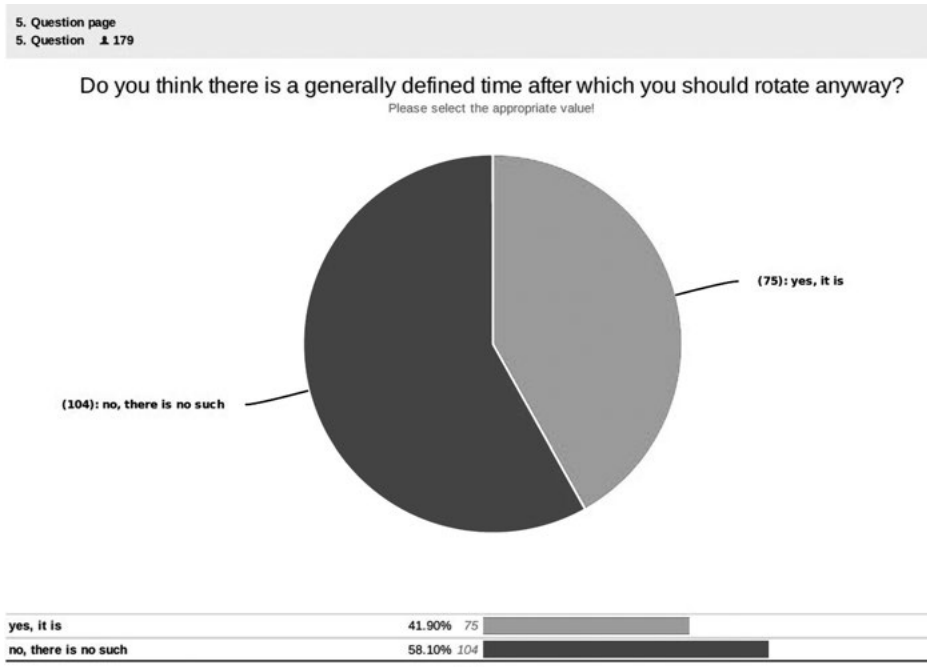


Source: Authors' figure based on survey

Figure 3 shows that Lamborghini managers were most likely to believe that between three and five years is an acceptable timeframe for job rotation. Figure 5 shows that most (58%) managers considered this the optimal time.

Conversely, within the confines of Audi Hungary, a comprehensive study involving 278 participants has indicated a prevailing inclination toward a six-year rotation cycle as the ideal or expected time frame (see Figure 6).

Figure 6 Management questionnaire results of Audi Hungary 1, n = 179



Source: Authors' figure based on survey

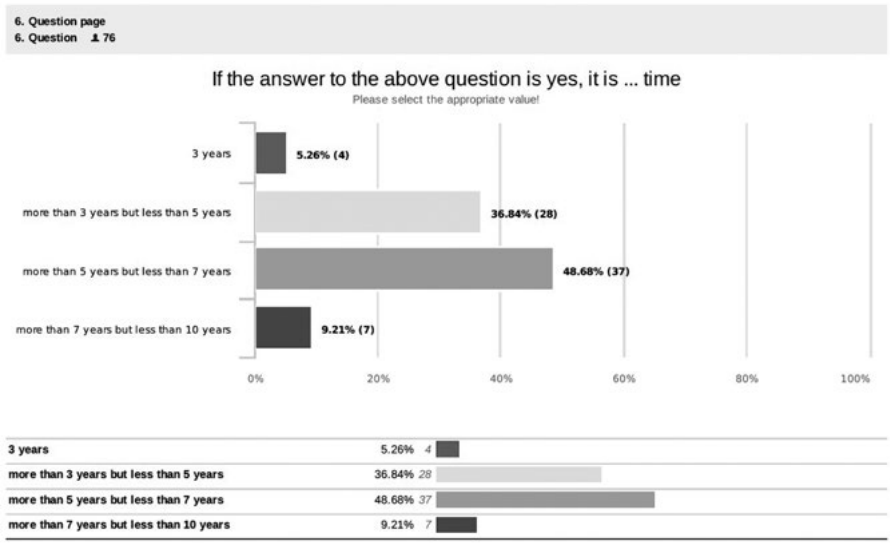
The study reveals a significant discrepancy in the optimal duration for managerial rotation, with research at Lamborghini suggesting a four-year interval. In contrast, research at Audi suggests a six-year cycle, indicating a need for further research.

This variance in the suggested optimal rotation durations between these two numbers suggests a need for further research. This differential is not merely numerical; it holds substantial theoretical and practical implications. This two-year difference in optimal rotation intervals within two major automotive companies raises questions about organizational dynamics, managerial effectiveness, and industry-specific requirements.

Future research should explore the underlying factors, contextual factors, and organizational imperatives that contribute to the contrasting perspectives on managerial rotation in the automotive sector, including organizational structures, market trends, strategic imperatives, and cultural factors.

These differences are not trivial, and they invite further investigation. Additional research is warranted to understand the complex factors influencing these divergent views on job rotation and timelines.

Figure 7 Management Questionnaire Results of Audi Hungary 2, n = 76



Source: Authors' figure based on survey

The six-year job rotation cycle favored by Audi management differs enough from the four-year cycle favored by Lamborgini management to pose many questions. Job rotation systems and timelines are inconsistently applied within and from one organization to the next. This lack of consistency may promote inefficiency.

Prolonged job rotation intervals can lead to burnout and increased employee attrition rates. Unstructured interviews reveal managers' skepticism about job rotation, adding complexity to the paradigm. Further research is needed to understand how job rotation is (and should be) implemented and how managers perceive it.

4. CONCLUSIONS

The paper steadfastly prioritizes empirical evidence, concentrating mainly on examining job rotation practices within luxury automotive brands, specifically Automobili Lamborghini and Audi Hungary. Within the framework of this research, we undertook an extensive literature review, revealing a noteworthy void in existing academic research. The extant literature emphasizes job rotation strategies for line workers, focusing mainly on measures to prevent burnout and maintain ergonomic health, leaving a conspicuous gap regarding the rotation of managerial positions. This study determinedly fills this academic void, underscoring the urgent need for a focused exploration of managerial job rotation, a sector conspicuously overlooked in prevailing studies, including those by notable scholars such as Ortega (2001) and Osterman (1994). This research categorically defines job rotation as a strategic organizational mechanism designed to enhance firms'

understanding and insights into diverse facets, including employee productivity, the profitability of various roles, and the associated costs and benefits. One of the significant outcomes of this research underlines the superiority of the firm learning theory.

This study investigates managerial job rotation practices in automotive companies, highlighting disparities across sectors, including compact, premium, sport, and luxury, highlighting the need for improved job rotation strategies throughout the industry.

The study reveals that managerial rotation is crucial for understanding workforce dynamics in the automotive industry. Intrafirm mobility, a common occurrence, can provide valuable insights and enhance job assignments. Despite skepticism from managers, research was conducted to examine and improve job rotation strategies. The study examines the experiences of Hungarian and Italian managers within the Audi Group, aiming to develop a strategic job rotation process applicable to all automotive sectors. While a single optimal rotation timeline has not been discovered, the researchers made findings that will guide future research in the right direction.

In the future, the researchers intend to extend their inquiry to the German managerial team within the Audi Group, aiming to bolster and enhance their empirical findings. This research aims to provide a comprehensive and empirically rich perspective on managerial job rotation in the automotive industry, bridging the gap in academic literature and offering practical insights for enhancing job rotation practices across various sectors and expanding managerial discourse on the topic.

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APPENDIX

SURVEY QUESTIONS

Date of Birth (Classification: Baby Boom, X, Y, Z Generation)
A. Baby Boomer (before 1965)
B. Generation X (between 1965 and 1979)
C. Generation Y (between 1980 and 1995)
D. Generation Z (after 1995)

How long have you been working at the company as a manager?
A. less than five years
B. between 5 and 10 years
C. between 10 and 15 years
D. more than 15 years

How many times have you been rotated as a manager?
A. None (0)
B. 1 or 2 times
C. 3 or 4 times
D. 5 times or more than five times

After how many years took place in your last rotation?
A. After less than three years
B. More than three years but less than 5
C. More than five years but less than seven years
D. More than seven years but less than 13 years

Do you think there is a generally defined time after which you should rotate?
A. Yes, there is.
B. No, there is no generally defined time.

If the answer to the above question is yes, it is . . .
A. 3 years
B. More than three years but less than five years
C. More than five years but less than seven years
D. More than seven years but less than ten years

Do you think there is an optimal rotation time?
A. Yes, there is.
B. No, there is no optimal rotation time.

If the answer to the above question is yes, it is . . .
A. After less than three years
B. More than three years but less than 5
C. More than five years but less than seven years
D. More than seven years but less than ten years

Do you think rotation is needed at all? (select all that apply)
A. Yes, because it is good for the employee (new impetus to achieve, possibilities, and learning opportunities).
B. Yes, because it is helpful for the company (helps departments, motivates employees, increases productivity).
C. Yes, because it is (other reason):_____.
D. No, because change causes stress for the manager.
E. No, because a long learning curve is a loss for the company.
F. No, because of lost know-how.
G. No, because (other reason): _____.

If the answer to the above question is yes, what degree of rotation is required at Automobili Lamborghini?
A. Within a given segment (e.g., Logistics, Production, Quality)
B. Between business areas (e.g., from Production to Finance, from Finance to HR)
C. Cross-border (international)
D. Person-dependent (from A, B, or C might apply)

In your experience so far, how has your rotation been helpful?
A. It was beneficial because it helped me to face new challenges.
B. It helped me get out of my comfort zone and gain new knowledge.
C. It was neither harmful nor beneficial.
D. It was a negative experience because _____

Who initiated the rotation? (select all that apply)
A. You
B. Your leader
C. Target area leader
D. The HR department
E. Company management
F. Territorial realignment

What was the driving force for your rotation? (select all that apply)
A. Opportunity to move forward
B. Challenge, development, learning
C. Get out of my comfort zone
D. Other reasons

What parts of your rotation were challenging? (select all that apply)
A. Mastering the jargon/ terminus technicus of the new field
B. Getting to know new employees, coordinating
C. Earning of respect, authority
D. Managing the stress of the challenge
E. Other reasons

What made the new role easier? (select all that apply)
A. The new task helped me recover from burnout.
B. New challenges helped me find new positive energy for success.
C. I gained new knowledge.
D. My working environment changed.
E. Other reasons.

How long did you need to integrate after relocation?
A. Between 0 and 3 months
B. Between 3 and 6 months
C. Between 6 and 9 months
D. Between 9 and 12 months
E. More than 12 months

Did your rotation place you in a higher position?
A. Yes
B. No

Have you rotated into a foreign manager's job (worked in a different country)?
A. Yes
B. No

If the answer to the above question is yes, please choose from the options below.
A. The foreign rotation was beneficial. I faced new challenges. I gained new knowledge.
B. The foreign rotation was beneficial. I got out of my comfort zone and gained new knowledge
C. The foreign rotation was neutral.
D. The foreign rotation was a negative experience because _____.

What difficulties did you experience in the foreign rotation? (select all that apply)
A. Misunderstandings arising from cultural differences, different values
B. Absence from my family
C. Learning the jargon of the field
D. Loss of specific skills
E. A decline in productivity
F. Stress and anxiety about whether I can perform well
G. Other reasons

What aspects of your foreign rotation were easier/less challenging? (select all that apply)
A. Preparatory intercultural training
B. Previous work experience with foreign partners
C. Supportive workplace culture
D. Learning stress management techniques
E. Other reasons

VERONIKA SZENTES – DÁNIEL RÓBERT SZABÓ
– PÉTER RIEGLER – ZSOLT SZAKÁLY – NORBERT KOVÁCS

Study of the factors influencing the survival of COVID-19-infected patients in Győr-Moson-Sopron County

Abstract

This research aims to contribute to a greater understanding of COVID-19 and its effects by assessing the factors influencing the survival of COVID-19-infected patients in the Győr-Moson-Sopron County region. The impact of age, comorbidities, and number of days on a ventilator on the survival of COVID-19-infected patients by gender and regional unit are presented based on anonymized data from the Petz Aladár County Teaching Hospital. Binary logistic regression was used to analyze explanatory variables' separate and combined effects. This study shows that age was the most critical determinant of the survival of COVID-19-infected patients, with an increase in age correlating to an elevated probability of death. No significant regional or gender differences in recovery or survival rates were found. This paper, which is grounded in the existing research, offers new insights into the progression of COVID-19 throughout its many waves throughout the region, the impact of local socioeconomic development on medical outcomes, and the relevance of specific comorbidities.

Keywords: COVID-19, spatial differences, survival probability, causality

JEL Codes: C20, C21, I11

INTRODUCTION

Several studies in the national and international literature have presented research results identifying the underlying factors for the possible outcomes of a COVID-19 infection.

Previous studies (Lutz et al., 2023; Ozyilmaz et al., 2022; Sannigrahi et al., 2020) aimed to determine the factors influencing the spread of COVID-19 infection and the dynamics of associated fatalities. Among the factors explaining transmission and mortality, a prominent role was attributed to indicators suitable for describing the state of society, the economy, and the healthcare system. Additionally, individual health conditions and sociodemographic variables characteristic of each person also played a significant role. These studies have established that the presence of primary diseases, in particular hypertension, and inadequate treatment of these diseases may exacerbate the consequences of the pandemic and increase patient mortality. Limitations in healthcare quality and care capacity also increase the likelihood of mortality. Overburdened health systems can also lead to suboptimal care and higher mortality rates.

Another important finding is that there is evidence that socioeconomic disadvantage and poverty are associated with increased COVID-19 mortality (Dukhovnov–Barbieri,

2022). Regional differences and geographical location may have an impact on COVID-19 mortality rates. Inland and peripheral areas show different mortality rates. Another critical factor is the proportion of older people in a population, with a greater number of older people corresponding to increased COVID-19 death rates. Additionally, the presence and sufficient number of health professionals can be crucial to addressing and reducing COVID-19 mortality. As would be expected, countries or areas with a shortage of adequately trained health professionals saw higher COVID-19 mortality rates.

In this study, we add to the state of knowledge by presenting our results on the impact of age, number of concomitant diseases, and number of days on a ventilator on the survival of COVID-19-infected patients in part of Hungary, disaggregated by region and gender.

There was an observable relationship between COVID-19 infection or mortality and various variables, including health status, age, gender, the number of comorbidities, educational attainment, and employment type. Additionally, the study considered aspects of the healthcare system, such as specific infrastructural and human characteristics, social and economic factors, and variables describing the built and natural environment. The analysis aimed to determine whether there was a connection between COVID-19 infection or mortality for the entire variable set or specific subsets of these variables. Our focus was on examining the impact of age, the number of comorbidities, and the duration of days on a ventilator on COVID-19 infection and its outcomes, along with potential gender and regional differences.

The analyses were based on a sample of anonymized data from the Petz Aladár University Teaching Hospital recorded between 2020 and 2022, specifically focusing on the Győr-Moson-Sopron County region. The statistics of the COVID-19 waves are not disaggregated in this study due to the nature of the analysis. The entire study period is treated as one uninterrupted timespan.

1. FACTORS AFFECTING THE SURVIVAL OF COVID-19-INFECTED PATIENTS

Several authors have investigated the influence of factors on the outcome of COVID-19 infection. These studies remain intriguing even after the waves of coronavirus infection have subsided, and they could play a crucial role in preventing further outbreaks and mitigating the harm of a COVID-19 surge. The theoretical part of the study investigates the influencing factors of demographic, climatic, cultural, or socioeconomic differences (including income and total population) to improve infection outcomes and control the spread of COVID-19.

Srikanta et al. (2020) analyzed the global and local spatial connections between key sociodemographic variables and COVID-19 morbidity and mortality in European regions using spatial regression models during the first wave of the pandemic. The spatial analysis and mapping were based on the results of running four spatial regression models: a geographically weighted regression (GWR), a spatial error model (SEM), a spatial lag model (SLM), and an ordinary least squares (OLS) model. In addition,

partial least squares (PLS) and principal component regression (PCR) were performed to estimate the overall explanatory power of the regression models. The distribution of confirmed COVID-19 cases and deaths was heterogeneous across Europe. This uneven distribution can be attributed to several relevant factors, including demographic, climatic, cultural, or socioeconomic differences between countries.

The Western European region (Spain, Italy, France, Germany, United Kingdom, Belgium, and the Netherlands) had the highest number of COVID-19 cases and deaths (actual values and per capita). In contrast, the Eastern European region (Romania, Bulgaria, Greece, Estonia, Latvia, and Lithuania) and the Northern European region (Norway, Finland, and Sweden) had lower numbers of cases and deaths (actual values and per capita). This mortality difference can be attributed to the sociodemographic composition of these countries, as Italy has the second oldest population in the world (23% of Italians are 65 years old or older) and the oldest in Europe. The statistical data suggest that for an unbiased estimate and practical interpretation of the results, it is necessary to consider the rates of COVID-19 infection and COVID-19 recovery rate, accounting for relevant factors, which would show a more logical and reliable estimate than an absolute infection/mortality rate.

Srikanta et al. (2020) found that several spatial regression models, including GWR, OLS, SLM, SEM, and others, have been used to explain the spatial non-stationary distribution of COVID-19 cases/deaths and to investigate their spatial dependence. The number of COVID-19 cases and deaths were considered dependent variables for regression modelling. All explanatory variables showed statistically significant, locally varying associations with COVID-19 cases/deaths. The highest associations were found in Germany, Austria, Italy, Spain, Luxembourg, and Croatia. In the Srikanta study, a strong positive correlation was found between income and total population and COVID cases/deaths, indicating that these two factors may be the critical responsible variables determining the total number of COVID-19 fatal and non-fatal cases in 19 European countries.

Ehlert (2021) examined the relationship of regional-level socioeconomic, demographic, and health variables with COVID-19-related cases and deaths in Germany during the first wave until mid-June 2020. His analysis is a retrospective ecological study at the level of 401 administrative districts and district cities (counties) in Germany, with populations ranging from about 34,000 (Zweibrücken) to about 3,664,000 (Berlin). The results showed that the sole proportion of people needing care did correlate to infection and mortality rates. In contrast, the effect of the density of people employed in the care sector on both outcomes is significantly positive. These results are even more interesting because they support the anecdotal evidence from the media that nursing homes are hotspots for the spread of COVID-19, and these results distinguish between different outcomes for residents and staff.

However, our data do not distinguish between home-based day-care and nursing homes. Factors well known in the literature to correlate with reduced COVID-19 infection and mortality rates include higher educational attainment, better access to medical care, and the information advantage associated with a higher income. However, at

the population level, the beneficial effects of these may be reduced, non-existent, or reversed (especially in the early stages of a pandemic). High levels of economic prosperity are often based on networking (including physical networking), travel, and social contacts, such as teamwork with colleagues or working in open offices – all of which increase the likelihood of contracting COVID-19. In other words, the accoutrements and necessities of wealth may either increase or decrease COVID-19 infection and mortality rates, depending upon circumstances.

A study by Ramirez et al. (2022) draws on statistics collected in 33 OECD countries and three other European countries (Bulgaria, Malta, and Romania). Their results show that lower health system capacity, higher population density, air pollution, elderly population, and lower institutional quality are significantly associated with higher excess mortality at the regional level.

Morshed and Sarkar (2021) examined the causes and common determinants of COVID-19 morbidity and mortality in the 50 countries most affected by the first wave. Obesity rates, the percentage of the population aged 65 and over, and the number of hospital beds per 1,000 population had a significant and positive correlation with infection and mortality.

Ozyilmaz et al. (2022) examined the impact of social and health indicators on morbidity and mortality during the COVID-19 pandemic. Using data from 93 countries, they created a model with five social and health indicators that were found to predict COVID-19 cases and deaths. The number of tourists, the population aged 15-64, and institutionalization positively correlated with the spread of infection and the number of cases in an area. In addition, cigarette consumption correlated positively with the number of cases in people aged 50 years and older, and vaccination rates positively correlated with the number of cases in people aged 25-75. Findings on social indicators of COVID-19 death rates show that higher average life expectancy rates for a region inversely correlate to the number of deaths in the 25-50 age group and that the proportion of the population aged 65 and over positively correlates with the number of deaths.

According to Kovács and Uzzoli's (2020) research, which was conducted following the first wave of the pandemic, districts in the Hungarian interior and those far from major urban areas saw worse COVID-19 outcomes than their more developed peers. Districts in Hungarian county capitals are in a better position due to the central location of health facilities. Budapest has the advantage of more accessible access to central health facilities. Poorer health and health conditions were found in districts with no outpatient clinics or only one in the district headquarters. In the Hungarian Great Plain districts, accessibility indicators are more favorable due to the lower number of small and underdeveloped settlements. In general, higher accessibility values were found in the vicinity of the county capitals, as there were no or few outpatient clinics in the neighbouring districts.

Due to the pandemic, the number of check-ups, screenings, and surgeries decreased, and people have avoided healthcare institutions. This lack of regular health care impacts the health system, with an increased role for telemedicine, home care, and private care. In the long term, missed interventions and services can lead to worse health

outcomes and increases in preventable deaths. Regular medical check-ups are essential for chronic patients but were difficult to arrange or remained unscheduled during the pandemic. Lack of screening reduces the chances of survival from cancer, and fear of infectious disease can lead to psychosomatic illnesses. An increase in symptoms and medical conditions not caused by COVID-19 may still be said to be an indirect result of the pandemic, which has severely harmed those who are unable to care for their other illnesses. Access to care remains a problem, and improving it is essential if poor health outcomes are to be effectively addressed. The on-call system of general practitioners must be strengthened, and care must be made more widely available to patients in remote areas.

According to Simonyi (2020), international and national experience suggests that old age and underlying cardiovascular and metabolic diseases worsen COVID-19 prognosis and increase mortality. Diabetes mellitus has been shown to increase the risk of adverse outcomes in COVID-19. These adverse outcomes can be reduced by preventing infection and ensuring compliance with hygiene and spacing rules. Additionally, careful control of blood sugar and insulin levels in patients with diabetes is essential for both the overall health of the patient and COVID-19 survival and recovery.

Kékes et al. (2020) reported that patients with hypertension saw worse recovery outcomes than those without, which does not establish that hypertension alone is at fault. The majority of confirmed COVID-19 cases are in the age group between 30 and 70 years. However, mortality is concentrated in the upper age boundaries of this group and above—those over 60. Among hypertensive patients, analyses have shown that hypertension comorbidities, such as diabetes, coronary artery disease, stroke, or chronic kidney disease, increase the likelihood of major morbidity and mortality. Kékes et al. also found that treatment with ACEI/ARB (angiotensin-converting enzyme inhibitors and angiotensin receptor blockers) does not appear to increase the risk of severe COVID-19 events or death. They suggest that although a positive association between hypertension and COVID-19 infection and its outcome severity has been found, hypertension alone does not appear to be a major risk factor for more severe COVID-19 cases or death. That said, comparing mortality rates across diverse populations can be difficult due to differences in data-gathering and analytical techniques.

Kovács and Vanus (2022) investigated factors determining differences in COVID-19 mortality rates across Hungarian districts. An increase in the female population aged 65 and over, a decrease in the number of nurses per 10,000 people, and an increase in the number of job seekers per 10,000 people showed a correlation with an increase in COVID-19 mortality rates. The positive correlation with the job seeker rate can presumably be explained by the fact that unemployment can be treated as an inverse indicator of the prosperity (and likely overall health) of the district's population. This indicator variable has a significant COVID-19 mortality-increasing effect alongside outpatient and inpatient care status variables. In Hungary, communities with disproportionate elderly populations are typically less developed, with younger people moving to more prosperous urban areas to find work. Thus, this positive old-age/COVID-19 mortality correlation may suggest a relationship between poverty and COVID-19 mortality rates.

In another study, Páger et al. (2023) investigated the geographic distribution of coronavirus-related mortality and explored the role of socioeconomic variables in its background. Their statistical analyses, based on ordinary least squares (OLS) and spatial regression analysis, were performed at the district level (175 districts) between the onset of the pandemic in Hungary and 31 January 2022. Their results show that the registered COVID-19 mortality was higher in areas with a higher-than-average proportion of older adults and a higher pre-pandemic prevalence of respiratory-related mortality. Districts with a greater-than-average number of college-educated people tended to have lower rates of deaths due to the coronavirus. However, contrary to most of the literature (including several studies mentioned above), access to health care did not significantly explain district-level recorded COVID-19 mortality rates.

Moreover, their results supported the finding that population density and settlement differences emerged as significant explanatory factors in the pattern of COVID-19 mortality. Spatial regression analysis revealed that less developed districts or areas peripheral to larger settlements had higher COVID-19 mortality. In contrast, the opposite was observed in more developed districts (e.g., in the capital region and suburbs).

Lutz et al. (2023) investigated the nature of the differences in the county-specific characteristics of COVID-19 mortality by age in the second year of the pandemic. The adult age pattern of COVID-19 mortality by county and gender was estimated using a Gompertz function with multilevel models. Their results showed that the Gompertz function is suitable for describing county-level patterns of COVID-19 mortality. They did not find significant regional differences in the age progression of mortality but substantial regional differences in mortality levels. Analysis of mortality levels showed a relationship between socioeconomic factors and healthcare indicators in the expected direction but with different strengths.

No factors changed the age-related pattern of mortality. However, significant differences in the level of mortality were found at the county level. COVID-19 mortality was more severe in those living in more deprived areas than in more affluent areas. A negative association was found between the number of doctors working in the county and the level of COVID-19 mortality, but no correlation was found in the analysis of ecological effects. In the more underdeveloped regions of Hungary, the proportion of unfilled GP practices in primary care was generally higher, peaking mainly during the second wave of the pandemic, when doctors over 65 were not allowed to practice. People living in underdeveloped areas visit their doctors less often for various tests and assessments, and they are inherently more isolated and have less access to care, even in ordinary times. The rules required to prevent the spread of coronavirus only exacerbated care-access issues. The level of epidemiological and professional information reaching the population in areas with more limited healthcare access was lacking, and important tests that play a key role in early disease detection were less frequently administered. Effective epidemiological work, such as early disease detection and patient isolation, can only be carried out with well-functioning primary care, which is important in containing the pandemic and reducing its impacts. Due to the comparatively limited level of care in remote areas, untreated underlying diseases may also be more common

and more severe in general than in the areas with better care access. Vaccine uptake and coverage are also lower in these remote areas, which may have further exacerbated mortality statistics.

In addition to analysing demographic and severity of illness factors in patients admitted to their intensive care unit (ICU), Koller et al. (2023) examined the impact of treatment modality changes on severely infected patients' outcomes in the third and fourth waves of the COVID-19 pandemic. They conducted a retrospective, observational study to record demographic, clinical, treatment, and outcome data of patients admitted with severe respiratory failure due to coronavirus infection. Data from 88 patients were processed. Fifty-three percent of patients were male, with a median age of 65 and a median BMI of 29. Non-invasive ventilation was used in 81% of cases, endotracheal intubation in 45%, and abdominal inversion in 59% at some point in the treatment process. Vasopressor therapy was required by 44% of patients, and secondary infection control was required by 36%. The survival rate was 41%. Survival risk factors were also assessed using multivariate modelling. In addition to lower age and APACHE II scores, non-diabetic status was associated with a better survival rate. During the pandemic, patients' treatments were continuously changed and updated. Treatment effects were monitored, with treatments found to be more effective being deployed and less effective treatments being discarded, likely leading to improved recovery outcomes after controlling for APACHE II score, gender, BMI, two comorbidities, and the administration of two drugs (remdesivir, tocilizumab).

Based on the presented literature, six main factor clusters can be said to affect the possible outcomes of COVID-19 infection:

1. The impact of health status: Deteriorating health status is associated with increased COVID-19 mortality. The prevalence and lack of treatment of underlying diseases may exacerbate the consequences of the pandemic and mortality.
2. The impact of health care: The level of health care and care capacity may influence the mortality rate of COVID-19. Overburdened health systems can lead to cumbersome care and higher mortality rates. Healthcare workloads, unfilled GP practices, and lack of access to care are associated with higher COVID-19 mortality rates.
3. The impact of socioeconomic factors: Socioeconomic disadvantage and poverty are associated with an increase in the COVID-19 mortality rate. People in more deprived regions may be more vulnerable to the pandemic's impact.
4. Age: An increase in the proportion of older adults is associated with increased COVID-19 mortality. The elderly population is most likely to be severely impacted by the pandemic.
5. Environmental factors: Regional differences and geographical location may impact the mortality rate of COVID-19. Inner and peripheral areas have different mortality rates.
6. The presence of health professionals: The presence and enough health professionals, including doctors and nurses, can be an important factor in managing and reducing the mortality rate of COVID-19. In counties or areas with a shortage of adequately trained health personnel, mortality rates may be higher.

2. EMPIRICAL RESEARCH FINDINGS

2.1. METHODOLOGY

In this study, we examine the impact of age, comorbidities, and the number of days on a ventilator on the outcome of COVID-19 infection, exploring age, gender, and regional differences based on available data.

In the first step, we selected individuals from the available observation dataset for analysis. In the second step, we examined the frequency and distribution of the studied metric-scaled target variables in selected regional, gender, and age groups. The results of the analysis are presented in the sample overview and descriptive statistics section.

According to the results of previous domestic and international studies, an increase in age, the number of comorbidities, and the number of days on a ventilator are associated with an increased likelihood of mortality. In other words, the older the individual, the more comorbidities they have, and the more severe their condition, the higher the chances of a fatal outcome of the infection.

The patient's age, the number of comorbidities, and the number of days on a ventilator are metric variables, and the outcome variable used is non-metric, with varying sample sizes across categories. We employ binary logistic regression to analyze explanatory variables' separate and combined effects. The results are presented following the descriptive statistics.

2.2. DESCRIPTIVE STATISTICS OF THE SAMPLE

The study analyses data recorded by Petz Aladár County Teaching Hospital for 2020-2022. From that dataset, information on 6,151 COVID-19-infected patients, including 3,167 men and 2,984 women, was obtained. Patients under 40 years of age made up 13.5% of the total, 24.1% were between 41 and 60 years of age, and 62.4% were over 60 years of age. Patients discharged to their home after treatment constituted 47.3% of the total, 22% died, and 30.7% had a different status (i.e., transferred to another hospital, institution, or a social home department or were discharged without a doctor's permission). Of the comorbidities recorded in patients, diabetes and hypertension were given priority, and 5.7% of COVID-19-infected patients had diabetes, 36% were hypertensive, and 11.8% had both comorbidities. All five COVID waves are considered in the analysis. One percent of patients were in the first wave, 27.6% in the second wave, 33.3% in the third wave, 18.5% in the fourth wave, and 19.1% in the fifth wave.

The vast majority of the patients (99.3%) were Hungarian citizens, 91.1% had a permanent address in the West Transdanubian Region, 88.8% were in the Győr-Moson-Sopron County region, 57.6% were in the district of Győr, 10.9% in the district of Csorna, and 39.5% were in the city of Győr.

The analyses only considered part of the larger dataset, with three conditions being used to restrict the sample size. The included patients must:

1. have a permanent address in the Győr-Moson-Sopron County region,
2. be registered at the hospital in the period 2020–2022, and
3. have a final status of either deceased or discharged from the hospital.

The first condition defines the geographical space, the second the temporality, and the third the outcome. We considered the address recorded in the hospital stronger than citizenship in delineating the sample.

The resulting sample of the larger dataset contains data from 3,783 patients, representing 61.5% of COVID-19-infected Petz Aladár County Teaching Hospital patients. The sample includes data from 1,941 men and 1,842 women. The age distribution of the sample is representative of the total population. Thirteen percent were under 40, 22.7% were between 41 and 60, and 64.3% were over 60. Two thousand five hundred ninety people went home after treatment, whereas 1,193 died in the hospital. As for the comorbidities highlighted in the study, diabetes affected 5.9%, hypertension 37.7%, and diabetes and hypertension together 11.8% of the patients, representing the rates observed for the overall population. Of the sample studied, 0.5% were included in the first wave, 27.3% in the second wave, 37.1% in the third wave, 18.6% in the fourth wave, and 16.6% in the fifth wave. The distribution by the waves is not significantly different from the overall population distribution. About a quarter—24.7%—of patients were registered in 2020, 57.1% in 2021 and 18.2% in 2022. Regarding the sample's spatial distribution (Table 1), the Győr district is dominant, with 67.4%, while the Csorna district stands out with 10.5%. Patients from the districts of Kapuvár, Mosonmagyaróvár, Pannonhalma, Sopron, and Tét are almost equally represented in the sample.

Table 1 Spatial distribution of the sample, n = 3,783

Districts	Frequency (persons)	Relative frequency	Cumulative relative frequency
Csorna	397	10.5%	10.5%
Győr	2,550	67.4%	77.9%
Kapuvár	131	3.5%	81.4%
Mosonmagyaróvár	224	5.9%	87.3%
Pannonhalma	187	4.9%	92.2%
Sopron	137	3.6%	95.8%
Tét	157	4.2%	100.0%
Total	3,783	100.0%	

Source: Own table based on data from Petz Aladár County Teaching Hospital

A majority of participants lived in either Győr or a town (larger settlement), with a minority living in smaller communities (*villages*) (Table 2).

Table 2 Distribution of the survey sample by settlement category, n = 3,783

Settlement	Frequency (persons)	Relative frequency	Cumulative relative frequency
Győr (county seat)	1,750	46.3%	46.3%
Villages in the sample	1,547	40.9%	87.2%
Towns in the sample without Győr	486	12.8%	100.0%
Total	3,783	100.0%	

Source: Own table based on data from Petz Aladár County Teaching Hospital

Examination of additional sample cross-sections will enable us to explore possible spatial differences in patient statistics and related patterns. Broken down by settlement category and gender, the proportion of men is higher in all three categories (Table 3). The difference in male and female rates is larger, but not significantly so, in the category of villages and county towns than in Győr.

Table 3 Distribution of the sample by settlement category and gender

Settlement	Gender	Frequency (persons)	Relative frequency	Cumulative relative frequency
Győr (county seat)	Men	885	50.6%	50.6%
	Female	865	49.4%	100.0%
	Total	1,750	100.0%	
Villages in the sample	Men	799	51.6%	51.6%
	Female	748	48.4%	100.0%
	Total	1,547	100.0%	
Towns in the sample without Győr	Men	257	52.9%	52.9%
	Female	229	47.1%	100.0%
	Total	486	100.0%	

Source: Own table based on data from Petz Aladár County Teaching Hospital

In all three categories, the share of older age groups is significantly higher by settlement and age group, especially in urban areas (Table 4).

Table 4 Distribution of the sample by settlement category and age group

Category of settlement	Age group	Frequency (persons)	Relative frequency	Cumulative relative frequency
Győr (county seat)	0-40	207	11.8%	11.8%
	41-60	376	21.5%	33.3%
	≥ 61	1,167	66.7%	100.0%
	Total	1,750	100.0%	
Villages in the sample	0-40	220	14.2%	14.2%
	41-60	383	24.8%	39.0%
	≥ 61	944	61.0%	100.0%
	Total	1,547	100.0%	
Towns in the sample without Győr	0-40	64	13.2%	13.2%
	41-60	101	20.8%	34.0%
	≥ 61	321	66.0%	100.0%
	Total	486	100.0%	

Source: Own table based on data from Petz Aladár County Teaching Hospital

Examining the sample by settlement category and final medical status (Table 5), we found that most people in all three settlement categories survived their hospital experience long enough to be discharged (and presumably recover from their illness), with no significant difference in proportional death rates.

Table 5 Distribution by settlement category and final patient status

Category of settlement	Status	Frequency (persons)	Relative frequency	Cumulative relative frequency
Győr (county seat)	Discharged from the hospital to home	1,203	68.7%	68.7%
	Deceased	547	31.3%	100.0%
	total	1,750	100,0%	
Villages in the sample	Discharged from the hospital to home	1,061	68.6%	68.6%
	Deceased	486	31.4%	100.0%
	Total	1,547	100.0%	
Towns in the sample without Győr	Discharged from the hospital to home	326	67.1%	67.1%
	Deceased	160	32.9%	100.0%
	Total	486	100.0%	

Source: Own table based on data from Petz Aladár County Teaching Hospital

It is also worth examining whether there is a significant difference in the final medical status by age group when the sample is split into three categories of settlements and three age brackets (Table 6). In Győr, men 61 years of age or older saw disproportionately poor outcomes relative to men in other age groups, with only slightly more (293) being

discharged than dying (263). A similar pattern was observed for female patients, with older women being far more likely than younger women to die. Similar age-related differences were observed for villages and towns. Among those who died, there was a significantly higher proportion of people aged 61 years of age and over. The distributions suggest that age influences mortality, but no significant spatial differences can be found.

Table 6 Distribution by settlement category and final patient status

Settlement category	Gender	Status	Age group	Frequency (persons)	Relative frequency	Cumulative relative frequency
Győr (county seat)	Male	Discharged from the hospital to home	0-40	79	13.7%	13.7%
			41-60	203	35.3%	49.0%
			≥ 61	293	51.0%	100.0%
			Total	575	100.0%	
		Deceased	0-40	3	1.0%	1.0%
			41-60	44	14.2%	15.2%
			≥ 61	263	84.8%	100.0%
			Total	310	100.0%	
	Female	Discharged from the hospital to home	0-40	122	19.4%	19.4%
			41-60	120	19.1%	38.5%
			≥ 61	386	61.5%	100.0%
			Total	628	100.0%	
		Deceased	0-40	3	1.3%	1.3%
			41-60	9	3.8%	5.1%
			≥ 61	225	94.9%	100.0%
			Total	237	100.0%	
Villages in the sample	Male	Discharged from the hospital to home	0-40	88	16.2%	16.2%
			41-60	196	36.0%	52.2%
			≥ 61	260	47.8%	100.0%
			Total	544	100.0%	
		Deceased	0-40	3	1.2 %	1.2 %
			41-60	43	16.9 %	18.0%
			≥ 61	209	82.0 %	100.0 %
			Total	255	100.0 %	
	Female	Discharged from the hospital to home	0-40	128	24.8 %	24.8 %
			41-60	124	24.0 %	48.7 %
			≥ 61	265	51.3 %	100.0 %
			Total	517	100.0 %	
		Deceased	0-40	1	0.4 %	0.4 %
			41-60	20	8.7 %	9.1 %
			≥ 61	210	90.9 %	100.0 %
			Total	231	100.0 %	

Towns in the sample without Győr	Male	Discharged from the hospital to home	0-40	23	14.9 %	14.9 %
			41-60	55	35.7 %	50.6 %
			≥ 61	76	49.4 %	100.0 %
			Total	154	100.0 %	
		Deceased	0-40	1	1.0 %	1.0 %
			41-60	14	13.6 %	14.6 %
			≥ 61	88	85.4 %	100.0 %
			Total	103	100.0 %	
	Female	Discharged from the hospital to home	0-40	40	23.3 %	23.3 %
			41-60	30	17.4 %	40.7%
			≥ 61	102	59.3 %	100.0%
			Total	172	100.0 %	
		Deceased	41-60	2	3.5 %	3.5%
			≥ 61	55	96.5%	100.0%
			Total	57	100.0%	

Source: Own table based on data from Petz Aladár County Teaching Hospital

Patient age, the number of comorbidities, and the potential mortality impact of certain diseases, such as diabetes and hypertension, should also be examined on smaller cross-sectional datasets, as this would provide an opportunity to show possible regional differences.

2.3. RESULTS OF MULTIVARIATE ANALYSES

2.3.1. SPATIAL AND GENDER DIFFERENCES IN THE SURVIVAL OF COVID-INFECTED PEOPLE—THE EFFECT OF AGE

As age increases, comorbidities increase, and a person's health often steadily declines. The emergence and rapid spread of new, unknown pathogens negatively impact older people's life expectancy. This disparate impact on older adults is generally true and a natural product of weaknesses in an ageing immune system. Even so, examining gender-specific outcome differences by region are worthwhile so that future researchers and policymakers may work to identify and help vulnerable groups.

The association between age and patient survival was examined using binary logistic regression (binary logistic model) (Table 7). We began by using our univariate model to explain the effect of age on the patient's life expectancy for men and women and to determine whether there are differences in the statistics for Győr, the county's cities, and the county's non-urban municipalities.

The model is significant for male patients living in Győr, improving the random classification by 5.8%. Their age explains 24.3% of the variance in the patient's survival

and 7.6% of the chance of correctly categorizing their survival. For female patients, the model is also significant, improving the odds of predicting patient outcomes by only 0.1% compared to random classification. Their age explains 23.1% of the variance in the patient's survival and 7% in the chance of correctly categorizing their survival.

The model is significant for hospitalized male patients from the villages of the county, with a 4.2% improvement in random classification. Their age explains 22.5% of the variance in the patient's survival and improves the chance of correctly categorizing their survival by 6.7%. The model improves the random classification by only 2.6% for female patients. Their age explains 29.1% of the variance in the patient's survival. Knowing the patient's age improves the chance of correctly categorizing his/her survival by 7.1%.

The model is significant for hospitalized men from the towns in the county, with a 10.9% improvement in random classification. Their age explains 26.7% of the variance in the patient's survival and improves the chance of correctly categorizing their survival by 7.5%. For women, the model improves the random classification by only 3.9%. Their age explains 39.4% of the variance in the patient's survival. Knowing the patient's age improves the chance of correctly categorizing his/her survival by 11.8%.

Age positively correlates with the probability of death, but the explanatory power and predictive power of age are low. For the samples studied, age as a classifier is a better determiner for women, has higher explanatory power, and the correct classification rate is also higher for women. No significant spatial differences can be found.

Table 7 The impact of age on the patient's survival by gender in the different territorial units

Subset of sample	n	Model sig.	Correct class. rate (random)	Const. Wald	Nagel-kerke R^2	Correct class. rate (model)	Age Wald	Exp (B)
Males (Győr)	885	0.000	65%	76.874 (sig.: 0.000)	0.243	70.8%	119.41 (sig.: 0.000)	1.071
Females (Győr)	865	0.000	72.6%	163.395 (sig.: 0.000)	0.231	72.7%	93.962 (sig.: 0.000)	1.07
Males (villages)	799	0.000	68.1%	99.671 (sig.: 0.000)	0.225	72.3%	97.185 (sig.: 0.000)	1.067
Females (villages)	748	0.000	69.1%	103.626 (sig.: 0.000)	0.291	71.7%	109.019 (sig.: 0.000)	1.071
Males (towns)	257	0.000	59.9%	9.985 (sig.: 0.002)	0.267	70.8%	38.574 (sig.: 0.000)	1.075
Females (towns)	229	0.000	75.1%	52.222 (sig.: 0.002)	0.394	79%	35.413 (sig.: 0.000)	1.118

Source: Own table based on data from Petz Aladár County Teaching Hospital

2.3.2. SPATIAL AND GENDER DIFFERENCES IN THE OUTCOME OF COVID INFECTIONS—THE IMPACT OF THE NUMBER OF COMORBIDITIES

The model is significant for male patients from Győr and cannot be used to improve the random classification (Table 8). The number of reported comorbidities explains 1.5% of the variance in the patient's survival. The model is significant for female patients but adding it cannot improve the random classification. The number of reported comorbidities explains 6.3% of the variance in the patient's survival.

The model is significant for male patients from the villages and cannot be used to improve the random classification. The number of recorded comorbidities explains 5.1% of the variance in the patient's survival. The model is significant for female patients, and the random classification cannot be improved. However, the number of recorded comorbidities explains 10.1% of the variance in the patient's survival.

The model is significant for male patients from the county's towns but cannot be used to improve the random classification. The number of recorded comorbidities explains 4.2% of the variance in the patient's survival. The model is also significant for female patients but cannot be used to improve the random classification. However, the number of recorded comorbidities explains 7.6% of the variance in the patient's survival. This seems to be somewhat of a contradiction. The model is statistically significant but practically meaningless, yet it can be used to explain 7.6% of the variance in patients' survival.

The effect of comorbidities was not significant, and the available data do not show that an increase in the number of comorbidities increases the probability of death. This number's explanatory power and predictive power are lower than those of age. For the samples examined, the number of comorbidities as a classifier behaves better for women, has a higher explanatory power and the correct classification rate is higher for women. No significant spatial differences can be found based on the available data. However, the results should be interpreted with care. Although our sample is large, further research is needed. Knowledge of the full list of concomitant diseases, the list of drugs used in treatment, dosage, and biometric and physical parameters of the patients is essential, and it would add further value to the conclusions.

Table 8 The impact of the number of comorbidities on the patient's survival by gender and by different territorial units

Subset of sample	n	Model sig.	Correct class. rate (random)	Const. Wald	Nagel-kerke R^2	Correct class. rate (model)	Age Wald	Exp (B)
Males (Győr)	885	0.002	65%	76.874 (sig.: 0.000)	0.015	65%	9.316 (sig.: 0.002)	1.196
Females (Győr)	865	0.000	72.6%	163.395 (sig.: 0.000)	0.063	72.6%	32.653 (sig.: 0.000)	1.566
Males (villages)	799	0.000	68.1%	99.671 (sig.: 0.000)	0.051	72.3%	27.025 (sig.: 0.000)	1.453

Females (villages)	748	0.000	69.1%	103.626 (sig.: 0.000)	0.101	69.1%	45.668 (sig.: 0.000)	1.768
Males (towns)	257	0.004	59.9%	9.985 (sig.: 0.002)	0.043	59.9%	7.754 (sig.: 0.005)	1.358
Females (towns)	229	0.000	75.1%	52.222 (sig.: 0.002)	0.076	75.1%	9.401 (sig.: 0.002)	1.775

Source: Own table based on data from Petz Aladár County Teaching Hospital

2.3.3. SPATIAL AND GENDER DIFFERENCES IN THE SURVIVAL OF PATIENTS WITH COVID—THE COMBINED EFFECT OF AGE AND THE NUMBER OF COMORBIDITIES

One way forward is to examine the age and the number of comorbidities together. The Pearson correlation coefficient of the two variables is 0.487, so it is possible to use them together as explanatory variables.

For men from Győr, the model is significant, with the random classification improving by 6.3% when the two variables are combined. The two variables together explain 24.8% of the variance in the patient's survival (Table 9). Age as a variable increased the ability to classify, improving the probability of correct classification by 7.6% in the bivariate model, all other things being equal. The model is significant for female patients, with no improvement in random classification. The variance of the patient's survival is explained by the two variables together in 23.1%. This percentage is slightly lower than for male patients. The explanatory and classificatory power of age are also more significant for women.

The model is significant for men from the villages of the county, with a 4.2% improvement compared to the random classification. The classification effect of age is more significant than for men. The model is also significant for women, with only a 2.8% improvement in random classification. For female patients from villages, the number of comorbidities increases the chance of correct classification more than age. For women, age and number of comorbidities together explain the variance of the dependent variable better.

The model is significant for men from the towns of the county, with a 10.4% improvement in random classification. For men from county towns, including age in the model increases the probability of successfully classifying a patient's outcome more than the number of comorbidities. The model is also significant for women, improving the random classification by 3.9%. The two variables together explain 39.5% of the variance in the patient's survival.

Using both variables slightly improved the chances of correct classification compared to using age as the single explanatory variable. For both men and women, age is the more significant explanatory variable. No significant gender or regional differences were found.

Table 9 The combined effect of the number of comorbidities and age on the patient's survival by gender, categorized by the different territorial units

Subset of sample	n	Model sig.	Correct class. rate (random)	Nagelkerke R squared	Correct class. rate (model)	Explanatory variables	Wald	Exp (B)
Males (Győr)	885	0.000	65%	0.248	71.3%	Age	117.166 (sig.: 0.002)	1.076
						Number of comorbidities	3.978 (sig.: 0.046)	0.871
Females (Győr)	865	0.000	72.6%	0.231	72.7%	Age	80.466 (sig.: 0.005)	1.07
						Number of comorbidities	0.005 (sig.: 0.994)	0.832
Males (villages)	799	0.000	68.1%	0.225	72.3%	Age	83.101 (sig.: 0.000)	1.067
						Number of comorbidities	0.0886 (sig.: 0.046)	0.998
Females (villages)	748	0.000	69.1%	0.294	71.9%	Age	86.584 (sig.: 0.005)	1.068
						Number of comorbidities	1.808 (sig.: 0.994)	1.138
Males (towns)	257	0.002	59.9%	0.268	70.4%	Age	34.540 (sig.: 0.000)	1.073
						Number of comorbidities	0.138 (sig.: 0.710)	1.047
Females (towns)	229	0.002	75.1%	0.395	79%	Age	33.267 (sig.: 0.000)	1.118
						Number of comorbidities	0.26 (sig.: 0.873)	1.036

Source: own calculation based on data from Petz Aladár County Teaching Hospital

2.3.4. HOW DOES THE NUMBER OF DAYS ON THE VENTILATOR IMPROVE THE ABILITY TO CLASSIFY?

Having assessed the relationship between survival and the already examined variables, we are left with the question of the extent to which the number of days spent on a ventilator contributes to correctly assessing the patient's survival. The variables are not correlated with the age of the patient and the number of concomitant diseases, with Pearson's correlation coefficients of -0.010 and -0.103, respectively. Therefore, their combined use as explanatory variables is not burdened by the problem of multicollinearity.

Using the three variables together significantly increased the Nagelkerke R squared value of the model, as running the model on the six subsamples resulted in at least a 20% increase in explained variance (Table 10). Thus, the number of days spent on the

ventilator significantly improves the model's explanatory power. Nevertheless, among the three variables, for all six subsamples, using the patient's age as a variable increases the probability of correctly classifying the patient's survival.

Table 10 The impact of the number of days spent on the ventilator on the model's classification ability

Subset of sample	n	Model sig.	Correct class. rate (random)	Nagel-kerke R squared	Correct class. rate ()	Explanatory variables	Wald
Males (Győr)	885	0.000	65%	0.581	81.4%	Age	117.166 (sig.: 0.002)
						Number of comorbidities	3.978 (sig.: 0.046)
						Number of days on the ventilator	0.001 (sig.: 0.976)
Females (Győr)	865	0.000	72.6%	0.453	77.8%	Age	117.166 (sig.: 0.002)
						Number of comorbidities	3.978 (sig.: 0.046)
						Number of days on the ventilator	0.001 (sig.: 0.976)
Males (villages)	799	0.000	68.1	0.532	78.6%	Age	88.467 (sig.: 0.000)
						Number of comorbidities	6.467 (sig.: 0.00)
						Number of days on the ventilator	24.781 (sig.: 0.11)
Females (villages)	748	0.000	69.1%	0.502	81.4%	Age	84.249 (sig.: 0.000)
						Number of comorbidities	0.01 (sig.: 0.982)
						Number of days on the ventilator	0.001 (sig.: 0.982)
Males (towns)	257	0.000	59.9	0.546	79.4%	Age	27.428 (sig.: 0.000)
						Number of comorbidities	5.789 (sig.: 0.016)
						Number of days on the ventilator	0.000 (sig.: 0.989)
Females (towns)	229	0.000	75.1%	0.562	83.8%	Age	32.519 (sig.: 0.000)
						Number of comorbidities	2.1 (sig.: 0.147)
						Number of days on the ventilator	0.000 (sig.: 0.995

Source: own calculation based on data from Petz Aladár County Teaching Hospital

The combination of the three variables improved the classification ability of the model. The proportion of cases correctly classified by the model is higher for men in

the sample of the patients from Győr and for women in the villages and other county towns. At the same time, the improvement was higher for men compared to random classification.

Overall, it can be seen that age was the most important determinant of the survival of patients, with an increase in the mortality gap. No significant regional or gender differences were found. Including the number of days spent on a ventilator significantly improves the model's explanatory power. Age and the number of concomitant diseases significantly explain the variance in the patient's survival, improving the classification's accuracy.

Analysis of the available data confirmed that age, an increase in the number of comorbidities, and an increase in the number of days on a ventilator together increase the risk of death. However, no significant gender or regional differences were found. The effect is slightly stronger for men.

3. CONCLUSIONS

In this study, based on national and international research and guided by the intention to contribute to previous findings, we investigated the effects on COVID-19 outcomes of age, number of comorbidities, and number of days on a ventilator, disaggregated by gender and by territorial units. We focused on Győr-Moson-Sopron County, based on Petz Aladár County Teaching Hospital data.

Age increases the probability of death. Its explanatory and predictive powers are low as a classification factor; it behaves more like age for women. No significant spatial differentiation can be found.

The effect of comorbidities was not significant, and the available data do not show that an increase in comorbidity would increase the probability of death. Its explanatory power and predictive ability are significantly lower than that of age. As a classification factor, it behaves better for women than men, similarly to the patient's age. No significant regional differences can be found based on the available data.

Using both variables together slightly improved the chances of classification compared to using age as a single explanatory variable. For both men and women, age was the more significant explanatory variable. No significant gender and spatial differences were found in the bivariate case.

The number of days spent on a ventilator was included in the classification model in the third stage, which has no linear relationship with age and the number of concomitant diseases. The combination of the three variables improved the classification ability of the model. The proportion of cases correctly classified using the model with the three explanatory variables is higher for men in the Győr sample and higher for women in the villages or other towns in the county. At the same time, the improvement is greater for men compared to random classification.

Our studies so far show that age was the most important determinant of the survival of COVID-19-infected patients, with an increase in the probability of death. No significant regional or gender differences were found. The number of days spent on the venti-

lator, age, and comorbidities significantly improved the model's explanatory power. Using age and the number of comorbidities significantly explains the variance in the patient's survival, improving the classification accuracy.

The present research contributes to a greater public understanding of COVID-19 outcomes. We hope to build on our results later and determine morbidity and mortality variation across the different pandemic waves. Additionally, we intend to conduct a deeper analysis of the links between socioeconomic development and the impact of certain comorbidities (some already addressed in the literature) and patient survival and recovery.

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ILDIKÓ BALATONI – ADAMU UMAR GAMBO

Impact of inflation on sports consumption: A study on fitness facilities

Abstract

Fitness centers, as micro and small enterprises, are important to the economic development of a country and the health of its citizens. However, the small size of most fitness centers makes their existence precarious. This study aims to assess the impact of inflation on fitness centers. The researchers chose Debrecen, a community in Hungary with a considerable fitness sector, as the center of their investigation. Telephone interviews using structured questionnaires were conducted among all twenty fitness centers operating in Debrecen. Answers were analyzed using descriptive statistical methods. Most respondents indicated that the price of their services had increased due to energy costs. One-third believed these increases negatively affected members' physical activity (PA). In contrast, two-thirds indicated that customers were willing to accept the price increase. Despite rising costs, workforce reductions seldom occurred. Instead, fitness centers were modernized to maintain attendance and reduce energy costs, and became increasingly active online, mainly through social media. It is concluded that price increases did not significantly affect physical activity participation.

Keywords: inflation; fitness centers; turnover; physical activity; health

JEL: I15

INTRODUCTION

Physical activity is an essential part of a healthy lifestyle. Everyday exercise helps to cope with stress, prevent chronic illnesses, and (if done publicly or in a group) promote mental well-being through social interactions (Vaquero-Abellan et al., 2022). Several of our previous studies conducted before the COVID-19 pandemic found that a higher proportion of adolescents take part in regular physical activity in Debrecen and the surrounding region than the national average (Balatoni et al., 2019; Kosztin–Balatoni, 2021). Many students attend fitness classes, thanks to the significant development of sports infrastructure in the last decade, both by the city government and the University of Debrecen. The COVID-19 epidemic had a deleterious effect on Hungary, just as it did the rest of the world, resulting in people becoming isolated. People's sporting opportunities were restricted; thus, their physical activity decreased, and attendance at sports facilities dropped significantly. This decrease in exercise and fitness harmed people's physical and mental health worldwide (Puccinelli et al., 2021).

Before Hungary had recovered from the COVID-19 epidemic, the Russo-Ukrainian War began. One of the consequences of the War and the subsequent sanctions and

restrictions was the rise in energy prices in Europe, including Hungary (Adolfsen et al., 2022). Energy cost increases and the resultant inflationary trends significantly impacted the country's economy and the viability of small and medium-sized enterprises. Inflation, primarily believed to be the result of the War, significantly influences how people live in Hungary.

With this in mind, our research aims to assess the impact of gas and electricity price increases on the operation of fitness facilities in Debrecen. Our study seeks to determine whether energy-related inflation leads to significant price increases for fitness services, decreased physical activity by fitness center members, staff downsizing, and attendance.

According to our hypothesis, companies should have retained the benefits of digitization during the COVID-19 epidemic. They tried to compensate for the increase in overhead costs in 2020 by modernizing heating and lighting that rationalized energy use and by increasing the price of entrance fees. According to our assumption, the increase in ticket prices should have resulted in a decrease in the number of fitness club members, i.e., a decrease in attendance.

In our study, after a literature review on the connection between physical activity and health status, we present how fitness centers were affected by the recent economic changes. In the conclusion section, we draw attention to the fact that economic austerity has also posed serious challenges for operators of sports facilities and that government support for these businesses should be made available as needed in similar situations to promote the population's health.

1. LITERATURE REVIEW

Inactivity, a widespread hazard of our time, is one of the most significant risk factors for ill health. It is also a leading cause of death, together with smoking, obesity, and hypertension. According to WHO data, the number of obese people tripled between 1975 and 2016, and in 2016, 39% of the world's population aged 18 and over was overweight or obese (WHO, 2021). In Hungary, the proportion of overweight and obese people is 58.2% (KSH, 2019a). To make matters worse, the proportion of people in Hungary who were sedentary at work increased from 36% to 40% between 2014 and 2019 (KSH, 2019b). Obesity and a lack of physical exercise are strongly linked. Research shows that the harmful effects of a sedentary lifestyle can only be counterbalanced by regular active exercise (Thivel et al., 2018; Varga Szépné et al., 2019; Liu et al., 2023).

The relation of physical activity (PA) to health and mental well-being is an ongoing topic of discussion. Their connection is continuously investigated, with recent research findings that active and healthy lifestyles and a good diet help maintain physical health and mental stability (Mathisen et al., 2023; Seefeldt et al., 2002). People who engage in routine PA are overwhelmingly happier than those who do not and have improved self-esteem, focus, and levels of optimism (Appelqvist-Schmidlechner et al., 2023). Physical activity builds confidence and is described as a therapeutic process that impacts individual health and well-being in complex ways (Williams et al., 2023). Yoga has been determined to be an effective treatment for people with dementia, and in the elderly, physical

fitness has been found to improve their cognitive functioning and mental health (Galle et al., 2023; Karamacoska et al., 2023). Managing lifestyle activities, including physical fitness, was found to be a first-line treatment for menstrual irregularity and infertility (Cowan et al., 2023). In a different study on adult lifestyle, researchers found frequent substance use, low diet quality, and low physical activity to have devastating effects on mental health (Collins et al., 2023).

Inversely, high physical activity level is correlated with appropriate diurnal cortisol levels, translating to better psychological functioning (MoyersHagger, 2023). Research confirms that regular fitness activity is a natural prescription for developing, regulating, and improving human health, including problems of depression, blood pressure, and anxiety (Nguyen et al., 2023). Similarly, another study found that exercise improves the quality of life and serves as a treatment enhancer for people with breast cancer (Natalucci et al., 2023). PA support programs help improve physical activity (Amatori et al., 2023; Braam et al., 2010). Individual income levels affect engagement in physical activity, an economic relationship that will be considered at greater length later in this research (Lakerveld et al., 2008; Lewanczyk et al., 2023).

Researchers have also found that the COVID-19 pandemic has not only caused significant harm to human health both through viral infection and worsening mental health outcomes not caused by the infection (Adamu–Balatoni, 2022; Flanagan et al., 2021; Laczkó et al., 2023). Authorities have forced people worldwide to stay at home, with restaurants, retail outlets, and other businesses in crowded places usually open to the public ordered to close. Regulations varied from country to country, but between March and June 2021, most fitness clubs were unavailable to the public. While the fitness market had been growing strongly in the decade before the COVID-19 epidemic, the epidemic threatened the existence of many gyms. Revenues fell significantly due to COVID-19 closures.

According to Deloitte (2021), while the number of fitness club members in Europe grew by an average of 4.7% per year between 2016 and 2019, the epidemic resulted in a 15.4% decline by 2020.

During the epidemic, most fitness chains moved towards digitalization in preparation for the future and to adapt to the circumstances of the times, looking for opportunities to increase revenue, so digital workout plans were created, online classes were held, and apps were developed to ensure online check-ins. As a result, the number of virtual users increased significantly in a matter of weeks by July 2020 (Deloitte 2021). At the same time, some of those who used to attend fitness classes have turned to outdoor workouts or bought home equipment (Rada–Szabó, 2022).

Following the pandemic, interest in fitness classes started to grow again. People crave fun workout experiences, and new technologies and artificial intelligence developments allow new fitness trends to emerge (Štajer et al., 2022). However, at the same time as the epidemic was winding down, Europe and thus Hungary faced a new threat – inflation – associated with the Russo-Ukrainian War.

Inflation is an overall increase in the price of services and commodities in an economy. In the case of War inflation, European Union and US sanctions on Russia in oil

and gas, fertilizer, banking, and other critical sectors were the primary drivers. Russia is the second largest oil producer in the world after Saudi Arabia. Before the sanctions, most European countries heavily depended on Russia's export of oil and gas to generate electricity and to provide heating (Chen et al., 2023).

The long-term economic effects caused by the War are too substantial for small businesses to overcome easily. Many energy companies across Europe have been forced to raise their prices, and this increase is passed on to consumers, who must pay more for goods and services from businesses of every size, particularly small and medium enterprises, which cannot easily absorb energy cost increases (Hungary Today, 2022). In the broader sense, the situation has exacerbated adverse outcomes in the European and global economies. The sensitivity of global trade to energy cost fluctuations has led to significant commodity price increases and delivery disruptions (Ihle et al., 2022). Increased commodity prices may further jeopardize the ability of individuals to participate in fitness programs as they struggle to meet their basic needs.

2. METHODOLOGY

Our cross-sectional survey study employed telephone interviews using a structured questionnaire in the first half of 2023. Our study targeted the operators and owners of gyms and fitness centers in Debrecen that use gas heating and electricity to power their machinery and provide services.

Debrecen is the second biggest Hungarian city after Budapest. It is in Hajdú-Bihar County, and the city has a total population of 203,914, with 52.05% women and 47.95% men. Children and adolescents (between 7 and 17 years old) account for 11.75% of the population. Young adults (those between 18 and 29 years old) account for 12.05% of the population. Adults between 30 and 59 years old account for 42.95%, and the elderly account for 18.8%. According to demographic data, the employment rate in Debrecen is 65.9%, with only a 4.1% unemployment rate (BDeex, 2023).

Our survey consisted of 26 questions addressing five dimensions: operational abilities, pricing, income and expenditure, and attendance.

A Google search using the terms *fitness/gym in Debrecen* found 39 fitness centers, gyms, and similar organizations. After careful identification, six companies were found to have closed prior to the commencement of the study. The remaining 33 organizations on the list were contacted by telephone; five were found not to be fitness businesses in their activities, and eight did not wish to participate in the survey. The twenty remaining currently operating fitness centers in Debrecen were included in the study. Our respondents were the owners or operators of these fitness centers and were contacted via telephone to obtain their opinions.

The completed questionnaires were processed using the EvaSys 8.2 software (VSL Inc., Szentendre, Hungary; http://www.vsl.hu). Descriptive statistical analysis was used to evaluate the data.

3. RESULTS

3.1. OPERATIONAL ABILITIES

Fitness centers were first bracketed into four categories – 1-3 years, 4-6 years, 7-10, or more than ten years of operation. Thirty percent of fitness centers reported having been in business more than ten years, 25% reported having been in business 4-6 years, 20% of fitness centers had been in business 1-3 years, an additional 20% of fitness center had been business 7-10, and a mere 5% had been in business less than one year.

The participating fitness centers offer a range of services to their clients, including group gymnastics, saunas, snack-bars, showers and changing rooms, spin classes, squash, and gyms. Showers and changing rooms were provided by 95% of surveyed facilities; gyms were offered by 90%, group gymnastics by 85%, snack-bars by 65%, and saunas and spin classes by 30%. Squash courts were the least common amenity, only offered by 15%, and no fitness offered access to a Jacuzzi (Table 1).

Table 1 Characteristics of the fitness centers

Fitness center code	Duration of operation	Services	Measures to reduce overhead costs	
			Short term	Long term
F1	7–10 years	Group gymnastics Gym Personal gymnastics Changing rooms/showers	Increase prices	None
F2	More than 10 years	Group gymnastics Gym Solarium Changing rooms/showers Snack bar	Increase prices	Renovation Heating and lighting upgrade
F3	Less than one year	Group gymnastics Gym Spinning Solarium Massage Sauna Changing rooms/showers Snack bar	None	Renovation Heating and lighting upgrade
F4	More than 10 years	Group gymnastics Gym Solarium Changing rooms/showers Snack bar	Increase prices Suspend certain services	Renovation Heating/lighting upgrade Downsize staff
F5	More than 10 years	Group gymnastics Personal gymnastics Changing rooms/showers	Decrease season-pass prices	None
F6	1–3 years	Group gymnastics Gym Changing rooms/showers Snack bar	Increase prices	Downsize staff

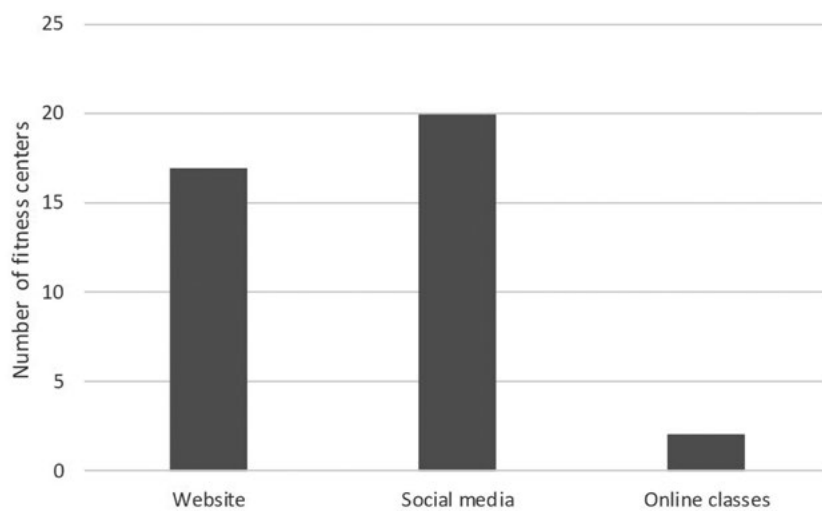
F7	7–10 years	Group gymnastics Gym Changing rooms/showers Snack bar	Increase prices	None
F8	4–6 years	Group gymnastics Gym Changing rooms/showers Spinning	Suspend certain services Reduced hours of operation	None
F9	4–6 years	Group gymnastics Gym Changing rooms/showers Snack bar	Increase prices	None
F10	4–6 years	Group gymnastics Gym Changing rooms/showers	None	Renovation Heating/lighting upgrade Downsize staff
F11	More than 10 years	Gym Changing rooms/showers Snack bar	Increase prices Suspend certain services	Renovation Heating/lighting upgrade Downsize staff
F12	7–10 years	Group gymnastics Gym Spinning Squash Personal gymnastics Sauna Changing rooms/showers Snack bar	Increase prices Suspend certain services	Renovation Heating/lighting upgrade
F13	More than 10 years	Group gymnastics Gym Spinning Sauna Changing rooms/showers Snack bar	Increase prices Reduced hours of operation	Renovation Heating/lighting upgrade
F14	More than 10 years	Group gymnastics Gym Sauna Changing rooms/showers Snack bar	Increase prices Reduced hours of operation	Renovation
F15	7–10 years	Group gymnastics Gym Changing rooms/showers Snack bar	Increase prices Suspend certain services	Renovation
F16	4–6 years	Group gymnastics Gym Spinning Squash Personal gymnastics Sauna Solarium Massage Indoor climbing Changing rooms/showers	Increase prices Decrease room temperature	Renovation

F17	1–3 years	Sauna Gym Changing rooms/showers Snack bar	Increase prices	Renovation
F18	4–6 years	Group gymnastics Gym Spinning Squash Changing rooms/showers Snack bar	Increase prices	None
F19	1–3 years	Group gymnastics Gym Changing rooms/showers	None	Renovation
F20	1–3 years	Personal gymnastics	None	Renovation

Source: Authors' questionnaire research

Timely technology adoption is crucial in today's business climate. Respondents were asked about their internet presence and use, and 85% indicated that their company had an operational website. Social media platforms are significant in our daily lives, and the level at which some organizations use them to increase their clientele base is worthy of examination. Generally, fitness centers seem eager to adopt social media as a marketing and business tool. One hundred percent of fitness centers reported having a social media presence on Facebook, WhatsApp, Instagram, or another platform to expand their organization's outreach. Figure 1 shows how many surveyed fitness centers use social media compared to other online resources.

Figure 1 Online presence of the fitness centers (website, social media, online classes)



Source: Authors' questionnaire research

Social media presence does not indicate fully embracing the internet as a business tool during COVID-19. To evaluate how these centers responded to COVID-19 shocks, researchers asked respondents if they offer online classes to their members or clients who wish to engage in sports or physical activity from their homes, offices, or anywhere outside of the fitness center at their convenience. Only 10% reported having organized classes for physical activity, while 90% admitted to no online classes (Figure 1). The number of fitness centers not offering online classes is surprisingly large, considering the growing uncertainties in today's business world.

Finally, communication is vital both within the company and outside. Therefore, to understand how these centers value email on top of social media in maintaining internal and external relations, participants were asked, and 75% of them confirmed using email to reach out to their customers and business partners.

3.2. PRICING

After evaluating the pricing strategy of the participating companies, researchers found that 85% of the 20 participating fitness centers offer discounts (such as student and pensioner passes, discounts for employees of certain companies, for those returning after a semester break, discounts for time slots, or short-term promotions), but an equal number recently increased the price of their services.

To the questions "Did your customer contest the price increase?" and "Do you believe your customers are willing to accept any price increase?" not everyone could/wanted to answer. However, 100% of those responding felt that the price increase caused resentment among club members, but two-thirds believed that the clients would remain even with the price increase and would not change their physical activity routine (Table 2).

Table 2 Pricing and pricing strategy of the fitness centers

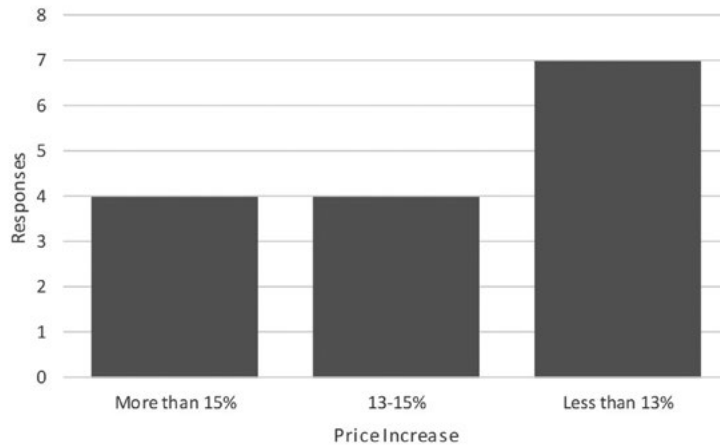
Items	Yes	No	number
1. Discounts offered	85%	15%	20
2. Price of services increase	85%	15%	20
3. Customers contest the price increase	0%	100%	14*
4. Customers willing to accept any price increase	66.7%	33.3%	15*
5. The physical activity routine of the members is affected by the price increase	35.3%	64.7%	17*

Source: Authors' questionnaire research

*Some respondents were unwilling or unable to comment on their customers' behavior.

On dealing with the increasing overhead, 85% indicated an increase in the price of their services, while 15% did not change the fees.

Figure 2 Price increase percentage



Source: Authors' questionnaire research

Price is one factor used when evaluating inflation. The respondents were asked about the percentage of price increase for their services. Figure 2 shows that out of 15 respondents who increased their prices, four reported increasing them more than 15%, and four reported increasing their prices between 13-15%. In contrast, seven respondents indicated increasing the price by less than 13%.

Combined with inflation in other domains, such as food, this increase in the price of fitness center memberships could be an economic imposition on consumers, yet there was no detectable relationship between the change in the number of guests and the price increase.

3.3. INCOME AND EXPENDITURE

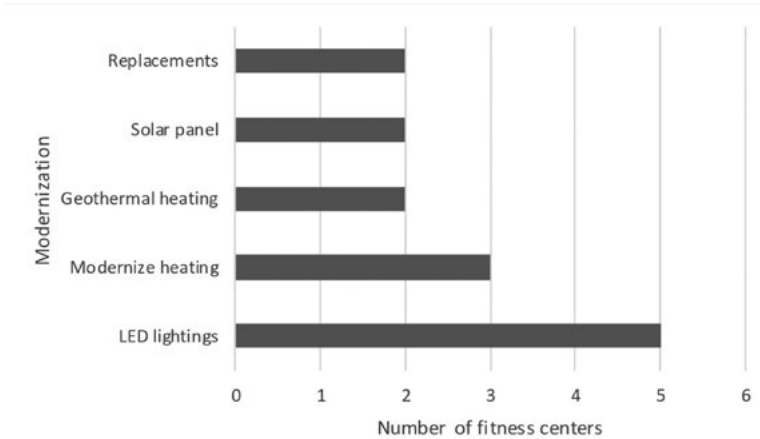
Evaluating income and expenses is very important for a company's continued survival. Maintaining the financial sustainability of a fitness club, despite gas and electricity price increases and general inflation, is possible by reducing expenses, increasing income, or some combination thereof.

Increasing revenues can be achieved by raising membership prices, increasing attendance and membership, or combining the aforementioned. Digitization, promotions (discussed above), or improvements to fitness rooms and the like can all contribute to increased profitability, and 68.8% of the respondents reported renovations or buying new machines and equipment in the last year. For 41.2% of the respondents, attendance did not change, and only 35.3% saw a decrease. Nine service providers (45%) saw no decrease in business and were able to undertake renovations despite raising their prices.

One way to reduce expenses is to reduce overhead costs through modernization and upgrades to more energy-efficient equipment. Many fitness centers did this, with 35% indicating that they upgraded their heating, lighting, or both. Ten percent installed a solar

energy source, 10% installed geothermal heating, 25% added LED lighting, 10% replaced windows and doors with more efficient ones, and 15% modernized heating (Figure 3).

Figure 3 Modernization of heating and lighting



Source: Authors' questionnaire research

In addition to reducing expenditures and dealing with operational realities, 20% of the respondents indicated reducing their workforce, a surprisingly small number.

4. CONCLUSIONS

We conducted this study to assess the impact of fuel-cost-related inflation – the rise in gas and electricity prices – on the operation of fitness centers in Debrecen. We sought to answer questions related to price increases of services, decreases in PA, declines in turnover, and workforce reductions due to inflation.

In order to evaluate inflation, pricing is a determining factor. Our results suggest that fitness centers raised prices to cover cost increases resulting from inflation, and the passing of inflation to consumers was unavoidable. We predicted this increase, fearing consumer engagement would be price-sensitive and decrease their physical activity. The results of our research establish that our fears were not fully realized, which does not establish that they were utterly unreasonable. We do not know how many fitness clubs closed during the COVID-19 epidemic or due to economic and activity restrictions imposed before our investigation. Notably, six companies were found to be closed but still included in the online database we searched at the time of the investigation, indicating that they closed their business recently.

Additionally, we caution that *some* price insensitivity on the part of consumers does not establish a *complete* inelasticity of demand for fitness center services. If inflation continues to increase, the danger of neglecting PA engagement will rise due to consumers needing to choose between ever-more expensive fitness center memberships and more pressing (and ever-more expensive) needs.

If consumers are forced to make this choice, both their health and the economy will suffer. The health effects are apparent—more obesity, more cardiovascular problems, and poorer overall life quality for the physically unengaged. The economic implications are also worthy of note. Fitness centers will lose revenue, cut back on services, and reduce their workforce, leading to higher unemployment levels. Small and medium enterprises are critical to the European economy, providing jobs and growth opportunities for employees and entrepreneurs. In 2019, 98.9% of EU businesses outside the financial services sector employed fewer than 50 people, qualifying them as micro or small enterprises (EuroStat, 2022).

A sector with this significant contribution to the economy deserves special attention, and fitness centers are an integral part of this sector.

Many fitness facilities have undergone renovation, modernization, or otherwise seen increased investment, suggesting that owners are optimistic about the future. At the same time, the battle between online training and home equipment and fitness clubs is still undecided. How many people will return to exercising in a public space post-COVID-19 remains to be seen.

The closure of fitness centers would have multiplying economic effects. We advise that more support be given to micro or small enterprises, especially fitness centers, to deal with rising overhead and other operational costs. Aid will increase the likelihood of survival of these organizations and the jobs and tax revenue they provide. This is to say nothing of the personal, economic, and community benefits of having a healthier population routinely engaging in PA.

We strongly recommend that future research focus on the opinions of potential customers and active fitness center members regarding price increases and the effects of these increases on their physical fitness engagement. Researchers should pay particular attention to the time immediately before and after the beginning of the Russo-Ukrainian War and its attendant inflation. Finally, they should investigate why some fitness centers survived this inflationary period, and others did not.

Our study is the first to analyze the situation of fitness facilities in Debrecen. This specificity makes it valuable to a particular community yet limited in its broader application. Debrecen is a small city at international level, which restricts the generalizability of this research to the national level or outside of Hungary. The number of fitness centers studied was also small, and not all centers contacted responded to our participation requests, leaving real questions about the representativeness of our sample. Finally, some of our research questions and conclusions were subjective.

Despite these limitations, we believe this research can do much to help promote the fitness industry and the overall health of the Hungarian people.

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MÁRIA KERESZTES – LÁSZLÓ IMRE KOMLÓSI

Neutral Space in Norm Recovery: Cultivating a Norm-Compliant HR System Amidst Multicultural Economic Shifts

Abstract

This research explores the Space—Economy—Humans conceptual triad, focusing on the interplay of space, economy, and human interactions, with particular attention to the concept of neutral space – an unbiased environment (in this case in the corporate world) where group and culturally complex interactions can occur. The primary objective of this paper is to examine a novel approach to cultural mentoring as an effective tool for optimizing human resource work and explore how norm-compliant systems can serve as alternatives to ethical workplace regulations. The methodology uses classical artistic tools such as music, literature, and painting to draw from cultural traditions and roots and promote unbiased collaboration and creative thinking in a corporate setting. The main findings indicate that mentoring based on these classical artistic tools within the neutral space fosters innovation, effective teamwork, and a diversity-oriented organizational culture, which are essential in today's dynamic business environment.

Keywords: norms recovery, norm-compliant HR system, art forms, neutral space, group dynamics, cultural mentoring, diversity-oriented organizational culture

JEL:

032 Management of Technological Innovation and R&D

035 Social Innovation

"Music, poetry, mathematics: great affinity."
Imre Madách

INTRODUCTION

Our research examines the intricate relationship between spatial dynamics, economic factors, and human interactions, framed within a broader conceptual understanding. Central to our investigation is exploring a neutral, unbiased environment in corporate settings, hypothesized to play a crucial role in facilitating effective group interactions and the restoration of normative behaviors. Nassim Nicholas Taleb's insights in *The Black Swan* (Taleb, 2010) emphasize the importance of preparing for unpredictable, random events in such environments. He advocates for an emotion-neutral approach to handling unexpected situations. This skill can be enhanced through artistic engagement, which aids in developing resilience and adaptability in the face of uncertainty.

This integration uses Taleb's concept of *black swan events* – unpredictable and impactful occurrences – to reinforce the need for emotional neutrality and adaptability

in corporate settings, potentially fostered through engagement with the arts. This study seeks to assess the impact and utility of innovative mentoring approaches, particularly those infused with cultural elements, in enhancing human resource management. These approaches are especially pertinent in the rapidly evolving modern workplace, where adaptability, ethical management, and innovative practices are essential to organizational competitiveness and sustainability.

Employing a unique methodology that integrates classical artistic tools and cultural traditions, our research aims to foster a creative and unbiased collaborative environment. This approach is expected to encourage innovation, teamwork and the development of a diverse and inclusive organizational culture, aligning with the needs of the contemporary business world. The theoretical underpinnings of our study are grounded in current scientific discourse and practical applications, offering insights into the strategic significance of neutral spaces in contemporary corporate environments.

1. THE CURRENT STATE OF AFFAIRS

The concept of a *neutral space* is relevant from two perspectives. Physically, it refers to an environment where individuals and social groups have equal opportunities, free from prejudice. Theoretically, it represents a mental state promoting objective, unbiased thinking. Such objective thinking and harmonious social interactions are vital in our complex world, particularly in the domain of crisis management. Modern crisis management focuses on individuals, economic competitiveness, and human resources, encompassing prevention, response, and restoration. Effective communication and collaboration are essential in reducing crises. Utilizing the benefits of this neutral space can significantly enhance crisis management strategies.

Introducing an art-driven economic model based on this new communication method offers unique opportunities. It allows for placing norms, compliance, cultural sublimation, and the sense of cultural exclusion into a neutral space. The introduction of this model facilitates addressing internal organizational issues like migration, wage ceilings, disease rates, and overall well-being.

This study is novel in that it presents fresh perspectives and methods for corporate human resource management using traditionally non-business social technologies and systems, such as artistic tools and neutrality-based group mentoring. It paves the way for innovation, creative problem-solving, and an inclusive organizational culture within the current business context.

1.1. NORMS

Workplace behaviour is primarily shaped by rules, internal expectations, and norms. Some norms originate from the social and societal sphere, while others are acquired through educational processes. Conflicts between work and family can negatively affect individuals' quality of life and psychological well-being. Other studies, such as those by Rantika and Yustina (2017) have shown that improving ethical leadership behaviour and

workplace morale can positively impact employees' personal lives and well-being. In the study by Hakanen et al. (2008), the effects of workplace stress on personal life were examined, and it was found that higher levels of workplace stress negatively impact individuals' mental and physical health. However, we believe norms should also be examined within the workplace to control their impact on work performance. The justification for the study is supported by the cultural mixing caused by globalization and cultural sublimation. Jens (1975) provides a historical perspective on how deeply ingrained cultural narratives – in the case of his research, around Judas – can influence norms and behaviours. Cultural diversity originates from different backgrounds, experiences, cultures, and perspectives. Native cultures fundamentally determine the relation of one's behaviour to one's culture. However, when confronted with different cultural settings, one may develop cultural syndrome while coping with emerging tensions (Oyserman, 2002). It is important to know that our conceptualization of cultural differences makes a conspicuous difference between native cultural acquisition and confrontations with foreign cultural settings on the one hand, and first language, second language acquisition on the other hand. The complexity and persistence of native culture is utilized as a means of neutralizing the cultural syndrome as a hindrance to multicultural cooperation.

1.2. THE CULTURAL SYNDROME AND CULTURAL DIFFERENCES

1.2.1. FOREIGN RESIDENCY AND EMERGENC CULTURAL SYNDROMES

The cultural syndrome can occur when one becomes disconnected from one's first (native) culture. This usually happens when someone spends an extended time abroad or immigrates to another country. The extent to which one develops cultural syndrome when there is one time one spends abroad. (Hakanen et al., 2008) For example, Japanese students who study in America, their individual cultural syndrome may change, and they may behave differently than what they were used to. Such changes can prove stressful. Studies have examined several cultural divides in which cultural syndrome may become particularly acute. Individual versus group orientation, communication style, and conflict management style vary from culture to culture, and addressing these differences can be complicated for those suffering from cultural syndrome. Some research shows that the extent to which one adopts part of a second culture depends on the individual's personality, the nature of their foreign experience, and the differences between the cultures involved.

Hofstede (2001) explored the deep-rooted cultural values influencing individuals' behaviors across different nations. One of Hofstede's findings highlighted the differences between individualist and collectivist cultures. Hypothetically, such differences could be exemplified by observing Korean university students, traditionally from a more collectivist culture, spending extended periods in the United States, where individualism is valued. As these students spend more time immersed in the U.S. culture, they might shift from valuing hierarchical social order and group cohesion to focusing on individual achievements. This phenomenon would underscore Hofstede's assertion that

exposure to different cultural contexts can lead individuals to reassess and potentially modify their inherent cultural values.

Both Japanese and Korean societies can often be characterized as collectivistic, but their unique cultural, social, and historical backgrounds can influence behaviors, norms, and educational outcomes in different ways. Collectivism in a cultural context refers to a societal orientation where individuals prioritize the goals, norms, and values of their group (such as family, community, or nation) over personal interests. In highly collectivistic cultures, the well-being, harmony, and cohesion of the group are considered more important than individual achievements or desires. This cultural approach affects many aspects of life, including decision-making, social interactions, and educational expectations. In such environments, individuals often find their identity, security, and success through their contributions to and alignment with the objectives and expectations of their group.

However, the effect of cultural syndromes can still persist in individuals' behavior, especially in cases where relationships between group members remain important.

1.2.2. CULTURAL SYNDROMES AND THEIR INFLUENCE ON INDIVIDUAL PERFORMANCE AND INNOVATION

Oyserman et al. (2002) examined how individual performance depends on the relationship between the individual and the group. The researchers concluded that individuals define themselves separately from others in individualistic cultures and focus on their goals. In contrast, in collectivist cultures, individual goals are related to group goals, and individual performance is assessed by the group's success. Chen et al. (2013) investigated the impact of cultural syndromes on individual performance in multicultural workplaces. The researchers concluded that cultural syndrome determines individuals' emotional reactions to workplace challenges, thus influencing individual performance, and Miron-Spektor and Paletz (2022) examined how individuals' cultural backgrounds influence innovation.

1.3. CULTURAL SUBLIMATION

1.3.1. ETHICAL AND CULTURAL NORMS: NAVIGATING ARTISTIC INTERPRETATION AND RESPONSIBILITY

Artistic norms are rules and methods for creating works of art and shape how people perceive and interpret art. Ethical norms are crucial in shaping people's opinions and attitudes towards art. The relationship between ethics and aesthetics can be complex and sometimes controversial, as ethical norms can sometimes clash with aesthetic values. However, artists must be aware of ethical norms in their work, as their creations can significantly impact society. Art can be a powerful tool for education, communication, and social change, and artists must use this tool responsibly. Thus, establishing a code of ethics in the neutral space of artistic practices is crucial for artists to be mindful of ethical norms and make their creations effective. In addition to ethical norms, social and

cultural norms influence artistic expression. For instance, specific themes or motifs may be considered taboo or offensive in some cultures, while in others, they may be celebrated or even essential to artistic expression. Cultural norms can also impact the types of artistic media used and the techniques applied. Therefore, artists must be sensitive to cultural and social norms, especially when creating art for a particular audience or context.

In conclusion, the relationship between ethics, norms, and art is complex and multifaceted. Ethical norms influence the content, style, and form of artistic creations, while cultural and social norms shape the interpretation and reception of art. Potter (2018a; 2018b) discusses the importance of cultural sublimation in this context, emphasizing the need to establish a code of ethics in the neutral space of artistic practices. Artists must create meaningful and compelling works that positively impact society, ensuring that the sublimation of culture through art adheres to ethical standards and societal norms.

1.3.2. FOSTERING CREATIVITY AND COLLABORATION IN NEUTRAL SPACES: MANAGING CULTURAL SYNDROMES AND CULTURAL TENSIONS

In a neutral space, norms are shaped through the sublimation of emotional tensions. Constructive emotion management within this space fosters better communication and behavior in groups. However, it is essential to acknowledge that sublimation is only part of the solution; social, cultural, and institutional factors also significantly contribute to this process.

One must also recognize the broad impact of cultural tensions and cultural syndromes on workplace dynamics, not limited to specific activities like group painting but also affecting ethical norms and creativity. Hierarchical and authority-driven cultures can influence workplace norms and potentially restrict creativity. By focusing on the positive elements of the cultural syndromes in a neutral space, norms and values that enhance creativity, unity, and effective teamwork can be fostered, positively impacting the workplace environment.

This study introduces novel perspectives and methods for corporate human resource management using traditionally non-business techniques, including artistic tools and neutrality-based group mentoring (Keresztes, 2023a). This approach opens new avenues for innovation, creative problem-solving, and building an inclusive organizational culture in today's business landscape.

1.3.3. UNIVERSAL NORMS AND CULTURAL CONNECTORS: HARNESSING SHARED AESTHETICS FOR WORKPLACE COHESION

In the context of universal norms and cultural connectors, it is essential to consider the theories of Kurt Lewin (1935), who introduced a dynamic theory of personality that can be applied to workplace cultural diversity. The dynamics described by Lewin evolve based on employee interactions, leadership styles, and corporate culture, impacting workplace performance and atmosphere. Lewin's theory suggests that communication is significantly influenced by individual personalities and group dynamics (conflict,

understanding, acceptance, style, performance, and motivation). These factors interact with the processes created in a neutral space within organizations to either facilitate or impede communication. In assessing cultural connection points, adopting Lewin's perspective can offer valuable insights into how individuals and groups interact and form connections within a multicultural environment. These connections are established through interviews, collaborative drama, artistic analyses, and musical experiences. By connecting these points conducive to identification, understanding in communication emerges. For instance, universally accepted norms like the Fibonacci sequence can be used to demonstrate Lewin's concepts in a multicultural community and artwork based on it can promote cooperative work and value creation. These dynamics evolve based on employee interactions, leadership styles, and corporate culture, impacting workplace performance and atmosphere. Particularly in a neutral space, communication is significantly influenced by these dynamics (conflict, understanding, acceptance, style, performance, and motivation) and significantly influence them. This is the result of processes created in a neutral space.

In every organization, assessing cultural connection points within the group is crucial. These were established through interviews, collaborative drama, artistic analyses, and musical experiences. Subsequently, by connecting these points conducive to identification, understanding in communication emerges.

Let us highlight an example. Every modern culture has some understanding of the Fibonacci sequence and the golden ratio, which are closely related (Basak, 2022). Some norms are universally accepted and can be reinforced in a multicultural community to promote cooperative work and create value. The golden ratio, a mathematical and aesthetic principle, appears in nature, architecture, art, and human body proportions. Ratios close to the golden ratio, such as the 1:1.618 ratio, are considered more aesthetically pleasing and are used in architecture, art, and design to create balance, harmony, and aesthetic appeal. The golden ratio also influences economic phenomena and fields, including stock market trends, economic cycles, financial returns, and marketing campaigns. It has numerous creative and valuable applications in economic and other fields and continues to play an essential role in design processes and artistic applications.

2. KNOWLEDGE AND MODELING

2.1. INTERPLAY OF ARTISTIC TOOLS AND CORPORATE EFFICACY: HARNESSING CREATIVITY FOR ENHANCED PERFORMANCE

The economy-based art mentorship program in a neutral space demonstrates the importance of an interdisciplinary approach in expediting and facilitating communication processes within organizations. Here, we recall thinkers and researchers such as Muzafer Sherif (1951) or Mihály Csikszentmihályi (1990) and refer to their connection to the flow

experience in creative processes. We are inspired by the work of Brown and Osborne, who emphasize the significance of creative thinking in the business environment.

These researchers and their conceptual systems are related to research in artistic tools, creativity, and human performance within the corporate environment. Mihály Csikszentmihályi's research on the flow experience describes the state of complete immersion and creative activity; therefore, it is significant for understanding norm-recreation. Csikszentmihályi analyzed creative processes and possibilities for optimizing human performance. Amabile and Kramer (2011) researched workplace creativity and performance, and they extensively examined how enhancing creative self-expression and positive experiences at the workplace can contribute to innovation and productivity. Stanfield (1997) introduced communication methods that can be applied in the corporate environment by incorporating artistic foundations. Roger Nierenberg (2009) examined parallels between orchestral leadership and corporate leadership. The works of these researchers are highly relevant because they directly address the interaction between artistic tools and the corporate environment, providing examples and case studies on how to effectively apply them in human resource management and organizational efficiency enhancement. Modern approaches often emphasize the importance of human resources (Ulrich, 1997).

The study by Stanfield (1997) on "The Art of Focused Conversation: 100 Ways to Access Group Wisdom in the Workplace" can be integrated into this section. It serves as a resource for understanding and enhancing the workforce's creativity and performance. Stanfield's work emphasizes the importance of effective communication and collaboration within organizations, which are essential factors in fostering employee abilities and performance. We thoroughly examine the characteristics of the workforce, such as education, experience, motivation, skills, and creativity. This assessment extends to employees' relevant education, professional experience, motivation, skills and creativity, where specific aspects detailed in parentheses (for example, how long they have gained experience in similar job roles, the extent of their readiness to perform their work) are evaluated through questionnaires and in-depth interviews prepared for assessing the effectiveness of artistic mentorship programs.

2.2. THE NEUTRAL SPACE IN ARTISTIC MENTORSHIP: THEORY, PRACTICE, AND IMPACT

Muzafer Sherif's (1937; 1951) ideas about neutral space provided the starting point for understanding their role in facilitating communication. Unfortunately, he did not examine the sustainability of the neutral space in complex artistic environments or culturally mixed groups. It remains a theoretical question in economics whether humans can re-evaluate themselves and, based on this, create new roles and relationships.

Henri Tajfel (1982) and Solomon Asch (1951) analyzed the interaction between people and group dynamics using different methods, but they also used the neutral space theory. They both believed that group influence determines the relationship of trust, power, and roles. They assumed that people could free themselves from group influence and see themselves and each other honestly within the neutral space.

The Art-Driven Economic Mentorship model has demonstrated successful outcomes in various countries, including Hungary, Slovakia, Indonesia, Taiwan, and the UK. This research has indicated that mentorship programs implemented within companies or organizations often result in slower growth and decreased motivation among participants, whereas mentorship activities carried out by external groups tend to experience significant expansion and development.

Future research will focus on employee dynamics following their participation in the artistic mentoring process. This investigation will delve into changes in trust and power dynamics within the organizational structure and the establishment of a normative regulatory system for future interactions. The research methodologies employed will encompass surveys and qualitative and quantitative analyses, with particular attention to elucidating the pivotal elements of the Art-Driven Economic Mentorship module.

2.3. BRIDGING ECONOMICS AND ART: THE HUMANISTIC PERSPECTIVE OF DECISION-MAKING AND SOCIAL PREFERENCES

The first question that may arise is what connection exists between economics and the arts. Amartya Sen (1981, 1992), a Nobel Prize-winning economist, found a relationship between ethics, literature, and economics. He believed that social phenomena such as inequality, poverty, and social justice can be more easily understood through literature. According to him, economics ignores real life and people's real feelings, interests, and preferences. He believed literature could help better understand emotions and create a more humane economy. The process that Sen presents to us is not made up of numbers and statistical worlds but manifests itself in human development. Along with examining economic decision-making, examining human values and value systems should also have a role, and the basis of these values can be found in artistic forms (Goetzmann et al., 2014). Through discourse with intellectuals, economic decision-making can become more sensitive.

One of the most significant studies developed the concept of social preferences. Data analysis, interviews, and focus groups have examined social preferences through the lenses of value systems, interests, demands, and goals. Examining social preferences can help us understand what consumers need, their demands, and how society operates based on norms.

2.4. HISTORICAL EVOLUTION OF ART AND ECONOMY: FROM ANCIENT ETHICAL CONSIDERATIONS TO ECONOMIC THEORIES OF VALUE

In the historical evolution of art and economy, Linda Naiman (2010) highlights how artistic approaches can significantly influence economic thinking and practices. Alongside Adam Smith's theories on economic growth and labor pricing, Naiman emphasizes

that artistic and creative approaches add value to the economy by fostering innovation and enhancing the quality of products and services.

The relationship between art and economy has a history of several thousand years. The ancient Greek philosophers Plato and Aristotle and the later Saint Augustine and Saint Thomas Aquinas have already spoken about the relationship between art and society, primarily examining ethical issues such as usury, speculation, and exploitation. The specific relationship to the economy became prominent only in the late 1800s with the growth of the economy and the spread of capitalism. Adam Smith wrote clearly about the relationship between art and the economy. In two treatises, *The Theory of Moral Sentiments* (Smith, 1759) and *An Inquiry into the Nature and Causes of the Wealth of Nations* (Smith, 1776), he developed his theory that wages and the price of labor continuously rise with economic growth. Referring to John Locke, Smith formulated the labor theory of value, stating that the work producing a service or product determines its price. The higher the price, the more work is invested in producing a product. However, products and services cannot be produced without the cooperation of productive forces such as labor, capital, technology, and land. These cooperation ratios also work to determine the price of goods and services. In addition to the value created by labor, the other productive forces only need to add enough value to complete it.

3. THE MODEL

In the following, we will provide a detailed overview of how to apply artistic tools and group mentoring in corporate practices. We will outline the applied methodological steps and tools and provide concrete examples of the impact of the arts and group mentoring through case studies. Here, we reference Gardner's (1983) work on multiple intelligences and the role of the arts in creative development.

The model we have developed and present here utilizes artistic elements – drama, music, painting, and sculpture – to shape and mold the group norm system without introducing biases. This novel model encourages active participation from workgroups and offers a fresh approach. Often regarded as hollowed-out and formulaic, attempts at communication are often ineffective within organizations. Traditional verbal and written messages frequently get lost or misinterpreted within groups, leading to further misunderstandings.

By employing artistic tools, we can interrupt this process and achieve an impact within and beyond the group—at organizational levels and in personal lives alike. We employ art to establish norms that can serve as universally accepted reference points, free from prejudice.

Furthermore, it is essential to understand that this model is not merely a creative approach to norm formation but also a toolkit that offers several advantages to organizations. Artistic tools help prevent communication errors and enhance group collaboration and understanding. Additionally, the results achieved through the model are not limited to workgroups but extend to the entire organization and potentially even to personal life. Consequently, our model contributes to more efficient and coordinated

work and healthier organizational functioning. Moreover, it can combat biases and support diversity within the organization. Such a versatile and practical approach can be invaluable in the corporate sector and organizational development.

4. THE COMPANY

The company under study, based in the Far East, predominantly operates with upper and middle management from Eastern regions in the heart of Europe, Hungary, managing its headquarters from a rural industrial park. Their main product categories include electronic components, connectors, cables, and industrial automation equipment. The versatility of these products allows the company to serve various sectors, including the automotive industry, IT device manufacturing, healthcare devices, and the energy sector. Although the company may be considered medium-sized, its extensive global network provides access to various resources and expertise. The parent company is in Asia and has multiple subsidiaries and manufacturing units across several continents. As a result, the company can efficiently serve its customers worldwide and maintain competitiveness in the electronics industry.

However, the company still faces challenges in competitiveness. The electronics industry brings rapid technological changes and constant market pressures. The company must adapt to new developments and trends while maintaining cost-efficiency and quality. Additionally, global demand can fluctuate, requiring the company to adjust to market changes. The industry as a whole also experiences a shortage of skilled professionals, necessitating the development of strategies to attract and retain a talented workforce.

Innovation and technological competitiveness are crucial for survival and growth in the highly competitive electronics market, marked by ongoing price competition. To remain profitable while delivering high-quality products, companies in this sector must embrace sustainable manufacturing and business practices and comply with environmental regulations and standards. Additionally, operating globally and catering to diverse markets, these firms must provide cultural support for their employees to ensure a conducive working environment. Market conditions, however, are subject to change, often necessitating diversification and adaptation. Therefore, strategies that enable adaptation to varying market demands and fluctuations are essential. A skilled workforce, which may command higher wages and face skills gaps, forms the cornerstone of this approach. In this context, a long-term mentorship program incorporating various cultural and artistic elements can effectively address these challenges and promote productive collaboration between workers of varied backgrounds.

5. THE PROCESS

Introducing the Neutral Space and Art Mentorship Program has become a strategic move for the Global Electronics Company in workforce selection, thus addressing the company's challenges and objectives. As the initial step, we conducted an assessment within the company to identify the areas and groups that could benefit the most from

the art mentorship program. These groups included technical experts, the product development team, and designers. External mentors were brought into the company to advance the program.

Based on the outcomes of the process, it can be concluded that the Art Mentorship Program has had a significant impact on the company's work culture and the creativity of its employees. Positive changes were especially noticed among employees working in areas where creativity plays a crucial role. The program revealed communication barriers and misunderstandings among groups that had not been addressed before. Following the conclusion of the mentorship program, employees valued the experience so highly that they were willing to contribute from their own budgets to ensure the sessions could be held regularly. This suggests that art mentorship has a positive effect on employees regardless of their profession, cultural background, and current emotional state. As an economic expert, it is noteworthy that this investment not only improves the workplace atmosphere but can also play a key role in enhancing the company's innovation capabilities and productivity in the long term.

During the group mentorship program, each mentor led a small group where employees could participate. The group size typically ranged from six to ten individuals to ensure effective functioning. However, at the leadership's request in this particular company, there were 13 participants during the initial meeting of the cycle – slightly larger than is typical but not so large as to make mentorship impossible. The mentorship program utilized various artistic tools, such as painting, music, or acting (with group compositions varying depending on the artistic domain).

The groups regularly met with their respective mentors, where, alongside artistic activities, the focus was on problem-solving, communication issues, flexibility, creativity enhancement, and idea generation. The company requested the program to span over several years, with a duration of one or two years for these specific corporate groups. It is generally advisable to plan for the long term and maintain the ongoing activity with the group weekly, bi-weekly, or monthly. Feedback and data from semi-annual or annual cycles indicated that the groups valued the program. Introducing participants to individual modules during the first cycle is recommended, allowing for a deeper immersion into artistic and creative practices in subsequent cycles.

In this company, starting with fewer groups during the first cycle might be worthwhile, as well as testing the program with smaller groups, perhaps with 2–3 groups, each consisting of 6–10 participants. This approach allows for developing effective group dynamics and fine-tuning the program; a step that is essential to foster open communication and trust between the mentor and the participants to improve group dynamics. Group members should encourage each other and be willing to share their ideas and experiences if the program is to be effective. The program's introduction has yielded several positive effects, which were analyzed through questionnaires and in-depth interviews. Based on these findings, it can be concluded that group mentoring has contributed to improved teamwork and more effective communication among teams. Participants' personal development improved during the mentorship program, reducing conflicts and enhancing their performance within the company. Participants drew

inspiration from artistic activities, boosting their creativity and innovative capabilities. They even applied specific techniques at home, eagerly anticipating and preparing for the sessions. Group members could develop and express their artistic skills and talents, encouraging their engagement and dedication to the program.

With the conclusion of the first program implementation cycle, the company can assess outcomes and determine if it desires to expand the program, increase the number of participants, extend it to additional areas, or discontinue the program altogether. Long-term success relies on adaptation, continuous improvement, and time. This model involves a more extended process, and all its positive effects should not be expected to manifest immediately, so the company is encouraged to demonstrate patience. The results should gradually become noticeable, and the program's long-term success requires commitment and perseverance.

While culturally agnostic, the mentorship program finds enhanced effectiveness in a multicultural environment. Certain aesthetic norms, such as the Fibonacci sequence, elicit uniform reactions across diverse cultures, facilitating the elevation of human values and more efficient alignment of employees. In human resources, Key Performance Indicators (KPIs) could utilize these principles as benchmarks, for instance, measuring sustainable or retrievable states post-group sessions. These measures aid companies in better leveraging workforce diversity and creativity, improving corporate performance and competitiveness.

6. CONCLUDING REMARKS

This study aimed to explore the complex interplay between spatial dynamics, economic factors, and human interactions within a broad conceptual framework. We specifically investigated the role of a neutral, unbiased environment in corporate settings, hypothesizing its significant impact on effective group interactions and the restoration of normative behaviors.

To achieve our goals, we assessed the impact of innovative mentoring approaches, particularly those infused with cultural elements, in enhancing human resource management. The assessment methods included case studies, self-assessments, peer evaluations, simulations, questionnaires, 360-degree evaluations, and in-depth interviews. These approaches are vital in the rapidly evolving modern workplace, characterized by the need for adaptability, ethical management, and innovative practices.

Our unique methodology integrated classical artistic tools and cultural traditions to foster a creative and unbiased collaborative environment. This approach was anticipated to promote innovation, teamwork, and the development of a diverse and inclusive organizational culture, meeting the contemporary business world's demands.

The theoretical foundation of our study, grounded in current scientific discourse and practical applications, provided insights into the strategic significance of neutral spaces in corporate environments. Our research contributed to a deeper understanding of these spaces, highlighting their role in crisis management and decision-making processes.

This study brought novelty by offering fresh perspectives and methods for corporate human resource management in traditionally non-business domains. We utilized artistic tools and neutrality-based group mentoring to pave the way for innovation, creative problem-solving, and the establishment of an inclusive organizational culture.

In conclusion, our findings suggest that a neutral space can significantly enhance corporate human resource management when combined with artistic and cultural elements. This approach fosters a conducive working environment and aligns with the evolving needs of businesses in the contemporary landscape. Integrating these innovative methods presents a promising avenue for future research and practice in corporate human resources and organizational development.

6.1. CHALLENGES AND POTENTIALS OF ARTISTIC MENTORSHIP IN STUDY AND PRACTICE

In exploring artistic mentorship's dynamics, several factors shape its effectiveness and impact. The varied personal abilities and experiences of group members within the cycles can influence their engagement in artistic activities and the application of these experiences to workplace problem-solving. The organization and maintenance of artistic mentorship group sessions require careful consideration of time and effort. Ensuring the availability of necessary tools, resources, and skilled mentors for these sessions demands a thoughtful allocation of resources.

Additionally, the assessment of the impact of artistic mentorship presents its own set of considerations. Understanding and recognizing the positive changes experienced by group members requires a nuanced approach, as these changes may not always be easily quantifiable. The diversity in participants' artistic preferences and experiences can also influence their engagement and responsiveness in group sessions.

Despite these considerations, the potential benefits of artistic mentorship groups for participants and organizations are significant. With strategic planning and continuous evaluation, the approach offers a valuable avenue for enhancing creativity, collaboration, and problem-solving abilities within a corporate setting. This method opens new opportunities for personal and organizational development, fostering an environment conducive to innovation and inclusive growth.

6.2. EXPANDING HORIZONS: FUTURE RESEARCH AVENUES IN ARTISTIC MENTORSHIP ACROSS PROFESSIONS AND APPLICATIONS

The research areas of artistic mentorship groups offer numerous potential directions for future investigations. Further research is needed to assess the impact of artistic mentorship groups on participants' workplace performance, creativity, well-being, and long-term careers. An examination could determine how artistic mentorship groups can be applied in various industries and organizations, including business, education, healthcare, and community sectors. Their application in emotion-demanding work

settings (Keresztes, 2023b) – judges, police officers, educators, lawyers, doctors – could also be explored. Additional studies, such as conflict resolution, leadership development, or creativity enhancement, are warranted where artistic mentorship groups can be applied. The selection, training, and support of mentors are crucial to the program's success. Research in this area should aim to understand the qualities and skills that make mentors effective.

6.3. ARTISTRY IN COMMUNICATION: BRIDGING GAPS AND PROMOTING WELL-BEING IN THE CORPORATE SPHERE

The relationship between communication levels within a company and a decrease in conflicts is significant, and this can be influenced by the role of artistic activities and the reduction in disease rates. Ken Robinson (2009) discusses how personal fulfilment and passion, often found through artistic pursuits, can positively impact workplace environments. This issue is particularly worthy of attention in the corporate sector, as a healthier work environment and reduced conflicts can lead to more efficient work outcomes.

The connection between enhanced communication levels within the company and reduced conflicts can be explained as follows: Improving communication within the workplace offers several advantages. Transparent and effective communication helps prevent misunderstandings and information gaps, often sources of conflicts. Employees better understand each other's needs and perspectives, making reaching agreements on common goals and tasks easier. Furthermore, open communication channels allow employees to express their concerns and opinions without fear of retaliation or suppression.

Integrating artistic activities into the corporate environment can improve communication and reduce conflict. Art provides a platform where employees can creatively express themselves and share their feelings and thoughts. This type of self-expression can contribute to better understanding and collaboration among teams. Additionally, artistic activities can have stress-reducing effects, which further aids in conflict reduction, as stress often acts as a source of conflict in the workplace.

The connection between artistic activities and decreased disease rates can be linked to stress reduction and promoting a healthier work environment. Artistic activities often offer a means of stress relief and relaxation for employees, which can have a positive impact on their overall health. A healthier work environment and stress reduction can contribute to a lower risk of illness and support general well-being. Based on the above cases, the most significant outcome is that group mentoring based on classical artistic tools within the neutral space enables prejudice-free collaboration and creative thinking in a corporate context. As a result, more effective human resource management, establishing norm-compliant systems, and developing value-driven human resources can all be realized. These collectively contribute to companies' competitiveness and long-term success in a dynamic work environment. Furthermore, the methodology lays the groundwork for discovering new solutions and perspectives, contributing to the development and innovation within the corporate landscape.

In summary, we can assert that improving communication levels within a company and reducing conflicts directly contribute to more efficient work outcomes and a healthier work environment. Introducing artistic activities can create opportunities to achieve these goals within an economically valuable context where health and efficiency are essential factors. The idea of artistic mentorship may best be summarized *as everything flows, panta rhei einai. (Heraclitus)*

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How pandemic and sustainability concerns transform the office market - a case study of Budapest, Hungary

Abstract

Major forces are transforming the office real estate market globally. One such force is the COVID-19 pandemic, which triggered a substantial growth in remote work. Another can be found in environmental concerns that demand sustainable buildings and operations. A third is the increasing emphasis on the health and safety concerns regarding buildings. A fourth is the changing economic/geopolitical landscape. The purpose of this paper is to evaluate the relationship between the increasing emphasis on remote work (partially as a result of COVID-19), environmental sustainability for buildings and office space, and larger financial concerns and the types and sizes of leasing and purchasing transactions for green-certified and non-green-certified spaces in Budapest before, during, and after the global pandemic. The goal of the research is to map the office tenants' size optimization attitudes since the global pandemic outburst. The research aimed to understand how the Budapest office market reacted to the global pandemic, with particular emphasis on green-certified office space. The research examined Budapest office market leasing transactions between 2018 and 2022 by way of a statistical analysis and individual interviews with market actors. Results show that after a small decrease in 2020, the average, green-certified transaction size increased in 2021; however, it showed a 13% decrease in 2022. In the case of not green-certified offices, the average transaction size decreased for 2 years, but in 2022, increased by 60%. Market actors see a large demand from multinational companies for green offices, as environmental, social, and governance (ESG) policies drive corporations; however, there are financial pressures at play, which motivate tenants to optimize their space decisions.

Keywords: Budapest office market, green-certified offices, real estate, lease sizes, COVID-19, ESG

JEL code: R11, R33

INTRODUCTION

The global coronavirus (COVID-19) pandemic strained public health resources throughout the world and disrupted the global economy. The public's interest in living in high-density cities drastically decreased as a result of COVID-19, which has also changed working and residential location preferences (Wen et al., 2022). Ramani and Bloom (2021) discovered that suburbs saw a net gain of 2%, while the central business districts (CBDs) of the top 12 U.S. cities experienced a net drop of 15% in population and business presence. Additionally, Barrero, Bloom, and Davis (2020) estimated that work-from-home activity will continue to account for 20% of total working hours – four

times the pre-pandemic level in the Western world. Gupta, Mittal, and van Nieuwerburgh (2022) discovered that the transition to remote work led to a 28% drop in the long-term value of office buildings in New York City. Gujral et al. (2020) established that this change will disrupt the CBD economic environment and reduce consumer spending in major cities' CBDs by about 5 to 10%. Several other studies stated that COVID-19's effects on firm closures, workplace norms, and consumer behaviour will result in less demand for commercial real estate (Ling et al., 2020; Maria del Rio-Chanona et al., 2020; Oladiran et al., 2023). In its global survey of 'superstar' cities, McKinsey Global Institute reports that demand for office space has been falling since the start of the pandemic and predicts that demand will continue to fall over the next seven years in most of the cities surveyed. The increasing number of remote workers correlated with the degree to which office attendance fell, showing that the two phenomena were related. Lower office attendance has similarly driven down asking rents in real terms as well. McKinsey predicts demand for office space in a moderate scenario will be 13% lower in 2030 than it was in 2019 for the median superstar city as a result of remote work and flexible working arrangements and as the amount of space allocated to each office worker is expected to shrink (Mischke et al., 2023).

Before the global pandemic, offices were widely believed to be important for employee productivity and business culture and a powerful winning tool for the struggle for talent. Businesses worldwide engaged in fierce competition for the best office space, and many of them concentrated on ideas that were thought to encourage teamwork. The recurring themes and objectives were densification, green certification, open-office layouts, hot-desking and co-working. Company managers, real estate agents and consultants, and also office workers themselves were shocked by how fast and efficiently videoconferencing technology and other digital collaboration tools have been adopted throughout the global pandemic. In the emerging world of remote work, many companies believe they can access fresh talent pools with fewer geographic restrictions, adopt cutting-edge techniques to increase productivity, forge a stronger culture, and drastically lower real estate expenditures all while relying less on the conventional office space and office culture (Umishio et al., 2022).

The purpose of this research is to evaluate the relationship among the increasing emphasis on remote work (largely fuelled by COVID-19), environmental sustainability for buildings and office space, and larger financial concerns and the types and sizes of leasing and purchasing transactions for green-certified and non-green-certified spaces in Budapest. The research does this by way of a detailed statistical analysis of office leasing deals and green certifications between 2018 and 2022 in Budapest, augmented by individual interviews with real estate market actors, including three property managers, five leasing agents and eight tenant representatives. The goal of the research is to map the office tenants' size optimization attitudes since the global pandemic outburst.

The main hypotheses were that since the appearance of the pandemic, office tenants prefer to lease smaller sizes of office building space and are hesitant to upgrade to larger spaces, with this effect being more moderate in green-certified buildings and more pronounced in the conventional (non-green-certified) office space market.

The paper is structured as follows: First is an international literature review of the COVID-19 and green certification office topic. This is followed by detailed research and analyses including the results of the survey and investigation conducted in Budapest. Finally, suggestions are made for further research such as country comparison or the repetition of the research after a few years.

1. LITERATURE REVIEW

The performance of the office space rental markets has received much examination in the literature over the past few decades. From the viewpoint of the occupier market, rent and vacancy rates are the major variables dictating the amount of cashflows received by owners and stakeholders of office real estate. The value of a real estate asset also directly links to the effective rental level and the vacancy level of nearby properties. Numerous theoretical and empirical studies have shown the close relationship between these two indicators: high vacancy fosters a "tenant market" that results in weaker (negative) rent growth, while low vacancy fosters a "landlord market" that results in stronger rent growth (Glascock et al., 1993; Hendershott et al., 1999; McDonald, 2000; Wheaton–Torto, 1988). Therefore, the same supply and demand factors affect both rent increase and vacancy rate. The latter (demand factors) include structural characteristics such as office space per employee (Miller, 2014), GDP growth (D'Arcy et al., 1997; Gardiner–Henneberry, 1989), employment in (office) settings (Hendershott et al., 1999; Sivitanides, 1997), and employment in general. An inverse relationship between the economies of office markets and working from home should be identifiable through an analysis of employment variables. The long-term impact on the total demand for office space and the performance of office markets continues to draw special attention from practitioners in light of the possibility of a higher level of homeworking in the future (Morawski, 2022).

Changes in the everyday routines of millions of office workers worldwide were one of the most obvious effects of the COVID-19 pandemic. No comparable episode in modern history has changed working arrangements as profoundly and quickly as has COVID-19. The shift from farms and craft production to factory jobs during the Industrial Revolution took about two centuries and the later shift from factory work and other goods production to a service economy has been an ongoing process for decades (Aksoy et al., 2022). The global working-from-home experiment during the pandemic has been relatively successful, and this has sparked concerns about a potential structural change in the office space and rental sector. The long-term effectiveness of working from home versus working at an office is still largely disputed, but if the homeworking trend persists, it may result in a considerable decline in the demand for office space, which would have the effect of increasing vacancy rates of office space, obsolescence of some office spaces, and dropping rents. Some forecasts, particularly the early ones, suggest that offices will be used less, leading to a depression in office space sector prices (Morawski, 2022; Nixey, 2020). Other researchers draw attention to the fact that face-to-face communication is still necessary also preferable and is most effective when it occurs in offices. Therefore, even if some work was done from home, it would only affect

the nature of the office space utilized by businesses rather than significantly damage it (Kröger, 2021; Schede, 2021).

Any analysis of the post-pandemic recovery process must take into account the global labour market disruptions that have led to numerous experiments with remote work, flexible work schedules, and novel connections to centralized work settings. However, when it comes to the long-term predictions, there is disagreement over whether the coronavirus disease was a singular event and that pre-pandemic working norms will return, or whether the world is going through a massive upheaval that will usher in a 'new normal' for working conditions, with researchers and governments speculating about a wide range of different 'new normal' future states of the world (Vyas, 2022).

The implementation of telework, upcoming workplace design and configuration changes to work norms and the office environment, and re-engineering of office work protocols have all been prompted or accelerated by COVID-19. Analyses of management techniques show the trade-offs made between financial rewards and workplace health and safety. Advancements in technology will make office management strategies and justifications for those strategies more easily assessable and will make those who implement them more readily answerable to office personnel and other stakeholders in a way that was impossible in the earlier era of official accountability reports (Parker, 2020). The pandemic had a catalytic role in the shift to remote work, as the pandemic induced a mass social experiment out of necessity. That experiment generated new information about working from home and it changed the perceptions of its effectiveness. The new information and the shift in perceptions led to individuals and organizations re-optimizing space use, which has proven to have a lasting effect even after the pandemic situation ceased (Aksoy et al., 2022).

Local circumstances have a significant impact on workplace strategy. Before the COVID-19 epidemic, on average, between 35% and 45% of workers in the USA and EU-28 worked occasionally or regularly from home or a public place (such as libraries or cafés), but the number of persons who did so varied greatly by nation (Tagliaro–Migliore, 2022). Italy and Portugal had low adoption rates (25%) compared to the Nordic countries in Europe (all above 50%) (OECD, 2020). The amount of working from home varies across countries and regions. The highest levels are in the Nordics – both in America and Europe. Lower levels characterise Southern Europe, and even lower Asia and developing countries, as the share of remote work highly depends on the share of employment in remote-friendly industries like technology or business services. There are a variety of explanations for this variation across countries and regions. North American homes tend to be larger and thus accommodating a home workspace is easier, whereas in Europe and particularly in Asia houses and apartments are often smaller (Barrero et al., 2020).

The state of industrialisation of a nation or region also influences this transformation. Those economies that are more oriented towards technology, finance, and business services are better suited to embrace remote work. In the United States, compared to other parts of the world, companies have more refined performance measurement and evaluation systems that make introducing and maintaining working from home

easier. The quality and availability of high-speed internet connections and the size and adaptability of residential accommodation have a considerable impact on working from home. Within countries, variations exist among regions as remote work is far more prevalent in urban and suburban communities than in rural areas, as urban and suburban economies are more reliant on technology and business services than on farming and industrial production (Aksoy et al., 2022).

Cross-country comparison of the Global Survey of Working Arrangements (G-SWA) data covering 27 countries proves that longer, stricter government lockdowns during the pandemic led to higher work-from-home levels as of mid-2021 and early 2022 and also to higher planned remote work levels after the pandemic. The social acceptance of remote work has risen in all countries since the pandemic, corporate cultures have embraced the concept, and managers are more willing to offer flexible conditions to retain and recruit employees. This improvement in social acceptance also contributes to the lasting effect of the pandemic (Aksoy et al., 2022). Only a minority of office employees would return to the corporate office full-time if given the choice, according to recent polls (Tagliaro–Migliore, 2022), while the majority are now willing to switch between the office, their homes, and other work sites. According to several studies, working from home is superior to working in an office in every way (Amoils, 2021; Gashi et al., 2022; Prodanova–Kocarev, 2022).

Collectively, these findings have compelled businesses to take unconventional real estate positions. Three primary work policies have served as the foundation for the most recent corporate real estate (CRE) strategies:

- the traditional, work from the office all the time method;
- work-from-home (WFH) all-the-time/remote work all-the-time method;
- *smart working* (hybrid working).

Changing work policies have also driven attention to the topic of *greenness*. Before the pandemic, sustainability was on the global radar, but Covid-19 has pushed it to the centre of the screen, making it a priority when evaluating every aspect of work that touches upon the environment, including offices, enterprises, and commutes. Investors, customers, and employees are increasingly demanding that businesses have a positive impact on the environment and society. There is growing evidence of enhanced revenue and profit growth, greater returns on equity and assets, and lower cost of capital as a result of greening the business model of how companies operate (Brounen et al., 2021; Gholami et al., 2022). The costs of sustainable practices implemented are direct and easily measurable; however, their impact on financial performance and asset value is more challenging to calculate as their value improvements are indirect and intangible. The key value drivers as defined by the United Kingdom Green Building Council (UKGBC) are factors that can be influenced, measured, managed, and controlled and as a result, affect the value of the business by reducing risks, increasing profitability, and increasing future probability. UKGBC has identified and ranked the most common drivers of value for businesses whose primary business is related to the built environment (such as real estate developers, construction-related businesses, property portfo-

lio managers). The 11 value drivers were: cost saving, talent attraction and retention, customer attraction and satisfaction, brand and reputation, licence to operate, resilience, access to capital, innovation, productivity, quality, and value of assets (UK Green Building Council, 2018). There are three categories of value drivers: growth drivers, efficiency drivers, and financial drivers (L. E. K Consulting, 2017). Green certification and sustainability reporting also foster monitoring of the operational efficiency of assets. Survey evidence proves that for the majority of large firms, it has become the norm to track sustainability data as this is required by eco-certifications and green reporting structures as well as by internal environmental, social, and governance (ESG) policies (Christensen et al., 2022).

As the built environment industry[1] is highly competitive, cost saving is a high priority. Sustainable business practices and cost savings are no longer viewed as separate or contradicting realities. On the contrary, embedded sustainability efforts result in a positive impact on business performance. Significant cost savings are to be realized through increases in environmental sustainability-related operational efficiency (Whelan–Fink, 2016). Resource-efficient companies that use less energy, resources, and materials and as a result produce less waste, tend to produce higher investment returns compared to their resource-intensive peers (Heyns, 2012). "The real estate sector consumes over 40% of global energy annually, while 20% of total global greenhouse gas emissions originate from buildings." (World Economic Forum, 2015, 6) After water, concrete is the most used material in the whole world. Furthermore, construction is responsible for 40% of raw material use globally and by 2030 buildings are expected to use 12% of global freshwater resources while generating 30% of total waste in the European Union (World Economic Forum, 2016).

Market value is the most commonly used value when comparing building assets. It is the estimated price at which a building can be sold on the marketplace to a willing buyer by a willing seller under normal market conditions, meaning that both transacting parties have reasonable time to research and evaluate the market and act knowledgeably. For income-producing properties, the market value directly links to the amount of rent tenants are willing to pay in exchange for the use of the building. The rental value strongly correlates with the location, prestige, technical quality of the building, and the lease terms and the operating expenses of the building. Studies conducted in the United States and Australia revealed that Energy Star, LEED, and Green Star-rated buildings command rental premiums of up to 17.3%. (World Green Building Council, 2013). Further evidence shows that the LEED brand communicates clear premiums to the market, while access to public transit, access to natural light, water conservation

[1] Based on the EPA's definition, the built environment „touches all aspects of our lives, encompassing the buildings we live in, the distribution systems that provide us with water and electricity, and the roads, bridges, and transportation systems we use to get from place to place. It can generally be described as the man-made or modified structures that provide people with living, working, and recreational spaces". The built environment industry includes all the professional fields that deal with the built environment. Source: https://www.epa.gov/smm/basic-information-about-built-environment

measures, premium HVAC systems, electric car charging stations, and walking access to services all provide value enhancements beyond a LEED certification. Other green measures like recycling facilities, measures to improve indoor air quality, showers on-site, fitness facilities, and energy-efficient electric systems may also provide value in some situations, likely dependent on other green variables in the mix in a particular market or building (Lee et al., 2017; S. Robinson et al., 2017; S. J. Robinson–Simons, 2018). Hereby it is important to highlight the notable significance of health and well-being features in the buildings when it comes to green solutions. As Allen et. al claims, green buildings, by definition, concentrate on reducing their negative environmental effects by using less water and energy, as well as causing as little disruptions to the surrounding environment as possible during the construction process. By definition, green buildings also seek to enhance human health by creating healthy indoor settings, albeit this goal may not be as well known (Allen et al., 2015). This means that green building features can improve mental well-being and reduce stress levels that can increase the occupant satisfaction and comfort. A great feature that can help to reach these goals is the on-site fitness or gym facility or even the bio food canteens and restaurants in the office buildings that serve healthy, vegetarian, fair trade and bio meal options for the occupants.

As commercial property is a multifaceted business – encompassing everything from investment strategies to building operations – and since the involved stakeholders have different interests and concerns, there are different perceptions of ESG and its value. Thus, determining the true performance and quality of a sustainable real estate business remains a challenge. One way to meet this challenge is to seek green certification of real estate properties and portfolios. (Vieira de Castro et al., 2020). Our research seeks to provide empirical evidence in workspace strategies regarding office space optimization and green ambitions of tenants in light of office leasing performance during and after the COVID-19 pandemic period.

2. RESEARCH METHODOLOGY

Research for this paper began in 2023 and included an analysis of office market data from Budapest between 2018 and 2022, the results of which were further augmented by individual interviews with office market actors. The basic aim of the research was to understand how the Hungarian office market was changed by the COVID-19 global pandemic. The main goal of the study was to find out if there was any measurable space optimization or lease size change trend observable due to the global pandemic in the Budapest office market. Did green-certified buildings see increases in space occupancy rates or lease transaction sizes compared to general office assets as a result of the pandemic?

Statistical analyses for this research project included office market leasing data from the past five years (from 2018 to 2022), which was collected from office market actors, such as real estate agents, landlords, tenants, and the Budapest Research Forum (BRF). The database included 2,826 office leasing transactions from 2018 to 2022, all of which were signed for modern office building space (Class 'A' and Class 'B') in Budapest, Hungary. As more than 90% of the total modern office stock of Hungary is located in

Budapest, an examination of the city's office market trends can show the country's office market situation. The database also included the name of the buildings, green certifications of the buildings (if there were any), the size of the leased office area in square metres (m^2), and the tenant sector as follows (Table 1).

Table 1 Structure of the database

Year	Building	Green certification	Tenant sector	Type of deal	Size of deal
The year when the lease agreement was signed (2018–2022)	Name of the office building	Does the office building have a green certification?	The business sector of the tenant (i.e., banking, consultancy, etc.)	Renewal, New, Pre-lease, Expansion, Sub-lease, Owner Occupation	Size of the leased office area in m^2

Source: Authors' research tool (database)

Table 2 shows the deal type definitions.

Table 2 Definition of different deal types

Renewal	The existing tenant renews its lease agreement in the same office space in the same building
New	A new tenant enters the office market or an existing tenant moves into a different office
Pre-lease	Tenant signs a lease agreement in a building which is under construction at the moment of signing the leasing contract
Expansion	The existing tenant expands its office space in the building
Sub-lease[2]	An existing tenant gives some of its office area permanently to a business partner/different tenant
Owner Occupation	A company moves into its own Headquarter building

Source: Authors' research tool (database)

Statistical analysis is the process of collecting and examining data to find patterns and trends. It is a technique that makes use of numerical analysis to remove bias from the evaluation of data. The procedures of data analytics and data analysis entail drawing conclusions from data so that decisions can be made with confidence. Additionally, statistical analysis techniques are useful for constructing statistical models, designing surveys, and accumulating research interpretations. In this study, the authors used descriptive statistics, a fundamental statistical technique that uses indices like mean and median to summarize data, within the scope of data analysis.

After the data collection and analysis, individual interviews were made with several

[2] Sub-lease agreements entered the Budapest office market as a result of the global pandemic. As most of the office lease agreements do not allow sub-lease contracts, this phenomenon is very rare in the Hungarian office market.

market actors (including three property managers, five leasing agents and eight tenant representatives), based on the results of the database. The main topics of the discussions were remote work, ESG and green strategies, and the future of office spaces. Our main questions were about their experience and opinion about green preferences on the Budapest office market, and also their potential green and sustainability strategy, including their everyday work and operation. We conducted the interviews within the framework of a personal meeting with the respondents. We made semi-structured interviews with our participants as few questions were predetermined, but other questions weren't planned, and we let the respondents sometimes freely flow in the topics to gain a deeper clarification and insight into their opinions and point of views. Generally, we prepared 6-8 questions for each interviews such as the following:

- What is the role of greenness and sustainability in the Budapest office market?
- What experience do you have with ESG frameworks in the Budapest office market?
- At your company, do you have a green/sustainability/ESG strategy? Do your clients usually have a green/sustainability/ESG strategy?
- Is there a remote work/telework/home office possibility at your company/at your clients' company? If yes, what are your experiences about it?
- What is your opinion about the COVID-effect on the office market? Do you experience any on the longer term?
- Do you think COVID-19 has been changing the office leasing trends, regarding lease terms, rent levels or leased space sizes?
- Based on your experience, what are the most important factors or features of a green-certified office?

The available academic literature mainly focuses on the trends of remote working and general office market sentiment trends related to the global pandemic, and less on analysis of lease size structure and changes from the past few years. Therefore, this paper is unique in that it addresses office leasing size trends related to the global pandemic. Taking into account the current office market trends and discussions with different market actors, the research addresses the validity of the following hypotheses (Table 3).

Table 3 Main hypotheses of the research

Hypothesis 1	As a result of remote working becoming widely used in the global business world in the past 3 years, companies started to lease smaller office areas
Hypothesis 2	The reduction in lease sizes differed by tenant type, depending on the business sector in which a company operates.
Hypothesis 3	There was no significant deal size change (meaning overall value or m^2 of space leased) in the case of green-certified office buildings as a result of the pandemic due to their consistent popularity with tenants.

Source: Authors' research

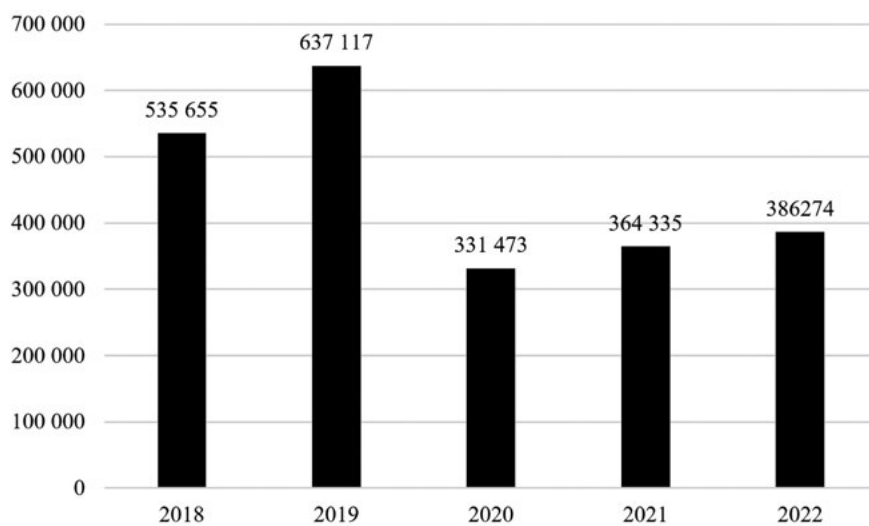
3. RESULTS

Based on the statistical data analysis, results show that the leasing activity significantly declined in the Budapest office market in 2020, when the COVID-19 global pandemic hit the economy. Figure 1 shows the annual volume of signed leases represented in square metres.

In 2019, the Budapest office market reached its all-time peak, with a total annual leasing activity of 637,117 m^2 of leased space. After this record volume of transactions, the leasing activity in the Budapest office market declined by 48% in 2020, when the global pandemic depressed office markets worldwide. Although the volume of space rented started to increase again in 2021, at the end of 2022 it was still 40% lower than in 2019, at an annual level of 386,274 m^2 leased space during 2022.

Table 3 represents the volume of the different office lease types between 2018 and 2022 in square metres. As can be seen from the data, although the volume of renewals dropped in 2020 compared to 2019, it never dropped significantly below 2018 levels, with 2019 appearing as a market outlier. This shows that tenants have remained reasonably confident in the market and renewed their leasing contracts at a rate that matches recent historical norms. On the other hand, Figure 2 indicates that the volume of new leases (new market entrants or existing tenants moving into new locations) significantly declined since COVID-19, suggesting a decreased willingness of market players to take risks in the form of relocations or new leases.

Figure 1 Total leasing activity (m^2) between 2018 and 2022 in the Budapest office market



Source: Authors' analysis of compiled dataset

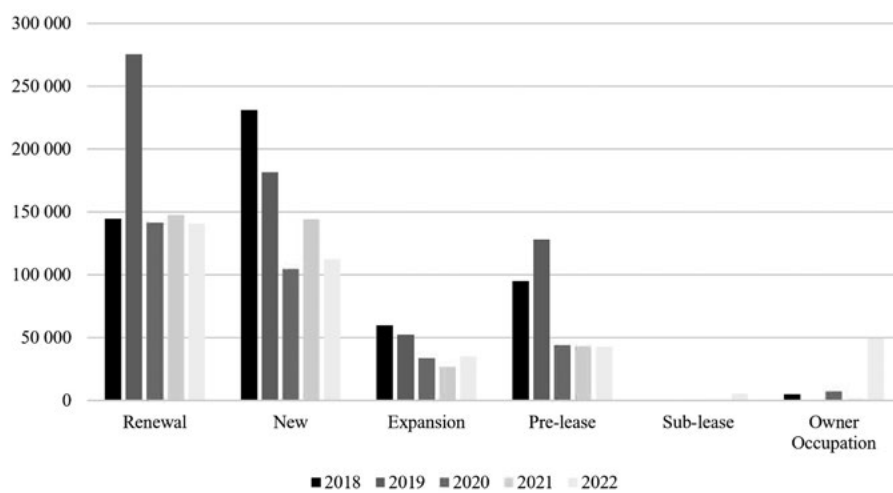
Table 3 Structure of office leasing deals (m^2) between 2018 and 2022 in Budapest

Year	Renewal	New	Expansion	Pre-lease	Sub-lease	Owner Occupation
2018	144,584	230,866	60,019	94,902	0	5,284
2019	275,137	181,600	52,369	128,011	0	0
2020	141,366	104,571	33,750	44,306	0	7,480
2021	147,832	144,051	26,716	43,420	1,037	1,279
2022	140,528	112,534	35,044	43,003	5,653	49,512

Source: Authors' analysis of compiled dataset

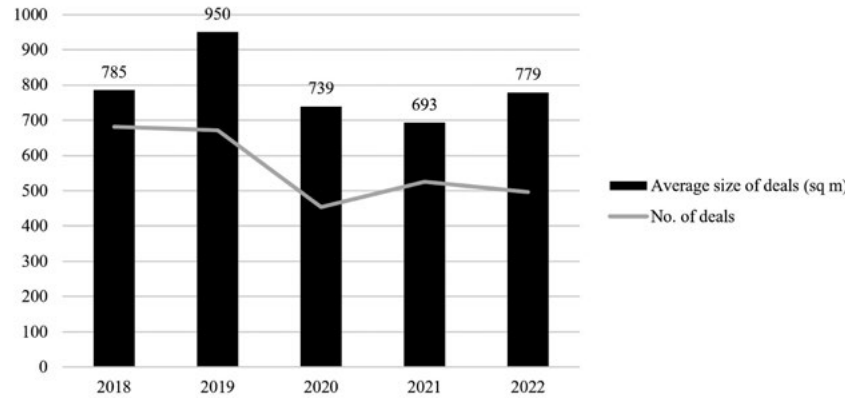
The level of expansion by existing tenants also dropped from 2019 levels between 2020 and 2022, although a 31% year-on-year increase was registered between 2021 and 2022, suggesting some recovery of the market. However, the 35,044 m^2 annual expansion volume in 2022 was still below the annual level of 50,000-60,000 m^2 of the pre-COVID years. Sub-leases appeared on the Budapest office market in 2021; however, there is no officially communicated data from the market actors about its real volume, and the registered seven thousand m^2 from 2021 and 2022 (combined) cannot be validated, as there may be more sub-lease agreements on the market that have not been reported by landlords or tenants. Two large headquarter buildings (developed by and for their respective company) were completed in 2022 in Budapest, which raised the volume of owner-occupation significantly last year and may distort the numbers presented in Table 3 by suggesting a more generalised trend of growth than is occurring.

Figure 2 The annual volume (m^2) of office deal types in Budapest between 2018 and 2022



Source: Authors' analysis of compiled dataset

Figure 3 The number and average size of office leasing deals in Budapest between 2018 and 2022



Source: Authors analysis of compiled dataset

Figure 3 shows the number and average size of office leasing transactions in Budapest between 2018 and 2022. In 2019, which was the record year for the Budapest office market by the size of leased floor space, the average (mean) deal size was 950 m^2, as four large renewals and two pre-lease agreements above 10,000 m^2 were signed. In 2018 and 2019, the number of deals was above 670; however, since the Covid-19 pandemic hit, the number of deals significantly decreased to 451 in 2020, 526 contracts in 2021, and 496 in 2022, as can be seen in Figure 3. The average transaction size during the Covid-19 and post-Covid-19 years was not much smaller than it was in 2018, and after a 6% year-on-year decrease from 2021 to 2022, started to increase again in 2022, reaching 779 m^2.

Table 4 shows the average deal size (m^2) in green-certified office building space and general (non-green-certified) office building space between 2018 and 2022. As can be seen, the average deal size was consistently higher for green-certified building space than for non-certified office building space; however, in 2022 the average deal size decreased in the case of green-certified office space market (by 13%) and significantly increased in the not-certified building space market (by 60%), which brought the two sectors closer in transaction size, with green-certified space still having a slight edge.

Table 4 Average office leasing deal sizes in green-certified and general buildings

Year	Average deal size in green-certified building space (m^2)	Average deal size in not certified building space (m^2)
2018	1,055	537
2019	1,196	711
2020	1,050	523
2021	1,004	437
2022	876	700

Source: Authors' analysis of compiled dataset

Deal size ranges are represented in Table 5. Data clearly show that there was little change in the share of the different deal size ranges between 2018 and 2022. The share of large, above 3,000 m^2 deals slightly decreased in 2022, whilst the share of leases signed between 500 and 999 m^2 increased by 5% in 2022 compared to 2021. However, these volume changes were not significant enough to establish an emerging trend.

In Table 6 we can see that that almost all of the most active tenant sectors on the market experienced a drop in the deal size in 2020.[3] In 2021, most of the sectors began to recover; however, in 2022 (when the war started in Ukraine and the possibility of a new economic crisis appeared), the average deal size of several sectors decreased.

Following the data analysis, individual interviews were carried out with selected office market actors representing a cross-section of the industry. The participants represented the key stakeholders: developers, tenants, and real estate agents facilitating transactions.

All of the respondents agreed that the workplace-workspace trends have changed since the global pandemic and that tenants are looking for more flexible office lease agreements and solutions in the post-COVID-19 era. The respondents observed that the global pandemic led to a marked increase in remote work in the Hungarian market due to the implemented anti-virus measures (the *lockdown effect*). However, workers began to return to office in 2021 and 2022 – after the lockdowns ended – although remote is still more prevalent than it was in the *before Covid-19* (BC-19) era.

The participants observed that the hybrid working model (in which employees work from home either two or three days a week) has remained popular, even after the pandemic passed. However, two respondents claimed from the tenant side that their workers do not want to work from home anymore, as they miss their offices and workplace-related amenities.

Table 5 Percentage share of deal sizes according to calendar years, m^2

Year	0–249 m^2	250–499	500–999	1,000–1,499	1,500–2,999	≥3,000
2018	28%	26%	20%	8%	10%	8%
2019	27%	23%	22%	8%	10%	10%
2020	29%	22%	23%	8%	10%	10%
2021	29%	27%	20%	8%	8%	8%
2022	28%	26%	25%	9%	7%	6%

Source: Authors' analysis of compiled dataset

[3] In the case of the Telecommunication sector, the size increase was due to a large pre-lease agreement in the first quarter of the year.

Table 6 Sectoral composition of office leasing, m^2

Year	IT average deal size (m^2)	Telecommunication average deal size	Banking/Finance average deal size	Governmental average deal size	Industrial/ Technology business average deal size
2018	796	1,980	1,160	3,113	617
2019	916	2,330	1,690	3,100	1,437
2020	730	2,949	827	1,389	522
2021	1,100	849	791	2,156	1,023
2022	679	630	1,596	1,513	1,177

Source: Authors' analysis of compiled dataset

Another important, discussed topic was the importance of green and sustainability efforts and strategies during the everyday work life. The respondents agreed that tenants had begun dedicating more attention to ESG and green strategies over the last several years, and several companies had become more focused on greening their operations. Also, the developers and real estate agents claimed that building retrofits leading to improved energy efficiency helps commercial buildings meet the conditions of international certifications, but these measures are not sufficient in themselves to achieve ESG goals. They also stated that based on their experience, to further their green credentials, companies rent office space in green-certified buildings, with many large international tenants only signing lease agreements for such facilities, which is evidenced by the consistently high demand for such space. This statement was also supported by the answers of the office tenant respondents at the interviews. Almost all of the participants also agreed on that health and safety-related features of office buildings have become a greater concern for tenants since the beginning of the global pandemic. This led the discussion to the importance of Indoor Environmental Quality. "Indoor Environmental Quality (IEQ) is most simply described as the conditions inside the building. It includes air quality, but also access to daylight and views, pleasant acoustic conditions, and occupant control over lighting and thermal comfort." (Rizk et al., 2017, 203) Almost all interview participants agreed on that since the appearance of Covid-19, office tenants pay larger attention to IEQ (mainly the air quality and ventilation) features of the office buildings as they are concerned about air filtering and the sterilization of the rooms. Also, the fitness and sport related building features (that are also viewed by occupiers as part of the sustainability and well-being package an office building can offer) are getting into more significance in the past years as tenants pay more attention to their workers' health status.

Based on the recorded and transcripted interview answers, large proportion of the tenants have been demanding green office properties. The respondents feel that there is

a lot of interdependence in the case of the market actors, that this was shown by Covid-19 and then by the explosion of energy prices. Technology change is mandatory, and financiers also take a close look at what projects they lend to, even if it is a new construction or a comprehensive renovation.

On the other hand, participants agreed, that office buildings that comply with ESG standards, have higher than average rents, regardless of the year they were built compared, to general offices. The rent level of sustainable buildings is determined by the reduction of negative environmental impacts (the lower level of carbon footprint), lower operation and maintenance costs, a better perception of the company associated with occupying sustainable office space, as well as a growing interest of office occupiers in sustainability and wider environmental impact compliance goals. In addition, it is also affected by the increase in the comfort, well-being and productivity of the tenants. The trend is further reinforced by government regulations that increasingly force tenants to report on their non-financial performance, such as ESG, globally. Based on the opinion of real estate agent respondents, the *green premium* for Budapest offices can be estimated at 9/10%, which is higher than the 5–7% typical in Warsaw or Bratislava, but lower than the 15–18% in Prague and Bucharest.

4. CONCLUSIONS

The goal of the research was to map the office tenants' size optimization attitudes since the global pandemic outburst: to evaluate the relationship between the increasing emphasis on remote work (partially as a result of Covid-19), environmental sustainability for buildings and office space, and larger financial concerns and the types and sizes of leasing and purchasing transactions for green-certified and non-green-certified spaces in Budapest before, during, and after the global pandemic.

The standard benchmark for comparing building assets is their market value. The location, prestige, technological quality, lease periods, and operational costs all have a significant impact on the rental level of a building. Rent and the vacancy rate control the cash flow generated by a property, which in turn affects its value.

In 2020, the global pandemic disrupted the economy. Lockdown procedures altered choices for working and living. Formerly bustling central business districts saw significant population declines, and remote work generated a significant rise in office vacancies, which decreased the value of office buildings. Market analysts and players anticipate this effect persisting for years.

Sustainability was already a growing concern for both tenants and landlords before the pandemic, but it accelerated major changes in the workplace, such as the growth of remote and flexible work models and a greater emphasis on corporate efficiency. Cost-cutting is a top priority in the highly competitive built environment sector, particularly in the post-Covid-19 era, and operational efficiency regarding environmental sustainability and energy use can result in significant cost savings. According to studies, green-certified buildings attract higher rents, presumably due to their economic advantages (amongst other regions).

This research analysed office market transactions from Budapest from 2018 to the end of 2022, augmenting these findings with interviews with office market actors on remote work, ESG and green strategies, and the future of office spaces. The statistical data for this research was collected from office market actors and included 2,826 office leasing transactions from 2018 to 2022, all of them signed in Class A and B modern office buildings.

The research aimed to understand how the Budapest office market reacted to the global pandemic, with particular emphasis on green-certified office space. Three hypotheses were tested:

- As remote working has widely spread in the global business world in the past 3 years, companies started to lease smaller office areas
- The reduction in lease sizes differed by tenant type, depending on the business sector in which a company operates.
- There was no significant deal size change (meaning overall value or m^2 of space leased) in the case of green-certified office buildings as a result of the pandemic due to their consistent popularity with tenants.

In 2019, the Budapest office market reached its all-time peak followed by a drop of 48% as a result of the 2020 pandemic. Although the volume of leases and space leased started to increase again in 2021, it was still 40% lower than at the end of 2022 than in 2019. The volume of renewals was relatively unchanged, remaining at nearly the 2019 level during the past three years.

While tenants who signed contracts during the past 3–5 years generally renewed their leasing contracts, the volume of new leases dropped both during and post-pandemic compared to 2018 and 2019. Expansions by existing tenants also dropped below 2019 levels in 2020 and 2022, although a 31% year-on-year increase occurred from 2021 to 2022, suggesting a partial market recovery, yet the annual expansion volume in 2022 was still well below that of the pre-Covid years.

In 2019 – a record year of the Budapest office market – the average lease was for 950 m^2, with four large renewal and two pre-lease agreements above 10,000 m^2 pushing the average to new heights. Despite the number of deals significantly decreasing during and immediately after Covid-19 (2020 and 2021), the average transaction size was not much smaller during these years than it was in 2018, and after a 6% year-on-year decrease from 2021 to 2022, average transaction size started to increase again in 2022 (779 m^2). The average deal size was higher for green-certified buildings during all years studied compared to the traditional offices; however, the difference between green-certified and non-green-certified office space rental markedly decreased in 2022, when the average amount of space rented (deal size) for green-certified office assets declined by 13% and significantly increased for non-green-certified buildings (by 60%). There were no significant changes in the space/size breakdown percentages for office space rentals: The share of large deals/space rentals (above 3,000 m^2) slightly decreased in 2022, whilst the share of leases signed between 500 and 999 m^2 increased by 5% in 2022 compared to 2021. However, such changes are insufficient to establish a long-term trend.

Almost all tenant sectors on the market experienced a drop in the deal size in 2020 when the global pandemic hit the economy and the office market. In 2021, most of the sectors started to recover; however, the beginning of the 2022 war in Ukraine and resultant market anxieties appeared to slow or reverse this recovery. The results of the data analysis proved the validity of hypotheses 1 and 2; however, disruptions to the economy caused by recent geopolitical changes have shifted leasing sentiment and harmed green-certified buildings' leasing performance.

The interviews confirmed the growing popularity of remote work in the Hungarian market, although its impact waned in 2021 and 2022. The hybrid working paradigm is still fairly common, and many businesses allow staff to work from home one to two days per week. However, there are instances where workers miss their workplaces and other office perks and no longer desire to work from home. ESG has gained importance in recent years, and many businesses now give priority to environmentally friendly operations.

This is evident given the persistent demand for green-certified office buildings and the fact that many major multinational tenants will only sign leases in green-certified buildings. Health and safety-related elements are also increasingly frequently requested by tenants. Even still, affordability is still a problem because it appears that recently there has been a decline in demand for newer, better-quality structures, which frequently have higher rental rates. In the case of Budapest offices, a 9-10% green premium rent level can be estimated compared to the general buildings. A more thorough justification might be offered by closer observation and examination of business dealings and building characteristics. Additionally, it will take some time to determine whether this is the beginning of a longer-term trend or only a sporadic short-term change in preference.

The study aimed at understanding changes of office rental in a specific geographical market area, Budapest, the capital city of Hungary. Further research would be needed to fully understand the specificities that make the Budapest market unique. We used statistics from landlords, the Budapest Research Forum (BRF) and office developers that helped us to understand the current rental trends and leasing contract volumes, however there were no available details on the sub-leasing market, therefore it would be an opportunity to further investigate this segment.

Another suggestion for further research is the comparison of the Hungarian capital's office market with other Central European cities' markets to monitor the trends, if there are similarities or any differences.

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Minerva baglya csak a beálló alkonnyal kezdi meg röptét.
(G. W. F. Hegel)

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