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The future of remote work in Japan: Covid-19's implications for international human resource management

Hitoshi Iwashita

A B S T R A C T
Objective: The objective of this article is to elaborate how the form of remote work can be hindered in an institutional cultural context in non-Western countries.
Research Design & Methods: The article adopts data collection based on public report and news release in reference to the current academic literature of human resource management.
Findings: The article finds that the institutional contexts of non-Western countries, unlike those of Western countries, may hinder or limit remote work because of a poor fit between remote work and human resource management (HRM). The article reveals that the cultural context of non-Western countries, such as Japan, may hinder remote work because of collectivism, high context, high power distance, and high uncertainty avoidance.
Implications & Recommendations: The article implicates a possible diversity of how remote work can be implemented in relation to the institutional and cultural contexts of both Western and non-Western countries, such as Japan.
Contribution & Value Added: The article contributes to future international human resource management by showing that there are some institutional and cultural hindrances to remote work in certain countries. The text contributes to future international business and human resource management by showing that other non-Western countries may have similar problems in terms of the execution of remote work due to contexts that are different institutional and cultural from Western examples.

Article type:	research article
Keywords:	Covid-19 pandemic; remote work; Japanese firms; managerial work; HRM practice
JEL codes:	F23, O15

Received: 25 February 2021	Revised: 11 May 2021	Accepted: 2 June 2021

INTRODUCTION

The Covid-19 pandemic has completely changed the landscape of strategy, organizations, and human resource management. During the pandemic, many people started to work at home instead of commuting to the workplace, bringing all work online by using online interaction tools (e.g. Zoom, Microsoft Meeting, and Google Hangouts). This tendency to adopt remote work may not simply be a temporary solution to the Covid-19 pandemic but may also be a permanent move to allow employees to work full time at home. Current studies tend to assume that remote work is not only inevitable but also triggers a change into a new style of work in the future (Collings *et al.*, 2021). This change makes extensive use of information technologies (IT), such as collaboration software, online meetings, and communication tools. In particular, this change makes sense in North American and European countries, and some service industries suit remote work better than others (e.g. information technology and finance industries). Indeed, an iconic move towards permanent remote work was announced by Google, even following the end of this pandemic. The move to remote work is about to be gradually taken for granted, not only because it protects employees against the Covid-19 pandemic but also

because it promotes the employees' productivity and motivation, especially those who are eager to keep a healthy balance between work and life, along with a high level of well-being.

This shift towards remote work may not be universally promoted or equally adopted across countries in the same way, simply because of the local institutional and cultural context in which employees work in a given country. In international human resource management (HRM), there are always variations in institutional and cultural practices between home and host countries. Each country has different institutional profiles whose influence includes regulatory and normative forces from institutional actors, such as lobbying, bank, state, education, trade union, and non-profit organizations, along with buyers and suppliers (Scott, 2008). These institutional actors are assumed to enable and constrain certain HRM practices. They also affect the national economy based on either liberal market economies (LMEs), which are based on competition, or coordinated market economies (CMEs), which are based on collaboration across institutional actors. Moreover, cultural contexts can also affect the implementations of certain HRM, especially because of power distance, collectivism, and individualism, but also high- and low-context communication (Hall, 1973; Hofstede, 2001; Hofstede, Hofstede, & Minkov, 2010). The high-performance work system was formulated in the US culture – based on high individualism and low power distance – may not always be accepted in Asian countries, such as Japan, due to the local low individualism and high-power distance (Abo, 2015).

This article considers how the form of remote work can be hindered in the institutional cultural context of non-Western countries. Consequently, it reviews desktop search news and public reports of remote work in Japan from 2020 to 2021 in reference to theoretical constructs of institutional and cultural theories. The article analyses the implementation of remote work and generates implications for HRM practices.

The rest of the article is divided into five sections. The first section reviews the existing literature with a focus on relevant institutional and cultural theories. The next section briefly explains the research method, including data collection and analysis. The third section describes findings and discusses how both institutional and cultural constraints enable the implementation of remote work. The final section concludes by outlining the limitations observed in this study and by recommending avenues for future research.

MATERIALS AND METHODS

The article examines the possibility that the institutional and cultural contexts of Japan may hinder the implementation of remote work during the Covid-19 pandemic and later. The study stems from institutional and cultural theories (Scott, 2008; Hofstede, 2001; Hofstede, Hofstede, & Minkov, 2010), which strongly implicate how differently remote work can be implemented in the context of Japan. Using current literature regarding news and reports of remote work before and during the Covid-19 pandemic, mainly in Western countries, this study elaborates why remote work implementation can be difficult in Japan.

Data were collected via news and public reports in two stages. First, I conducted data collection by using key words in Japanese, such as 'Covid-19,' 'remote work,' 'telework,' and 'Japan,' using a news archive in 6-16 January 2021. There appeared more than 100 000 results in Google news search, and I briefly checked the top 300 hits to examine institutional cultural influence on the execution of remote work in Japan. Broad categories regarding HRM practices emerged in terms of why remote work may be hindered. These are types of recruitment, employment, appraisal, trainings, and daily routines and communication. Then, I used these practices for further search in order to see how these practices were conducted before and after Covid-19. At the second stage, I added some industry and government reports about remote work during Covid-19.

During the data analyses, these broad categories were sorted by the cause of hindrance of remote work into two social influences: institutional and cultural contexts in Japan. After the iterative process of theory and data collection, the sorting reached seven categories of HRM practices that can be constrained by institutions and culture in Japan: seniority-based HRM; long-term employment; process-based appraisal; teamwork; on-the-job training (OJT); overtime work; surveillance.

LITERATURE REVIEW AND THEORY DEVELOPMENT

Remote work emergence, its benefits, and drawbacks

Following the Covid-19 pandemic and lockdown in Europe and North America in 2020, remote work quickly became a de facto work style. Many companies already adopted remote work, mainly for work-life balance, especially for employees with families. However, the Covid-19 pandemic triggered a rush towards remote work, making it crucial for business continuity. Reports by OECD (2020) show that remote work is a convenient and useful solution to the Covid-19 pandemic. During lockdowns, the public were required to isolate and quarantine themselves from the spread of Covid-19. They were also required to work from home whenever possible and not commute to work in their offices. Consequently, remote work has been required in all organizations (OECD, 2020; Ozimek, 2020). The OECD (2020) reports that how the remote work is implemented varies by country and company: highly skilled workers in knowledge-intensive industries, such as management education (e.g. Brammer & Clark, 2020), are more suited for remote work than low-skilled workers in less knowledge-intensive industries and manufacturing. In addition, remote work could have some advantages, such as saving commute time, shorter work time, flexible working hours; while the disadvantages include overtime work, an unbalanced work-life ratio, and work intensification (George, Lakhani, & Puranam, 2020; Leonardi, 2020; OECD, 2020). However, most literature regarding the matter focuses on Western countries, particularly North America and Europe.

Remote work is associated with productivity and wellbeing. Taking an example of a consulting firm, Dahik *et al.* (2020) conclude that perceived own productivity has increased through remote work, although there are variants in outcomes depending on functions. Remote work in the pandemic may have a profound impact on the well-being of employees, many of whom feel isolated from society. In a global survey of 2 700 employees, Smith (2020) reports that 75% of all respondents feel socially isolated, while 67% of them feel highly stressed, while more than half feel high anxiety and are emotionally exhausted. However, this low level of wellbeing has to be carefully examined and independently analysed in remote work without the effects of the pandemic. Furthermore, this move towards remote work varies according to industry and organizations. For example, IT industries are used to this remote working style, and some made it a permanent style of work in the post-Covid-19 pandemic. In contrast, manufacturers continue to commute, produce, and ship products from site, as do other service industries – such as restaurants and cafes – possibly causing difficulties to adopt about remote work (e.g. Collings *et al.*, 2021). The relationship between remote work productivity and well-being is even more complicated.

The existing literature tends to argue for the consequences and effects of remote work, on the assumption that remote work is inevitable and thus accepted thoroughly during the Covid-19 pandemic in Western countries. This may be so due to the fact that most studies focus on Western countries, both Europe and North America, where remote work had been accepted to some degree as a proper form of work. However, this may not be true in non-Western countries, such as Japan. By taking Japan as an example, the next subsection discusses the possibility that remote work – albeit absolutely inevitable during the Covid-19 pandemic in the Western countries – may not be seen as useful outside of the Western world.

Japanese HRM's institutional and cultural context

As in Western countries, the Covid-19 pandemic forced the Japanese government to encourage remote work in all organizations (OECD, 2020; Ozimek, 2020). Indeed, the OECD (2020) indicates that how remote work is implemented varies according to country and company: highly-skilled workers in knowledge-intensive industries, such as management education (e.g. Brammer & Clark, 2020), are more suited for remote work than low-skilled workers in less knowledge-intensive industries and manufacturing. In addition, remote work could have some advantages, such as saving commute time, shortening work time, and promoting flexible working hours; while the disadvantages include overtime work, an unbalanced work-life ratio, and work intensification (George *et al.*, 2020; Leonardi, 2020; OECD, 2020). These advantages and disadvantages can also be found remote work in Japan (NIRA,

2020a/b; COJ, 2020). However, the Japanese government has been promoting remote work for full-time and part-time employees, and also for freelancers, since before the Covid-19 pandemic, and it had already set up a call centre, subsidiary, and seminars for remote work (MLHW, 2020).

This shift towards remote work may not be implemented in Japan as in the Western countries because of an institutional and cultural context of Japanese HRM. In the institutional context, seniority-based HRM has traditionally been a standard of Japanese HRM, although with some variations (Endo *et al.*, 2015). Indeed, before the Covid-19 pandemic, Japan had less remote work than Western countries because it has a traditional work culture, in which employees are encouraged to collaborate with others through teamwork rather than relying on individual work-based performance: teamwork is promoted and evaluated without clear boundaries of individual responsibility rather than working as an individual. Japanese seniority-based HRM is usually associated with manufacturing plants and, thus, may not be accompanied with remote work because of the necessity to work on site (Sekiguchi, Froese, & Iguchi, 2016). Furthermore, the dominant manufacturing sector in Japan, including large, small, and medium-sized firms, may hinder the execution of remote work due to the lack of resources and IT facilities, especially for small and medium-sized parts manufacturers (Gordon, 2017). The Covid-19 pandemic may also have led to a change from long-term to short-term employment. Moreover, Japan's tradition of process-oriented rather than results-oriented appraisals may hinder the execution of remote work (Sekiguchi *et al.*, 2016). In contrast to the high adoption ratio of remote work in Scandinavian and Anglo-Saxon countries, with around 40-50% working remotely (OECD, 2020), a recent public report shows that remote work has gradually been adopted by around 30% of Japanese firms, who have either already adopted or will adopt remote work in the future (MIAC, 2020; NIRA, 2020a/b). This confirms a public report which shows that firms in the US adopted remote work swiftly and reduced the workforce (e.g. Bartik *et al.*, 2020; Brynjolfsson *et al.*, 2020).

Japan has less remote work than Western countries because it has a traditional work culture, in which employees are encouraged to collaborate with others through teamwork rather than relying on individual work-based performance: teamwork is promoted and evaluated without clear boundaries of individual responsibility. Indeed, remote work cannot be separated from communication styles between employees. In particular, Japan is characterized as a high-context culture (Hall, 1973) rather than low-context culture. This point is strongly implicated as to how remote work may not work well in the Covid-19 pandemic in a high-context culture (e.g, Singh & Matsuo, 2004). In high-context cultures, what is important besides message delivery and exchange are situational factors, external environments, and non-verbal communication. As in Southern European and Arabic countries, Japan is one of the most context-oriented countries in which paralanguage and facial expressions matter to communication as well as setting and timing of communication (Boyacigiller & Adler, 1991). In contrast, clear and explicit messages are highly appreciated in low-context cultures, especially in Anglo-Saxon and Northern European countries. This low-context culture is likely to affect and perhaps hinder remote work because messages that include context are preferred. In addition, Japanese culture is characterized by collectivism, high-power distance, and paternalism. This may imply that Japan is unfit for remote work based on the assumption that work is assigned and monitored individually and remotely rather than through physical working together in an office (House, 2004; Hofstede, 2001; Hofstede, Hofstede, & Minkov, 2010).

RESULTS AND DISCUSSION

Institutional constraints on remote work

The study identified three institutional constraints in terms of Japanese HRM practices: seniority, long-term employment, and process-oriented appraisal.

Change from seniority- to performance-based HRM

Before the Covid-19 pandemic, scholars widely acknowledged that Japan has gradually started to move from seniority-based to performance-based HRM. For example, Aoki *et al.* (2007) found that Japanese firms are becoming increasingly diverse in terms of their adopted HRM practices. Some studies em-

phasised a shift to westernised HRM practices in Japan, with the gradual adoption of the concept of performance-based HRM instead of seniority-based HRMs (Morris *et al.*, 2006; Keizer *et al.*, 2012). Other studies indicate a divide between Japanese and westernised HRM practices according to the industry and foreign ownership (Morris *et al.*, 2018). Manufacturers tend to keep seniority-based HRM more than non-manufactures, while active foreign shareholders tend to prefer to promote performance-based HRM than keeping seniority-based HRM. Studies provide a nuanced picture of the difference between adopting a westernised or keeping a traditional Japanese HRM. The persistent adoption of lifetime and long-term employment is often limited to core employees with full-time tenured contracts and does not extend to temporary or part-time contracts that do not guarantee employment until retirement age (as reported in Ministry of Health, Labour and Welfare; MHLW, 2020). Conventional HRM continues to persist in some traditional large Japanese firms, including manufacturers and service providers, who rely on subcontracting and hiring part-time workers. This report also shows that there is a mix of continuity and change in Japanese HRMs practices among small and medium-sized firms, while younger Japanese firms may adopt westernised HRM practices. Thus, for some Japanese firms, the seniority-based HRM is still an institutionally legitimate practice in Japan.

In the post-Covid-19 pandemic era, remote work may be limited only to those who adopt performance-based HRM rather than those who stick with traditional seniority-based HRM. Generally, remote work is more suited to the westernised performance-based HRM, which assumes that the managers plan, assign, monitor, and evaluate the jobs of subordinates, with a clear scope of command and control on an individual basis (Sekiguchi *et al.*, 2016). Facing the necessity of remote work, Japanese HRM based on long-term employment and teamwork may need to be reconsidered. Otherwise, remote work may be treated as a temporary solution and will be forgotten as soon as the pandemic is over for those firms who tend to stick to traditional seniority-based HRM. Nevertheless, a change in HRM may be more closely associated with the industry and size of firms, as briefly indicated in a public report of Japanese firms in knowledge-intensive industries (e.g. IT and finance). Moreover, highly-skilled workers are likely to continue to adopt remote work in the post-Covid-19 era.

Thus, further research should focus on change and continuity in Japanese HRM via remote work in the post-Covid-19 era. In particular, how and why does remote work trigger change and or maintain continuity in HRM in Japan?

Long-term and lifetime employment

Before the Covid-19 pandemic, Japan's traditional long-term and lifetime employment had been at risk because of economic stagnation, as in the rest of the world (e.g. Verma & Anders, 2020;). In particular, large multinational companies (e.g. automotive and electronic manufacturers) continued to restructure their businesses since the 2000s. For example, Panasonic announced its corporate restructuring in 2009 (Panasonic, 2009) and stated that it was going to reduce its workforce by around 10,000 employees. The tradition of long-term and lifetime employment resulted also from the choices made by Japanese firms, often influenced by factors such as best practices, corporate owners' and investors' profiles (e.g. Japanese or non-Japanese), and type of business (e.g. Morris *et al.*, 2018). Nevertheless, long-term and lifetime employment can still be found in some large Japanese firms but is usually reserved for core employees with tenured contracts – hired as university graduates – and excludes peripheral employees with limited-term contracts and part-time employees (MHLW, 2020).

After the Covid-19 pandemic, remote work may be differently adopted according to types of employment, including both core and peripheral employees. On the one hand, core employees may continue remote work with secured employment, while on the other hand, peripheral employees will simply be dismissed. This may eventually accelerate into a more flexible form, possibly changing core employees into peripheral ones with temporary and part-time contracts, or more outsourcing may be used (MHLW, 2013). This change is already evident in macro data. For example, a government report shows a rise in the unemployment rate in Japan, from 2% in 2020 to nearly 3% in 2021, which echoes that of the rest of the world. Japan's increase in the unemployment rate is consistent with the rest of the world, such as the USA, where firms have increasingly laid off employees and reduced working time (Dey & Loewenstein, 2020). Even large traditional Japanese manufacturers

have started to question the efficiency of long-term and lifetime employment. For example, Akio Toyoda, the president of Toyota, announced that lifetime employment may no longer be sustainable. This statement was controversial and shook not only the automotive industry but also the rest of the industry in Japan (Toyotatimes, 2021). This parallels the corporate restructuring of Panasonic following its formal announcement that it would reduce workforce. This shift may become more apparent with the widespread adoption of remote work and the high unemployment rate following the Covid-19 pandemic. Nevertheless, remote work has the potential to reduce office costs and enable employees to work in a more productive manner, perhaps leading to a sustained or even increased use of long-term and lifetime employment.

Thus, further research should focus on remote work in relation to long-term and lifetime employment in the post-Covid-19 era. In particular, how is remote work utilized in long-term and lifetime employment?

Process-oriented appraisal

Before the Covid-19 pandemic, a process-oriented appraisal was evident in a series of studies conducted in 2010s. Some scholars emphasized a change from process-oriented towards results- and outcome-based appraisals. Keizer (2012) also concludes that process-based appraisals with seniority are replaced by results- and performance-based appraisals in some Japanese firms, a trend confirmed by Sekiguchi (2013). Indeed, Sekiguchi (2013) concludes that performance-based HRM practices – initially treated as a management fashion in the 1990s – had become institutionalized in Japanese firms. Other scholars found that traditional process-based evaluation with seniority remained in many Japanese firms. For example, Aoki *et al*. (2014) find that Japanese manufacturers shift towards a more American style in both domestic and international plants so as to improve labour productivity. These authors also illustrate that some Japanese manufacturers acquired by US multinational corporations (MNCs) adopt performance-based HRM across all levels of their organization, from managers to factory workers, while in other manufacturing companies' performance-based HRM is limited only to managers. Furthermore, a recent study by Morris *et al*. (2018) investigates both traditional large Japanese firms (e.g. electronic manufacturers and telecommunications providers) and non-traditional younger large Japanese firms (e.g. retailers and information technology providers). Therefore, performance appraisal methods may vary depending on the ratio of foreign shareholders who tend to push towards performance-based appraisals rather than simply the size and length of operations (MHLW, 2013; 2020). All in all, a process-oriented appraisal is still institutionally legitimate for those Japanese firms that adopt seniority-based HRM.

In the post-Covid-19 era, remote work may be renounced in those Japanese firms who stuck with a process-oriented appraisal simply because remote work is more fitted to results-based evaluation. In fact, the firms that adopted process-oriented evaluation currently face difficulties in evaluating the work process following Covid-19 (e.g. COJ, 2020; NIRA, 2020a; b). In particular, it is difficult for managers to evaluate the process of the subordinate's remote work because they had previously been able to monitor and closely communicate with them in the office. Consequently, the amount of overtime that employees do may increase when they work remotely, which is often perceived and evaluated positively at Japanese firms that have adopted process-oriented appraisals. In addition, this change matters not to staff but managers, who have subordinates to evaluate. For Japanese firms who had already adopted result-based evaluation, this change may be supported and reinforced by implementing remote work.

Thus, further research should focus on remote work in relation to both process- and results-oriented appraisals in the post-Covid-19 era. In particular, how can remote work be reconciled with the existing process-oriented evaluation or promote results-oriented evaluation?

Cultural constraints on remote work

The study identified four elements as possible practices in remote work that could be greatly affected by Japanese cultural characteristics: collectivism, high-context culture, high-power distance culture, and high-uncertainty avoidance (Hofstede, 2001; 2010).

Collectivism: Teamwork

Before the Covid-19 pandemic, the importance of teamwork was already being implicitly questioned by a move towards performance-based HRM, manifesting the collectivist national culture (Hofstede, 2010; Abo, 2015). On the one hand, teamwork in Japan has long been emphasized in manufacturing operations, such as just-in-time, kaizen, nemawashi, and total quality management (e.g. Kotabe, 2020). The concept of teamwork has been used by large manufacturers because it enables workers to feel responsible for an end product, rather than the job that they are assigned to do. However, the concept of a team is not limited only to the individual level, such as teams and peers (e.g. Keiretsu can be seen as an interorganizational manifestation of teamwork). On the other hand, the conception of teamwork has been questioned and perhaps downplayed by those Japanese firms who adopted performance-based evaluation. Morris *et al.* (2018) demonstrate that performance-based evaluation may lead to the denial of teamwork because working as a team may conflict with individual performance. A performance-based HRM with a focus on individual evaluation goes hand-in-hand with anti-teamwork, which downplays the value of teamwork. Finally, the manufacturing industry has one of the lowest levels of adoption of remote work (NIRA, 2020a; b).

In the post-Covid-19 era, remote work may be limited to individual work rather than teamwork because the collectivistic tendency may remain unchanged. Indeed, as a core part of teamwork, the formerly conducted intensive communication among colleagues is very difficult in remote work (NIRA, 2020a; b). Some Japanese employees continue to commute to their offices despite the pandemic because of a perceived need of teamwork or simply because they follow their managers' orders. This aligns with the collectivist aspects of process-oriented evaluation and long-term orientation, especially apparent in manufacturing (e.g. COJ, 2020; NIRA, 2020a; b). Otherwise, the adoption of remote work might continue to be limited to non-manufacturing industries and highly knowledge-intensive sectors (OECD 2020). In addition, the limitation of socialization practices may affect the quality of teamwork because socialization helps employees to know and understand other team members and, thus, work towards shared goals (Brammer, Branicki, & Linnenluecke, 2020).

Further research should focus on remote work and collectivist culture in relation to types of work, function, and industry in the post-Covid-19 era. In particular, how can teamwork coexist with or be reduced through remote work?

High context culture: Training

Before the Covid-19 pandemic, training at Japanese firms was provided by a combination of on-the-job (OJT) and off-the-job training, which is part of a high-context culture (Hall, 1973). In particular, OJT was a core part of Japanese manufacturers work on the assembly line, and it ensured that workers were able to learn tacit knowledge at work. In general, Japanese manufacturers proactively adopt OJTs on site and use apprenticeship in which fresh graduates are supposed to work together with experienced employees. This type of OJT goes hand-in-hand with the importance of on-site presence for Japanese firms to create knowledge (e.g. Nonaka *et al.*, 2001). This type of apprenticeship is now mentorship-driven training in the talent management system (Hosomi, Sekiguchi, & Froese, 2020). However, Japanese-styled training is a much more informal mentorship when compared with Western formal mentorship, which is in alignment with long-term and lifetime employment, informal network within a firm, and teamwork promotion. This strong preference for OJTs was strongly linked to the importance of organizational harmony and clan relationship between employees and organizations, which is often characterized as 'company as family' (Bhappu, 2000).

In the post-Covid-19 era, remote work may be abandoned for OJT activities online simply because it is not easy to implement OJTs. Remote work also limits constant communication with mentors, supervisors, and peers because they prefer to communicate not only with verbal but also non-verbal messages. In particular, OJTs assumed that supervisors and supervisees work together in the same office or on the shop floor. Here, supervisees can learn implicit and explicit knowledge by shadowing their supervisors, which may be limited by remote work. Otherwise, remote work may be equipped with new technologies to constantly connect supervisors and supervisees as part of OJTs.

Thus, further research should focus on remote work and the implementations of OJTs in relation to types of work, function, and industry in high-context cultures in the post-Covid-19 era. In particular, how can remote work sustain or dismiss OJT in high-context rather than low-context communication?

High power distance: Overtime work

Before the Covid-19 pandemic, overtime work was a contentious topic in Japan that was frequently criticized and roundly condemned in the media discourse, which manifested a cultural construct of high-power distance between the managers and the managed (Hofstede, 2010). This was strongly linked to a trend characterizing Japanese firms as either black, white, or grey (e.g. Russell, 2017). On the one hand, black Japanese firms tend to exploit employees by relying on overtime work and they have a poor reputation. They pressure employees to illegally work overtime, they harass their employees, and they pay them few benefits. White Japanese firms tend to care about the health and well-being of their employees, have benefit programs, comply with employment law, and have a good reputation. Their employees are treated with respect, do less overtime work, are not harassed, and receive many benefits. Gray Japanese firms move between black and white. Overtime work in Japan is closely associated with overtime death, in which employees commit suicide or suffer heart attacks or strokes due to the pressures of overtime work. Overtime work is perceived very negatively but can be explained by different factors, such as molecular (genetic), micro (individual), meso (organizational), and macro (cultural) evolutionary forces (Timming, 2020).

In the post-Covid-19 era, remote work may either reduce or further increase overtime work in reference to power relationship between managers and the managed. On the one hand, overtime work could be increased by remote work, partially because employees may face a blurred boundary between work and life balance because their colleagues constantly send messages via email and chat applications (e.g. Morris & Hassard, 2020), which possibly refers to gender issues and productivity in remote work (e.g. Feng & Savani, 2020), particularly women with a family. These constant messages and persistent interruptions and distractions may unnecessarily prolong work time. In addition, those who live with families and children during the lockdown may face difficulties in their work time because they need to deal with work and life chores (NIRA, 2020). On the other hand, overtime work may be significantly decreased by remote work. Indeed, some employees may work more efficiently and in a shorter time in the post-Covid-19 era because they are freed from chores and unnecessary conversations caused in the office, and hence can work more productively.

Thus, further research should focus on remote work and overtime work in high power distance cultures in relation to types of work, function, and industry in the post-Covid-19 era. In particular, how can the problem of overtime work be solved by remote work in high power distance cultures?

High uncertainty avoidance: Surveillance

Before the Covid-19 pandemic, employees were expected to closely communicate with managers on site. Therefore, it was reasonably easy for managers to monitor how subordinates work in the office. In cross-cultural studies, this is characterized as part of high uncertainty avoidance, as frequently argued for the case of Japan (Hofstede, 2010). This is connected to the importance of the employee's attitude and personality rather than that of skills based on lifetime employment, which is closely associated with OJTs and process-oriented appraisal. The need to work on site is emphasized so that managers need to constantly stay in touch with and observe subordinates for evaluation, OJTs, teamwork, unity, and so on. Moreover, this is closely associated with overtime work, in which employees were observed to work longer than necessary so as to show a work process and hard they work in the office.

In the post-Covid-19 era, remote work may promote online surveillance for those who used to evaluate and be evaluated by how hard employees work on site (e.g. Hodder, 2020). In remote work, this may be connected to a need for managers to constantly observe and monitor whether or not the subordinates work properly without absence at home. Several technologies can already support managers who wish to monitor their subordinates as they did before the Covid-19 pandemic. For example, software applications such as KnockMe! and LOOOC can keep the employee's camera on and show their work on the monitor, which enables the managers to monitor and even interrupt

whenever they want. However, this surveillance activity may raise legal issues regarding employees' privacy, and it may also breach employment law, as identified in the legal issues of remote work in Romania and Hungary (e.g. Vallasek & Melypataki, 2020).

Thus, further research should focus on how remote work agrees with online surveillance systems in high and low uncertainty avoidance cultures. Furthermore, what should be examined in more depth is the relationship between firms in high and low uncertainty avoidance cultures, along with methods and frequency of online surveillance systems. In particular, are surveillance systems implemented for lower knowledge-intensive workers or lower knowledge-intensive industries in both high- and low-uncertainty avoidance cultures? If so, then why? And if not, then why not?

CONCLUSIONS

This article aimed to elaborate how the form of remote work can be hindered in the institutional cultural context of non-Western countries. By talking Japan as an example of non-Western countries, the study clarified how remote work can be hampered by institutional and cultural contexts in Japan. On the one hand, I identified institutional constraints in relatively formal HRM practices, such as seniority, long-term employment, process-oriented appraisal. On the other hand, I found cultural constraints in more informal and daily work and communication, such as teamwork, training, overtime, and surveillance.

This article implicates that the execution of remote work may not have been universally efficient as argued in the current literature based on cases from Western countries. This implication can be especially the case for those non-Western countries, such as Asian countries, where seniority and long-term employment are prioritized over performance and short-term results. Moreover, it can also be the case for those countries whose cultures prefer collectivism, high context communication, high power distance, and high uncertainty avoidance. This raises a serious concern about the assumption that remote work has been preferred and was even essential during and even after the pandemic as observed in the Western countries.

I should mention some research limitations of the above study. First, the research was based on news archives and reports published mainly in 2020, thus this timeline may be short to conclude the institutional and cultural effects on remote work. However, this article shows some results regarding the possible institutional cultural constraints in Japan. Second, this study is based solely on the case of Japan, so it may not be generalizable to other non-Western countries. However, the article shows possible key constraints of remote work that have been heretofore almost neglected in the subject literature.

This article opens up new research avenues for the future. Possible research questions encompass such matters as how remote work can be hindered by institutional and cultural constraints in other non-Western countries, such as Asian and the others, which have similar institutional and cultural profiles to Japan? Another question could be how national culture enables remote work to be adopted across Western and non-Western countries.

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Author

Hitoshi Iwashita

Academic researcher and teacher of cross-cultural management in multinational firms. His continuing interest lies in developing theory and practice regarding Japanese management in a cross-cultural context with a focus on leadership, culture, organizational behaviour, and strategy in Asia and other regions. As a corporate educator and consultant, he delivered a number of consulting projects to Japanese multinational corporations facing cross-cultural issues on strategy, post integration, organizational development, and leadership. He completed an International MBA from IE Business School and received a PhD in Business and Management from Cardiff Business School. He was formerly a management consultant, helping large Japanese multinationals to build strategy and leadership in cross-cultural environments.

Correspondence to: Dr Hitoshi Iwashita, Vietnamese German University, Faculty of Economics and Management, Ho Chi Minh City, Le Lai Street, Hoa Phu Ward, Thu Dau Mot City, Binh Duong Province, Vietnam, e-mail: hitoshi.iwashita@vgu.edu.vn

ORCID http://orcid.org/0000-0002-4173-9341

Covid-19 and transformational megatrends in the European automotive industry: Evidence from business decisions with a Central and Eastern European focus

Anita Pelle, Gabriella Tabajdi

A B S T R A C T

Objective: The objective of the article is to reveal the effects of the Covid-19 pandemic on the businesses in the European automotive sector, with a special focus on Central and Eastern Europe. The further objective is to identify how these effects relate to the ongoing transformational megatrends in the sector (digitalisation, electrification).

Research Design & Methods: We have collected a large (>700 items) sample of relevant business decisions in the European automotive sector over four years (2017-2021), including those taken especially due to the Covid-19 pandemic. In our research, we transformed our qualitative inputs into a quantitatively analysable database through coding. Then, we applied descriptive statistical analysis on the retrieved data combined with qualitative analysis of the contents behind these data.

Findings: Based on our sample, our primary finding is that the Covid-19 pandemic does trigger the already existing trends of digitalisation and electrification in the European automotive sector. Very similar effects characterise the relatively less developed but deeply integrated Central and Eastern European periphery, although to a lesser extent. Obviously, the Covid-19 pandemic has induced numerous temporary business decisions, mainly plant closures. Layoffs occurred as well but these were not prevalent. Then, the second wave of the pandemic in early 2021 brought about the global shortage of semiconductor chips, which substantially affected the sector in Europe.

Implications & Recommendations: The longer lasting impact of the short-term pandemic-related European automotive business decisions is yet to be explored. Nevertheless, the global shortage of semiconductor chips is already showing signs of influencing the industry over a longer time scale, in Europe as well. Forward-looking, future-oriented, and brave responses to the pandemic can well be the keys for businesses to successfully overcome the negative effects of the Covid-19 pandemic.

Contribution & Value Added: Our sample of more than 700 items and a four-year-long timespan is in itself a unique collection of business decisions in the European automotive sector. In addition, by processing the inputs through coding, our sample becomes a treasury of potential information. In this article, we conduct an exploration along the events to which the decisions can be related, and along the decision types. We also look at the involvement of Central and Eastern Europe. Obviously, our ongoing primary research was ready to be extended to the firm level analysis of the effects of the Covid-19 pandemic, immediately upon its outburst.

Article type:	research article
Keywords:	Covid-19; automotive industry; Central and Eastern Europe; digitalisation; electrification
JEL codes:	F23, O14, F15

Received: 30 March 2021	Revised: 2 June 2021	Accepted: 15 July 2021

INTRODUCTION

The European automotive industry has been going through substantial transformation over the past years due to digitalisation and the shift towards lower emission engine solutions, mainly electrification – these can be considered as the megatrends that currently shape the industry. However, the ongoing transformation has recently been affected by Covid-19. As a result of the pandemic, the overall GDP of the EU dropped significantly (by 6.2% in 2020), accompanied by a substantial decrease in consumption (-4.5%) and investments (-4.25%) (EC, 2021). On the one hand, the pandemic has undoubtedly disrupted global value chains (GVCs) (Betti & Hong, 2020). On the other hand, it has given further impetus to the already traceable changes both in the core EU member states (Western and Northern old members of the EU) and in the periphery, including Central and Eastern Europe (CEE), not to mention the Southern Eurozone countries (Simonazzi, Sandinés, & Russo, 2020).

Our objective is to reveal the effects of the Covid-19 pandemic on the businesses in the European automotive sector, with a special focus on CEE. Our further objective is to identify how these effects relate to the ongoing transformational megatrends in the sector (digitalisation, electrification). To such ends, we analysed a self-collected sample of business decisions through coding. We found no similar research in terms of method, industrial scope, or overall size, so our work can be considered original and novel.

In our research, we sought answers to the following questions. How has the Covid-19 pandemic affected the European automotive industry? Do the trends in CEE align with those in respect of the complete European sector? How does the impact of the Covid-19 pandemic interfere with the ongoing megatrends of transformation (i.e. digitalisation and electrification) in the automotive industry globally and in Europe?

Our study starts with a literature review covering the latest trends in the automotive industry, the automotive sector in Central and Eastern Europe, and the impact of the Covid-19 pandemic on the sector. Then, we describe our research methodology including our sample and coding. Next, we provide a discussion and our results with respect to Covid-19 and the automotive sector in Europe with a focus on CEE. Moreover, we seek to indicate the interference of the pandemic with sectoral megatrends. Our conclusions reflect on literature and own findings along these dimensions.

LITERATURE REVIEW

We focus here on the European and, specifically, Central and Eastern European automotive industry. The automotive industry is one of the fastest growing industries in Europe; it is a significant employer and investor, and it is one of the most determinant industrial sectors of the EU (Drelich-Skulska & Bobowski, 2021). Due to its high technology needs, the industry has a traditionally crucial role in research and development (R&D), besides production. Thus, it is an essential innovator and has serious investment capacities (Vosta & Kocourek, 2016). The European automotive industry consists of more than 20 000 enterprises, produces ca. 7% of the EU's GDP, accounts for 8.3% of manufacturing employment, and for 6% of total employment. Moreover, European production is responsible for 20% of the global sectoral output. All this emphasises the industry's importance in Europe's economy and Europe's global prominence (Vosta & Kocourek, 2016, ACEA, 2018).

In the past years, a strong restructuring of production from the old towards the new EU member states has been going on to exploit possible advantages. The CEE countries' relevance is growing with respect to production and trade since their accession to the EU (Ricci, 2019). These countries continue to be considered as preferred locations for automotive firms.

The automotive industry of the CEE region highly depends on foreign capital, which is the basis for its high technological development level (Farkas, 2011; Pavlínek, Aláez-Aller, Gil-Canaleta, & Ullibarri-Arce, 2017). The rapid development of the sector in CEE is driven by transnational corporations (TNCs) headquartered in the core of the EU, who control the CEE region through direct ownership of both assembly plants and suppliers. The region's automotive industry is concentrated mostly in Czechia,

Poland, Hungary, and Slovakia (*i.e.* the Visegrad countries), but also to a growing extent, in Romania (Pavlínek *et al.*, 2017). This position was acquired through foreign direct investment (FDI), and the region, especially the Visegrad country group, remains among the most attractive locations for investment (Dorożyński, Dobrowolska, & Kuna-Marszałek, 2020; Makieła, Wojciechowski & Wach, 2021). At the same time, this attractiveness has contributed to the evolution of these countries, dependency on the Western European core (Nölke & Vliegenthart, 2009) and has enhanced the vulnerability of these economies in times of crisis.

Automotive firms have several reasons to prefer CEE countries; one of them is geographical proximity, specifically to Germany (Belniak, 2015; Pavlínek, 2015). A further reason is the relatively low wage level, combined with qualified workforce and industrial traditions (Pavlínek & Guzik, 2009; Rechnitzer, Hausmann & Tóth, 2017). The relatively stable political system and the accession to the EU were also key factors, together with the FDI-friendly environment and various investment incentives. In addition, flexible labour laws and weak trade unions compared to Western Europe add to their popularity for FDIs (Pavlínek, 2015; Cieślik, 2017; Götz, Jankowska, Matysek-Jędrych, & Mroczek-Dąbrowska, 2018).

Today, the automotive industry undoubtedly plays an influential role in the economy of the CEE countries through its impact on production, employment, value added, and export. Moreover, it has multiplier effects through its significant connecting supplier base that contributes to the competitiveness of the small and medium-sized enterprises in the region and has considerable modernisation effects (Molnár, 2013).

However, the automotive sector has recently been determined primarily by digitalisation and electrification, both globally and in Europe. The automotive industry has increasingly moved towards automation in production and the growing use of IT solutions (digitalisation), while due to CO_2 emission standard modifications and climate change mitigation efforts, car manufacturers began to direct their development capacities towards hybrid and electric car production (electrification). For decades, cars with internal combustion engines were dominant; however, alternative, mainly electricity-based solutions are emerging, and their market share is steadily increasing (Casper & Sundin, 2020).

Digitalisation affects society and business alike. As far as business is concerned, digital technologies allow for the development of new, innovative (e.g. platform-based) business models or the use of decentralised models through blockchain or 3D printing. Digitalisation may also lower entry barriers, sometimes cross-industry, potentially leading to the emergence of innovative IT companies as new competitors, even in traditional industries such as the automotive industry (Urbach & Röglinger, 2018). These shifts are likely to change the global structure of industrial production, in part through competitors from emerging countries and from other industries (e.g. ICT firms) (Simonazzi *et al.*, 2020).

The ongoing transformation does not only result in production restructuring but also in the reorganisation of GVCs between well-established firms and new entrants. This affects location advantages, the regionalisation of production, and the distribution of labour in general. Importantly, Covid-19 is likely to further accelerate these changes (Simonazzi *et al.*, 2020).

As an accompanying phenomenon, there is an emerging trend of establishing partnerships due to electrification and digitalisation as automotive firms fear falling behind in competition. Many such strategic partnerships of car makers aim at sharing costs and risks arising from the development and application of more advanced and cleaner technologies, but also to share their knowledge (Giffi, Vitale, Schiller, & Robinson, 2020; Dutt, Natarajan, Wilson, & Robinson, 2020). Similar reasons motivate the acquisition of innovative digital firms by car manufacturers. The Covid-19 pandemic has clearly given an additional impetus to such acquisitions (Simonazzi *et al.*, 2020).

Nevertheless, the Covid-19 pandemic has mainly affected the European automotive industry (and especially CEE) through global value chains. The impact could already be identified when the pandemic was just China's problem (Kinnunen, Georgescu, Hosseini, & Androniceanu, 2021). Over the years, China and especially Wuhan, where the coronavirus was first detected, had become an important supplier of intermediate products to the global automotive industry. Thus, any major disruption in Chinese supply was to have a significant impact on manufacturers globally (UNCTAD, 2020a). During the spring of 2020, GVCs actually suffered sudden disruptions, with significant consequences for businesses, con-

sumers, and the global economy. Due to the outbreak of the pandemic, and the related declining demand, supplier problems, and government decisions, many companies decided to close factories or significantly reduce production. This is especially true for the automotive industry whose just-in-time production system was quickly disturbed by production suspensions (Betti & Hong, 2020). In June 2020, the average closure time for car factories in the EU and the United Kingdom was around 30 days, and slightly lower in CEE with 28 days (ACEA, 2020a). Shutdowns made production capacities unable to recover to pre-crisis levels by the end of 2020, which had resulted in production losses in the EU amounting to more than 4.2 million vehicles or 22.9% of 2019 vehicle production. The loss was the largest for Germany (1.19 million vehicles), followed by France and Spain. In the CEE region, the most significant drop in production occurred in Czechia and Poland (ACEA, 2020b).

Supply problems intensified as the virus entered Europe, especially in CEE as production here is highly dependent on intermediates from the EU (especially Germany). Moreover, these countries were also affected by the demolishing of value chains on the export side as a significant part of their automotive production is intended for export (Leering & Spakman, 2020). CEE countries are actually largely exposed to GVC shocks, mainly through their integration in the German automotive supply chain (Demertzis & Masllorens, 2020).

Although production restarted gradually following the first shock in early 2020, the negative effects were clear. However, we should mention two benefits of GVC shocks caused by the Covid-19 pandemic. Firstly, to improve the resilience of supply chains, some activities previously placed abroad may be transferred back to Europe, thus shortening GVCs (UNCTAD, 2020b). Another benefit of the pandemic may be that the use of advanced, new manufacturing technologies can provide flexible responses to possible future shocks (Betti & Hong, 2020).

Based on the literature, we formulate the following research hypotheses:

H1:   The Covid-19 pandemic fundamentally affected the European automotive industry, amidst the ongoing sectoral megatrends of digitalisation and electrification.

H2:   The trends and effects in Central and Eastern Europe are in line with those identified at the European level.

H3:   Interference between the effects of the pandemic and the sectoral megatrends may well yield unexpected advancements; in particular, businesses may take the pandemic-induced crisis as an opportunity to engage in transformation.

RESEARCH METHODOLOGY

We conducted our empirical research based on a self-collected database consisting of relevant business decisions. The sources of our inputs were international and Hungarian business news portals (international: Reuters, Bloomberg; Hungarian: Portfolio, HVG) that report on companies' press conferences and public announcements. Our full sample contained 703 items that were in fact announcements of 166 firms related to the automotive industry (578 items), and further announcements at the industry or country level (51 and 74 items, respectively). The timeframe of the dataset was March 2017 – February 2021 (*i.e.* four years); however, most of the announcements were from 2020 (46.23%) and 2019 (26.74%). The larger weight of 2020 in the sample can be partly attributed to the pandemic-related announcements. Overall, our sample was incomplete and not representative, although we strove for its largest possible width and depth.

Our applied research method was fundamentally a quantitative descriptive analysis of a coded database of qualitative inputs. Coding can be understood as the conversion of raw qualitative information into communicative and reliable quantitative data. In coding, we labelled the items of our empirical dataset with words or short phrases that well summarised their contents. The reduction of the large amount of empirical material, thus making the data ready for immediate analysis, is a great advantage of coding and the main reason for its use (Böhm, 2004; Linneberg & Korsgaard, 2019). Coding always consists of multiple rounds. The first round of coding is performed on a certain amount of pre-existing data (Saldaña, 2009; 2015). Coding provides a comprehensive and thorough

insight in our dataset as it makes data easily accessible and retrievable, and it ensures transparency and validity (Linneberg & Korsgaard, 2019).

We coded our sample along the following dimensions: topic of the decision, firm type (Original Equipment Manufacturer called OEM, or supplier), location concerned by the decision (country, the EU, globe), nationality of firm, CEE involvement (yes/no), decision type (Figure 1).
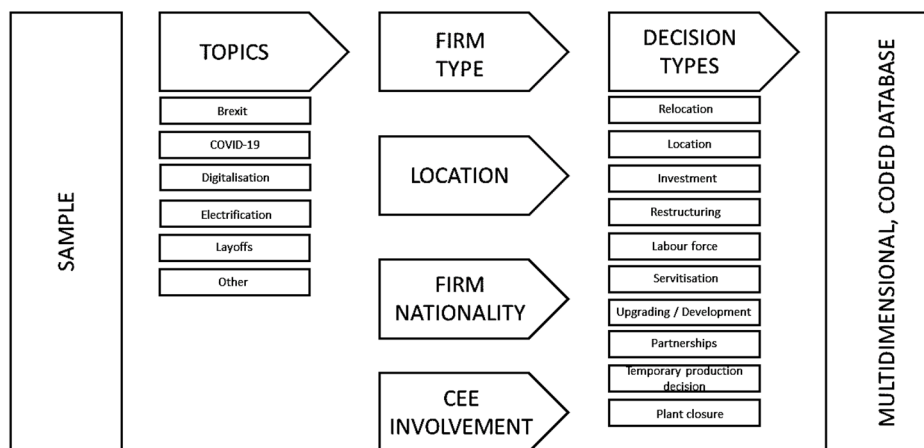
Figure 1. The coding of our sample of business decisions in the European automotive industry
Source: own elaboration.

In the first round of coding, we classified every element of our sample into the topics that we defined as the following: Brexit, digitalisation, electrification, layoff, Covid-19, and an 'other' category that consisted of announcements relevant for the European automotive industry but not belonging to either of the specified topics (e.g. announcements of site expansions or new production facilities). When coding and evaluating each announcement, we sought particular decisions made by industrial actors. Regarding decision types, we defined the categories of relocation, new location (be it a production site or an R&D centre), investment, restructuring (mostly business), labour force (layoffs, changes in labour cost, remuneration), servitisation, upgrading/development, partnership, temporary production decision (shutdowns and restart of production), and (terminal) plant closure. As a result of coding, we received a 962-line, multidimensional, coded, and therefore quantified database from our 703-item sample, now ready to be analysed with descriptive statistical methods.

RESULTS AND DISCUSSION

In our analysis, we combined statistics with qualitative inquiry into the contents. Our investigation focused on the topics of the business announcements, firm characteristics and location, decision types, CEE involvement, and last but not least, the Covid-19 pandemic.

Business announcements: Topics

First, we checked our database along the topics of business announcements (Figure 2). Many entries belonged to two categories: these were considered twice. Most of the entries were connected to electrification (281), the Covid-19 pandemic (205), and digitalisation (133).

Let us provide some qualitative details regarding the contents behind the inputs. In the electrification category, most of the items were firm- or industry-level decisions on the planned timing of full shift to electric engines in production and retail or the planned timing of switching the majority of produced cars to electric. The pandemic-related inputs were typically related either to lockdowns and restrictions or value chain restructuring, but there were also examples for announcements on state aid and other policy measures. Within digitalisation, autonomous driving and the appearance of IT firms in the sector prevailed. The categories of layoff and Brexit require no further explanation. The

group of 'other' announcements was dominated by location decisions, many times concerning new establishments and CEE as the location.

Regarding those items that belong to two categories, the parallel involvement of electrification and Covid-19 (27 items) pointed to two main connections. On the one hand, the global chip shortage caused by Covid-19-induced delays in electric vehicle production. On the other hand, many traditional companies (e.g. Volkswagen) escaped forward from the Covid-19-induced economic crisis and accelerated the production and sale of their electric models. Electrification and digitalisation (22 items) together covered partnerships aiming at exploiting the opportunities in both dimensions, and developments where digital technologies were applied in electrification (e.g. the Internet of Things, robotisation, production process optimisation). The combination of Covid-19 and layoffs (25 items) or Brexit and layoff (9 items) was rather obvious. Electrification and layoff (13 items) might have occurred jointly as electric vehicles consist of fewer spare parts hence need less labour input in their production. The rest of such dual cases was negligible in share and importance.
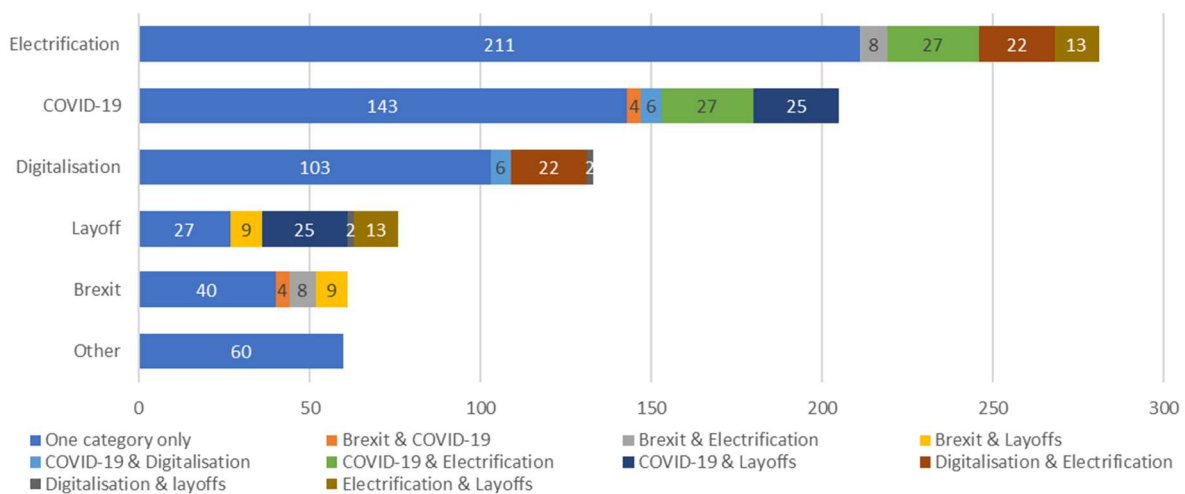
Figure 2. Business announcements by topics (number)
Source: own elaboration.

Business announcements: Decision types

We analysed business announcements concerning different decision types to see their impact. When coding decision types, one announcement often belonged to more than one category, but in certain cases, we could not relate the entry to any of them (99 items, mostly in connection with electrification and Covid-19[1]).

In decision type breakdown, many of the announcements in our sample could be connected to upgrading/development (20.62%), investment (19.18%), and labour force (15.41%), while the least frequent decision types were plant closures and relocations.

We were interested in how electrification, digitalisation, Brexit, the Covid-19 pandemic, and other events were connected to the types of decisions made by businesses and other stakeholders (Table 3).

In the case of the Covid-19 pandemic, more than half of the related decisions in our dataset were temporary production decisions. During the waves of the pandemic, many companies decided to conduct shutdowns to preserve the health of their employees, but also because demand for new vehicles decreased or breakages in their global value chains caused problems of certain parts supply. In the first months of 2021, there was a second wave of such temporary production decisions due to the global shortage of semiconductor chips forcing automotive firms to decrease production volumes.

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[1] The reason why we could not relate these entries to any of the defined decision categories is that the majority of these announcements are either in connection with sales drop (mostly for Covid-19), increased competition (for electrification) or state related announcements like financial help for automotive firms suffering from the impacts of Covid-19.

Regarding digitalisation, decisions related to upgrading/development and partnership formed the majority of our dataset. We may attribute this to the fact that digitalisation brings development, and many of the automotive industry's actors try to leverage on partnerships either with another automotive firm or, actually, in many cases, with ICT firms. However, somewhat strikingly, no firm in our sample announced decisions in connection with possible relocation. This is specifically notable from the viewpoint of CEE due to the fear of possible backshoring of activities to countries with higher purchasing power or larger cohorts of consumers.

Table 1. Business decisions, breakdown by main topic (number)

Topic	Relocation	Location	Investment	Restructuring	Labour force	Servitisation	Upgrading/Development	Partnerships	Temporary production decision	Plant closure	Total
Brexit	11	2	11	2	11	0	4	0	10	4	**55**
Covid-19	2	2	10	6	37	0	5	4	103	1	**170**
Digitalisation	0	7	27	6	12	25	65	54	0	0	**196**
Electrification	3	33	91	19	26	5	102	47	1	5	**332**
Layoffs	3	0	0	3	29	0	1	0	0	3	**39**
Other	3	20	34	6	24	0	9	6	4	4	**110**
Total	**22**	**64**	**173**	**42**	**139**	**30**	**186**	**111**	**118**	**17**	**902**

Source: own study.

As for electrification, upgrading/development and investment decisions dominated. Investment often concerned a new location. Partnerships were also frequent in electrification decisions, yet these mostly referred to partnerships between automotive firms to exploit the benefits of cooperation.

Obviously, the labour force was strongly connected to layoffs. For the 'other' category, investment decisions had the largest share. In fact, these were investments not connected to either of the other main themes but are important specifically for the CEE region, e.g. enhancing production capacities, opening a new unit of production, typically with lower value added.

Firm-related characteristics and location

The majority of the announcements in our dataset were of OEMs (61.04%), while 25% were of suppliers. The remaining 13.96% concerned certain countries' industries rather than any explicit firm. In these cases, both OEMs and suppliers were likely affected. We also analysed the decision breakdown by OEMs (583) and suppliers (330) (Table 4). For relocation, restructuring, upgrading/development, temporary production decisions, and plant closure, OEMs were overrepresented. For location decisions, suppliers actually outweighed OEMs in the sample, implying that mostly suppliers have chosen to invest in new locations. Actually, more than half of their investment decisions can be linked to a new location while the same figure is much lower for OEMs. OEMs' decisions are mostly connected to upgrading/development, partnerships, and investment.

In a company breakdown, the Volkswagen (VW) Group is overrepresented in the sample with 18.03% of entries (mostly VW and Audi). BMW (7.75%) and Daimler Mercedes-Benz (7.61%) follow the VW Group. However, suppliers made fewer announcements, the ones accounting for most entries in our database were Continental, Bosch, and Thyssenkrupp. These numbers suggest that German automotive firms are heavily represented in our sample and are responsible for a large share of the announcements (Table 3). Altogether, 40% of the entries were connected to German automotive firms. What dominated in main topic breakdown were German automotive announcements on electrification, digitalisation, and the Covid-19 pandemic.

Because we partly focused on CEE, we also checked its involvement. In fact, 27.6% of the sample related to CEE, mostly for Covid-19 and electrification.

Table 2. Business decisions made by OEMs and suppliers, by type (number)

Types	Relocation	Location	Investment	Restructuring	Labour force	Servitisation	Upgrading/Development	Partnerships	Temporary production decision	Plant closure	Total
OEM	18	23	93	34	73	20	125	98	85	14	583
Supplier	3	39	78	5	48	16	63	65	11	2	330
Neither	1	3	9	3	19	2	19	1	22	1	80

Source: own study.

Table 3. Entries related to CEE and German automotive firms (number)

Firms	CEE	German automotive firms	Both
Brexit	0	7	0
Covid-19	64	58	19
Digitalisation	26	58	7
Electrification	59	119	27
Layoff	7	20	6
Other	38	22	16
Total	194	284	75

Source: own study.

As a further dimension, we looked at the location affected by the announcements. The locations most represented in our sample were Germany and Hungary, followed by the United Kingdom. Many decisions had a global and European effect. Outside Europe, the United States of America, Japan, and China were the most frequently concerned locations. Yet, as mentioned above, our sample was not representative.

Looking at the different decisions affecting the CEE region, electrification prevailed followed by the 'other' category, here covering mostly new investments and, in many cases, new locations in the region. Notably, these were not digitalisation-, electrification-, or pandemic-related investments but other types, mostly investments of suppliers targeting development, capacity enhancement, or new production plants. Nevertheless, this was a signal that the CEE remained an attractive location, even in times of fundamental changes and the pandemic. In this subset, we found no Brexit-related announcements. For the Covid-19 pandemic, temporary production decisions and measures related to labour force dominated the dataset, mostly covering layoffs and reduced working hours. Based on our sample, digitalisation and electrification affected the region primarily through upgrading/development and investments. In addition, numerous new location decisions were made that related directly to electrification. Apparently, firms invested in the modernisation of their branches in CEE instead of moving them to the West.

Business announcements and Covid-19, with a CEE focus

After analysing the whole sample, we removed the entries connected solely to Brexit, layoffs, electrification, digitalisation, or other and undertook a deep analysis regarding the subset of the pandemic-related entries, which consisted of 205 elements.

The timeframe for this subset was March 2020 – February 2021. The start of the period was obvious as Covid-19 appeared in the majority of the EU countries in March 2020, substantially affecting our lives, including industrial production. In particular, most entries were from March, April, and May 2020, adding up to 57.87% of all pandemic-related cases. The reason for this was that the first wave of the pandemic hit automotive firms hard: GVCs were disrupted, employers were concerned about the

health of employees, and they had no protocol for such an event. Nevertheless, in January and February 2021, a new wave of announcements occurred (20.3% of total Covid-19 entries in our dataset) due to the global shortage of semiconductor chips.

Table 4. CEE related decisions by main topic breakdown and by decision type (number)

Types	Relocation	Location	Investment	Restructuring	Labour force	Servitisation	Upgrading/Development	Partnerships	Temporary production decision	Plant Closure	Total
Brexit	0	0	0	0	0	0	0	0	0	0	0
Covid- 19	0	2	7	2	15	0	2	0	37	0	65
Digitalisation	0	6	16	1	6	1	21	1	0	0	52
Electrification	3	22	40	5	13	0	24	0	0	1	108
Layoffs	3	0	0	2	7	0	0	0	0	1	13
Other	2	18	29	2	20	0	0	0	2	0	73
Total	8	48	92	12	61	1	47	1	39	2	311

Source: own study.

Our database gathered 43 firms overall making decisions in connection with the Covid-19 pandemic, but this number hid the fact that, in many cases, entries referred to the automotive industry of a certain country, the EU, or the globe, implying that many further firms were impacted. Even 57.36% of the pandemic-related announcements in our dataset were of OEMs, 14.72% were of suppliers, and 27.92% were sectoral. The OEMs with the most entries in our sample were the Renault-Nissan-Mitsubishi alliance (12.69%), the VW Group (8.12%), and BMW (5.08%).

Moreover, we looked into CEE's involvement and the share of German automotive firms in relation to the Covid-19 pandemic announcements. Central and Eastern European countries were engaged in 31.22% of these cases, while 28.29% of these announcements were connected to German automotive firms (Table 5). Thus, the CEE-related entries were slightly overrepresented in this subset, while those linked to the German automotive firms were relatively underrepresented compared to the full sample.

Table 5. Pandemic-related announcements with the involvement of CEE and German automotive firms

Category	CEE	German automotive firm	Both
Number in full sample	194	284	75
Number of Covid-19 related announcements	64	58	19
Share (%) in Covid-19 subset	31.22	28.29	9.27

Source: own study.

We also looked at the location affected by the announcements in our dataset. For many decisions the whole globe (20.81%) or the EU (10.66%) were concerned, and countrywise, Germany, Italy, and the United Kingdom appeared the most frequently. Of course, China, Japan, or the USA were also heavily concerned locations but our focus was on Europe.

What about the Covid-19 pandemic and decision types? These results were presented in Table 6 along the number and share of decisions in the Covid-19 subset, share in the decision type category, and CEE involvement. Concerning the pandemic-related decisions within the whole sample, 18.96% of all business decisions had some relation to Covid-19. However, based on our database, 87.29% of the decisions on temporary production decisions and 27.34% of the labour force decisions were made in connection with the pandemic. Almost one-tenth of the relocation-related announcements referred to Covid-19, although this only meant two occurrences.

Most of the pandemic-related decisions belonged to the temporary production decision type (60%). These were mostly temporary shutdowns, re-openings, and restarts or production volume decrease decisions, the latter due to health and safety or GVC reasons. Labour-force-related issues formed the second largest category (22.22%), yet not all of these decisions covered layoffs. In some cases, labour force announcements concerned extra bonuses paid to the workforce during the pandemic. All other related decisions had lower significance with less than 10% share in the subset. Plant closures, relocations, and new location decisions were the least prevalent.

Table 6. Covid-19 related decisions, by type

Types	Relocation	Location	Investment	Restructuring	Labour force	Servitisation	Upgrading/Development	Partnerships	Temporary production decision	Plant Closure	Total
Decisions (number)	2	2	10	6	38	0	5	4	103	1	171
Decisions (share, %)	1.17	1.17	5.85	3.51	22.22	0.00	2.93	2.34	60.23	0.58	100
Covid-19 related decisions (share in whole category)	9.09	3.13	5.78	14.28	27.34	0.00	2.69	3.60	87.29	5.88	18.96
CEE involvement (number)	0	2	7	2	15	0	2	0	37	0	65
CEE involvement (share, %)	0.00	3.08	10.76	3.08	23.08	0.00	3.08	0.00	56.92	0.00	100
CEE involvement (% of Covid-19 related decisions)	0.00	100	70	33.33	39.47	0.00	40	0.00	26.81	0.00	38.01

Source: own study.

Although we found only 10 decisions in connection with investments in our Covid-19 subset, they were worth considering as – in the majority of these cases – only few (three) decisions were delays of planned investments, while the majority (seven) referred to investments in digitalisation and electrification. Thus, these decisions could have been seen as ways of coping with the damages and losses caused by Covid-19. Furthermore, they were signals of firms concentrating on the future and on longer-term developments rather than short-term disturbances. Upgrading/development (five) and partnership (four) decisions – taken even in times of the uncertainty brought about by the pandemic – also supported this statement.

Regarding Covid-19 decisions with CEE involvement along firms' country of origin breakdown, 29.69% of these decisions were made by German automotive firms. Japanese (14.06%), Korean, and French (4.69% each) industry players also appeared in pandemic-related decisions in CEE (Japanese and Korean mostly through suppliers). Temporary production decisions dominated the cases with CEE involvement in the pandemic-related subsample, implying that CEE was not an exception in this respect. In our sample, 23.08% of Covid-19 decisions in CEE countries were made in connection with the labour force, mostly covering layoffs. To save costs, many OEMs and even more suppliers decided to reduce the labour force base either worldwide or just in CEE. Large cutbacks occurred at Continental and Bosch in Hungary or Renault in Slovenia, among others. Investments came third in the CEE region, making up 10.76% of pandemic-related CEE announcements. In fact, 70% of all Covid-related investment decisions in our sample involved the CEE region; moreover, all the new location decisions were CEE related. This is a further proof that CEE could remain an important region for automotive firms, even during the pandemic.

The fact that among the analysed business decisions, the topics of electrification and digitalisation were highly prevalent is in line with the main findings of literature (Casper & Sundin, 2020; Urbach & Röglinger, 2018). The third most frequent topic in our sample was the Covid-19 pandemic. Upon the outbreak of the coronavirus epidemic evolving into a pandemic, Simonazzi *et al.* (2020) foresaw that it would likely become an accelerator of existing trends in the automotive sector. Our sample of business decisions justifies this projection. At the same time, our finding that Covid-19

induced temporary production decisions and other decisions, affecting the labour force is in line with the findings of Betti & Hong (2020) or Żak & Garncarz (2020).

Upgrading and development, investment, and labour-force-related decisions dominated our sample – the three made 55.21% of all decisions. Investment in innovation and development in downturns is also revealed by Kaszowska and Mojsa (2020). The dominance of German manufacturers in the CEE region comes by no surprise (Pavlínek, 2015; Demertzis & Masllorens, 2020). However, based on our sample, the CEE region importantly does not appear to have a second-rank position, which contradicts the mainstream conclusion of the truncated development literature emphasising the controversial nature of FDI-based growth in peripheral Europe (Pavlínek, 2015), and also challenges the idea of the CEE region's desperate dependence on the West (Nölke & Vliegenthart, 2009). Nevertheless, increasing investment in the automation of peripheral manufacturing plants is lately indicated by Drahokoupil (2020).

CONCLUSIONS

In our study, we aimed at examining how Covid-19 has affected the European automotive industry, with a special focus on Central and Eastern Europe. In our analysis, we tried to emphasise the relationship between the pandemic and the ongoing sectoral megatrends (i.e. electrification and digitalisation), relying on our self-collected sample of business announcements.

Coding our inputs has enabled us to carry out a complex analysis, aiming at verifying our hypotheses. Our first hypothesis concerned the fundamental effect of the Covid-19 pandemic on the European automotive industry. Approximately 30% (205 out of 703) of the items in our sample are related to Covid-19, which already reveals its importance. Actually, 27 of these cases involved electrification in parallel, which implies that the Covid-19 pandemic may be an opportunity for firms to accelerate transformation to electrification. On the other hand, 25 pandemic-related announcements concerned layoff (one-third of all the items under layoff), spectacularly revealing the negative effects of Covid-19 in the European automotive industry. In terms of business decision types, those related to Covid-19 were heavily dominated (60.59%) by temporary production decisions. On the other hand, 87.29% of all the temporary business decisions in our sample were Covid-19 related. These numbers highlight the short-term effects of the pandemic in the industry that were mainly negative in nature. Nevertheless, the fact that the global shortage of semiconductor chips has driven automotive firms to make decisions resulting in weaker dependence on Asian producers, even by establishing chip production plants in Europe, implies that – along these lines – the pandemic may have long-term effects on the sector. Overall, we consider our first hypothesis as verified.

In terms of our second hypothesis, we have demonstrated the intensive involvement of the CEE region in the whole sample and in the Covid-19 related subset. Based on our research, CEE as a location for automotive industrial actors lost none of its attractiveness. In addition, the trends in this region show no diverse pattern but fit in the main European and global trends, which may be surprising and can be a sign of the CEE region's upgrade within the European automotive industrial structure, from a peripheral to a more central status. Accordingly, we accept our second hypothesis as well.

Our third hypothesis addressed the interference of Covid-19 with the transformational megatrends of digitalisation and electrification in the industry. In this respect, we foresaw unexpected advancements. Our analysis did not reveal this element. Nevertheless, the Covid-19 induced crisis taken as an opportunity by business actors was traceable in our sample, especially by firms who undertook development investments and engaged in forward looking partnerships, many times with firms from the ICT sector, which is a rather new phenomenon. Many of these advancements may well have taken effect without Covid-19; however, the pandemic has proven to be a trigger in this situation. Consequently, we partly accept our third hypothesis.

Based on our research, our main suggestion for business is to concentrate on the sectoral megatrends, and never miss the long run from the decision-making horizon. Through such an approach, Covid-19 can also be viewed as an opportunity to introduce developments. One policy implication deriving from our research is that the actors of the automotive industry were rather responsive both to

the ongoing transformation and to the pandemic, so the winning policy targeting this sector may be to ensure an enabling environment that fosters change undertaken by the business actors themselves.

The main limitation of our research is the lack of representativeness and completeness of our sample. Nevertheless, trends can be drawn from the sample due to its large size. A further limitation is our negligence of government decisions and other policy measures, especially those related to the Covid-19 pandemic with a direct or indirect effect on the automotive sector; this has been a deliberate decision as we focused on business decisions. As we were monitoring international and Hungarian sources, we may have missed announcements only available in other national languages and other sources of information. Last but not least, even if we strove for objectivity, our primary research may be limited by a certain degree of inevitable subjectivity.

Regarding the possible directions of future research, our sample can be extended by the involvement of government decisions and further policy measures targeting the European automotive industry, be it directly or indirectly. Going further in depth with research on business decisions, potentially on a selective case study basis, future studies could investigate whether the pandemic led to new projects and operational changes or challenged the current mode of operation at firms' level. Certainly, should any future events similar to the Covid-19 pandemic unfold with a comparable potential to shape the life of businesses, the amplification of the sample involving these newly evolving aspects is also a way to go forward.

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Authors

The contribution share of authors is equal and amounted to 50% for each of them.

Anita Pelle

Associate Professor at the University of Szeged. She holds a PhD in Economics (2010). She received a post-doctoral scholarship from the National Centre of Excellence of Hungary in 2013-2014 and has held a Jean Monnet Chair since 2014. She teaches on and studies the economy of the EU, the European economic integration process, the history of European economic thought, the EU internal market and its regulation, and lately, the internal EU divide. She has also been visiting professor at Université d'Angers (France), Université Jean Moulin Lyon III (France), Universitá di Pavia (Italy), Vysoká Škola Ekonomická v Praze (Czech Republic), Universitá di Macerata (Italy), and Uniwersytet Warszawski (Poland).

Correspondence to: Anita Pelle, PhD, the University of Szeged, Faculty of Economics and Business Administration, Kálvária Avenue 1, 6722 Szeged, Hungary, e-mail: tabajdi.gabriella@eco.u-szeged.hu
ORCID http://orcid.org/0000-0001-9115-4264

Gabriella Tabajdi

PhD Student and junior researcher at the Faculty of Economics and Business Administration of the University of Szeged. She holds an MSc in International Economy and Business (University of Szeged) and an MSc in International Business and Entrepreneurship (Universitá di Pavia). Her research focuses on the process of European integration, the internal market of the European Union, and international business and location decisions.

Correspondence to: Ms. Gabriella Tabajdi, University of Szeged, Faculty of Economics and Business Administration, Kálvária Ave-nue 1, 6722 Szeged, Hungary, e-mail: tabajdi.gabriella@eco.u-szeged.hu
ORCID http://orcid.org/0000-0002-4059-0514

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The Covid-19 pandemic as a potential change agent for selected economic concepts

Piotr Banaszyk, Przemysław Deszczyński, Marian Gorynia, Krzysztof Malaga

A B S T R A C T
Objective: The objective of the article is to refer to the thesis about the need to modify the main paradigm of economic sciences – by which we mean mainstream economics – with all its consequences that influence the whole economic sciences. We posit the need for the modification of how economic sciences are practiced in ontological, epistemological, and methodological aspects. The need results from the impact of several factors that appeared even in the pre-pandemic period, for which Covid-19 may be a complementary and reinforcing circumstance that may even directly determine the change.
Research Design & Methods: The main method we used was that of critical literature analysis. We constructed a set of normative recommendations for changes in economic sciences. Next, we selected four issues to exemplify the areas that require change, for which we proposed a set of postulates that constitute the desired modifications in economic sciences.
Findings: The conducted literature review shows that the number of people convinced of the need to modify the assumptions and content of economic sciences grows systematically. Sometimes, there even appears a more elaborate demand for the revision of economic sciences, not only of their modification.
Implications & Recommendations: Firstly, the most important consequence of the study is the justification of the postulate of departing from the dominance of the main paradigm of economic sciences contained in mainstream economics towards noticing the multi-paradigm character of economic sciences, and secondly, the support of the position leaning towards the active and normative involvement of economic sciences in creating/correcting the surrounding reality.
Contribution & Value Added: The text is a synthesis of the postulates previously reported in the literature regarding the modification of economic sciences with the consequences caused by the Covid-19 pandemic. Chronologically, the Covid-19 pandemic is the last of the causative factors of the revision under consideration – neither the only nor the most important factor – but what draws attention are its direct nature, violence, and the surprise associated with its appearance.

Article type:	research article
Keywords:	Covid-19 pandemic; methodology of economics; paradigm; change agent; economic theory; homo economicus
JEL codes:	A11, A12, B41, B50

Received: 14 April 2021	Revised: 20 July 2021	Accepted: 22 July 2021

INTRODUCTION

In this article, we reflect on the necessity to modify the current main paradigms in the economic sciences[1], with all its consequences that influence theoretical and empirical research in economics, finance, business, management, or socio-economic geography and public management. Within the

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[1] The term "economic sciencies" used in this article should be understood as the equivalent of the terms "economics and business" or "economics and management".

economy of the real world and individual national economies, there are so many factors in favour of change that we deem it necessary to consider this issue once again. We know that we are neither the first nor the only ones to write about the matter. However, we believe that – this time – such a change requires more determination and persistence. The Covid-19 pandemic appears to be the critical factor that made the world stop – for a moment, a few months, or maybe even a few years – and it appears to some as a factor that directly prejudges the need for that change. Of course, the pandemic is not the sole determinant of the postulated re-evaluation, but it is the most recent factor among many other, and by decelerating socio-economic processes, it encourages reflection and allows time for deliberation and action. The change of the real world requires many actions in practically all spheres of human activity and on various levels. Moreover, the change requires that we include in it the sphere of science and education. In other words, the change should also concern the modification of concepts developed by science. As representatives of the economic sciences, we join the discussion on the change – its goals, foundations, mechanisms, and tools – following our belief that such a contribution can influence other spheres and levels of human activity.

To illustrate our thesis, we refer to several examples of issues, subjects, theories, concepts, and models of modern economic sciences. This choice is not predetermined and closed, while the set of problems may be extended, for which we certainly hope. However, our choice is neither voluntaristic nor accidental, as it refers to our combined scientific interests, which represent distant specializations within economic sciences. The noticeable heterogeneity of our examples intends to encourage a wide range of scholars in economic sciences to expand the scope of issues that require change in research approach. Moreover, it appears to us that the accuracy of our choice of issues has been verified by the pandemic itself, among other things, as they are visibly present in the discussion concerning Covid-19 in scientific literature and journalism and have been the subject of serious polemics in economic literature for decades. These examples are homo economicus, business performance, the essence and measurement of national wealth, and globalization. In general, we seek answers to the question: What should change in economic sciences' approach to each of the issues? The order of discussion of individual issues was based on the principle of reasoning from micro to macro and global levels of inquiry[2].

We seek to provoke a debate on a wide range of significant economic subjects, which raised controversy even before the outbreak of the Covid-19 pandemic, possibly leading to the creation of an outline of a modified economic sciences' research plan. The general framework of such a program could be composed of the following research questions:

RQ1: What has changed, is changing, and will change in the real world grasped in each issue (ontology) both before, during, and after the Covid-19 pandemic?

RQ2: What has changed, is changing, and will change in our understanding of the world that is significant and cognitively investigable (epistemology) both before, during, and after the Covid-19 pandemic?

RQ3: What has changed, is changing, and will change in our methodology of cognizing this world (methodology) both before, during, and after the Covid-19 pandemic?

RQ4: Are there any premises for changing the proportions of economic sciences' functions towards a descriptive-explanatory or normative role?

The implementation of the signalled framework research program would require a reflection on the relationship between the cognitive versus normative functions of economic sciences aimed at formulating postulates about what should change in economic sciences' practice. We intend to contribute to such a research program.

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[2] The logic of the text is based on moving from micro problems, through meso to macro. Human nature as described by the homo economicus model can be considered a key microeconomic issue, therefore this is an initial problem. Further, the EVA-based business management practice resulting from homo economicus model of financial capital providers must lead to over-exploitation of the bio-natural system, so it is another important factor for modification. At the level of economic policy, the commonly used optimization (decision) criterion in the form of GDP pc is an unambiguous source of ecological and climate problems. Finally, social factors resulting from the unfair distribution of wealth are also important.

The article consists of four sections. The introduction presents the objective of the article and outlines the idea of the creation of an outline of a modified economic sciences' research plan. In the second section, we briefly describe the materials and the methods used. The third section consists of six parts: the first is devoted to the discussion of the direction of modifying the reflection about economic sciences and the second is devoted to the dispute over the descriptive-explanatory versus normative character of economic sciences. Parts three to six contain a critical diagnosis and normative considerations relating to four examples of selected economic concepts: the model of homo economicus, business performance measurement and management, the essence and measurement of national wealth, and globalization. Section four presents the most important conclusions concerning the necessity to change the way economic sciences are practiced in ontological, epistemological, and methodological aspects.

RESEARCH METHODOLOGY

Method-wise, this article critically analyses subject literature and constructs a set of normative recommendations for changes in economic sciences. In this respect this is a theory development article.

As for the materials used, the authors referred to two groups of sources. The first group concerns a critical diagnosis of the way economic sciences were practiced, both before the world financial crisis in 2008-2011, during the crisis and after it, but before the outbreak of the Covid-19 pandemic. The general conclusion of these analyses was critical of the way economic sciences were practiced in ontological, epistemological, and methodological aspects. Despite the postulates for changes, the method of conducting research in economic sciences has not changed significantly.

The second group of sources used were publications created after the outbreak of the Covid-19 pandemic, which strongly emphasize the thesis that the unfavourable processes in the functioning of our civilization have gone so far that rapid and radical changes are necessary. They concern both the practice of economic activity and the way of practicing economic sciences. During the preparation of the article, we mainly used English-language literature.

In summary, our intention is that this text should be treated as a study of literature leading to the formulation of proposals for changes in economic sciences.

LITERATURE REVIEW AND THEORY DEVELOPMENT

The direction of modifying the reflection about economic sciences

Economic sciences may be considered within a set of disciplines called instrumental (Popper, 1963). The global or national economy is simply too complex and dynamic to be explained definitively once and for all. Changes in the economic behaviour of major economic players and the infrastructure they use are rapid, so it is surprising that some people promote the belief that there is one main and universal paradigm in economic sciences. Instead, economic sciences are multi-paradigmatic by nature. Fiedor (2019) indicates that the same notion was used to describe the achievements of 'mainstream' economics, without any reference to alternative economic schools. A similar position was presented by Gorynia (2019a), who applies the notion of a multi-paradigmatic approach to the entire economic sciences. It is possible that instead of seeking one or more universal paradigms of economic sciences, we should assume that the pattern for conducting research in economic sciences emerges from a permanent discussion among the subjects of this research. The sensible result of the discourse of economics should be ensured by the goodwill of speakers and the logic of content that they present. After all, contradictions in the promoted ideas can be a source of inspiration for new ideas.

Meanwhile, 'mainstream' economics dominates the economic sciences, and the limits of this current are ambiguous. Some postulate this term should be attributed in sociological perspective to the achievements of 'elite' economists, *i.e.* the most acclaimed scientists who work at the best universities. A more rigorous term is 'economic orthodoxy' identified for intellectual reasons and now associated with the neoclassical school in economics (Colander, 2003, p. 5). Its most important assumptions include a) common microeconomic rationality explained by the homo economicus model, b) tendency to general and partial equilibrium, c) mathematical formalism (Fiedor, 2019, p. 49). Therefore, the

characteristic of core research presented by Fiedor refers to economic orthodoxy and is one of the components of mainstream economics. However, this component is very expansive and is responsible for 'economic imperialism,' *i.e.* the pursuit of imposing exclusive correctness on other schools of thought, other scientific disciplines, and even the extra-scientific practice of human activities (Davis, 2006, pp. 7-8). Nevertheless, this orthodox thought – along with the neo-Keynesian school of thought, among other approaches – forms the basis of the proposal of the 'new neoclassical synthesis,' which we can now treat from a sociological perspective precisely as a mainstream concept.

According to some, mainstream economics justifies and is responsible for the devastation of the natural environment and the often-encountered separation of economic rationality from ethical and moral imponderables. The proponents of mainstream economics even secured for themselves institutional support for the promotion of their ideas around the world in the form of the Washington Consensus as an instruction of conduct for the officers of the International Monetary Fund and the World Bank. As a result, what counts around the world is the continuous increase in production (e.g. measured by the dynamics of gross domestic product, or GDP) and providing investors with ever more added value (e.g. measured by economic value added, or EVA), which require growing consumption (now in the stage of excessive consumerism). In other words, when recording these effects, we should indicate the frequently encountered overexploitation of natural resources (as the basis for production) and often uncritical search for the cheapest locations of production plants (to multiply profits), along with confusing aggressive marketing (which deprives consumers of the right to the freedom of choice).

The number of people convinced of the need to modify the assumptions and content of economic sciences grows systematically (*The Economist*, 2020; Coyle, 2020; Skidelski, 2020). Sometimes, there even appears a more elaborate demand for the revision of economic sciences. We argue that – in order to make progress in the matter – the essence of modification/revision of economic sciences should be evaluated and changed in the spirit of kindness and awareness of the value of scientific achievements to date.

Chronologically, the Covid-19 pandemic is the last of the causative factors of the revision under consideration – neither the only nor the most important factor – but what draws attention are its direct nature, violence, and the surprise associated with its appearance.

At this point, let us focus on several features of the Covid-19 pandemic that determine the specificity of its impact on the socioeconomic system and the crisis phenomena characteristics that it engendered. Firstly, the pandemic has all the characteristics of a 'black swan' event, *i.e.* an unexpected and unlikely event but one with enormous consequences (Taleb, 2010; Roubini, 2020a). Secondly, the nature of the crisis caused by the pandemic as a non-economic phenomenon concerns the supply, demand, and financial spheres, so it can be the subject of interest for all areas of economic sciences, which we notice in the number and scope of ongoing research projects and the already published output. Thirdly, the most important features of the crisis are its violent course, deep recession, and the significant decrease in global GDP, employment, and other indicators; not to mention the industry-sectoral and spatial diversification (Roubini, 2020b). We find ourselves amid the deepest peacetime recession in the last 150 years, which has already had a devastating impact on the world economy (Wolf, 2020). Fourthly, counteracting the negative economic impact of the pandemic has led to unprecedented interventions by governments and international organizations (IMF, 2020). Fifthly, we must indicate the difficulties in forecasting the post-crisis future and the rebuilding of the world economy, characterized by very diverse forecasts and the need for their systematic updates (Wolf, 2020). These uncertainties and dilemmas seem to indicate a great need for reflection of all economic sciences' areas, which may contribute to building a 'new normality' free from past mistakes in economic development.

As a result of the Covid-19 pandemic – but not limited to that – the dangers related to the overexploitation of our planet's resources have not only been revealed but also acknowledged. On the other hand, there currently emerges good social atmosphere that encourages changes. The destruction of the natural environment results directly from excessive production and consumption and indirectly from the logic of market economy, while the deepest causes of this process are cultural. The social climate for modification/revision manifests in many spontaneous protest movements.

Therefore, it is worthwhile to discuss this matter right now as the passage of time and socioeconomic processes dilute what is stagnant and immobile.

The descriptive-explanatory versus normative character of economic sciences

A matter frequently raised in discussions concerning the crisis caused by the Covid-19 pandemic is the character of economics and, more broadly, economic sciences in terms of the functions they perform. The result of centuries of reflection on this issue brought no unequivocal solutions. We can distinguish two different positions in this regard: a) a position that promotes a positive approach, b) a position that leans towards the active and normative involvement of economic sciences in creating/fixing reality.

The positive approach primarily assigns economic sciences with the descriptive-explanatory function. In this view, science should be devoid of evaluative and normative elements. One of the precursors of such an understanding of the function of science may be considered David Hume, who stated that we should not derive value judgments from descriptive judgments of facts, which is called Hume's guillotine (Hume, 1969, p. 469). Robbins (1932) and Friedman (1953) shared this view. The knowledge of how reality works may be useful at most for forecasting – *i.e.* predicting the future – but it should not be used for reality's creation in the sense of setting goals. However, it is hard to resist the impression that one cannot fully defend such an approach. If descriptive and explanatory knowledge show that the use of certain tools of economic policy are highly likely to lead to negatively assessed effects, then such knowledge results in a recommendation not to use these tools. Notwithstanding, this is a different situation than creating goals for socioeconomic development, and in this sense, it appears to fall within the framework that Lionel Robbins envisaged for economic sciences. Setting goals and selecting methods or means to achieve these goals are two different things.

The normative approach recommends a broader range of using economic sciences – both for setting development goals and defining the means to achieve them (Krugman, 2020). In this case, Max Weber's notion of rational action, in which the adoption of a particular intention is accompanied by the selection of means and consideration of side effects. A contemporary version of this approach is notion of new pragmatism.

In discussions about the post-Covid-19 economy, experts emphasize the need for a broader use of scientific achievements – including economic sciences – to shape reality in such a way as to minimize the likelihood of similar pandemics and crises they cause. Some indicate that the accumulation of factors negatively affecting the development of human civilization has reached unprecedented proportions, and this alone justifies the need for the use of science to rationalize civilization. Indeed, in reality the range of problems that require a solution is very wide, which we will signal below. Their cognition and explanation are essential as it is on them that the economic sciences research efforts should focus in the ontological-epistemological sense. In the sphere of ontology and epistemology, the great complexity and intricacy of relationships among components of civilization requires a comprehensive, holistic, and multidimensional approach. In this view, we should broaden the scope of empirical research to explain economic reality, especially in the area of modern civilization's shortcomings and the resulting crises. The sphere of methodology requires us to adopt a pragmatic approach, oriented towards solving specific problems, whose essence should be the focus of researchers' attention, without fixed assumptions that characterize specific schools of philosophy and dependence on a particular class of methods (Creshwell & Creshwell, 2018). In other words, we recommend eclecticism and pluralism in the individual choice of methods. Such understood, pragmatism remains open to various visions of the studied world, diverse research assumptions, and various forms of data collection and analysis. Therefore, we may expect an increase in the role of methodological triangulation, which implies a parallel flexible use of research methods that should complement each other and contribute to the better recognition of cause-and-effect relationships in economic activity.

However, let us highlight the troublesome limitations of economic sciences. First limitation regards their multi-paradigmatic character, namely the coexistence of various notions, which some interpret as evidence of the underdevelopment of these sciences, while others as an expression of the complexity of the socioeconomic system (Gorynia, 2019a). The second limitation is related to

the fact that the economic aspect is only one of the many dimensions of civilization, so its understanding and recommendations' construction in relation to practice should be multidimensional, considering the entirety of systemic properties. The third and final limitation is the difficulty of building economic forecasts based on theory, as signalled by *e.g.* Popper, Morgenstern, Lucas, or Merton. These difficulties may be viewed as premises for a constructive exchange of ideas among different schools of economic sciences and even among various disciplines or fields of study.

Thus, on the one hand, the demand for socioeconomic practice in economic knowledge necessary for the rationalization of civilization seems to be high and increased as a result of the pandemic. However, on the other hand, what hinders the rationalization of civilization is the influencing of economic reality with the use of ambiguous results of theoretical and practical research, many of which are objective in nature. In this situation, it seems to us that what may be a useful measure is even the most basic education of societies in the cardinal and unquestionable rudimentary mechanisms of economic life. We might risk a statement that changes in science should necessarily be accompanied by changes in education. Indeed, the former is not enough. In general, we may recommend that – in the face of pluralism and imperfections in created notions – we should follow a heterodox rather than an orthodox approach in education.

The model of a homo economicus

Several centuries in the evolution of the economic man construct has not led to the development of a uniform and coherent concept of both economic and extra-economic human behaviour. Various schools of economics present very different approaches to the matter by assuming 'that the goal of the economic man is the maximization of wealth, profit, utility, or preference, by which they can pursue such a goal in a rational manner' (Dzionek-Kozłowska, 2018, p. 8). In the above definition, we may identify two elements: the element of egoism and the element of rationality (optimization). The definitions of each are also ambiguous. It seems that regarding both these elements a broad compromise is possible among different positions, one that shows the usefulness of this construct in various economic theories. Simultaneously, this usefulness may be seen from the viewpoint of its two different roles: the description of the economic system and the modelling of market behaviours (North, 1990, p. 17).

As far as the element of egoism is concerned, we should note that when building the above compromise – even with a literal pejorative understanding of egoism – most economic theorists did not assume it to be the only motive of human economic activity, let alone the only motive of all human activity. Even the proponents of forming an 'economic theory of everything' based on the homo economicus model would not argue that humans pursue rational utility maximization. These scholars only assume that people behave as if they were driven by such a motive (Becker, 1976). In this context, the notion of utility seems particularly useful, as it may be defined so broadly as to include other motives for human activity.

The element of rationality (optimization) may be approached in a similar compromise manner. Representatives of many economic schools – generally, most heterodox schools – rightly reject full rationality as a descriptive and explanatory notion of human action, which is particularly emphasized by representatives of behavioural economics. The minimum condition for a compromise, then, seems to be the recognition of human rationality's limitations and imperfections. Nevertheless, the usefulness of the construct itself may be considered an idealized model or an ideal type – after Max Weber – to be used for comparisons among real human behaviours.

It seems that even before the Covid-19 pandemic, economic sciences quite unanimously moved away from the extreme and strict homo economicus model as the maximization of preferences and full rationality typical of mainstream economics. By contrast, it does not appear that Covid-19 will lead to any significant change in this situation. However, some modification in the understanding and use of the economic man model should occur. The pandemic is likely to influence the necessity to redefine the homo economicus model so as to include ontologically relevant factors that affect utility and human preferences, such as health safety, health care expenditures, disease prevention efforts, or more broadly, investment in public goods, the reliability of supply, the location of production near markets, and the understanding of the role of inventories. This does not mean that the homo economicus model's framework was too tight that these factors could not have been included in the past. There was simply no need for

it or, more precisely, people saw no need for such an inclusion. However, in the Covid-19 and post-Covid-19 reality, adding new elements to the explanans of the economic man model seems indispensable. The changes occurring in the real world (ontology) should be recognized in the sphere of cognition (epistemology) and taken into account in the construction of adequate research methods (methodology).

Let us note that observing the behaviour of people in difficult life situations caused by the Covid-19 pandemic – suffice it to consider the difficult access to medicines, medical equipment, and food and hygiene resources or the greed of some entrepreneurs and cases of fraud – it seems that these conditions elevated the tendency towards selfish behaviour, which would indicate a significant descriptive role of the model widely criticized for its unrealistic nature. In turn, the concept of homo economicus does not seem to have become more attractive in the normative view because of psychological and social processes triggered by the pandemic.

We may argue that a desirable and recommended evolution of this notion can be legitimately named *homo economicus moralis*, which would mean the inclusion of ethical, ecological, or anti-poverty economic values and inequalities among the criteria shaping human behaviour[3]. In particular, what should be stressed is the impact of the pandemic on increasing the probability of rising inequality levels, which was the subject of a lively discussion even before the appearance of Covid-19 (Boushey, Delong & Steinbaum, 2017) and is a frequently raised topic during the pandemic (Sandbu, 2020). This expected and recommended shift in focus on the capturing and exploring of the construct of economic man is part of the broader call for a shift in the practice of economic sciences in ontological-epistemological and methodological terms that we develop in this text.

Business performance measurement and management

An important element of the body of practice and theory of economic sciences is the collection of business performance management principles and techniques. Over time, this knowledge has been improved, taught at universities, and promoted by numerous consulting companies. Its development can be divided into three stages. The first one, oldest and precursory, is the view from the turn of the nineteenth and twentieth centuries, which consists in applying financial accounting criteria (e.g. return on investment, or ROE, and earnings per share, or EPS). From around 1920s to 1970s, there were attempts to broaden the reception of applied economic indicators by including non-financial measures (e.g. the French *Tableau de Bord*). Since the 1970s, many conceptual proposals have been made with approaches that combine strategic or qualitative achievements with financial results (activity based costing, or ABC, balanced scorecard, or BSC, time based line, or TBL) (Yadav, Sushil, & Sagal, 2013, pp. 949-950).

However, the most widespread view regarding the desired measure of corporate management efficiency is the maximization of shareholder value, *i.e.* that of the owners whose capital finances company activities. The perspective of shareholder value assumes that the providers of capital finance the establishment and operation of a company, bearing a high economic risk. By providing financial resources, they expect to be adequately rewarded for their monetary contribution. Economic value added is the difference between the operating profit achieved and the cost of capital engaged in the company (Brilman, 2004). Unfortunately, the described process has triggered the so-called pursuit of undue profitability (Stiglitz, 2002), which in turn has become the source of negative economic externalities' intensification. One of these effects is the growing sanitary risk.

As early as in 1999, Neely (1999, pp. 205-228) called for a revolution in business performance management. Unfortunately, this revolution has not been implemented to a satisfactory degree to this day. Some experts emphasize that keeping with the current principles and methods will lead to a disaster. This is because maximizing EVA leads to a permanent increase in profit, which in the conditions of hypercompetition (D'Aveni, 1995) requires an equally permanent increase in sales, which is possible only thanks to intensive marketing campaigns encouraging excessive consumption. In turn, negative economic externalities cause growing social costs. These costs should be included in the reception field of measuring enterprises' business performance.

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[3] It is worth mentioning other concepts that are under discussion in the economic sciences like: *homo reciprocans*, *homo cooperativus*, *homo sociologicus, homo ecologicus/sustinens, homo hedonicus or homo urbanicus*.

Therefore, a change in the approach to measuring business performance of firms should result from the following circumstances. (1) The changing realities that after all constitute the subject of research in economic sciences. Due to the recent economic shock, the realized negative externalities force many to evaluate the business performance of any economic entity differently than they did in the past. Maintaining a company's human resources capacity involves an appreciation of the sanitary and work health and safety areas. The defence and expansion of market share requires reacting more quickly to demand volatility. These are ontic determinants of desired innovations. (2) Many of the determinants of required research modification in economic sciences were not identified and properly appreciated in the past. The pandemic might be understood as a catalyst for a qualitative change in the perception of the horror of the disaster impending for all of humanity. This essentially epistemic shift is proved *e.g.* by the view expressed in a McKinsey Institute report (Manyika, Pinkus, & Tiun, 2020), which states that the need for capitalism reform is recognized by economists and business leaders, as reflected in the American Business Council's declaration to define the purpose of the corporation differently: as moving beyond serving shareholders and towards obligations to all stakeholders. Thus, such an approach more clearly recognizes the complexity of the relationship between the economy, the society, nature, and climate. (3) Thus, the research stream called business performance management transforms its postulated methods of managerial decision-making. These have a methodical character.

We might believe that – over time – economic resilience will become a more common system of measuring business performance. The literature defines the term 'resilience' in various ways (Bharma *et al.*, 2011, pp. 5379-5380). Seemingly the most accurate definition of all states that resilience is the fundamental competence to respond efficiently to significant changes that disrupt the achievement of adopted plans without falling into long periods of crisis. Economic resilience should comprise three main components: productivity, security, and agility. Productivity refers to the relationship between the volume of output sold and the number of resources consumed to produce that output. Security refers to sanitary protection and ergonomic working conditions as studies show that companies that protect workplaces and workers have smaller stock market declines compared to firms that do not (Herma-Fox, LaPerla, Serafeim, & Wang, 2020, p. 16). Finally, agility is the flexibility to adapt to changing demand requirements.

Agility and security rates are constrained by the productivity rate, which ensures at least exceeding the break-even point in business activity. Thus, it is impossible to positively evaluate a company's business activity that results in losses. At the same time, taking into consideration security and agility allows for moving away from serving only the owners of financial capital towards fulfilling obligations to all stakeholders.

The essence and measurement of national wealth

One of the most important demarcation lines between our ignorance and knowledge of economic phenomena and processes is determined by the state of the development of theory and empirical applications of statistics. These two allow us to interpret the essence and measure of the wealth of nations. For several decades now, the literature on economics and statistics continues a critical discussion on the role of GDP and derived measures in macroeconomic analyses. With GDP we measure the aggregate value of production streams of goods and services produced typically during one calendar year in a country. Thus, GDP is an average measure that allows us to evaluate in a general way the condition of different economies or their evolution over time, but it does not allow us to explain the causes and extent of social inequalities or their evolution over time.

We must remember that GDP is calculated based on data declared by economic agents. Thus, its calculation generally ignores unpaid work (e.g. housework), voluntary work, own production or consumption, monetized but undeclared production, work in the grey economy, undeclared work, billed but unneeded or unused services, environment's devastation in local, regional, and global dimensions, natural resources and the degree of their depletion, the impact of natural disasters, wars, and debts from taking unpayable loans. As a quantitative measure, GDP neglects many important social phenomena or processes of a qualitative nature such as well-being, leisure, safety, the level of education, innovative-

ness, new technologies' productivity, various types of freedom guaranteed by democratic states, governance efficiency, public institutions' effectiveness, and respect for legal orders[4]. In contrast, GDP does account for the streams of products and services related to activities that are unacceptable for health, ethical, or cultural reasons such as drug trafficking, prostitution, the development of production technologies harmful to the environment, production activities associated with excessive emissions of carbon dioxide and other types of pollutants that adversely affect the global climate, along with the arms race and the excessive development of the arms industry. These lists irresistibly pose the following question: Should we continue to privilege such an imperfect measure? After all, GDP includes phenomena that worsen the condition of societies and lacks some of those that improve this condition. From the viewpoint of ontology and epistemology, it is logical to conclude that economists focus their attention on only some realities and ignore other important processes and phenomena.

Admittedly, economists are aware of the limitations that arise from the practical applications of GDP and derivative measures,[5] so there is an ongoing discussion and work on the construction of new measures of socioeconomic development that would better recognize them and give a more appropriate basis for economic policies, thus ensuring a higher quality of life, environment, and health care systems, while accounting for the elimination of negative climate change causes, the more rational use of limited natural resources, non-invasive sources of energy, and improvements in the quality of human and social capital resources in relation to heterogeneous economic entities and economies. The above is clearly evidenced by the studies of international expert groups such as the report of the Commission in the Measurement of Economic Performance and Social Progress (Stiglitz, Sen, & Fitoussi, 2009), the report of the High-Level Expert Group on the Measurement of Economic Performance and Social Progress (Stiglitz, Fitoussi, & Durand, 2018), or the UN resolution on 'Sustainable Development Goals' from 2015. The latter identifies as many as 169 sustainable or balanced development goals with more than 200 indicators for global monitoring that jointly provide sufficient background material for a discussion on the essence and rational ways to measure the wealth of nations identified more with socioeconomic development in the world than with economic growth. The need to construct new indicators of growth and socioeconomic development is a serious challenge for scientific and research communities and statistical institutions that respect the highest methodological and ethical standards. According to van der Bergh and Antal (2011, pp. 9-10), there is currently no perfect indicator of social well-being, so economists have a serious task to perform.

The recognition of previously neglected economic processes (the ontological-epistemological aspect) and the development and dissemination of new measures of national wealth should be seen (the methodological aspect) as a necessary adaptation to new trends that emerge in economic thought. An example of such a trend beyond the economic sphere is the Covid-19 pandemic and its socioeconomic consequences. Phenomena or processes of this type – which have a very large impact on how contemporary economies or societies function – should be of particular interest to public statistics. Even if only so that all rational activities of mankind in this area of global needs effectively eliminate ignorance or negative and irrational social behaviour. This particularly concerns the due registration of the impact of Covid-19 on the resources and quality of human and social capital, the resources and functioning of labour markets, the demographic potential of individual countries, and the quality and manner of the

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[4] First, GDP does not capture the broad range of outcomes that matter to people and contribute to their well-being. These elements are material and non-material in nature: they include income and jobs, but also health, education, work-life balance and social connections. Secondly, GDP ignores the distribution of well-being outcomes across society, as statistical averages mask important disparities between different individuals, households or groups. Thirdly, GDP alone does not provide a sufficient understanding of the role played by different drivers of economic growth and the way in which they interact to sustain growth over the long-term (Nozal, Martin & Murtin 2019, p. 12).

[5] One evidence for this is that in the late 1980s, following the initiative of Daly and Cobb Jr (1989), efforts were made to develop alternative national income accounting systems aimed at determining the "Green" GDP as a competing measure of well-being and sustainable development to GDP. Examples of such measures are the Index of Sustainable Economic Welfare (ISEW) and the Genuine Progress Index (GPI). Unfortunately, despite their implementation and encouraging results, neither measure has so far reduced the importance of GDP in economic analysis. This negative conclusion is confirmed by the fact that in the assessment of the impact of the Covid-19 pandemic by political circles and the media, significant declines in GDP continue to be assigned key importance, including for the first time since the beginning of political transition in the 1990s in Poland.

reorganization of systems of education, social welfare, and health care[6]. Such a registration can be achieved, among other things, through the tackling of latest challenges: the equalizing of economic phenomena and processes measurement frequency in the real and nominal spheres of the economy (which has never been so close to realization thanks to the development of information technologies); the bolder, fuller, and more rational use of the latest information and communication technologies (closely related to the implementation of the 4.0 economy model); the redefinition of the wealth of nations concept away from the notion of economic growth and in favour of the category of sustainable socioeconomic development;[7] and finally, the continued construction of unified growth and socioeconomic development theories.

Globalization

In the economic sense, globalization (mundialization) may be treated as a special case of the internationalization of economic cooperation, characterized by the following features: a) in its essence, globalization is a logical consequence of the existing development of market economy and a natural stage of its evolution, which means it is immanent and unavoidable; b) the intensity, universality (global reach), uniformity, unification, and standardization of actions on a world scale are the basic attributes of the globalization participants; c) globalization is a higher (the highest?) stage of internationalization; d) the most important manifestations of globalization are international trade (exports, imports), foreign direct investments, international financial (capital) markets, with the role in this process played by information technology and the Internet (Gorynia, 2019b).

Noteworthy, there are large discrepancies in the understanding of globalization, especially the possible perceptions of globalization in the category of opportunities, threats, and its effects. From this viewpoint, the extensive literature on the subject (Al-Rodhan & Stoudmann, 2006; Kowalski, 2013) reveals four basic attitudes in the understanding of globalization: an approach dominated by enthusiasm slightly cooled by reason that can be described as pro-globalization or affirming globalization (but not blindly) (Bhagwati, 2004); an approach of concerned reflexivity, characterized by the balanced understanding of the nature of globalization (Streeten, 2001); an approach imbued with a high degree of suspicion, strongly critical but without outright negation (Stiglitz, 2002); an approach that involves questioning the meaning of globalization, manifested in ideas and policies described as new protectionism and new nationalism (e.g. the actions of President Donald Trump's administration and of similar leaders; Rodrik, 2017).

From the perspective of Poland, we should note that economic globalization intensified after the fall of the Iron Curtain. From an economic standpoint, it meant the liberalization of international economic and political relations and the opening of the opportunities for the integration of previously independent markets of goods, capital, and labour into a single global market. As time passed, not only the benefits of globalization were becoming clear but also its negative effects. Stiglitz (2002) highlights such negative features of globalization as unfair rules of the game imposed by the more powerful developed countries, the uneven distribution of globalization benefits, losses of some participants in the process, imposing of an economic system inappropriate for the traditions, culture, and developmental challenges of many developing countries. Some studies even indicate that economically developed countries gain more than they lose from economic globalization, while developing countries lose rather than gain (Deszczyński, 2009).

The reputation of globalization was further undermined by emerging crises. Existing solutions were perceived as dogmatic and incapable of resolving emerging conflicts on internal and international levels. Many progressively lost faith in the reliability of neoliberal solutions in the spheres of economics (the undermining of the Washington Consensus) and politics (the functioning of liberal democracy) (Stiglitz, 2002; Rodrik, 2011; 2017).

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[6] Examples of such efforts include: (Varshney & Socher 2020).

[7] This is supported by Hall & Day Jr. (2009) who assess the projections for the world economy presented in the so-called Rome Report, The Limits to Growth (1972).

One of the consequences of the global financial crisis of 2007-2011 was the emergence of symptoms of a process described as 'slowbalization' (meaning slow globalization; *The Economist* 2019). The process of deglobalization thus occurred before the Covid-19 pandemic (Gorynia, 2021). The difference resides in the new element of fear that future highly probable pathogens may cause rapidly spreading incurable diseases, which makes many expect the petrification of the deglobalization tendency in all the spheres that are synonymous with the broadly understood security of the state and its citizens. Considering the above, there must happen a redefinition of economic efficiency from short-term to long-term, and the abandonment of low prices primacy and the ensuing lack of diversified supply. What best exemplifies these matters are the problems with purchasing and manufacturing medicines in Europe, even before the outbreak of the pandemic, and then after the appearance of the coronavirus on the continent, ranging from simple personal protection equipment through disinfectants to specialized equipment such as medical ventilators. However, it remains an open question how deep the deglobalization will be and whether the opponents of neoliberal solutions in economic, political, and social systems would not want to take advantage of this objective situation to introduce and, perhaps, even impose their preferred solutions, motivated only by subjective and axiological rather than pragmatic considerations? This, however, appears to us as a rather a rhetorical question.

When it comes to the projected consequences of the Covid-19 pandemic in the sphere of globalization and the balance of economic power in the world, we encounter a plethora of views in the literature, which encourages various authors to build possible scenarios for the future of globalization (Gorynia, 2021). On the one hand, some indicate that, generally, China is recovering from the pandemic relatively better than the USA, because it has managed to avoid a recession and is rapidly returning to the path of above-average growth. On the other hand, others remark that China's role as the factory of the world may diminish. This is important because with the passage of time, there increases the probability of social unrest in China and, in consequence, a socioeconomic and political crisis. If this were to happen, it would have a disastrous impact on the global economy, given the current high dependence on Chinese supplies. If the pessimistic scenario comes true, the geography of globalization will change.

From an ontological perspective, the caesura of the Covid-19 pandemic may serve as a starting point for a change in the essence of economic processes. This change consists in the diminishing of the role of an important factor that intensifies economic globalization: consumption. Its increasing degree – often stimulated by marketing instruments – suctioned production and, in consequence, accelerated natural resources depletion, the natural environment pollution, and climate warming processes. It is possible, and at the same time advisable, that the change that now happens will lead to the abandonment – or at least limitation in scope – of the economy based on consumerism and to the transition to a closed loop economy. As the nature of management changes, what also changes is how we perceive and evaluate management (epistemological aspect). Economic globalization should respect the requirements of the closed circulation of resources, goods, and waste. There arises a need for a new analysis and critical evaluation of systems of production of consumer and investment goods around the world. Moreover, we should probably study the efficiency of economic units and the wealth of nations in a different manner (the methodological aspect). Therefore, the indicated circumstances should imply shifts both in the subject of economic sciences' research interests and in the methodology of scientific research. These are extremely important, current, and real challenges for economic sciences.

CONCLUSIONS

With this article, we intended to indicate the need for a serious reflection on the contents of economic sciences. Our reflection assumes only outlining problems and sketching argumentations that justify the change/revision in approach and content of these sciences. Real economic processes, economic policy, and business management methods prove since long that our civilization seems to be heading for a dead end. The wall with which humanity is about to painfully collide already appeared at the turn of the century with the dot-com bubble, the 2008 global financial crisis, repeated social protests against the growing stratification of income and wealth, increasingly frequent natural disasters resulting from the devastation of the environment and global warming, and now the global economic crisis

provoked by the Covid-19 pandemic. Crises often stimulate new ideas and falsify old views. Mainstream economics and the management principles and guidelines derived from it at the global, macro, meso, and micro levels prove not fully effective. Therefore, it is reasonable to ask what and why should change in the area for which economists are responsible?

The above overview and discussion lead us to conclusions that are only signal the necessary reflection. Nevertheless, changes in economic practice and policy have already been announced (the ontological aspect), fundamental values and principles of management and the possibilities of their scientific cognition are perceived differently (the epistemological aspect), and there appear new demands of methods in economic activity research (the methodological aspect). First, we advocate cooperation between science, politics, and business, and we oppose the cynical use of each other to justify arbitrary views and pursue particularist interests. This will allow for the ideological neutrality of economic sciences and – in the long run – the strengthening of its prestige. Second, we propose posit that it is untenable to refer in the axiological sphere to the consequences of perceiving each person as homo economicus, especially in the radical version of the notion. Of course, elements of rationality and egoism are probably inherent attributes of humanity, but at the same time they cannot and should not be denied the characteristic of responsibility. Third, we prompt the inclusion of ethical values in the set of management imponderables. The problem of including these values in the standard model of rational choice has long been discussed among economists. There appear postulates to develop a model of *homo economicus moralis* not so much by supplementing the concept of rational choice but by its significant modification *e.g.* with the concept of rational compliance with norms or the concept of meta-ranking of preferences. The understanding and postulates of economic sciences towards the practice of business management should finally be liberated from the influence of at least some ideas of economic orthodoxy. In particular, the evaluation of top management's performance should cease to exclusively rely on the philosophy of managing on behalf of shareholders and with EVA. The vicious cycle of pursuing ever greater wealth for owners through ever greater production driven by excessive consumption should be broken if ecological, climatic, and civilizational risks are taken seriously. Many aptly believe that it is reasonable to include factors related to security and business agility in such an evaluation system. A consequence of accounting for business management agility with the EVA measure resides also in the drive to build extremely distributed and modularized international supply chains or, more broadly, specialize in international economic cooperation. Security requires reconsidering the validity of such a practice. We mean here not only security in the sense of ensuring economic continuity but also security in the sense of protecting nature and the climate. Economists must urgently coordinate international – or, rather, global – regulations concerning not only the above issues but also labour law, social security, education, or environmental protection. Jointly, these issues demand a different approach to the concepts of shaping the competitiveness of both nations and companies. In addition to the already developed mechanisms of competitiveness in the form of sectoral adjustments and the creation of innovation, it seems only reasonable to account for cultural mechanism. Economists usually cannot break away from the equilibrium metaphor as an instrument for explaining and deriving recommendations for economic processes. Of course, equilibrium can be a useful heuristic tool in economics deliberations, but other metaphors that illuminate the studied phenomena from different angles – and thus enrich the methodical workshop and knowledge of economic sciences representatives – should not be overlooked. An even more serious problem is the search for the correct measure of national wealth. So far, the commonly used measure is GDP, which is known to have a plethora of imperfections. The argument that nothing better has been invented so far is difficult to accept. After all, many alternative solutions have already appeared in this field, and they should finally be considered seriously. Another topic for discussion is the economic meaning of globalization. Gathered experiences show that globalization is not just a source of benefits. Theorists should conceptually confront the emerging processes of deglobalization and slowbalization. Last but not least important is the problem of the increasingly dangerous process of uneven distribution of wealth in the world. This is the domain of development economics, whose postulates have long proved ineffective. Moreover, it is right now when there appears a chance to take a closer look at the mechanism of rotation of metropolises and peripheries.

We realize that they we barely hint at the need to modernize the contents and methods of economic sciences. It seems that the pandemic crisis is the last straw that breaks the camel's back – a camel that already bears ignorance and hypocrisy – and it also is a motivating factor to intensify cognitive efforts. We deem it preferable to begin with an inventory of achievements, deficiencies, and new ideas of economic sciences.

Finally, we recognize that our analysis above is not free from numerous limitations. First, some of the issues raised have been stirring the emotions of scientists, intellectuals, and journalists for a long time, and it is not certain whether the Covid-19 pandemic will change their attitude, which seems to be the sine qua non condition for change. Second, the list of issues for modification/revision is much longer than the one presented above, and we hope that it will be expanded by others, encouraged to participate in the discussion we propose. Third, paradoxically, the magnitude of potential changes – both in real economic life and in science, including economic sciences – can be expected to be proportional to the duration of the pandemic. The relatively rapid containment of the pandemic seems to foster the eventual undertaking of relatively minor adjustments to economic sciences, while its prolonged duration may trigger more radical transformations in how economic sciences perform its descriptive, explanatory, and normative functions.

We are aware that not all important problems have been discussed and that the presented descriptions of the indicated problems are selective in nature and are based on the experience and views of the authors (*i.e.* an intuitive component appears) and on exemplary literature sources only (which does not exhaust the existing achievements). These circumstances indicate the justification of the extensive reflection and discussion on the modification of the economic sciences paradigm postulated by the authors.

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Authors

The contribution share of authors is equal and amounted to 25% for each of them.

Piotr Banaszyk

PhD in Economics (1989, Poznań University of Economics and Business, Poland); Professor at Poznań University of Economics and Business (Poland). His research interests include international supply chain management and strategic management.

Correspondence to: Prof. Piotr Banaszyk, PhD, Poznań University of Economics and Business, al. Niepodległości, 10, 61-875 Poznań, e-mail: piotr.banaszyk@ue.poznan.pl

ORCID ⓘ http://orcid.org/0000-0002-9457-3613

Przemysław Deszczyński

PhD of Humanities in Political Science (1989, Adam Mickiewicz University in Poznań, Poland); Professor at Poznań University of Economics and Business (Poland). His research interests include international economics, economy of development, and information economics.

Correspondence to: Prof. Przemysław Deszczyński, PhD, Poznań University of Economics and Business, al. Niepodległości, 10, 61-875 Poznań, e-mail: przemyslaw.deszczyński@ue.poznan.pl

ORCID ⓘ http://orcid.org/0000-0003-2286-3395

Marian Gorynia

PhD in Economics (1985, Poznań University of Economics and Business, Poland); Professor at Poznań University of Economics and Business (Poland). His research interests include international economics and international business.

Correspondence to: Prof. Marian Gorynia, PhD, Poznań University of Economics and Business, al. Niepodległości, 10, 61-875 Poznań, e-mail: marian.gorynia@ue.poznan.pl

ORCID ⓘ http://orcid.org/0000-0002-7633-8249

Krzysztof Malaga

PhD in Economics (1990, Poznań University of Economics and Business, Poland); Professor at Poznań University of Economics and Business (Poland). His research interests include economic growth and development, microeconomics, macroeconomics.

Correspondence to: Prof. Krzysztof Malaga, PhD, Poznań University of Economics and Business, al. Niepodległości, 10, 61-875 Poznań, e-mail: krzysztof.malaga@ue.poznan.pl

ORCID ⓘ http://orcid.org/0000-0001-7079-9880

Self-employment and over-indebtedness in Poland: Modelling income and debt repayments distribution

Agnieszka Wałęga, Grzegorz Wałęga

A B S T R A C T

Objective: The objective of the article is to assess financial situation and debt repayments in households of self-employed individuals and compare them to these of other types of households. The article aims to identify the determinants of over-indebtedness.

Research Design & Methods: The study focuses on households of self-employed. The results are based on a nationwide CATI survey conducted among 1107 Polish indebted households. Theoretical models of the income distribution (log-logistic, Burr III) and the power-exponential model were used to achieve the research goals.

Findings: The economic status of indebted households differentiates income and debt repayments distributions. Self-employed households have a better financial situation and greater inequalities than households of the paid employees and individuals sustaining themselves from other sources of income. The debt repayments of entrepreneurs are higher than in households of paid employees but lower than in other groups of households. The determinants of over-indebtedness are essentially similar regardless of the work status, but the impact of income, number of loans, and debt type on over-indebtedness is greater for self-employed households.

Implications & Recommendations: The results on the debt repayments distribution and determinants of over-indebtedness may be helpful in creating regulations that preventing household bankruptcies and policies aimed at combating social exclusion.

Contribution & Value Added: Introducing the issue of self-employment into the discussion on income and debt distribution and identifying the over-indebtedness among households of self-employed. To assess the debt repayments, we adopt theoretical income distributions and unique source of data on Polish households in debt.

INTRODUCTION

The financial standing of households is one of the basic factors impacting satisfaction of needs and the living conditions that determine the needs. With access to loans, current consumption may be increased above the level of income generated at a given time. Hence, debts constitute an important source of financing for household consumption. In 2009-2019, the gross debt-to-income ratio of households in Poland increased by over nine percentage points to 57.67%. As in other countries of Central and Eastern Europe, this value is about 1.5 to two times lower than the average for the European Union. Moreover, this difference is almost fourfold in relation to the most debt-burdened households in the Nordic countries (Eurostat, 2020). The growing level of household indebtedness affects the ability to meet the needs, for example, by purchasing durable goods and real estate. This trend, however, carries the risk of over-indebtedness – the burden of debt repayments may have a negative influence on the economic situation of households (Betti *et al.,* 2007; Fatoki, 2015; Mutsonziwa & Fanta, 2019); their well-being (Bialowolski

et al., 2021; Brown & Gray, 2016; Coste *et al.*, 2020; Tay *et al.*, 2017) and, more broadly, on the stability of the banking system (Ciukaj & Kil, 2020).

While the issues related to household income, or more precisely the distribution of income, have been addressed in numerous studies (Jędrzejczak, 2009; Jędrzejczak & Pekasiewicz, 2020; Kośny, 2013; Trzcińska, 2020; Ulman, 2020), the indebtedness of Polish households at the microeconomic level remains under-researched (Anioła-Mikołajczak, 2017; Białowolski, 2019; Wałęga & Wałęga, 2021). The present study focuses on households with income based on self-employment, which has not raised much interest so far. In our opinion, what deserves attention is the feature of households ran by entrepreneurs, which manifests itself in volatile income and propensity to use external sources of financing. We employ a unique dataset on Polish indebted households. Data obtained from over 1100 respondents in a nationwide CATI survey allowed for a detailed analysis of the financial situation of households sustained by self-employed persons. Moreover, to the best of our knowledge, the proposed adaptation of theoretical income distributions to the assessment of debt repayment distribution is a novel methodological approach.

The purpose of the article is threefold. Firstly, it aims to assess financial situation in households of self-employed individuals and compare it to that of other types of households with the use of theoretical models of income distribution. There, the subject of interest is also the level of income inequality in households of self-employed individuals. Secondly, our goal is to compare the amount of household debt repayments in Poland between the self-employed, the employees, and individuals with other sources of income. Income and debt burden determine the purchasing power of household. On the basis of the above considerations, the degree of over-indebtedness in various types of households was determined. The third and final goal of the article is to identify the determinants of over-indebtedness with the use of regression modelling.

The article is organised as follows: firstly, we will review the literature with regard to income, indebtedness, and over-indebtedness in order to formulate research hypotheses. In the next section, we will present the data source and research methodology in detail. Then, we will discuss the results of our empirical research. What follows will be the presentation of income and debt repayment distributions, along with an exploration of their similarities. We identify the determinants of over-indebtedness using the power-exponential model. The last part of the study will be a summary in which we refer to the hypotheses. In this part, we will present the broader implications of our research and outline its further directions.

LITERATURE REVIEW

Income inequalities have been the subject of many analyses by economists and statisticians. In recent years, these issues have gained importance due to their role in economic development. With knowledge about income distribution in society, we can now measure the quality of life, poverty, and welfare both in time and space (Łukasiewicz *et al.*, 2018; Jędrzejczak & Pekasiewicz, 2020; Kot, 2020). Apart from individual factors such as gender, age, abilities, talent, and health, the income inequality is influenced by external factors, among which assignment of household members to a specific socio-economic group plays an important role (Landmesser, 2019). Such nature of inequality requires that income distributions at the microeconomic level be analysed and compared between different types of households.

A review of previous studies indicates that households of self-employed individuals in Poland achieve relatively higher incomes than those of paid employees or other socio-economic groups (Szczygieł & Piecuch, 2016; Ulman & Wałęga, 2013). A similar situation is observed, for example, in the Czech Republic (Bartošová & Bína, 2009). The advantage of the self-employed can be explained by their distinctive entrepreneurial personality traits, which determine the profitability of business (Sarwoko & Nurfarida, 2021).

Many individuals want to become self-employed due to the autonomy and flexibility it brings (Binder & Blankenberg, 2021). A very common reason for undertaking business activities by individuals is profit,

which not only enables the development of their firms but also guarantees funds for supporting themselves and their families. Profit is the entrepreneur's compensation for the risk of losing not only company assets but also private capital resources in the event of bankruptcy. Previous research results show that there is a significant positive relationship between self-employment and happiness, life satisfaction (Crum & Chen, 2015; Johansson Sevä *et al.*, 2016), and job satisfaction (Benz & Frey, 2008; Blanchflower, 2004). These relations are especially obvious for younger groups of employed which prefer higher independence to plan and maintain the work-life balance instead of incomes stability (Tvaronavičienė *et al.*, 2021). On the other hand, some studies indicate the opposite effect: self-employment is associated with predominantly negative well-being effects (Bencsik & Chuluun, 2021).

The work status is important considering that different labour groups are likely to differ in job security, flexibility in labour supply, and access to credit. It is justified especially for the groups of self-employed and paid employees. These groups may experience different types of income fluctuations and deal with them in distinct ways. This is relevant for the income inequality in these groups (Albarran *et al.*, 2009). Research on employment status and income inequality shows that the proportion of self-employed in the labour force increases income dispersion (Halvarsson *et al.*, 2018). Schneck (2020) confirmed also that self-employment is a source of income inequality. This can be associated with the attitude towards risk indicated by Friedman (1953). However, the impact of self-employment on income is more complex. Entrepreneurship has an indirect impact through employment creation, which seems to reduce income inequality, especially in regard to surviving companies (Gaweł, 2020).

One of the most important factors that determine the level of household debt is income. In general, higher income is accompanied by a higher level of indebtedness, which can be explained by the positive correlation between the income, consumption aspirations, and creditworthiness. The inevitable consequence of higher indebtedness is a higher repayment burden, which in turn, increases the risk of over-indebtedness. However, with rising income households borrow less relative to their income and also use a smaller proportion of their income for repayments (Wildauer, 2016). There are also many studies (Anderloni & Vandone, 2008; Bridges & Disney, 2004) that point to low-income levels as the cause of over-indebtedness, as they require more expensive forms of debt (e.g. loans from pawnbrokers and non-bank financial institutions) and result in lower resilience to consequences of unexpected events. Therefore, the relationship between the amount of debt repayment and income may be ambiguous: the financial situation of a household may have different effects on the level of debt.

The risk of over-indebtedness is also related to employment status. Yilmazer and DeVaney (2005) proved that self-employment has significant effects on the probability of holding both secured and unsecured debt. The work status affects not only the possibility to generate income but also determines its stability over time. Stable employment allows access to a greater number of credit instruments and enables obtaining more favourable interest rates. However, the above circumstances may encourage excessive indebtedness in absolute terms (Anderloni & Vandone, 2008). Therefore, the amount of income may not be as decisive for the risk of over-indebtedness as employment stability and the cash flow it generates. Kempson (2002) indicates that financial difficulties are strongly associated with low and unstable incomes. These links are obvious during the pandemic period, when financial risks and their negative outcomes became more perceptible (Cepel *et al.*, 2021). Magri (2007) argues that the reason for greater debt among the self-employed, despite the higher uncertainty of income and risks involved in their business activity, may stem from lesser perceived importance of precautionary saving in this group. Apart from the economic situation of entrepreneurs, the debt-related problems are also affected by socio-demographic characteristics. For instance, some researchers propose evidence that state support of microfinance programs aimed at widening the access to credit positively affects self-employment of women (Haque *et al.*, 2019). Other stress that the risk of debt service difficulties in households of the self-employed increases if the household's head is poorly educated or is a woman (Sánchez-Martínez *et al.*, 2016).

The work status affects not only the debt burden but also the types of credit instruments used. Debt among the self-employed is driven by the needs of small businesses, not by consumer and household finances (Castronova & Hagstrom, 2004). This was confirmed, among others, by Kim (2017) who working on data from South Korea, indicated that the increase of self-employed business debt is closely

linked to intensifying competition in the self-employed sector and the rise in business costs. It is a determinant that does not occur among other types of households.

Therefore, diagnosis of the income distribution in the self-employed households is of great importance if we are to better understand the distribution of debt repayments and thus over-indebtedness. The above-mentioned previous empirical results suggested the following research hypotheses:

H1: Households of the self-employed have a better income situation than other socio-economic groups, but their income distribution is characterised by greater inequality.

H2: Households of the self-employed have a higher level of debt burden and a higher risk of being over-indebted than those of other socio-economic groups.

H3: The main determinants of debt burden among the self-employed are the level of income, the number of loans, and the number of persons in a household.

RESEARCH METHODOLOGY

The study was based on a unique dataset obtained from the nationwide CATI survey conducted among Polish households in the second quarter of 2018. The CEM Market and Public Opinion Research Institute, a professional market and opinion research agency, partnered in the data collection phase of the survey. All the respondents were at least 18 years old and had one or more loan commitments (secured or unsecured). Finally, 1107 individuals from all over Poland were interviewed. The use of random sampling and sample size enabled us to generalise the results on indebted households in Poland.

The unit of analysis was the indebted household, not the individual respondent. The reason was that many decisions, such as the work status of family members and debt, are made at the household level. A household was classified as self-employed when the respondent obtained income from self-employment or his own business.

The subject of analyses were the monthly income and the debt repayments per a household member. To describe the distribution of income per capita and debt repayments per capita, we employed the log-normal distribution, the log-logistic distribution, and the Burr III distribution. The estimation of income distribution parameters was performed by adjusting the selected theoretical distribution model to the actual data. We were able to compare the properties of theoretical models for the analyzed income in separate groups using descriptive statistics.

Let us note that since research on income distribution has over a hundred years of history in economic theory, many theoretical solutions have already been proposed for this problem. Using a mathematical function to describe income distribution was first proposed by Pareto. In the literature, the following distributions often appear: the log-normal distribution popularised in the area of research on income by Aitchison and Brown; distributions of the Burr type, namely the Burr Type XII described by Singh and Maddala in 1976 and the Burr Type III described by Dagum in 1977; along with the log-logistic distribution (Fisk distribution). A classification of the majority of theoretical frameworks used to model empirical income distributions is available in the work of McDonald and Xu (1995). On the basis of family income data, the above-mentioned researchers conclude that the generalised Beta distribution of the second type best approximates empirical income distributions. However, the Dagum distribution (Burr III) turns out to be only slightly worse according to the statistical fitting measures. The Dagum distribution is recognised in the income research literature as one of the best income distribution models (Łukasiewicz & Orłowski, 2004). This is also confirmed by Bandourian, McDonald, and Turley (2002) who found that the Dagum distribution is the best among the three-parameter distributions and better than the two-parameter distributions studied. The frequency of its use and its usefulness have been confirmed in many works, as documented in the study by Kleiber and Kotz (2003). The distribution was used also in Poland, for instance by Jędrzejczak (2009), Jędrzejczak and Pekasiewicz (2020), Ulman (2015), Wałęga and Wałęga (2017). Let us emphasise that a better fitting of a given theoretical distribution to specific empirical data does not mean that this distribution would also be the best model for other datasets (for a different sample, in a different period, or for different variables).

In this study, the best results in the statistical sense (the lowest value of the Akaike information criterion) were obtained by the use of the two-parameter log-logistic Fisk model and the Burr III distribution. The density function in the Dagum distribution can be recorded as follows (Kleiber & Kotz, 2003):

$$f(y) = \frac{cb \, exp(-a)y^{-(b+1)}}{[1 + exp(-a)y^{-b}]^{c+1}} \tag{1}$$

in which *a*, *b*, and *c* are distribution parameters.

The ordinary moment of order *r* in this distribution is expressed as follows:

$$m_r = B\left(1 - \frac{r}{b}, c + \frac{r}{b}\right) exp\left(\frac{-a}{b}\right) rc \tag{2}$$

in which B is the Euler's beta function. Using the formula (2), the average value of income can be determined as the ordinary moment of order *r* = 1, while the standard deviation is obtained using the formula:

$$D(Y)^2 = m_2 - (m_1)^2 \tag{3}$$

The formula for the Gini coefficient is as follows:

$$G = \frac{\Gamma(c)\Gamma\left(2c + \frac{1}{b}\right)}{\Gamma(2c)\Gamma\left(c + \frac{1}{b}\right)} - 1 \tag{4}$$

in which Γ is Euler's gamma function.

In the log-logistic distribution, the density function can be recorded as follows (Kleiber & Kotz, 2003):

$$f(y) = \frac{b \, exp(-(a + b \, ln \, y))}{y[1 + exp(-(a + b \, ln \, y))]^2} \tag{5}$$

in which *a* and *b* are distribution parameters.

The expected value in this distribution is obtained using the formula:

$$E(Y) = \frac{\pi}{b \, sin\left(\frac{\pi}{b}\right)} exp\left(-\frac{a}{b}\right) \tag{6}$$

and the standard deviation:

$$D(Y) = \sqrt{(E(Y))^2 \left[\frac{b}{\pi} tg\left(\frac{\pi}{b}\right) - 1\right]} \tag{7}$$

The income distribution inequality can be assessed using the Gini coefficient, which is given by the formula:

$$G = \frac{1}{b} \tag{8}$$

The fundamental issue for the practical application of the theoretical functions as models of income distributions is the knowledge of distribution parameters. Among many estimation methods, the most frequently used is the maximum likelihood estimation (MLE), which provides consistent, asymptotically unbiased, asymptotically efficient, and asymptotically normal estimators of parameters. To assess the matching rate of the theoretical distribution and the empirical income distribution values of the Akaike information criterion were applied.

The Sen index (9) was used to determine the measure of well-being (Ulman, 2015):

$$W_S = \mu(1 - G) \tag{9}$$

The difference between the analysed distributions was measured by the Bhattacharyya (D_B) distance (Bhattacharyya, 1943). It is based on a comparison of the density function of two distributions according to the formula (Ulman & Ćwiek, 2019):

$$D_B(f_1, f_2) = -ln(\rho) \tag{10}$$

in which $\rho = \int \sqrt{f_1(y)f_2(y)}dy$ and $\rho \in [0, 1]$.

The Bhattacharyya distance ranges from 0 to ∞. The value of zero indicates a perfect match between distributions, whereas the higher the value of this distance, the greater the difference between compared distributions.

Income and debt repayments were compared using the debt service to income ratio (DSTI). This ratio is commonly used as an objective criterion for determining which households are recognised as

over-indebted (D'Alessio & Iezzi, 2013; Ntsalaze & Ikhide, 2016; Sánchez-Martínez *et al.*, 2016). Concurrently, regression modelling was used to assess the determinants of over-indebtedness. The analyses included linear, exponential, and power-exponential models. The best results (the highest coefficient of determination R^2) were obtained through the use of the power-exponential model:

$$y_i = \alpha_0 \prod_{j=1}^{s} x_{ij}{}^{\alpha_j} \cdot exp(\alpha_{s+1} x_{is+1} + \alpha_{s+2} x_{is+2} + \ldots + \alpha_k x_{ik} + \varepsilon_i) \tag{11}$$

where:

y_i - debt service to income of the *i*-th household,

x_{ij} - *j*-th independent variable for the *i*-th household,

α_j - parameter for the *j*-th independent variable,

ε_i - value of the random component for the *i*-th household.

The variable selection method was the stepwise regression, and the parameters were estimated using the least squares method. Among the independent variables for the model, the characteristics of the respondents (gender, age, education level) and their households (income, subjective assessment of the financial situation, number of persons, place of residence, floor area of the flat or house), but also variables characterising the household debt were used (number of loans, type of debt: bank (ref.), non-bank, mixed).

RESULTS AND DISCUSSION

Table 1 presents those results of estimation of theoretical models of income distribution per capita and debt repayments per capita, which were most relevant in a statistical sense (the lowest level of the Akaike information criterion), namely the Fisk logistic distribution and the Dagum distribution. In each of the presented models, all parameter estimates turned out to be statistically significant. This enabled the presentation of the studied distributions in two ways: by calculating their descriptive characteristics (Table 2) and by drawing graphs of density function (Figure 1).

The comparison of the density function graphs presented in Figure 1 allows us to conclude that both the distribution of debt repayments as well as the distribution of income are right-skewed. In both cases, the function for households of the self-employed is shifted to the right which means that they have, on average, higher incomes and higher debt repayments. The functions are also more flattened which indicates a greater dispersion around the mean, and thus their greater differentiation.

The information presented in Table 2 corroborates the findings obtained from the graphs analysis. Characteristics of income distribution indicate a significant difference between average values for the per capita income in households of the self-employed and paid employees compared to individuals sustaining themselves from other sources of income, in favour of the former. However, the difference between the dominants is not a major one. This is probably caused by very high incomes in some households of the self-employed, significantly exceeding both the incomes of the paid employees and the average level of entrepreneurs' earnings. This shifts the average income value towards its higher end without changing – in comparison to the range – the dominant value. This suggests that the income within the group of households of the self-employed is more diverse compared to the group of households of the paid employees and others. This is confirmed both by the coefficient of income variation and the Gini coefficient, which are significantly higher for households of the self-employed than other types of households. This agrees with the previous research by Merz (2000). Compared to the paid employees, the self-employed show greater income volatility because they are over-represented at both the left and right tails of the total income distribution (Carter, 2011). These inequalities also result from the heterogeneity of the self-employed as a group (Parker, 1997).

Table 1. Estimation results for the distributions of income per capita and debt repayments

Parameter	Estimator	Standard error	Z statistics	p-value	Likelihood ratio	Bayesian information criterion	Akaike criterion
income per capita							
self-employed*							
a	-17.039	1.334	-12.770	<0.0001	-1289.96	2589.89	2583.91
b	2.247	0.173	12.973	<0.0001			
employees*							
a	-20.036	0.698	-28.705	<0.0001	-5607.25	11227.51	11218.50
b	2.714	0.094	28.920	<0.0001			
others**							
a	-28.180	4.173	-6.752	<0.0001	-1574.59	3164.96	3155.17
b	3.735	0.508	7.347	<0.0001			
c	0.492	0.130	3.778	0.0002			
debt repayments per capita							
self-employed**							
a	-12.722	2.458	-5.177	<0.0001	-1165.84	2347.02	2337.68
b	2.079	0.343	6.061	<0.0001			
c	0.509	0.149	3.426	0.0006			
employees**							
a	-10.833	1.019	-10.627	<0.0001	-4879.87	9779.46	9765.73
b	1.908	0.145	13.169	<0.0001			
c	0.668	0.104	6.425	<0.0001			
others*							
a	-8.334	0.563	-14.812	<0.0001	-1442.27	2895.26	2888.54
b	1.582	0.107	14.799	<0.0001			

* – Fisk log-logistic distribution; ** – Dagum (Burr III) distribution.
Source: own elaboration of CATI survey data.
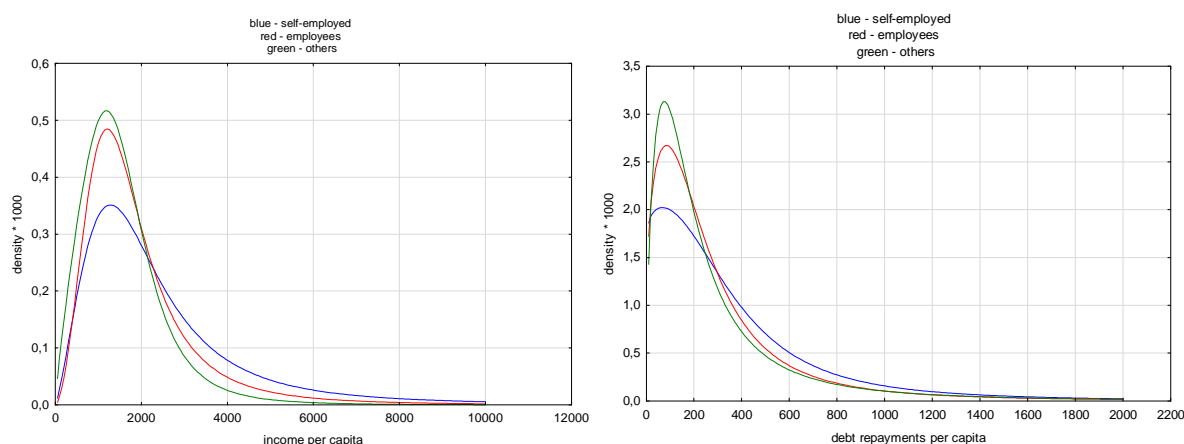
Figure 1. Income and debt repayments distribution in selected types of households
Source: own elaboration of modelling results.

A conglomerate of average incomes and their inequality included in the Sen index formula indicates that self-employment generates higher social welfare than income from hired work. Better financial situation of households of the self-employed in Poland are confirmed by Kośny (2013). The upper groups of income are dominated by households declaring paid employment and self-employment as their main source of income, while in the lower groups of income the share of such households is significantly lower. On the other hand, Szczygieł and Piecuch (2016) found that running a business by the head of a household contributes to higher average income than in other socio-economic groups. The better financial position of self-employed individuals (compared to those relying on other sources of income) is also confirmed by studies conducted for the household as a whole by Ulman and Wałęga (2013) and separately for women and men by Ulman (2015).

Table 2. Characteristics of the distribution of income per capita and debt repayment per capita

Measure	Self-employed	Employees	Others
income per capita			
Mean (PLN)	2786.18	2032.88	1592.03
Median (PLN)	1963.26	1608.32	1398.43
Mode (PLN)	1282.45	1209.53	1189.85
Third quartile (PLN)	3201.10	2410.91	2011.66
Gini coefficient (%)	44.50	36.85	33.27
Coefficient of variation (%)	176.04	98.51	3.95
Sen index (PLN)	1546.30	1283.80	1062.37
debt repayments per capita			
Mean (PLN)	449.19	370.16	421.74
Median (PLN)	272.56	213.36	194.27
Mode (PLN)	67.63	84.97	75.72
Third quartile (PLN)	519.37	404.21	389.10
Gini coefficient (%)	55.01	56.09	63.22

Source: own elaboration of CATI survey data.

The distribution of debt repayment reveals higher inequalities than in the distribution of income. The values of the Gini coefficient exceed those calculated for income, with the largest inequalities in debt repayments occurring in households sustained from other sources of income. Repayments in households of the self-employed are, on average, higher than in other households, but the inequalities in this group are among the lowest.

Therefore, it becomes reasonable to determine whether the income and debt repayment distributions differ between the studied groups of households. For this purpose, the differences between these distributions in the surveyed household groups were assessed using the Bhattacharyya distance (Table 3). Generally, the distance between the distributions is not large, but the greatest differences can be noticed between the income distribution within households of the self-employed and those sustained from other sources of income. On the other hand, the greatest distance separates the distribution of debt repayments in households of the self-employed and the paid employees.

The more favourable income situation means that households of entrepreneurs generally have higher nominal monthly debt repayments, which nevertheless does not translate into a much greater debt burden in relation to income. This agrees with the findings by Wildaeur (2016), which show that with rising income, households use a smaller proportion of their income for debt repayments. The average debt service to income ratio (DSTI) in these households is about 20%, while it amounts to about 18% for households of the paid employees and to 25% for other groups of households.

Table 3. Bhattacharyya distance (DB) between the distributions of income per capita and debt repayment per capita for selected groups of households

Specification	Income per capita			Debt repayments per capita		
	self-employed	employees	others	self-employed	employees	others
Self-employed	0	0.0200	0.0470	0	0.0214	0.0128
Employees	0.0200	0	0.0257	0.0214	0	0.0187
Others	0.0470	0.0257	0	0.0128	0.0187	0

Source: own elaboration of CATI survey data.

A greater debt burden increases the risk of over-indebtedness. Considering the DSTI ratio, regardless of the adopted threshold, the financial situation of households sustained from other sources of income is the worst (Figure 2). However, we should note that the higher the DSTI level is adopted as the threshold of over-indebtedness, the smaller the difference in share of over-indebted households between the group of the self-employed and others. The percentage of over-indebted households in the self-employed group is higher than in the paid employees, albeit by no more than 1.8 percentage points. Assuming that over-indebted households have DSTI > 30% (D'Alessio & Iezzi, 2013, 2016; Michelangeli & Pietrunti, 2014; Tiongson *et al.*, 2009), the self-employed group included 16.3% of such households, the paid employee group – 14.6%, while other work status groups – 24.5%. These results are consistent with the findings from previous research using the DSTI as a measure of over-indebtedness. Self-employed households are generally more likely to be over-indebted compared to those in which the head is a paid employee (D'Alessio & Iezzi, 2016; Du Caju *et al.*, 2016). Moreover, Yilmazer and DeVaney (2005) confirm that self-employment has significant effects on the debt ratios but only for other types of credit (other than mortgage, credit cards, and instalments). Furthermore, other research indicates that self-employment may be associated with a more serious debt repayment problem: mortgage arrears (Duygan-Bump & Grant, 2009) or insolvency.
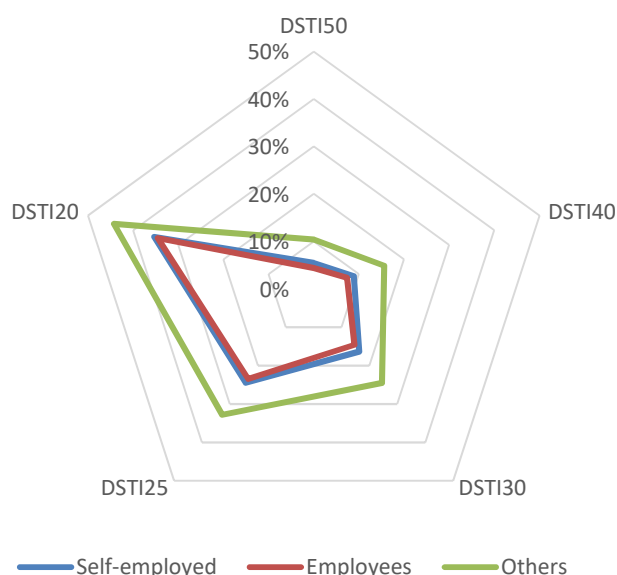
Figure 2. Over-indebtedness according to the DSTI ratio for selected groups of households
Source: own elaboration of CATI survey data.

Figure 3 presents the empirical DSTI distribution ratios for the analysed household groups. Within each group, the distribution of this ratio can be defined as multimodal. For households sustained from other sources of income, but also among the self-employed, we notice outliers as the ratio exceeds 100%.
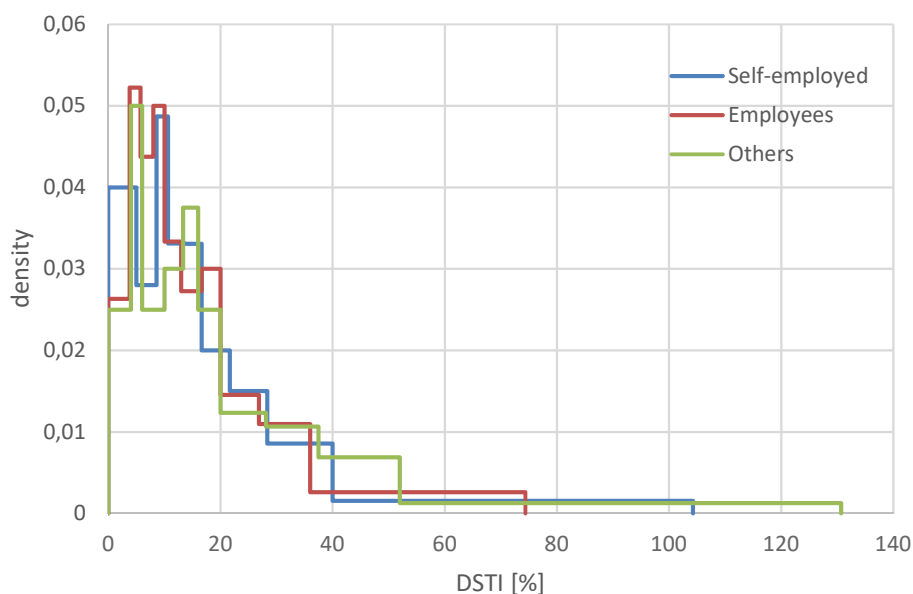
Figure 3. Empirical distribution of the DSTI ratio
Source: own elaboration of CATI survey data.

Due to the fact that an excessively high share of debt repayments in income may lead to over-indebtedness, it seems reasonable to identify the factors determining this relationship and to examine whether they differ depending on the type of household. For this purpose, we estimated the parameters of the power-exponential model for the DSTI (dependent variable). Among the independent variables, we considered the characteristics of the respondents, their households, and their debt, for which we used backward stepwise regression. Following this approach, only the statistically significant variables that determined the DSTI ratio remained in the model.

Table 3. Power-exponential model: estimation results

Specification	Self-employed			Employees			Others		
	Parameter	Standard error	p-value	Parameter	Standard error	p-value	Parameter	Standard error	p-value
Constant	7.462	0.816	0.0000	6.778	0.424	0.0000	6.242	0.747	0.0000
Education	–	–	–	0.147	0.041	0.0003	–	–	–
No. of persons	-0.245	0.065	0.0002	-0.285	0.029	0.0000	-0.191	0.051	0.0002
ln(income)	-0.620	0.094	0.0000	-0.543	0.054	0.0000	-0.475	0.096	0.0000
Flat area	–	–	–	0.001	0.001	0.0249	–	–	–
No. of loans	0.595	0.101	0.0000	0.343	0.042	0.0000	0.432	0.080	0.0000
Non-banking	-1.294	0.166	0.0000	-0.960	0.063	0.0000	-0.872	0.127	0.0000
Mixed	-0.464	0.235	0.0501	-0.183	0.092	0.0480	–	–	–
Model fitting									
R^2	0.4615			0.4073			0.3633		
F statistics	$F(5.141)=24.17$ $p<0.001$			$F(7.657)=66.18$ $p<0.001$			$F(4.187)=28.25$ $p<0.001$		
Standard error	0.8263			0.6953			0.7859		
N	147			665			192		

Source: own elaboration of CATI survey data.

The results in Table 3 show that the increase in the DSTI ratio, and thus the risk of over-indebtedness, is influenced by the number of loans (in any analysed group of households) and, in the case of paid employees, also by the level of education and the floor area. Generally, the factors determining

the level of DSTI ratio do not differ substantially between the analysed groups of households. However, we should note that the impact of income, number of loans, and type of debt (non-bank and mixed) in households of the self-employed is stronger than in other groups.

CONCLUSIONS

The analysis of income distribution and income inequality has a long history. The novelty of the present study lies in introducing the perspective of self-employment into the discussion on income and debt distribution and the problem of over-indebtedness.

The research carried out on a sample of Polish indebted households shows that the economic status differentiates distributions of income and debt repayments. Therefore, it is justified to study these household groups separately. The self-employed households have a better financial situation than households of paid employees and individuals who support themselves from other sources of income. On the other hand, the Gini coefficient confirms the occurrence of greater inequalities in distribution of income for households of entrepreneurs compared to other analysed groups. These results agree with expectations and confirm greater income inequality for this group of households. Thus, the conducted analyses allow us to positively verify hypothesis H1. The households of entrepreneurs exhibit the income debt burden higher than those of paid employees but lower than households of individuals who support themselves from other sources of income. This may suggest that greater income fluctuation leads to over-indebtedness. In this context, we may assume that hypothesis H2 is partially confirmed. On the other hand, the identification of the variables that determine the extent to which income is encumbered with repayments did not show any fundamental differences: the determinants are essentially similar regardless of the work status. However, the impact of income, credit, and type of debt on the over-indebtedness is greater for households of the self-employed.

The limitation of this study is that the analysis concerned only a single year. A longitudinal study focused on the situation of the self-employed would certainly prove valuable. Moreover, the group of self-employed households is very heterogeneous, which results in high income inequality. Therefore, future analyses should distinguish more homogeneous types of self-employed households (e.g. freelancers, entrepreneurs, etc.). Moreover, future research should scrutinise the characteristics of the debt held by self-employed households because – as Castronova and Hagstrom (2004) and Yilmazer and DeVaney (2005) indicate – the type of their debt is different from other households. However, this would require gathering more detailed data and a different research methodology based on in-depth interviews with entrepreneurs. Such an approach would shed light on self-employment and perhaps challenge the findings made in this study. Given that the situation of self-employed workers depends on the local context and the conditions in which they operate (Erkut, 2016; Onwe *et al.*, 2020), we believe future scholarship should prepare an international comparative study on income and debt among households of the self-employed. It would also be valuable to compare the financial situation of indebted and non-indebted households of self-employed.

The use of debt increases the range of consumer choices and is a necessary function in the modern economy. At the same time, as long as borrowing is available, some people will get into difficulties with debt. However, as is the case with poverty, appropriate policies can reduce the risk. Research results on debt distribution and its determinants may help to create regulations that prevent household bankruptcies and policies aimed at combating social exclusion. Identifying the characteristics of over-indebted households could also allow for designing better solutions that would increase stability of the financial system and provide debt counselling for groups prone to over-indebtedness.

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Authors

The contribution share of authors is equal and amounted to 50% for each of them.

Agnieszka Wałęga

PhD, Assistant Professor at Cracow University of Economics (Poland), Department of Statistics at the College of Economics, Finance, and Law. Her research interests include social and labour statistics, statistical analysis of household budgets, poverty, well-being and household indebtedness (especially over-indebtedness).
Correspondence to: dr Agnieszka Wałęga, Cracow University of Economics, Department of Statistics, ul. Rakowicka 27, 31-510 Kraków, Poland, e-mail: agnieskza.walega@uek.krakow.pl
ORCID ⓘ http://orcid.org/0000-0002-6386-0433

Grzegorz Wałęga

PhD, Assistant Professor at Cracow University of Economics (Poland), Department of Microeconomics at the College of Economics, Finance, and Law. He conducts research on household debt, over-indebtedness and financial well-being. His research interests focus on household economics, household finance and microeconomics.
Correspondence to: dr Grzegorz Wałęga, Cracow University of Economics, Department of Microeconomics, ul. Rakowicka 27, 31-510 Kraków, Poland, e-mail: grzegorz.walega@uek.krakow.pl
ORCID ⓘ http://orcid.org/0000-0002-4355-5204

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Mediating role of entrepreneurial alertness between prior entrepreneurial exposures and entrepreneurial intentions

Anthony Ogbuinya Edigbo, Anastasia Ogbo, Chukwuemeka Christain Onwe, Anthony Igwe, Lawrence Chima Okafor

A B S T R A C T
Objective: The objective of the study is to ascertain the mediating role of entrepreneurial alertness (EA) on the prior entrepreneurial exposures (PEE) and entrepreneurial intentions (EI) relationship of fresh graduates in Nigeria.
Research Design & Methods: We conducted a survey on fresh graduates in Nigeria (n = 387). The data gathered were analysed using Hayes' simultaneous entry on SPSS 23.0 and PROCESS 3.
Findings: We found that PEE leads to an entrepreneurship career intention. We concluded that EA improves the PEE–EI relationship amongst fresh graduates in an emerging economy.
Implications & Recommendations: The theory of EA is a good predictor of EI and a good mediator in the PEE–EI relationships, therefore further studies should consider EI models, especially those that involve EA and fresh graduates instead of students.
Contribution & Value Added: We advance the understanding of PEE-EI relationship by utilizing the EA theory as a mediator while also testing this on a fresh graduate population in an emerging economy.

INTRODUCTION

Entrepreneurial intention (EI) involves the initial steps towards entrepreneurship (Zapkau, Schwens, Steinmetz, & Kabst, 2014; Nowiński *et al.*, 2020). It is the desires and commitments of individuals to starting up new businesses (Miralles, Giones, & Riverola, 2015; Soria-Barreto, Honores-Marin, & Gutierrez-Zepeda, 2017), and it has been identified to be crucial to economies as well because new businesses foster growth, innovation, stability, and job creation (Maresch, Harms, Kailer, & Wimmer-Wurm, 2016). What stands out amongst the factors that influence EI is Prior Entrepreneurial Exposures (PEE). Entrepreneurship is a planned and purposeful act (Li & Wu, 2019), and PEE involves various activities like entrepreneurial parents or prior work experience in a small or newly founded firm (Austin & Nauta, 2015; Zapkau *et al.,* 2014), along with entrepreneurship education that prepares individuals for entrepreneurship (Chukwu, Olaitan, & Omeje 2018; Li & Wu, 2019). The importance of PEE in entrepreneurship has been adequately identified and discussed (Krueger, 1993; Zapkau *et al.,* 2014; Uchenna, Olawale, & Omeje, 2018). Individuals with PEE are more likely to have the desire and commitment towards entrepreneurship than individuals without it (Chlosta *et al.,* 2012; Uchenna *et al.,* 2018).

There is no lack of empirical studies that examine the effects of PEE on EI (e.g. Malebana, & Swanepoel, 2014; Mueller, Zapkau & Schwens, 2014; Nowinski & Haddoud, 2019). The findings so

far show that PEE majorly affects EI in a positive way (e.g. Malebana & Swanepoel, 2014), and that these effects are usually higher when meditated by attitudinal variables such as attitude, subjective norms, and perceived behavioural control as presented in Ajzien's (1991) theory of planned behaviour (TPB) or perceived feasibility, perceived desirability, and propensity to act as suggested by Shapero's and Sokol's (1982) entrepreneurial event model (EEM). Despite these discoveries, some knowledge concerning the PEE–EI effects is yet to be uncovered.

It appears that there is no agreement between researchers on what constitutes PEE. Whereas some studies like Austin and Nauta (2015) suggest that PEE only involves parental role modelling; other studies (e.g. Mueller *et al.,* 2014; Zapkau *et al.,* 2016) believe that it also involves prior work experiences in newly founded firms. Entrialgo and Iglesias (2017) and Soria-Barreto *et al. (*2017) in their studies tip entrepreneurship studies to be part of such constructs. We subscribe to these different schools of thought because they all bear tenets of the social cognitive career theory (SCCT) as propounded by Lent, Brown, and Hackett*,* (1994). This theory suggests that the various exposures that individuals receive as a result of their interactions within their social environments would model their intentions towards a career that is in line with the exposures (Liguori, Winkler, Vanevenhoven, Winkel, & James*,* 2019). Accordingly, exposures to entrepreneurial activities are either through observation or direct experience. In this case, exposure to entrepreneurial role models and entrepreneurship education represents observational learning, whereas prior work experience represents direct experiences. We believe that PEE should comprise of these three dimensions, as they should provide a more comprehensive result of the effect of PEE on EI; but no study as we know it has combined these three dimensions in a single research. Similarly, the quality of exposures is bound to affect an individual's EI positively or negatively (Krueger, 1993; Zapkau *et al.,* 2014), but most studies have not captured these aspects in their measures of PEE (Chlosta *et al.,* 2012; Entrialgo & Iglesias, 2017).

Another concern is that virtually every prior study in this area has been conducted on student populations (Li & Wu, 2019; Nowinski & Haddoud, 2019). We argue that such populations may not be the best suited for a study that has to do with EI because intentions are not stable and are subject to changes that may occur as a result of the experiences that individuals face. Student populations are not necessarily facing immediate career issues; moreover, they are engaged in specific courses of studies that reflect their career paths already. It is most likely that the EI of students may not give a clearer picture like the intentions of fresh graduates. Fresh graduate populations are individuals that face either pursuing paid employment or self-employment, and whose exposures to entrepreneurial activities are most likely to affect their intentions toward starting up businesses.

Accordingly, attitudes may not be the best predictors of EI as have been identified in prior studies (e.g. Zapkau *et al.,* 2014; Lu & Wang, 2018), rather dispositions like one's ability to identify and recognize opportunities as indicated in Krizner's 1992 alertness theory of entrepreneurship may fair better (Krizner, 1997). This argument is predicated upon assertions that entrepreneurial processes are acts of alertness and do not involve the processes of forming behaviour as suggested by the TPB. As such, we posit that intentions are a function of opportunities recognized from alertness as a result of exposures (Ma & Huang, 2019; Chavoushi *et al.,* 2020). In other words, the PEE–EI relationship may be better predicted by entrepreneurial alertness; i.e. the ability of an individual to scan and search for opportunities; associations and connections; evaluation and judgment.

Moreover, understandings about the effects of PEE on EI appear to be incomplete because only a few studies have investigated how qualitative PEE impacts EI (Krueger & Carsrud, 1993; Zapkau *et al.,* 2014). Nevertheless, there is a dearth of such studies from a developing economy like Nigeria, and the results of prior studies are often different from reality. Various studies have indicated a germane existence of PEE with positive effects on EI (Li & Wu, 2019; Nowinski & Haddoud, 2019), but increased cases of business failures and decreased in business start-ups as recorded by SMEDAN and NBS (2017) indicate that current PEE may not be qualitative enough to drive intentions or sustain them to fruition. Therefore, against this backdrop we posed the following questions. To what extent does quality in various dimensions of PEE (parental role model, prior work experience, and entrepreneurship studies) affect the EI of fresh graduates in Nigeria? What mediating roles does EA play on the PEE–EI relationship of fresh graduates in Nigeria?

This study is significant, firstly, for it hopes to extend the understanding of the PEE-EI effects by adopting a comprehensive scale that comprises parental role model, work experience, and entrepreneurship education. These dimensions are used separately in different scales in previous studies as measures of PEE (Mueller *et al.*, 2014; Zapkau *et al.,* 2014; Soria-Barreto *et al.,* 2017; Chukwu *et al.,* 2018; Li & Wu, 2019). We argue in line with Lent *et al.*'s (1994) social cognitive career theory that knowledge – both formal and informal – is acquired through the observation of other peoples' behaviour, attitudes, and the outcomes of those behaviours. These are the tenets of these various dimensions of PEE, therefore we believe that PEE must comprise of all three elements: parental role model, work experience, and entrepreneurship education respectively.

Secondly, this study contributes the perspective of fresh graduates to the EI discourse. Studies in this area tend to study student populations. We argue that intentions are susceptible to changes, particularly for students whose academic performance may drive them to pursue other intentions outside entrepreneurship. By examining the EI of fresh graduates, this study's contribution would help policymakers determine the quality of PEE and in making effective policies that would enhance the quality of PEE which would influence graduates' EI.

Finally, this study extends the discourse in the field by including the effects of mediating roles of EA in the PEE–EI relationship. By doing so, this study extends existing knowledge centred on the mediating roles of attitudinal variables to include dispositional variables (scanning and search; association and connections; evaluation and judgment). By this, we hope to present a much clearer effect, whereby the previously well-established relationship between PEE and EI may be enhanced with the inclusion of alertness into the model. If supported, this would suggest that at least one of the reasons PEE drives intentions stems from the fact that PEE makes budding entrepreneurs more alert about entrepreneurial opportunities.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Theoretical framework

The arguments in this study hinge on two basic theories that form the theoretical framework of this study. The first theory laid the theoretical foundation of the predictor variable – PEE – while the second theory explains the foundation for the mediators: EA. The former refers to the SCCT of Lent *et al.* (1994), which argues that there is interrelatedness between individuals, contexts, and experiences and that these factors combined would shape an individual's career-related intentions (Liguori *et al.*, 2019). By implication, the entire gamut of exposure to entrepreneurship – either directly or through observations – is a cognitive process that can be learned just as EA can be learned as well (Krueger *et al.,* 2000; Wang *et al.,* 2017). In perspective to our study, we view PEE as a social cognitive processes that involves the individuals garnering experiences related to entrepreneurial activities within their environments that will shape their EI.

The second theory draws from Krizner 1992 alertness theory of entrepreneurship. The theory is of the view that entrepreneurs strike a balance by detecting and exploiting imperfections caused by information asymmetry and bounded rationality in markets (Krizner, 1997). Varying information about the state of business environment requires alert individuals to discover and exploit such opportunities. This theory is a diversion from the TPB, which asserts that certain behavioural dispositions are required to discover opportunities; rather opportunities are stumbled on as a result of an individual's ability of scanning and search, associating and connections and evaluation and judgments.

Hypotheses development: Prior entrepreneurial exposure and entrepreneurial intention (PEE & EI)

PEE is seen as prior entrepreneurial knowledge garnered through the influence of role models, prior work experience in a small or new firm, and entrepreneurship education that influenced one's interest entrepreneurially (Liguori *et al.*, 2019; Zapkau *et al.,* 2016; Zapkau *et al.,* 2014). Role models in entrepreneurship discourse according to Choukir *et al.* (2019); Nowinski and Haddoud (2019) could be parents, relatives, friends, or individuals who are or have been entrepreneurs. Evident in SCCT,

knowledge, and skills acquired by observing role models influence self-efficacy, outcome expectation, and intention of an individual (Liguori *et al.*, 2019); as such, it is decisive in career choice into self-employment (*Schere et al.,* 1989).

Chlosta *et al.* (2012) found that parental role models directly influence the decision of an individual to seek self-employment. Zapkau *et al.* (2014) discovered a positive and significant relationship existing between parental role models and student's EI, though mediated through the attitudinal variable of the subjective norm.

Work experience received in a small or new firm equally helps in forming the behaviour of an individual towards entrepreneurship (Patricia & Silangrn, 2016). In line with SCCT, having the opportunity to work in a small or new created firm would provide direct knowledge that would help fresh graduates to perceive entrepreneurship as advantageous or otherwise. Long-term survival issues could deter interest in business amongst fresh graduates in developing economies owing to associated economic, social, and personal costs of business failures (Wyrwich *et al.,* 2015; Eid *et al.,* 2019; Okwo, Ezenwakwelu, Igwe & Imhanrenialena, 2019). However, by working in a small or newly created firm, an individual could acquire the basic skills on how to leverage inherent challenges of business (Cacciotti *et al.,* 2016; Paunescu, Popescu & Duennweber*,* 2018; Vallaster, Kraus, Lindahl & Niielsen*,* 2019) to ones' advantage. This is pivotal towards considering new venture creation, which is in turn vital to a nation's economic growth (Krueger, 1993; Shava & Chinyamurindi, 2019).

Sorensen (2007) found that work experience in a small or new firm significantly affects the proclivity of an individual towards being an entrepreneur. Monsen *et al.* (2012) found that work experience in a small or new firm significantly influences the EI formation of an individual. However, Kautonen, Luoto, and Tomikoski (2010) found that prior work experience does not significantly affect the EI of an individual. We argue that by working in a small or new firm an individual would garner knowledge that would be instrumental towards entrepreneurship instead of paid employment.

Entrepreneurship education is a process designed to instil an entrepreneurship attitude and skills in participants (Maresch *et al.,* 2016; Boldureanu, Inoescu, Bedrule-Griguruta, & Boldureanu*,* 2020). According to Bae *et al.* (2014) entrepreneurship education is another form of PEE for developing entrepreneurship consciousness, which is to instil self-efficacy in students towards entrepreneurship activities. Gerba (2012) – in a study of Ethiopian students – found a positive and significant effect of entrepreneurship education on the EA of students. Boldureanu *et al.* (2020) found a positive and significant effect of entrepreneurship education exposure on the EI of students. Bae *et al.* (2014) in their meta-analytical review found that entrepreneurship education positively and significantly influences EI. Lim *et al.* (2014) found that the relationship between entrepreneurship education and EI is partially mediated by EA. In line with SCCT, entrepreneurship education is capable of widening fresh graduate youth's horizons with greater cognitive ability and entrepreneurial skills leading to positive self-efficacy, outcome expectation, and meaningful goal-directed activities (Liguori *et al.,* 2017). Otache (2019) posits that entrepreneurship education plays an influential role in career choice towards self-employment over paid employment.

Thus, EI is the willingness or desire to make a career choice in new venture creation instead of seeking paid employment (Entrialgo & Iglesias, 2017; Bogatyrewa *et al.,* 2019; Zaremohzzabieh *et al.,* 2019). Such a desire is inspired in an individual through PEE (Zapkau *et al.,* 2014). We posit that the PEE as a cognitive process is a precursor that would influence the career choice of fresh graduates' EI formation (Ma & Huang, 2019). Therefore, we formulate the following sets of hypotheses:

H1: Prior entrepreneurial exposure (PRM, WEX, and ENT.Edu) has a direct significant effect on fresh graduates' entrepreneurial intentions.

Hypotheses development: The mediating role of entrepreneurial alertness (EA)

Kirzner's EA theory (Kirzner, 1997) has been pivotal in recognizing opportunities in an environment and EA in that regard has been considered a central element of all entrepreneurship process (Chavoushi *et al*. 2020; Machado *et al.,* 2016). As a decisive driver of entrepreneurship processes, EA enables one to

utilize information in an environment through abilities of scanning and searching, association and connection, evaluation and judgment to reveal entrepreneurial opportunities (Campos, 2017; Tang *et al.*, 2012). Langowitz and Minniti (2007) posit that alertness to entrepreneurial opportunities has a positive relationship with an individuals' proclivity to seek self-employment like starting a new business. Social networks maintained by parental role models would give individual access to networking resources. Such access would be a reliable source of getting vital market information such as technological change, government policies, and their implications, consumer preference, supply needs, or market demand, which would be instrumental in revealing opportunities unnoticed by others within an environment (Ma & Huang, 2019; Adamako, Danso, & Narteh, 2018; Turkina, 2018). In emerging economies characterized by weak institutions, having networking ties has been identified as a major source of information sharing and aiding opportunity identification (Turkina, 2018; Xie & Lv, 2016). This helps an individual to gain proclivity to scan and search for opportunities, which agrees with SCCT. In line with this reasoning, Tang (2010) found a significant effect of role models on the ability to scan and search for valuable information leading to opportunity identification in an environment for entrepreneurship. Armed with information from social networks, one could readily probe information (i.e. alertness association and connection) emanating from the dynamics of the environment to build coherent information alternatives leading to entrepreneurial opportunity (Ozgen & Baron, 2007). Urban (2017) maintains that changes in the environment present varying information hints which require an individual to cognitively harmonize in a logical sequence. Without prior knowledge, one could be bereft of requisite insights on what represents valuable information and how to utilize it for opportunity identification (Webb, Irel, Hitt, Kistruck, & Tihanyi, 2011). The ability to reveal opportunities unnoticed by others would drive an individual towards EI (Liguori *et al.*, 2019; Hosseini, 2016). Yu (2001) posits that an individual would only decipher opportunity in areas where they have an apparent knowledge of what represents an opportunity.

Prior work experience has been found to positively influence the EI of individuals (Zapkau *et al.*, 2014). This influence would be boosted through the intervening variable of EA. Work experience in small and related firms helps an individual garner related to market information (Amato, Baron, Barbieri, Belanger, & Pierro, 2016). Hadjizadeh and Zali (2015) maintained that knowledge of market trends or industry dynamics would support an individual with the zeal to scan and search for apt information that would lead to opportunities. By working in a small or related firm, an individual would interact with varying industry players (Amato *et al.,* 2016). This interaction could develop into a network of social ties that would provide additional information cues that would help to appraise information with utmost exactitude to lead to entrepreneurial opportunity (Xie & Lv, 2016; Ozge & Baron, 2007). In line with the views of Amato *et al.* (2016), prior work experience in a small or related firm would lead to an individual inclination to associate and connect diverse market information within an environment to identify opportunities that would lead to EI. Hajizadeh and Zali (2015) found a positive relationship between prior knowledge and individual ability to recognize an entrepreneurial opportunity.

Entrepreneurship education has been highlighted by Liguori *et al*. (2019), Ma and Huang (2019), and Sang and Lin (2019) as a source of acquiring skills and knowledge that could spur fresh graduates into making career choices towards entrepreneurship. Entrepreneurship education both in theory and practical (internship and excursion visits) would build an individuals' cognitive ability to scan and search for opportunities in the environment (Ho, Uy, Kang, & Chan, 2018). Such an exposure can influence an individuals' instinct in association and connection of otherwise dissimilar information in an environment into opportunity cues (Shane, 2000). Ho *et al*. (2018) posit that entrepreneurship education positively enhances the evaluation and judgment skills of young people towards new venture creation. Sang and Lin (2019) found that EA mediates the relationship between entrepreneurship education and EI of college students.

On this premise, we form the following hypotheses:

H2:   Scanning and search play a significant mediating role in the dimensions of PEE effects on entrepreneurial intentions of fresh graduates.

H3:   Association and connection play a significant mediating role in the dimensions of PEE effects on the EI of fresh graduates.

H4: Evaluation and judgment play a significant mediating role in the dimensions of PEE effects on the EI of fresh graduates.

RESEARCH METHODOLOGY

Survey sample

The population of this study was fresh graduates (i.e. corps members) who were engaged in their compulsory National Youth Service Corps (NYSC) program in Nigeria. They were fresh university graduates under the age of 30 from different parts of the country. The reason for selecting this population was because they faced career decisions to either seek employment or to start up their businesses. Moreover, we believed that most have been exposed to different forms of entrepreneurship, i.e. some of them have parents involved in starting or running businesses that may still be running, and they could have been groomed in the rudiments of business. Many believe that such exposures would tilt their intentions towards business (i.e. entrepreneurship). Furthermore, we believed that some of these graduates would have garnered work experiences during their school days (holiday jobs), plus at the moment of this study, they were earning basic wages for their services from the Federal Government of Nigeria (FGN), coupled with the fact that they also earned from their places of primary assignment. It is most likely that this exposure would have an impact on their orientations towards starting up their businesses. Finally, entrepreneurship courses have been offered by some of these corps members during their studies at universities, so we believed that before reaching this stage, some of the graduates would have been exposed to one form of entrepreneurship exposure or another (i.e. through theory or training).

The sampling frame was taken from the population of Batch B NYSC Corps Members permanent Register (2018), comprising all serving youth corps members in Nigeria between June 2018 to May 2019. This amounted to a total of 11,500 corps members, and with the aid of a simple random sample, we obtained a sample of 387, which we used for this study. To determine the number of questionnaires to be distributed per state, we adopted a propionate sampling technique. The distribution process of research instruments was done towards the last two months preceding their passing out parade (POP) when they were receiving pre-passing out orientation courses. We addressed the corps members concerning the purpose of the study and how they were selected. We also did not fail to highlight to them that the study was strictly an academic exercise, and that no response was wrong, plus that we retained the anonymity of every respondent.

Given the peculiar nature of the PEE scale and the fact that we had a specific number of questionnaires to distribute per state as informed by the propionate sample, we asked those not interested in partaking in the survey to step aside. Furthermore, we asked those interested in the survey to indicate if they had either parental role models or had worked before or have taken entrepreneurship courses. This further reduced the number and brought us closer to accessing corps members with quality entrepreneurial exposure. At this point, we asked those with role models that had negative experiences in businesses, those that had negative experiences in their jobs, and those that received entrepreneurship education that they believe is not good enough to make them want to start a business to respond to the questionnaires alongside those who did not have such negative experiences at all. A total of 354 (92.2 percent) of the distributed questionnaires were returned, the remaining 33 (7.8 percent) questionnaires were not properly completed, so the final sample utilized in this study was 354.

Measurements and scale development

Control variable (gender)

Corps members of different gender may have different exposures or may display different attitudinal dispositions that would influence their EI. Studies by Gerba (2012) and Vaillant and Lafuente (2018) indicate that both males and females partake significantly in entrepreneurial activities, so gender could help in isolating the different effects that the types of exposures and attitudinal dispositions have on EI. Gender was used as a control variable of this study, the respondents were asked to indicate their gender by ticking either female or male (Female =1, Male =2).

Prior entrepreneurial exposure (PEE)

Entrepreneurial exposure as investigated in this study comprised of three different dimensions: PEE with regards to observations, i.e. parental role models, and PEE with regards to direct exposure, i.e. work experience and entrepreneurial studies would affect the EI of corps members. The third dimension was added because we consider entrepreneurial studies to be a great form of exposure, given this study population. We assume that since entrepreneurship courses are offered by some students in all Nigerian universities, some corps members would receive exposure in this regard even if they missed the other two. We measured these dimensions by asking respondents to indicate "Yes" or "No" to questions such as: Have your parents been involved in business activities? Have you been involved in any form of employment before? Did you take any entrepreneurship courses before you graduated? However, in line with the Zapkau *et al.*'s (2014) measure – which suggests that the best approach to access entrepreneurial exposure is to access the levels of quality of the exposure – we adopted the perceived quality of the PEE scale. Respondents that indicated that they have prior exposure in a specific area (i.e. parental role model, work experience, and entrepreneurship education) were asked to rate their perception about their exposure as either negative (coded "-1"), neither/nor (coded "0"), or positive (coded "1").

Scanning and search

Scanning and search comprise the extent to which individuals are willing to interact with others to gain information about economic opportunities. In other words, we measured this variable as the extent to which corps members consider the intentions of starting their businesses to be a function of their abilities to "interact with others to acquire new information," the extent of their agreement that they "regularly read news, magazines or publications to get new information," and the extent to which they "surf the internet every day looking for information." This scale was in line with the alertness scale proposed by Tang *et al.* (2012), and we organized the responses of this scale on a five-point Likert scale. We obtained internal reliability above 0.7 for this scale (Cronbach's alpha = 0.865).

Association and connection

Associations and connections comprise an individual's disposition towards finding relationships between events and recognizing opportunities amongst them. We also adopted Tang *et al.*'s (2012) scale in this study. The original scale comprised three items, i.e. the extent to which corps members agree that they "see associations between seemingly unrelated information," the extent to which they agree that they "usually see a connection between information from various seemingly unconnected fields of knowledge." We organized the responses of our scale on a five-point Likert scale. We obtained internal reliability above 0.7 for this scale (Cronbach's alpha = 0.833).

Evaluation and judgment

Evaluation and judgment include the levels of an individual's instincts towards recognizing and exploiting opportunities. We adapted the scale for this variable from Tang *et al*.'s (2012) scale. The scale comprised four items that asked the respondents to indicate the extent to which they agree that they "have the instinct to find opportunities with potential," the extent to which they agree they "have a talent for separating high-value opportunities from low-value opportunities," and the extent to which they can select good opportunities when they come across several opportunities. The measures were organized on a five-point Likert scale, and internal reliability was above 0.7 for this scale (Cronbach's alpha = 0.957).

Entrepreneurial intentions (EI)

EI includes the individuals' desires to delve into entrepreneurship in the nearest future. We adapted the pure intention scale by Linan and Chen (2009) to measure the EI of fresh graduates. The scale comprises of five items, and it measures the extent to which these fresh graduates agree that they are "ready to do anything to be entrepreneurs," the extent to which they agree that they are "determined to create a firm in the future," and the extent to which they agreed that they are willing to make every

effort to start and run their firms. The measures were organized on a five-point Likert scale, and internal reliability was above 0.7 for this scale (Cronbach's alpha = 0.863).

RESULTS

We analysed this study's data in four different statistical packages: the Statistical Package for Social Sciences 23.0 (SPSS) to run the principal factor analysis (PCA); the confirmatory factor analysis (CFA) using the Analysis of Moment Structures 18 (AMOS); and the James Gaskin macro plugin used to estimate the composite reliability scores. The test of hypotheses was done with the SPSS macro PROCESS 3. PROCESS is a new software advanced by Andrew Hayes (2018) to test the mediation effect with a new approach, i.e. through multiple entries. The advantage of this approach against Baron and Kenny's approach of mediation is that whereas Baron and Kenny categorize mediation as either partial or full, Hayes insists that mediation is either attained or not and there is no such thing as a partial mediation. We subscribe to the latter view, so we adopt Hayes' approach in testing the direct and mediation effects in this study.

Preliminary diagnostics like the PCA performed on the data showed that the four items measuring EI loaded together under a single construct, four items loaded together under the scanning and search construct, three items loaded under the association, connection, evaluation, and judgment. The CFA of the four constructs – i.e. EI, scanning and search, association and connection, and evaluation and judgment – showed loadings with standardized estimates above the base value of 0.5 (Schreiber $et\ al$., 2006). Average variance extracted (AVE) for these constructs was: EI (0.612), scanning and search (0.616), association and connection (0.629), and evaluation and judgment (0.884); all of which exceeded the threshold of 0.5 forwarded by Bagozzi and Yi (1988), Hu and Bentler (1999), and Schreiber $et\ al$. (2006). Composite reliability (CR) scores were: EI (0.863), scanning and search (0.865), association and connection (0.835), and evaluation and judgment (0.958); all of which exceeded the 0.7 threshold. The model fit indices – i.e. the χ^2/df, = 1.32 goodness of fit (GIF), = 0.963 the adjusted goodness of fit index (AGFI), = 0.946 the incremental fit index (IFI), = 0.992 the comparative fit index (CFI), = 0.992 and root mean square error of approximation (RMSEA) = 0.030 – were way above the thresholds indicated by Poon $et\ al.$ (2006); Bagozzi and Yi (1998). Factors loadings also showed that the items in the research instruments were recognizable to the study respondents. Discriminant and convergent validity also loaded well.

Table 1. Descriptive statistics and correlations

Variables	Mean	SD	1	2	3	4	5	6	7	8
Gender	1.55	0.49	1							
PRM	0.14	0.88	0.39**	1						
WEX	0.18	0.85	0.47**	0.37**	1					
Ent. Edu	0.19	0.83	0.15**	0.29**	0.26**	1				
SS	12.6	4.37	0.11*	0.18**	0.18**	0.15**	(0.87)			
AC	10.9	3.29	0.06	0.095	0.16**	0.13*	0.15**	(0.83)		
EJ	11.2	3.74	0.08	0.13*	0.19*	0.12*	0.32**	0.31**	(0.96)	
EI	13.9	4.52	0.35**	0.49**	0.45**	0.49**	0.28**	0.21**	0.29**	(0.86)

Note: PRM = parental role model; PWX = work experience; Ent.Edu = entrepreneurial education; SS = searching and scanning; AC = association and connection; EJ = evaluation and judgment; EI = entrepreneurial intentions.
Source: own elaboration in SPSS 23.0.

Table 1 presents the means, standard deviations, and correlations between the variables of this study (gender, PEE, EA, and EI). Table 1 reveals that the relationship between gender and EI is a significant one (r = 0.351, p<.01), meaning that gender accounts for fresh graduates' EI. Similarly, the relationship between a parental role model and EI is significant (r = 0.498, <p.01), meaning that the amount of mentorship fresh graduates receive from their parents would translate to higher EI. The relationship between work experience and EI was significant also (r = 0.454, <p.01); implying that the experiences

that fresh graduates must have garnered from working increases their EI as well. The relationship between entrepreneurship education exposure with EI also turned out significant (r = 0.486, <p.01), meaning that the extent of exposure that fresh graduates get concerning entrepreneurship education increases their EI. The table also shows that other variables like scanning and search, association and connection, and evaluation and judgment have significant relationships with EI.
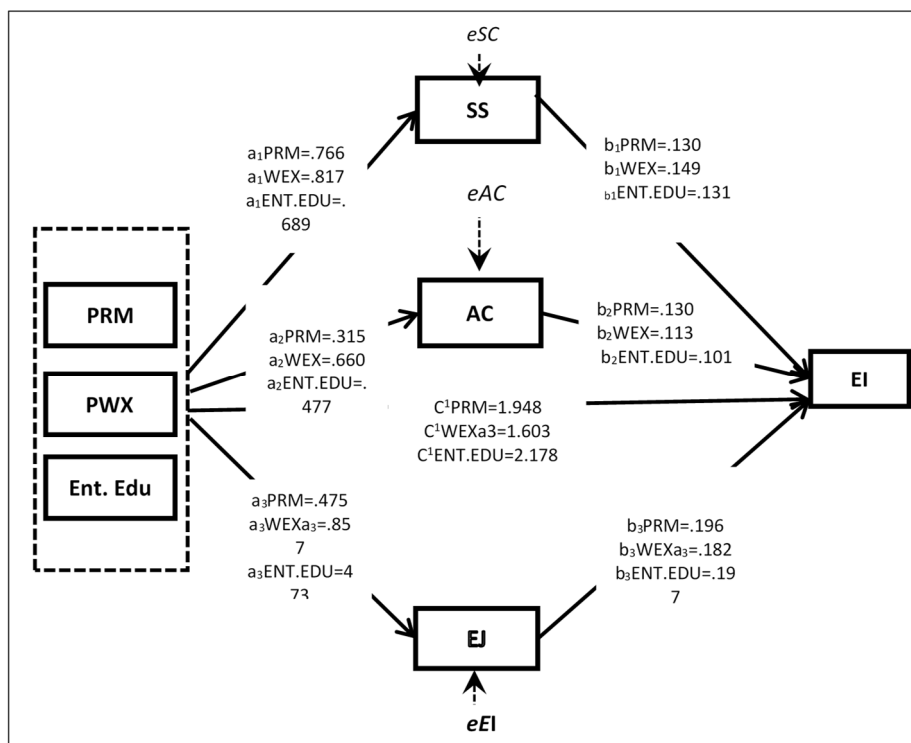
Figure 1. A statistical model of the hypothesized effects

Note: PRM = parental role model; PWX = work experience; Ent.Edu = entrepreneurial education; SS = searching and scanning; AC = association and connection; EJ = evaluation and judgment; EI = entrepreneurial intentions.

Source: own elaboration.

Figure 1 shows that there is a direct effect between PEE and EI as proposed in the first sets of hypotheses: parental role model exposure, work experience, and entrepreneurship education significantly affect the EI of fresh graduates. In model 1, parental role model exposure has a direct effect on the EI of fresh graduates (C^1 =1.948, t (348) =8.025; p<0.001) and work experience has a direct effect on the EI of fresh graduates (C^1= 1.603, t (348) =5.824; p<0.001) as well. The hypothesis that entrepreneurship education has a direct effect on the EI of graduates was also supported (C^1= 2.178, t (348) = 9.308; p<0.001). The second set of hypotheses that scanning and search, association and connection, and evaluation and judgment mediate the PEE-EI relationship of fresh graduates varied slightly in contrary to our prior expectations. To be specific, the hypothesis that scanning and searching improve the parental role model-EI relationship of fresh graduates was supported (a=0.0135≤a_1≤0.2292). Association and connection influence on parental role model exposure-EI relationship was not supported (a=-0.0196≤s_1≤0.1422), and lastly, the influence of evaluation and judgment on parental role model exposure-EI relationship (a = -0.0013≤p_1≤0.2385) was equally not supported.

Hypothesis 2, which stated that scanning and search improve the work experience-EI relationship of fresh graduates was supported (a=0.0183≤a_2≤0.2744), while hypothesis 3, which stated that association and connection improve the effect of work experience on EI of fresh graduates was not supported (a=-0.0171≤s_{21}≤0.2187). However, the influence of evaluation and judgment on the work experience-EI effect i.e. hypothesis 4, was supported (a=0.0228≤p_{21}≤0.3484). Regarding the entrepreneurship education–EI relationship, only one of the proposed hypotheses was supported. Specifically, scanning and search as a mediator in entrepreneurship education-EI effect was supported (s=0.0084≤a_3≤0.2084). The

hypothesis that association and connection mediate the influence of entrepreneurship education–EI effect was not supported ($s = -0.0228 \leq s_3 \leq 0.1495$). The influence of evaluation and judgment as a mediator in entrepreneurship education effect on EI was also not supported ($p = -0.0031 \leq p_3 \leq 0.2369$).

On the total effect as highlighted in our last sets of hypotheses, parental role model exposure when combined with the sum of the mediators indicated a positive and significant total effect ($C_1 = 2.1817$, $1.6866 \leq c \leq 2.6768$, $p < 0.001$), the total effect of work experience when combined with the sum of the mediators indicated a significant positive total effect ($C_2 = 1.9546$, $1.4132 \leq c \leq 2.5060$, $p < 0.001$). We equally confirmed the positive significant total effect of entrepreneurship education on EI when combined with the sum of the mediators ($C_3 = 1.4100$, $1.9341 \leq c \leq 2.8860$, $p < 0.001$), Thus, all the various PEE variables when combined with the sum of the mediators (scanning and search; association and connection, and evaluation and judgment) produced positive and significant total effects.

Table 2. Summary of effects

Variables					β	Finding
PRM	⟶	EI			1.948	Supported
WEX	⟶	EI			1.603	Supported
ENT.EDU	⟶	EI			2.178	Supported
PRM	⟶	SC	⟶	EI	0.010	Supported
PRM	⟶	AC	⟶	EI	0.041	Not supported
PRM	⟶	EVJ.	⟶	EI	0.093	Not supported
WEX	⟶	SC	⟶	EI	0.122	Supported
WEX	⟶	AC	⟶	EI	0.074	Not supported
WEX	⟶	EVJ.	⟶	EI	0.156	Supported
ENT.EDU	⟶	SC	⟶	EI	0.091	Supported
ENT.EDU	⟶	AC	⟶	EI	0.048	Not supported
ENT.EDU	⟶	EVJ.	⟶	EI	0.093	Not supported

Note: PRM = parental role model; PWX = work experience; Ent.Edu = entrepreneurial education; SS = searching and scanning; AC = association and connection; EJ = evaluation and judgment; EI = entrepreneurial intentions.
Source: own elaboration in PROCESS V3.

RESULTS AND DISCUSSION

Our findings indicated a significant direct effect of all the PEE variables on the EI of fresh graduates. This direct effect clearly supports prior findings of Chlosta *et al.* (2012), Monsen *et al.* (2012), and Bae *et al.* (2014) who found a significant influence of PEE on individual EI. We garnered support for our first hypothesis, which implies that PEE is a means of endowing an individual with a cognitive ability that would motivate fresh graduates towards new venture creation instead of seeking paid employment. However, our findings contradict the positions of Gird and Bagraim (2008) and Kautonen *et al.* (2010) in their respective studies of PEE variables, which revealed no significant effect of PEE on EI. This difference in findings could well be explained on the premise that we examined the quality of PEE as suggested by Krueger (1993) and Zapkau *et al.* (2014), while the previous studies failed to reveal the quality of PEE in their studies. We posit that PEE would only influence an individual towards entrepreneurship when considered positive by the individual. The positive influence of PEE refers to the extent to which an individual considered knowledge acquired through exposures (be it positive or negative) as motivating to make a career towards self-employment.

We considered the mediating role of EA to further knowledge in the EI discourse. Our findings make a modest contribution as scanning and search appeared to significantly mediate in all the various dimensions of the PEE–EI relationship. This finding is well supported in the views of Machado *et al.* (2016) who posit that EI is dependent on the ability to utilize valuable information to identify opportunities overlooked by others or the ability to adapt to environmental changes to create opportunities to one's advantage. Having parents that are or have been in business creates a social pressure on an individual to go into business (Zapkau *et al.,* 2014). This would drive one to make career choices towards self-employment given the ability to scan and search for opportunities or

create opportunities within the environment. What additionally supports our findings are Sang and Lin's (2019) findings that EA mediates the effect of entrepreneurship education on the EI of students. Scanning and search ability would motivate one towards utilizing the excess of knowledge acquired in a small or new firm to leverage information about an environment and thus identify viable entrepreneurship opportunities. Entrepreneurship courses at school undoubtedly arm people with the necessary skills to identify opportunities (Otache, 2019; Sang & Lin, 2019).

We found that evaluation and judgment alertness significantly mediate the effect of work experience on fresh graduates' EI. Our findings agree with the findings of Gozukara and Colakoglu (2016) who posit that prior work experience increases EI when an individual can decipher whether an opportunity is worth leveraging on. The import of this result is that exposures to entrepreneurial activities (be it through observational or direct learning) apparently increase an individual's inclination to start a new venture when he or she can evaluate and judge information within the environment accurately as to represent a viable opportunity. However, we did not find any support of the mediating roles of evaluation and judgment on the PRM–EI relationship. This finding could be attributed to the peculiarity of our clime of study, in which businesses face long-term survival issues (Okwo *et al.,* 2019; SMEDAN & NBS, 2017). Having a PRM who lost business would cast doubt in an individual that the identified entrepreneurship opportunity would be sustained in an environment posed with business long-term survival issues (SMEDAN & NBS, 2017). We also found no support for evaluation and judgment mediating role in the EE–EI relationship. However, this finding is not surprising as Hajizadeh and Zali (2015) opine that entrepreneurship education would lead to opportunity recognition when an individual has been properly exposed to varying knowledge in terms of industry, technology changes, and information on market dictates. In an emerging market like Nigeria – where entrepreneurship education curriculum relies more on theory with a lack of internship programs that would expose students to practical requisite entrepreneurship knowledge – it would be difficult to evaluate information and judge whether such information represent a viable entrepreneurship opportunity (Agbonlahor, 2016).

Contrary to our expectation, we did not find any support of the mediating role of association and connection dimension of alertness in any of the PEE–EI relationships, although Neneh (2019) found that alertness positively predicts intention. This finding is similar to the earlier findings of Lu and Wang (2018) who posit that association and connection are more of a psychological model of an individual which shows the internal cognitive ability of an individual to unravel opportunity from varying information sources. The cognitive ability is built over time by factors such as training and exposure (Lu & Wang, 2018), which we infer is linked with the quality of PEE. The import of this is that exposures to entrepreneurial activities would only influence fresh graduates to develop career choices towards entrepreneurship – given the quality of exposures (Krueger *et al.*, 2000) – and that ability to identify business opportunity given asymmetric information within the environment would depend on the quality of association and connection ability but is outside the scope of this study. This finding is somewhat attributable to our topic, whereby the entrepreneurship exposure patterns may not be considered qualitative enough (Agbonlahor, 2016).

CONCLUSIONS

Scholars identified EI to be crucial to economies, so investigating how EI are developed through prior exposures to entrepreneurial activities amongst fresh graduates is a worthwhile course of research. Previous studies showed that PEE predict the EI of fresh graduates, but our findings revealed that PEE predicts intentions better when fresh graduates are entrepreneurially alert. Although the TPB also revealed an increasing effect of PEE on intentions, the EA theory tends to show a better impact. More studies need to be directed into the EI models, especially those that involve EA and fresh graduates instead of students.

The mediating role of EA discovered in the effects of PEE–EI of fresh graduates in this study confirms that the awareness of entrepreneurial opportunities is crucial for entrepreneurship. Such discovery can assist managers, teachers, and policymakers in designing and implementing interventions that will enhance graduates' entrepreneurial intentions. This study emphasizes the contributions of each

dimension of EA, which implies that alertness could be cultivated through exposures to entrepreneurial activities, and this would enhance graduates' intentions towards venturing into entrepreneurship after schooling. However, EA may not be completely beneficial because it could become irrational to the point where individuals sacrifice subjectivity over objectivity. The implication of this is that individuals may delve into ventures whose intentions were not adequately developed. Therefore, it behoves managers and teachers to ensure that graduates are groomed adequately in the art of alertness (searching and scanning; association and connection; evaluation and judgment), such that they will be able to sieve out feasible opportunities from non-feasible ones.

Policy-wise, the results of this study underscore the importance of entrepreneurial exposures on fresh graduates in a developing economy like Nigeria, such that it could be a leeway for policymakers to tackle the ever-rising unemployment problems in the country. Therefore, the emphasis should be on enhancing the quality of entrepreneurial exposures and the EA of fresh graduates, as this will increase their intentions towards entrepreneurship. By implication, this will assist policymakers in developing quality curricula and policies that will in turn ensure quality entrepreneurial education to foster proper exposure and alertness.

Our study has two major limitations. One limitation is that we only studied corps members that served in the NYSC Scheme in one batch out of the three. The implication of this is that general assertion cannot be made easily with regards to the findings as they represent the findings from one batch of the other two. This does not imply that our findings are faulty because the preliminary diagnostics indicated no concerns with our sample and model fitness. However, the above suggests that other findings may arise from these other batches that will be different from our study. Therefore, we suggest that further studies of this nature should be conducted on all batches of the NYSC. Another major limitation of this study is the unavailability of an entrepreneurial intentions scale for the fresh graduate population. Previous studies utilized entrepreneurial intention scales designed for student populations, which made it difficult to adapt the same for a different population of fresh graduates. Therefore, we adapted the more comprehensive scale by Linan and Chen (2000) with slight modifications to suit our population. We suggest that future studies in this area should consider developing a scale that captures the EI of other populations outside the students' population.

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Authors

The contribution share of authors is as follows:
A.O. Edigbo – 30%, A. Ogbo – 25%, A. Igwe – 15%, C.C. Onwe – 20%, L.C. Okafor – 10%.

Anthony Ogbuinya Edigbo
PhD Candidate. His research interests include entrepreneurship, economic policy, and strategic management, organizational behaviours.
Correspondence to: Mr. Anthony Ogbuinya Edigbo, University of Nigeria, Nsukka, Faculty of Business Administration, Department of Management, email: anthony.edigbo.pg02779@unn.edu.ng
ORCID ⬤ http://orcid.org/000-0002-4795-9791

Anastasia Ogbo
Senior Lecturer, PhD in Management. Her research interests include management, business, entrepreneurship, innovation, strategic planning, business development, human resource management, economic development, and business management.
Correspondence to: Dr. Anastasia Ogbo, University of Nigeria, Nsukka, Faculty of Business Administration, Department of Management, email: ann.ogbo.@unn.edu.ng
ORCID ⬤ http://orcid.org/0000-0002-4569-9623

Chukwuemeka Christain Onwe
PhD Candidate. His research interests include entrepreneurship, strategic management, organizational behaviours, and operational research.
Correspondence to: Mr. Chukwuemeka Christian Onwe, University of Nigeria, Nsukka, Faculty of Business Administration, Department of Management, email: Chukwuemeka.onwe.pg002459@unn.edu.ng
ORCID ⬤ http://orcid.org/0000-0002-7976-5385

Anthony Igwe
Senior Lecturer, PhD in Management. His research interests include business policy, entrepreneurship, business economics, strategic planning, and business development.
Correspondence to: Dr. Anthony Igwe, University of Nigeria, Nsukka, Faculty of Business Administration, Department of Management, email: anthonyigwe121@yahoo.com
ORCID ⬤ http://orcid.org/0000-0002-2905-8471

Lawrence Chima Okafor
Senior Lecturer, PhD in Management. His research interest includes industrial relations, organizational behaviour, human resource management and in entrepreneurship.
Correspondence to: Dr. Lawrence Chiedozie Okafor Ebonyi State University, Abakaliki, Nigeria Faculty of Business Administration, Department of Management, email: chiedozieuzom@gmail.com
ORCID ⓘ http://orcid.org/0000-0003-3210-4499

Acknowledgements and Financial Disclosure

Conflict of Interest

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Green entrepreneurship intention in university students: The case of Peru

Aldo Alvarez-Risco, Sabina Mlodzianowska, Ulises Zamora-Ramos, Shyla Del-Aguila-Arcentales

A B S T R A C T
Objective: The aim is to better understand how education supports green entrepreneurship among students by analyzing their education development support, institutional support, country support, and entrepreneurial self-efficacy.
Research Design & Methods: A total of 320 international business students in Peru filled the online survey. Eight questions focused on demographic information, and twenty-six questions evaluated the green entrepreneurship intention of students. We used the SEM-PLS technical analysis.
Findings: We found that education development support (EDS; 0.146), institutional support (IS; 0.183), and country support (CS; 0.158) had a positive influence on entrepreneurial self-efficacy (ESE), while ESE had a positive influence (0.757) on the green entrepreneurial intention (GEI). The model explained 57.3% of the green entrepreneurial intention. Findings of the bootstrapping test showed that the path coefficients were significant.
Implications & Recommendations: This study showed the impact of education development support, institutional support, and country support on entrepreneurs' ability to successfully carry out green entrepreneurship, which will serve universities to implement strategic plans to achieve their ecological ventures and develop such ventures on campus with the students that have the necessary skills.
Contribution & Value Added: The research findings will prove helpful to governments in establishing new norms to promote entrepreneurship. The novelty of the current study is supported in using the PLS-SEM technique.

Article type:	research article
Keywords:	Green entrepreneurship intention; international business students; Covid-19; Peru
JEL codes:	L26, L31, Q57

Received: 3 March 2021	Revised: 28 June 2021	Accepted: 14 July 2021

INTRODUCTION

Entrepreneurship is continuously growing in recent years, and it has diversified its proposal for new values as green entrepreneurship. Some reports described outcomes of learning and development activities focused on entrepreneurship (Lamont, 1972). Suffice it to mention the initial university experiences of entrepreneurship in Canada (Hay, 1981). There, the scholars identified the weaknesses of university education regarding the knowledge and skills necessary for entrepreneurship, along with identifying the role of universities in promoting business development from theoretical and practical academic training (Segal, 1986), which is to give added value to universities (McMullan, Long, & Graham, 1986). Thus, university education has been seen to gradually orient more towards entrepreneurship (Hills, 1988; Hopkins, & Feldman, 1989).

Entrepreneurship has grown and has been seen as an alternative for personal development, even associated with personal survival. In this way, we may argue that the aspects that impact society trigger different actions of people. Since the beginning of 2020, we could have observed the beginning of a new

global social dynamic. The Covid-19 pandemic dramatically changed people's lives and businesses, causing 3.7 million people to die as of 5 June 2021 (WHO, 2021). This pandemic has led to significant damages among health professionals (Chen *et al.*, 2020; Yáñez, Afshar Jahanshahi, Alvarez-Risco, Li, & Zhang, 2020; Zhang *et al.*, 2021; Zhang *et al.*, 2020), population behaviour (Aldo Alvarez-Risco, Mejia, *et al.*, 2020; Quispe-Cañari *et al.*, 2021; Yáñez, Alvarez-Risco, & Delgado-Zegarra, 2020), population education (Aldo Alvarez-Risco *et al.*, 2021; Aldo Alvarez-Risco, Estrada-Merino, Anderson-Seminario, *et al.*, 2020), firms (A. Alvarez-Risco, Del-Aguila-Arcentales, & Diaz-Risco, 2018; Aldo Alvarez-Risco, Estrada-Merino, & Perez-Luyo, 2020; Yan *et al.*, 2021), and finally, the global economy (Ashraf, 2020; Laing, 2020).

During this Covid-19 pandemic, many people lost their jobs, which created severe problems for families with insufficient resources to survive. In this situation, some studies seek to obtain information from students regarding the intention of entrepreneurship that would meet the social demand for more jobs if implemented logically. In this sense, recent studies investigate entrepreneurship variables in times of the Covid-19 pandemic (cf. Liguori & Winkler, 2020).

The novelty of this study is that globally, the universities seek to promote entrepreneurship among their students, and today, intergovernmental organizations are encouraged to develop activities based on United Nations' Sustainable Development Goals (SDG). It is very important for universities and policymakers to know which factors influence green entrepreneurship to elaborate green entrepreneurship programs for their students.

We should learn if universities offer elective courses on entrepreneurship, which shows students' knowledge about it; likewise, we should learn if the universities promote entrepreneurship through the implementation of projects, workshops, postgraduate courses, and conferences. On the other hand, we should learn if the universities connect students with entrepreneurs, create awareness about entrepreneurship, provide knowledge, and motivate students to be entrepreneurial. Finally, we should learn what students think about their country's support for green entrepreneurship, whether they are encouraged by any state proposal, if the government offers opportunities through programs to promote green entrepreneurship, and does it facilitate bank loans necessary to start the green business. In this sense, we should also learn whether students can develop an ecological enterprise today or in the future.

Therefore, we seek to better understand how education supports green entrepreneurship among students by analyzing their education development support, institutional support, country support, and entrepreneurial self-efficacy.

The following section will describe the literature review and then the hypotheses development. Next, we will detail the methodology, results, and discussion. Finally, the article ends with conclusions, along with theoretical and practical implications.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The experiences of training in entrepreneurship at universities were reported from different countries. Thus, we can recognize initial reports of entrepreneurship in universities. Initially, Huu-Phuong and Soo-Jiuan (1990) foreground the importance of SMEs in technological innovation and their entrepreneurial spirit, thus highlighting the advantage of small-scale to respond more quickly to variations in the market. Interviews with 1200 exporters in the manufacturing and services sectors showed the intentions of sustainable ventures that would open up new markets. Through empirical research, Johannisson (1991) evidence that social skills are relevant to promote entrepreneurial activities; likewise, he finds that entrepreneurial education requires an approach that considers social, personal, and organizational resources. Chrisman, Hynes, and Fraser (1995) evaluate business activities at the University of Calgary to find that around 100 start-ups began because of significant contributions from professors, generating new job positions; likewise, it was projected that approximately 14 companies would be created in short-term. Dill (1995) measures the management and perceived performance effectiveness by evaluating patent and licensing offices to recognize the great importance of all these units in the support of entrepreneurship from universities. Dill also mentions that governments have a crucial role in promoting the development of these strategic units. Tamkivi (1999) describes the successful transfer of university-developed technologies. Klofsten and Jones-Evans (2000) report some teachers' actions involved with industrial and

commercial industry in Sweden and Ireland. Their results show considerable business experience among academics, which translates into consulting activities, although not the creation of technological spin-offs. Udayanan (2019) studies entrepreneurial intention among 263 university graduates, taking self-efficacy for a mediator variable, evaluated with the AMOS software. We find that the ESE mediates the effect of self-efficacy on GEI. The above research is helpful for the formulation of public policies and for university authorities that promote the development of sustainable entrepreneurship courses.

Variables

Green entrepreneurial intention (GEI)

The green entrepreneurial intention could be understood as a situation or state of the individual that generates interest, attention, and decision to implement a specific action (Bird, 1988; Meoli, Fini, Sobrero, & Wiklund, 2020; Santos Susana & Liguori Eric, 2019). The intention to act contains different motivating factors that directly influence the behaviour, as indicated by the TPB (Fishbein & Ajzen, 1975). Intention is the step preceding behaviour. Studies show that entrepreneurship's intention positively influences the materialization of entrepreneurship (Meoli *et al*., 2020; Neneh, 2019; Rauch & Hulsink, 2015). This study considers the intention to develop green entrepreneurship by university students.

Scholars can identify investigations that focus on different variables that affect green entrepreneurship. Bonnet, Quist, Hoogwater, Spaans, and Wehrmann (2006) show that we can establish a combination of education in projects, sustainability, and entrepreneurship among engineering students. They mention a mode of integration of sustainability and entrepreneurship by moving from the idea to analysing context, marketing, production, and financing. Moreover, they evaluate the results of the reported start-ups and the learning outcomes of professors and students. Futagami and Helms (2009) describe that an economical solution to reverse the financial challenges is the development of entrepreneurship, which they report as increasing in Japan outside of traditional business development systems, without ties to business unions and the country's culture, which usually promotes entrepreneurship, group counselling, and a low-risk approach. Banschbach and Letovsky (2011) recount the experience of natural science students teaching environmental science concepts to senior entrepreneurs, while entrepreneurs taught natural science students the aspects of business development. Campelo Rodríguez (2013) describe the results of two projects on the acquisition of entrepreneurial skills in which they studied the professional, social, and green entrepreneurship profiles of 72 students. Opara (2013) recognizes that promoting entrepreneurship programs is necessary to take advantage of innovative technologies to increase productivity and university knowledge. There is evidence that these green entrepreneurship efforts will positively impact the emergence of sustainable agriculture in Africa. Soomro, Ghumro, and Shah (2020) seek to establish the preference of developing green entrepreneurship among 284 university students of business management and entrepreneurship courses. The authors recognize the effect of an orientation towards sustainability and the effect of education for creating an inclination to green entrepreneurship. These data are of great value for the government and university authorities as it shows the need to create awareness programs and, at the same time, adapt curricula to incorporate training about green entrepreneurship. Nguyen (2020) evaluates factors on entrepreneurial intention among 635 students in 11 universities by using the SEM PLS to analyse data and to find the effect of perceived environmental factors on students' perceived entrepreneurial behavioural control.

This study used the theory of planned behaviour (TPB) as a theoretical approach to determine the influence of contextual factors and self-efficacy on the intention of green entrepreneurship. The TPB was first proposed by Fishbein and Ajzen (Fishbein & Ajzen, 1975) to explain that people's intentions follow certain factors which also convey confidence to face an activity, described as self-efficacy. Likewise, the TPB includes intention as a strong predictor of behaviour, which in our study implied that if students receive support from a country's regulations for green entrepreneurship, they will have the self-efficacy to develop green entrepreneurship, and finally, the intention to implement green entrepreneurship.

Moreover, this study used the theory of social cognition. Bandura (1986) was the one to develop this theory to emphasize that behaviours are within the individual's control. We know it also as self-

efficacy. There is a two-way relationship between environmental aspects, personal factors, and behaviour. These aspects are reflected in the development of motivations to undertake entrepreneurship, educational support for green entrepreneurship, and the legislation that facilitates these undertakings.

Education development support (EDS)

Education development support is understood as the set of training activities offered by the university to develop enterprises (Bergmann, Geissler, Hundt, & Grave, 2018). We expect that the educational support will focus on offering compulsory courses or elective courses that can help to understand how to develop ventures, carrying out practical projects to learn the implementation and development of ventures. On the other hand, the educational support focuses on offering pre-professional internships in organizations concentrated on entrepreneurship. It is even related to the offer of professional career or postgraduate studies that may be linked to entrepreneurship content. We measured whether conferences and practical workshops were held to develop competencies and obtain more knowledge about entrepreneurship, including linking students with real entrepreneurs. Education development support would influence self-efficacy for the development of ecological entrepreneurship, so we hypothesize that:

> **H1:**   Education development support has a positive influence on entrepreneurial self-efficacy.

Institutional support (IS)

Institutional support is understood as the efforts made by the university to provide new technical knowledge about entrepreneurship and thereby contribute to the generation of awareness about entrepreneurship in students – who upon graduation can develop successful ventures – by directly motivating students to form new business as professional development (Ferreira, Loiola, & Guedes Gondim, 2017). Likewise, students generate new business ideas both in the social field and in the environmental field by assuming a business approach. Institutional support would influence self-efficacy for the development of ecological entrepreneurship, so we hypothesize that:

> **H2:**   Institutional support has a positive influence on entrepreneurial self-efficacy.

Country support (CS)

Country support is understood as a country's efforts to contribute to the development of ventures (Fichter & Tiemann, 2018). In this way, we evaluated whether a students believed they are institutionally motivated to establish ecological enterprises in their country. Another evaluated aspect was whether students viewed their country's economy as offering many options for entrepreneurship, which can also be evidenced in their emotions and feelings about obtaining bank loans for the development of entrepreneurship. Specific laws would promote and make accessible the development of businesses, so we hypothesize that:

> **H3:**   Country support has a positive influence on entrepreneurial self-efficacy.

Entrepreneurial self-efficacy (ESE)

Self-efficacy is when one believes s/he can achieve success in an activity and incorporate specific behaviours into one's daily routine (Bandura, 1992; Krueger, Reilly, & Carsrud, 2000). Specifically, ESE is one's confidence in developing entrepreneurial activities and thus generating business (Newman, Obschonka, Schwarz, Cohen, & Nielsen, 2019; Shahab, Chengang, Arbizu Angel, & Haider Muhammad, 2019). Studies show that there is a positive influence of ESE on the intention of entrepreneurial intention (Kumar & Shukla, 2019; Li et al., 2020; Mei *et al*., 2017), which means that people with high self-efficacy – based on great confidence – are more likely to create new entrepreneurship activities. The same applies to green businesses, which are of great importance in the times of the Covid-19 pandemic (Tajvidi & Tajvidi, 2020). Thus, we hypothesize that:

> **H4:**   Entrepreneurial self-efficacy has a positive influence on green entrepreneurial intention.

Research model

Following previous literature, we established the relation of the variables recognized in the research model proposed to be tested (see Figure 1).
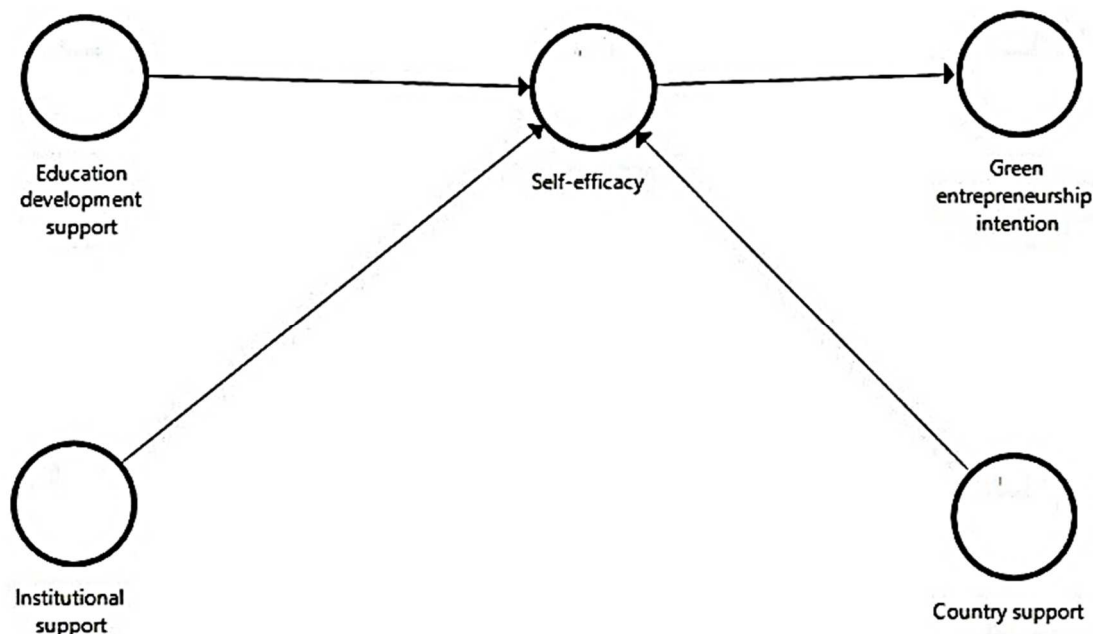
Figure 1. Research model
Source: own elaboration.

RESEARCH METHODOLOGY

Sample and data collection

We used the survey method to collect data from university students in Peru. The sampling was non-probabilistic. We obtained the data via a questionnaire in Google Forms in 10-26 December 2020, which resulted in a sample of 320 university students. The collection of the data was implemented through the distribution to university students by emails and online chats. For ethical purposes, the questionnaire was applied to students that agreed to answer after reading the following statement: "Your participation is voluntary; therefore, the information obtained will be confidential and will only be used for research purposes." We did not ask for approval for the current research because it does not involve risks for participants. The questionnaires were completed by 177 men (55.31%) and 143 women (44.69%) aged 18-33 (mean: 21.68; SD: 3.07 years).

Measures

The six items for education development support (EDS) were adopted after Wegner, Teixeira, and Maehler (2019). The α was 0.937.

The four items for institutional support (IS) were adopted from Wegner *et al*. (2019), including its four items. The α was 0.930. We included the four items for the measurement of country support (CS). The α was 0.795.

The four items for entrepreneurial self-efficacy (ESE) were adopted from Soria-Barreto, Zúñiga-Jara, and Ruiz Campo (2016), including the four items. The α was 0.912.

The eight items for green entrepreneurial intention (GEI) were adopted from Moriano (2005), Liñán and Chen (2009), and Wegner *et al*. (2020). The α was 0.945. We used a five-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5).

Data analysis

The PLS-SEM as a technique of analysis allows for the evaluation of structural models considering measurement errors. We used the SmartPLS software 3.3.2 for data analysis. The data analysis was initiated to evaluate the internal consistency of each subscale (Cronbach > 0.707). Next, we analysed construct and discriminant validity and internal consistency (Ringle, Wende, & Becker, 2015). A good fit requires the value of average extracted variance (AVE) to be higher than 0.5. We used the Fornell-Larcker criterion to test discriminant validity (Fornell & Larcker, 1981).

Reliability

The scales showed Cronbach's alpha to be higher than 0.5 in an exploratory analysis (Lopez-Odar, Alvarez-Risco, Vara-Horna, Chafloque-Cespedes, & Sekar, 2020; see Table 1).

Table 1. Evaluation of internal consistency

Variables	Items	Alpha of Cronbach values	Range of item values
Education development support (EDS)	6	0.937	0.832–0.898
Institutional support (IS)	4	0.930	0.868–0.932
Country support (CS)	4	0.795	0.751–0.830
Entrepreneurial self-efficacy (ESE)	4	0.912	0.858–0.918
Green entrepreneurial intention (GEI)	8	0.945	0.795–0.915

Source: own study.

Validation and compound reliability

The questionnaire validation using SEM-PLS based on an analysis developed by Lopez-Odar *et al*. (2020). The validation expected a value higher than 0.707 for acceptable composite reliability (Lopez-Odar *et al*., 2020). The coefficients of reliability composed oscillated between 0.867 and 0.954 (see Table 2).

Table 2. Construct validity evaluation

Variables – Items	Factorial weight	Composite reliability	AVE
EDS (My university…….)			
…. offers elective courses on entrepreneurship	0.866		
…. offers project work focused on entrepreneurship	0.886		
…. offers practices focused on entrepreneurship	0.898	0.950	0.760
…. offers a bachelor's or master's degree study in entrepreneurship	0.868		
…. organize conferences/workshops on entrepreneurship	0.879		
…. connects students with entrepreneurs	0.832		
IS (My university…….)			
…. creates awareness of entrepreneurship as a possible career choice	0.868		
…. motivates students to start a new business	0.932	0.950	0.827
…. provides students with ideas to start a new business	0.917		
…. provides students with the knowledge needed to start a new business	0.921		
CS			
In my country, green entrepreneurs are encouraged by an institutional structu	0.751		
My country's economy offers many opportunities for entrepreneurs	0.815	0.867	0.621
Obtaining bank loans is quite difficult for entrepreneurs in my country	0.752		
The state laws of my country are adverse to the management of a company	0.830		
ESE			
Creating and maintaining an ecological business is a task that I can do	0.858	0.938	0.792

Variables – Items	Factorial weight	Composite reliability	AVE
I have the necessary knowledge to develop an ecological business	0.884		
I have enough skills to develop an ecological business	0.918		
I believe that in the future, I will be able to develop a successful green busines	0.897		
GEI			
I plan to develop an enterprise that addresses the ecological problems of my	0.795		
I recommend to my colleagues to develop enterprises that solve ecological	0.795		
My future initiatives will prioritize ecological benefits over financial ones	0.822		
If I had the opportunity and resources, so I would definitely go green	0.789	0.954	0.723
I have seriously thought about becoming a green entrepreneur	0.881		
I will do my best to start and run my own green business	0.913		
I have a firm intention of starting an ecological business one day	0.882		
I propose to undertake and act in the management of my own ecological enter	0.915		

Source: own study.

Discriminant validity

Table 3 below shows that the evaluated data meet the Fornell-Larcker criterion; it means the variance extracted square root was higher than the correlations presented by one sub-scale against the rest of the sub-scales (Lopez-Odar *et al.*, 2020).

Table 3. Discriminant validity

Scales	Institutional support	Country support	Education development support	Entrepreneurial self-efficacy	Green entrepreneurial intention
IS	**(0.910)**				
CS	0.447	**(0.788)**			
EDS	0.815	0.466	**(0.872)**		
ESE	0.372	0.308	0.368	**(0.890)**	
GEI	0.386	0.375	0.387	0.757	0.851

Source: own study.

RESULTS AND DISCUSSION

Bootstrapping

Bootstrapping Technique (5000 times) demonstrated that path coefficients were significant (p values <0.01; see Table 4).

Table 4. Trajectory coefficients (beta)

Scales	Original sample	Mean sample	Standard deviation	t-statistic	P
IS → ESE	0.183	0.188	0.099	2.845	0.012
CS → ESE	0.158	0.164	0.063	2.528	0.016
EDS → ESE	0.146	0.141	0.099	2.474	0.031
ESE → GEI	0.757	0.758	0.039	19.264	0.000

p-value <0.01.
Source: own study.

Figure 2 below presents the evaluation of the research model. We confirmed that – through ESE – EDS, IS, and CS positively influence GEI in international business students.
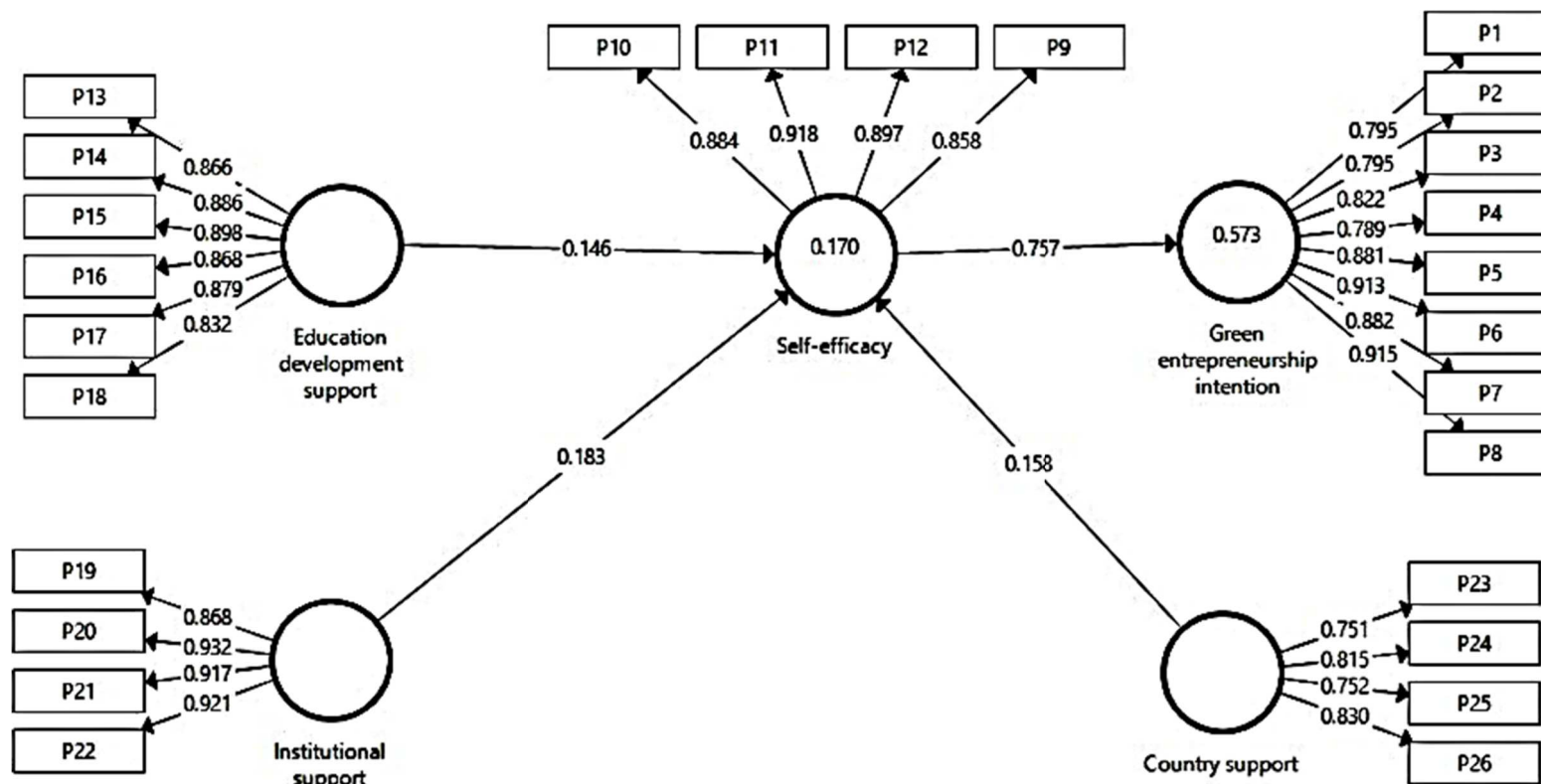
Figure 2. Research model tested
Source: own elaboration.

Hypotheses test

Entrepreneurial development support had a positive influence of 0.146 over ESE. Thus, we confirmed hypothesis H1. Moreover, IS had a positive influence of 0.183 over ESE, which confirmed hypothesis H2. Furthermore, CS had a positive influence of 0.158 over ESE, thus confirming hypothesis H3. Finally, CS with EDS and IS explain 17% of ESE. Entrepreneurial self-efficacy has a positive influence of 0.757 over GEI, which confirms hypothesis H4.

Discussion

We evaluated the influence of education development support, institutional support, and country support through entrepreneurial self-efficacy over green entrepreneurial intention in international business students in Peru. The discriminant validity and reliability were verified to ensure that the employed questionnaire can be trusted.

The verified influence of IS on ESE agrees with the finding of Shi, Yao, and Wu (2019) who studied 374 Chinese university students, the study of Mozahem and Adlouni (2020) who examined in 560 university students from Lebanon, and with a study of 376 university students in Indonesia (Wardana *et al.*, 2020). It is priceless to know if universities offer elective entrepreneurship courses because although there may be accelerators that can allow new ideas to gain in scale and become successful star-ups, a course with all its theoretical and practical components can doubtlessly give further training to students. Moreover, it is helpful that we can evidence if universities call for entrepreneurship projects and collaborate with companies so that students can gain entrepreneurial practice. A very unusual aspect – but a possibly revolutionary one – is to know if universities offer careers focused on entrepreneurship or offering postgraduate programs in entrepreneurship like the ones by the University of Melbourne (Melbourne, 2021) and Amsterdam Business School (School, 2021). Moreover, it is also relevant to confirm that universities organize conferences on entrepreneurship since, in this way, preliminary results of entrepreneurship efforts can be disseminated and contact with successful entrepreneurs can be generated, who can then present their experience and motivate students to become entrepreneurs.

The verified influence of IS on ESE is in line with the report by Burnette *et al.* (2019), another study of 109 undergraduate university students (van der Westhuizen & Goyayi, 2019), but also with the findings by Cadenas, Cantú, Lynn, Spence, and Ruth (2020) in the USA, Shi *et al.* (2019) in China, and Elnadi and Gheith (2021) in Saudi Arabia. It is essential to know if the university has focused on creating awareness about entrepreneurship so that students can decide on entrepreneurship as a professional career at the end of their classes. Likewise, significant is the motivation that students may want to generate to start a new business. Among the most important aspects is knowledge whether the university provides systematic ways to generate new businesses based on entrepreneurship. In this sense, it is crucial that future researchers specifically ask whether universities have think tanks as those promoted by the University of Oxford (Oxford, 2021) and Harvard University (Harvard, 2021).

The influence of CS on ESE that was verified in the present study agrees with the study by Memon, Soomro Bahadur, and Shah (2019), who evaluated 564 university students from Pakistan, and with findings reported by Nowiński, Haddoud, Wach, and Schaefer (2020), who evaluated 360 university students in USA and 1054 university students in Poland. When entrepreneurship is evaluated, scholars usually test if students receive institutional support, but they very rarely evaluate the support and impulse given by governments for green entrepreneurship. Therefore, it is helpful to evaluate this support from the country, which also must modify specific laws and banks to promote investment in green enterprises and back loans at reasonable rates to encourage new green entrepreneurs. Jointly, CS, EDS, and IS explain 17% of ESE. This outcome is very relevant since it allows us to understand that these variables can make students feel they can conduct green ventures based on the knowledge obtained and the skills developed due to the support through courses, practices, and regulatory support. These aspects imbue students with great confidence to develop green ventures that contribute to the United Nations' SDGs.

The influence of ESE on green entrepreneurship intention demonstrated in the current study is like the one reported by Soomro *et al.* (2020), who studied 284 university students from Pakistan. We researched the intention of ecological entrepreneurship which will make this study be a point of

reference for other Latin American inquiries. There is a significant growth of entrepreneurship, which can be an unbeatable opportunity to implement this type of entrepreneurship with an evident impact environment.

The outcomes obtained are like Bonnet *et al*. (2006), based on the similar influence of entrepreneurship programs with financing in the universities that are so relevant for new entrepreneurs who usually lack money. Moreover, our outcomes are like Futagami and Helms (2009), who recognize the university's role in providing counselling to students in the development of green entrepreneurship. The current study found data like those reported by Campelo Rodríguez (2013) and Opara (2013), who refer to the importance of the organization and support of green entrepreneurship projects, which allow students to develop their skills. Another important outcome is that, according to Eyo (2014), universities can offer technical support but not constant funds for developing green entrepreneurship.

Moreover, Nuringsih and Puspitowati (2017) report similar data about educational and structural support for developing green entrepreneurship, while Soomro *et al*. (2020) show outcomes in similar populations about the significant impact of education for sustainability on developing green entrepreneurship at universities.

CONCLUSIONS

The main contribution of this study is the demonstration that the variables we elaborated affect entrepreneurship intention. We found that our variables have a relevant impact on self-efficacy, which will be the first step for whom to have the intention of developing ecological enterprises. We were able to recognize that the literature is limited to green enterprises, so this study seeks to broaden this field of interest. The analysis is a strength of this article, as we find correlations between the same variables used in multivariate analyses by modelling structural equations using partial least squares (SEM PLS).

Theoretical implications

Studies in green entrepreneurship intention remain limited to a few countries, and not much is known about the factors that affect students. As a novelty, we incorporated into our model the support that students feel they receive from their governments, based on specific laws or programs directed towards students. We expect that in each country, this result may be different since different agendas are managed to support green entrepreneurship. By using SEM PLS, we found results that accurately confirm the relationship between the variables, and at the same time, we received a model that not only measures what universities do on campus through their courses or events but also conveys what are other incentives that motivate students towards green entrepreneurship.

We followed the TPB considering the dependent variable was the intention of behaviour; in this case, the intention of green entrepreneurship. The TPB has been beneficial to our study in putting together the research model since although we could measure behaviour – that is, current undertakings – it was very likely that students are not doing it today but potentially want to do it in the future. Therefore, the intention of green entrepreneurship was a pertinent variable that should be evaluated to see if it is constant in other situations. Likewise, this study followed the theory of social cognition with which we could demonstrate the critical role of ESE as the predictor of the intention of green entrepreneurship. Hence, we may provide a model proposal that takes the external aspects of the student to generate an influence on the conviction of developing a green enterprise, and that will finally translate into an express intention. External contexts are varied, and it is very important to be able to evaluate the influence, which in the present study is quite similar between the three independent variables. It should be considered that external contexts and elf-efficacy showed equal importance on the intention of entrepreneurship green.

Practical implications

Universities conduct their action plans annually, including the actions they will implement in most daily activities. Our results should attract the attention of universities so that they can recognize the elements that students seek to achieve in this way, the curricular changes, and the implementation of

green entrepreneurship policy. The modification of universities' offer will facilitate their better support of students. At the same time, the offer can become attractive to new students since it will show that they improve universities integral programs that occur to achieve green undertakings among a significant number of students.

Limitations and future scope

The current study was only conducted among international business students, so the findings must be applied only to this group. It would be interesting to incorporate another group of students to test whether the relation between variables remains the same. Moreover, this study should be reproduced in other cities, but mainly in Latin American countries to help to discern the variables that influence the situation the most.

The future development of green entrepreneurship must be specifically evaluated to know what factors influenced entrepreneurs and recognize what changes the universities must emphasize among students for the development of green entrepreneurship.

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Authors

The contribution of each author is equal to 25%
AAR, SM, UZR – conceptualization AAR, SDAA – literature review, AAR – methodology, AAR, SDAA, – calculations, AAR, SM, UZR, SDAA – discussion.

Aldo Alvarez-Risco

PhD in Administration (2020, Universidad Autónoma de Nuevo León, Mexico); Professor at the Career of In-ternational Business, Universidad de Lima. His research interests include sustainability, international business, entrepreneurship, and circular economy.
Correspondence to: Aldo Alvarez-Risco, Universidad de Lima, Avenida Javier Prado Este 4600, Santiago de Surco, Lima, Peru, e-mail: aralvare@ulima.edu.pe
ORCID ⓘ http://orcid.org/0000-0003-0786-6555

Sabina Mlodzianowska

PhD in Economics (2008, University of Gdańsk, Poland); Director of Operations and Project Management Mas-ter Program at the Graduate School and Professor at the International Business Program, Universidad de Lima. Her research interests include mining, international business, sustainability and entrepreneurship.
Correspondence to: Sabina Mlodzianowska, Universidad de Lima, Avenida Javier Prado Este 4600, Santiago de Surco, Lima, Peru, e-mail: email: smlodzia@ulima.edu.pe
ORCID ⓘ http://orcid.org/0000-0002-9649-2024

Ulises Zamora Ramos

Master's degree in International Commerce (2014) from Universidad Nacional Mayor de San Marcos, Peru; Professor in International Business, Universidad ESAN. His research interests include international business, international marketing, and entrepreneurship.
Correspondence to: Ulises Zamora Ramos, Universidad ESAN, Alonso de Molina, 1652, Monterrico, Surco, Lima, Peru, e-mail: uzamora@esan.edu.pe
ORCID ⓘ http://orcid.org/0000-0001-8937-5076

Shyla Del-Aguila-Arcentales

Master's degree in Industrial Pharmacy (2017) from Universidad Nacional Mayor de San Marcos, Peru; Profes-sor at Escuela Nacional de Marina Mercante "Almirante Miguel Grau" in Peru. Her research interests include sustainability, entrepreneurship, international business, e-commerce, and digital business.
Correspondence to: Shyla Del-Aguila-Arcentales, Escuela Nacional de Marina Mercante "Almirante Miguel Grau", Avenida Progreso 632, Callao, Lima, Peru, e-mail: sdelaguila@enamm.edu.pe
ORCID ⓘ http://orcid.org/0000-0002-9532-6462

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relation-ships that could be construed as a potential conflict of interest.

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Rural entrepreneurial ecosystems: A systematic literature review for advancing conceptualisation

Evelyn Calispa Aguilar

A B S T R A C T
Objective: The objective of the article is to identify the specific contextual factors and mechanisms that are important for the functioning of entrepreneurial ecosystems in rural areas.
Research Design & Methods: Qualitative analysis of 70 high-quality articles which results from a systematic literature review.
Findings: Rural poverty, natural resources endowment, peripheral location, and rural cultural values are important features of rurality which influences entrepreneurial ecosystems' performance in several ways.
Implications & Recommendations: Features of rurality are yet to be embedded into current general entrepreneurial ecosystem frameworks as they have the potential to enhance models' capacity to capture local aspects when employed to understand and measure entrepreneurship in rural contexts.
Contribution & Value Added: This study makes an important contribution by identifying the relevant factors and mechanisms associated with entrepreneurial ecosystems in rural contexts from the emerging literature in rural entrepreneurship.

Article type:	research article
Keywords:	rural entrepreneurship; rural entrepreneurial ecosystem; entrepreneurial ecosystems
JEL codes:	L26

Received: 6 October 2020	Revised: 4 April 2021	Accepted: 6 May 2021

INTRODUCTION

Recent years have witnessed a growing academic interest in understanding the functioning of entrepreneurial (eco) systems. During the last decades, a strong emphasis has been placed on understanding the relationships between individual actors and their local socio-economic contexts, giving rise to a new concept that laid the foundations for a systemic view of entrepreneurship, known as the entrepreneurial ecosystem (EE). The term 'entrepreneurial ecosystem' is used in its broadest sense to refer to all 'those economic, social, institutional and all other important factors that interactively influence the creation, discovery, and exploitation of entrepreneurial opportunities' (Qian, Acs, & Stough, 2013, p. 561). Entrepreneurial ecosystems research departs from the recognition that entrepreneurship can only be understood as the result of the dynamic interaction of individual factors and the local-global environmental context. In this vein, we recently observe a rapid rise in the number of academic articles about EE published in influential databases (Alvedalen & Boschma, 2017; Cavallo, Ghezzi, & Balocco, 2019; Malecki, 2018). However, although extensive research has been carried out, problems regarding the ecosystem's conceptualisation must still be addressed.

The main issue for the ecosystem's conceptualisation is that scholars derive their interpretations of EE from an overly narrow definition of entrepreneurship. Due to the promising effects of productive entrepreneurship in economic growth observed in some places with strong entrepreneurial ecosystems,

researchers and policymakers intensively try to emulate such system structures elsewhere. This over-exclusive approach has led to the emergence of a 'decontextualized body of literature' on entrepreneurship (Welter, Baker, & Wirsching, 2019). Consequently, entrepreneurial ecosystems are conceptualized and operationalized in a way they can support and be conducive for a kind of entrepreneurship like that in outstanding locations such as Silicon Valley, Route 128, or Israel. This narrow conceptualisation has implications in practice as well as it leads to policymakers' frustration when their efforts in trying to build local ecosystems based on well-known successful ecosystems' structures fail (Isenberg, 2010). In the face of this situation, several prominent researchers call for the study of diversity in entrepreneurship for better theory-building based on a wider, non-discriminatory perspective on what constitutes entrepreneurship. This involves overcoming the assumption that only certain kinds of entrepreneurship can lead to wealth and job creation (Welter, Audretsch, & Gartner, 2016). Scholars must rethink entrepreneurship, placing context at the heart of the EE concept.

The applicability of EE frameworks to examine every kind of ecosystem remains debatable. Current configurations of EE's components and assumed systemic conditions – interactions among pillars – probably cannot accurately pinpoint the relevant aspects of entrepreneurship when employed in contexts of rural or predominantly rural locations. Although at different scales and ratios, most countries and regions are composed of a combination of urban and rural settings, and entrepreneurship happens in both. However, there are differences in the geographical, social, economic, and developmental state of urban and rural locations. The specificities location are likely to influence entrepreneurial dynamics. Therefore, in this study, I argue that there are spatial specificities from rurality, which can cause EEs to function fundamentally differently from those in urban areas. This issue has not been broadly explored in previous research.

This article conveys a systematic review of 70 high-quality articles to identify the specific contextual factors and mechanisms important for developing EEs in rural areas. The study seeks to answer the following research questions: What are the most relevant factors for entrepreneurship in rural locations? To what extent are specific spatial components from rurality integrated in current EEs' frameworks? The first section of the text provides a brief overview of the state of research in the conceptualisation of entrepreneurial ecosystems. The next section explains the research methodology employed for conducting this systematic review. Then, I discuss the results, and I conclude in the last section.

LITERATURE REVIEW

Van de Ven (1993) and Spilling (1996) pioneered a new approach to examining entrepreneurship systematically. They were among the first investigators who suggested that entrepreneurial performance of a region or locality is determined not only by the characteristics and behaviours of individual entrepreneurs, but also by the interaction of various social, economic, and political factors. They looked at entrepreneurship within a comprehensive framework to examine how these diverse actors interact to facilitate or inhibit entrepreneurial performance within a region or country. Since then, the concept of EE has become increasingly popular among researchers in the entrepreneurship field. For policymaking, the EE concept has important practical implications since it informs regional economic development strategies aiming to create supportive environments that foster innovative business (Spigel & Harrison, 2018) and sustainable entrepreneurship (Bischoff & Volkmann, 2018).

Despite the great academic interest, the concept of EE continues to be developed, and many fundamental conceptual, theoretical, and empirical questions remain unanswered (Kuratko, Fisher, Bloodgood, & Hornsby, 2017; Malecki, 2018; Stam, 2015). Nevertheless, the concept of EE has already informed the development of several methods for measuring quality of EEs in practice. Each framework proposes a unique configuration of components and mechanisms within the ecosystem. For instance, the measurement framework proposed by Stangler and Bell-Masterson (2015) indicates that density, fluidity, connectivity, and diversity are four key indicators of entrepreneurial vibrancy. The Global Entrepreneurship Index and the Regional Entrepreneurship and Development Index (GEI and REDI) view entrepreneurship as the result of the 'dynamic, institutionally embedded interaction between entrepreneurial attitudes, entrepreneurial abilities, and entrepreneurial

aspirations by individuals' (Ács, Autio, & Szerb, 2014, p. 479). More recently, the Global Entrepreneurship Monitor (GEM) introduced the Entrepreneurial Ecosystem Quality Composite Index (ESI) diagnostic tool for measuring the quality of cities and regions entrepreneurial ecosystem based on the theoretical model of Stam (2015).

Although current EEs frameworks are very well elaborated, none of them distinguishes the 'type' of location where the index aims to be employed (apart from the national-regional distinction), thus suggesting that the frameworks are generalisable to most entrepreneurial ecosystems. Certainly, entrepreneurship exists in both urban (central) and rural (peripheral) locations, but it happens in different forms. There are contextual differences in the developmental conditions and in the levels of agglomeration of urban and rural settings which influence entrepreneurial dynamics. That is, spatial context is significant to the rural entrepreneurial process (Henderson, 2002; Müller & Korsgaard, 2017). Surprisingly, little attention has been paid to theoretically understand such differences in the context of entrepreneurial systems. In the same vein, one critique of the literature is that current EE models remain insufficient for explaining the factors and mechanisms that affect rural entrepreneurship and thus unable to inform policies at the communal level (Muñoz & Kimmitt, 2019).

RESEARCH METHODOLOGY

Method: Systematic literature review

For this review, I firstly formulated a clear research question following the CIMO logic (context, intervention, mechanism, outcome) developed by Denyer and Tranfield (2009). This logic serves to evaluate the inclusion or exclusion of studies. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was used to design and document the overall process of this systematic review (Figure 1). I sought studies through the EBSCO electronic databases (Academic Search Complete, Business Source Premier, and Science Direct) and Web of Science. The search was conducted with conditions presented in Table 1 below. Keywords and synonyms for the terms were combined into 10 complex search queries, which I ran in the four databases under the same inclusion criteria, and all the records were collected. I ran the last search in May 2019.

Table 1. Inclusion criteria for screening stage

Keywords	a) 'rural AND entrepre*' b) 'actor' or 'elements' or 'components or 'determinant' or 'cause' or 'factor' c) 'entrep* context' or 'entrep* environment' 'entrep*area' or 'entrepr*ecosystem' or 'entrepr*setting' or 'entrep* system'
Inclusion criteria	Language: only English Years: 1975-2019 Methodology: Any type, no limitation Subject area: No limited Type of publication: only journal articles Citation number: +50; No minimum citation number for 'additional search' stage

Source: own study.

The initial search retrieved 20 344 articles. From these, 501 records were collected based on the inclusion criteria. The exclusion of duplicates reduced this number to 248. A total of 88 new articles were identified by manual search. A manual search using the criteria in Table 1 was conducted on 32 high-quality journals (Q1 and Q2 according to SCImago Journal Rank) in the fields of economics, econometrics, finance, economic geography, and A-type journals in regional sciences. Additional searches were conducted on 10 highly ranked journals selected from the reference list of Cavallo *et al.* (2019), which offers the most up-to-date review of research in EE. The first search and additional search records were merged, and duplicates were removed, giving a total of 327 articles. Based on the title and abstract examination, 224 studies were discarded for not meeting the CIMO logic criteria. The final 103 articles were categorised into three types – not relevant, relevant, and highly

relevant – based on a critical and detailed full-text reading. To avoid unintentional bias in the selection, the categorisation I made was evaluated and approved by an external expert. Finally, only those papers categorised as 'highly relevant' (*n* = 70) were employed for the synthesis. Mendeley was employed to merge and deduplicate records. After deduplication, no specialized software was employed to manage the bibliography. Rather the process was manually performed with the support of Microsoft Excel and Word to tabulate and synthetise results.
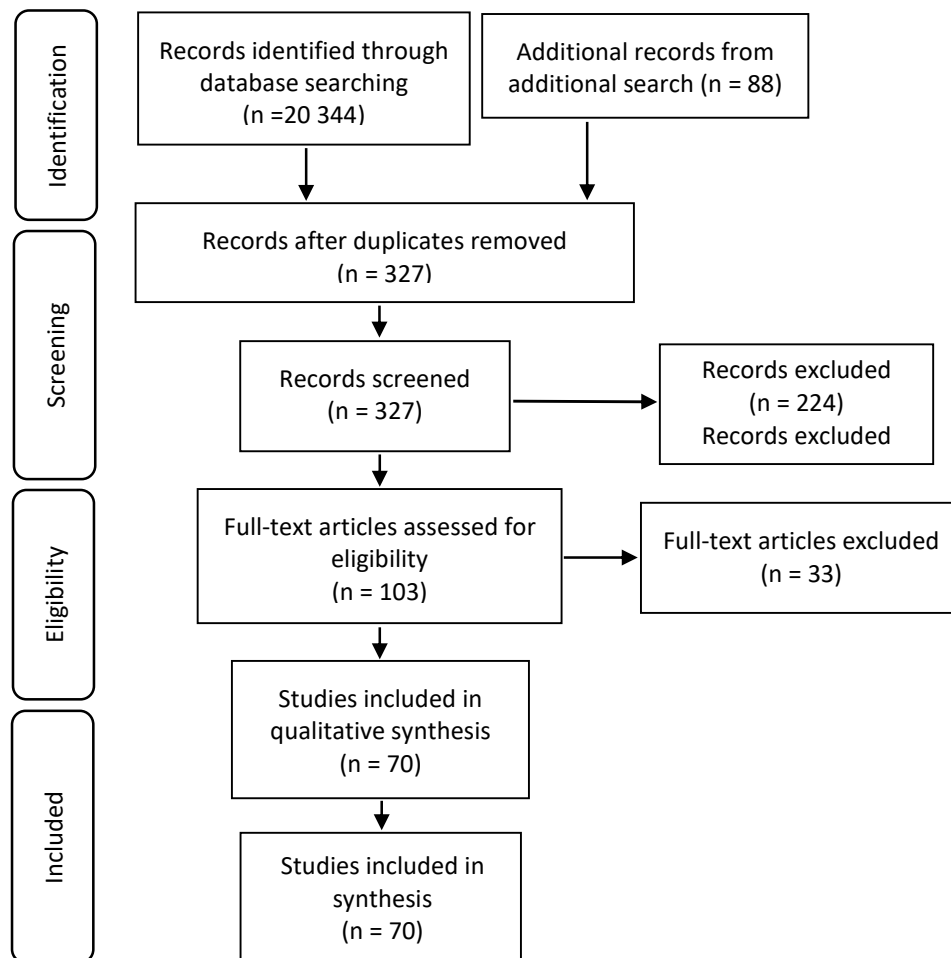
Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram
Source: own elaboration.

The conceptual model

The model for EEs proposed by Stam and Van De Ven (2019) was employed as the conceptual guideline for data analysis. This well-known model provides an updated and integrative approach consisting of ten constituent elements and entrepreneurial outputs (Figure 2). The ten constructs belong to two main concepts: institutional arrangements and resource endowment. The third component of the model is the output of the entrepreneurial ecosystem, conceptualised as new value creation and represented by productive entrepreneurship. I selected an approach that is explicitly proposed as a general model of EEs. The authors of the model, Stam and Van De Ven (2019), intend their conceptual definitions to be generalisable to most entrepreneurial ecosystems.

The literature collected in this review is extensive, and the topics are scattered. Therefore, based on the focus, definitions, variables, and indicators employed in every reviewed paper, I categorised the studies according to their conceptual closeness to one or more of the ten theoretical constructs of the Stam and Van De Ven (2019) model. In this way, I determined which elements from rural literature are similar or novel to current frameworks.
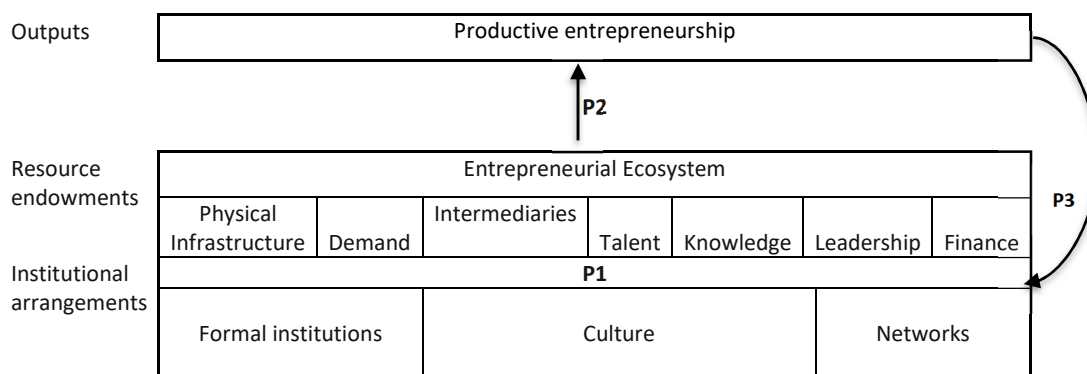
Figure 2. Elements and outputs of the entrepreneurial ecosystem
Source: Stam and Van De Ven (2019).

RESULTS AND DISCUSSION

The key elements and mechanisms for rural entrepreneurial ecosystems

The main result from studies categorisation is an extended version of the constructs of entrepreneurial ecosystem elements complemented by the findings of the reviewed literature (Table 2). This synthesis stage allowed me to find two important insights. Firstly, rural literature validates the importance of both institutional and resource endowment concepts. However, some of the EE constructs seem to more attention from researchers. Most studies in this review explore formal and informal institutions, social networks, social capital, and human capital constructs while paying significantly less attention to understanding the means of consumption and services. Secondly, because they deal swith novel elements, not all 70 articles relevant for this review fit into one of the ten theoretical constructs of the model. I discuss the nature of these specific aspects in the next section.

The specificities of rurality and their effect on entrepreneurship

Rural poverty

The reviewed literature acknowledges rural poverty as a generalised concern for rural entrepreneurship in developing economies. In the shape of new business creation or economic activities diversification, entrepreneurship is mainly approached and pursued as a tool to alleviate poverty. This specific motivation has led to policymakers' pro-entrepreneurship initiatives such as government projects to focus entrepreneurship policy on the poorest. Therefore, the outcome of rural areas' EEs in developing contexts (rural livelihoods' sustainability and poverty reduction) can be different from the generally expected outcome of the systems in other contexts (value creation, job, and wealth creation). Furthermore, poverty shapes attitudes toward entrepreneurship. In deprivation circumstances, people's decisions for start-up involvement are above all influenced by the possibility of gaining a reasonable income (George *et al.*, 2016).

Financial constraints (insufficient funds) play an important role in shaping entrepreneurship patterns. Wealthier households are more likely to start and invest in businesses as they face fewer financial limitations (Paulson & Townsend, 2004), whereas those lacking sufficient funds turn to microfinance. Thirdly, the effects of microfinance seem to work differently for rural entrepreneurs in poor traditional contexts. Microcredit borrowing might have an indirect negative effect on the entrepreneur's overall lifestyle by increasing levels of people's worry (Bhuiyan & Ivlevs, 2018) or reinforcing subsistence entrepreneurship, which often locks the entrepreneur in a low-level equilibrium trap (Dutta & Banerjee, 2018). Therefore, when attempting to understand, measure, and support the development of EEs in developing economies, we must consider rural poverty as an influencing element as it can have a restricting effect on the financial resources construct. Poverty persistence in rural areas also determines the overall purchasing power of the population. Consequently, the means of consumption of poor rural areas (demand) will be different than in richer contexts.

Table 2. Extended constructs of entrepreneurial ecosystems elements and outputs

Concept	Constructs from rural literature	Elements
Institutional arrangements	**1. Formal and informal institutions** Perceptions of the status of entrepreneurship (Basson & Erdiaw-Kwasie, 2019) Risk aversion (Cieslik & Aoust, 2017) Trust in officials and public servants (Lanjouw, Quizon, & Sparrow, 2001) The local policy approach and entrepreneurial development (Nguyen, Frederick, & Nguyen, 2014) Increased support for associations (Padilla-Meléndez & Ciruela-Lorenzo, 2018) Creation of a supporting environment (Balfour, Fortunato, & Alter, 2016) Political and administrative framework (Langenbach & Tuppen, 2017) Public institutions, policymakers (Musolino, Crea, & Marcianò, 2018) Agricultural competitiveness (Pindado & Sánchez, 2018) Local entrepreneurial context (McGranahan, Wojan, & Lambert, 2010) Better developed non-farm economy (Brünjes & Diez, 2012) **2. Social Networks** Relationships within rural entrepreneurs (Aastard, Haugland, & Arent, 2010; Ring, Peredo, & Chrisman, 2010) Social ties (Meccheri & Pelloni, 2006) Social relationships (Zhao, Ritchie, & Echtner, 2011) Ability to collaborate with local and non-local stakeholders (Milone & Ventura, 2018) Participating in networks (Cieslik & Aoust, 2017) Village level social groups (associations) (Lanjouw *et al.*, 2001) Embeddedness in the social structure (Jack & Anderson, 2002) 'Placial embeddedness' (Korsgaard, Ferguson, & Gaddefors, 2015) Kin and personal relationships (Alsos, Carter, & Ljunggren, 2013; George, Kotha, Parikh, Alnuaimi, & Bahaj, 2016; Peng, 2004; Venkatesh, Shaw, Sykes, Fosso Wamba, & Macharia, 2017; Yu & Artz, 2018) Isolated rural communities are likely to be rich in social capital; 'island networks' (Shantz *et al.*, 2018) Collective action as productive local social capital in rural areas (Ring *et al.*, 2010)	Formal institutions. Culture Networks
Resource endowments	**1. Physical resources** Regional levels of urbanisation (Radicic, Bennett, & Newton, 2017) **2. Financial resources** Joint liability-based teams as a type of network (Chakravarty & Shahriar, 2015) Microcredit (Bhuiyan & Ivlevs, 2018; Dutta & Banerjee, 2018) **3. Leadership** Entrepreneurial role models (Lafuente, Vaillant, & Rialp, 2007) Leading role models (Musolino *et al.*, 2018) The role of visionary entrepreneurs (Brooker & Joppe, 2014) The effect of legitimized 'high profile entrepreneurs' (Anderson, Warren, & Bensemann, 2018) Entrepreneurial examples -role models (Basson & Erdiaw-Kwasie, 2019) **4. Human Capital** Educational level (Folmer, Dutta, & Oud, 2010) Higher education and training as an efficiency enhancer for rural women entrepreneurs (Nguyen *et al.*, 2014) Entrepreneurial behaviour, professional background and networks (Hassink, Hulsink, & Grin, 2016) Entrepreneur's characteristics: gender, race, age, main occupation (Barbieri & Mshenga, 2008; Folmer *et al.,* 2010; Kalantaridis, 2006; Radicic *et al.,* 2017) Language proficiency (Wei, Jiao, & Growe, 2018) Ability of entrepreneurs to respond to changes (Milone & Ventura, 2018; Yachin, 2017) Innovative behaviour (Pindado & Sánchez, 2019) Business competencies (Kasabov, 2016; Phelan & Sharpley, 2011) Entrepreneurial skills (Dias, Rodrigues, & Ferreira, 2018)	Physical infrastructure. Finance Leadership

Concept	Constructs from rural literature	Elements
Resource endowments	**5. Knowledge** Access to new technologies: the Internet (Cumming & Johan, 2010) Competitive environment (Freire-Gibb & Nielsen, 2014) Knowledge of the available entrepreneurial support (Malebana, 2017) Farm diversification (Barbieri & Mshenga, 2008; Basson & Erdiaw-kwasie, 2019; Brünjes & Diez, 2012; Folmer *et al.*, 2010; Hassink *et al.*, 2016; Milone & Ventura, 2018; Radicic *et al.*, 2017; Sohns & Diez, 2017) **6. Means of consumption** Market demand consumers' requests (Yachin, 2017) **7. Producer services** No papers related to this element were found in this review	Physical infrastructure. Finance Leadership
New value creation	Productive entrepreneurship	Productive entrepreneurship

Source: own study.

Natural resources endowment in rural locations

Although deprived in comparative terms, the assets' structure of rural locations offers unique entrepreneurial opportunities. Firstly, there is a role of the available natural resources in shaping the nature of rural businesses. Using the data from populations and samples, we found that businesses in rural areas are diverse, including manufacturing, farming, tourism, and trade. There is evidence that the manufacturing industry is highly shaped by locally available natural resources (e.g. vegetables, fruits, herbal plants, wood, and minerals) and locally available human resources (e.g. craftsmen, local knowledge on herbal plants use and traditional medicine or brewery). For entrepreneurs in rural areas, developing ventures based on uniquely locally available resources may be the most advantageous strategy and, indeed, may lead to distinct competitive advantages and value adding to traditional products. Such advantages are inherently difficult or impossible to replicate in other spatial settings (Dinis, 2007; Müller & Korsgaard, 2017).

Besides, even though small towns may not have some of the advantages of large urban centres' entrepreneurial systems, there have other ecosystem elements that may compensate for these deficiencies (Roundy, 2017). Despite lacking certain resources, peripheral locations can also provide unique environments in which business start-ups and quality lifestyle can be balanced easier than in urban contexts. This feature of rurality seems to be fostering 'lifestyle-oriented' entrepreneurship in rural areas. Lifestyle entrepreneurs are understood as those individuals who run businesses in rural areas and are primarily motivated by the favourable environmental characteristics of rural areas for everyday life. Peripheral locations provide an optimal environment in which the ease of doing business and quality of life can be more easily achieved compared to urban areas (Abreu *et al.*, 2018). Peripheral contexts can also provide spaces that stimulate moments of thinking and transformative learning, leading to creativity and innovation (Rae, 2017). More recent works on this topic focus on the potential of attracting 'creative classes' to rural areas. This approach is underpinned by the premise that the creative class – people specialising in producing new goods or designs that are broadly useful – are highly sensitive to spatial and environmental attributes (Florida, 2002). In the same line, a trend of entrepreneurs aiming at a 'slow but steady growth' is growing in rural locations. 'Exporting' and 'ambition to internationalise' are not notorious aspirations among rural entrepreneurs. Rural entrepreneurs want their business to primarily suit their lifestyle and, thus, they would rather keep their

business simple than have it grow too big (Bensemann & Hall, 2010). Similarly, Smith (2017) shows that rural and urban entrepreneurs may have differing entrepreneurial modes of operation. 'Making slow-money' appears to be a common practice among village entrepreneurs. They prefer to make their wealth slowly over a lifetime by hard work and not necessarily by taking important risks.

Much literature in this review emphasises the active role of in-migrants on the creation of new ventures in the host location. Particularly, return migration can help to revitalise rural economies and alleviate poverty (Akgün, Baycan-Levent, Nijkamp, & Poot, 2011; Démurger & Xu, 2011). Repatriated capital is a key driving factor for promoting rural entrepreneurial development. Arrivals of entrepreneurs not only enhance economic development but also can directly contribute to compensating for the current out-migratory direction of young productive individuals (Kalantaridis & Bika, 2006). Migrants can bring innovative ideas, connections to networks outside the local community, and different perspectives on thinking about local economic development, new start-ups, and entrepreneurship (Deller *et al.,* 2019). However, the incorporation of advantageous resources and creativity assets into the local economy depends on the provision of a supportive local entrepreneurial context. Creative workers certainly demonstrate strong preferences for various outdoor amenities, and these preferences affect the location of talent, but this effect is highly dependent on a supporting entrepreneurial environment. To realise the positive effects of creative class attraction to rural areas and sustain robust growth in the periphery, locations require an 'effective growth trifecta' among outdoor amenities, creative class, and entrepreneurial context (McGranahan *et al.,* 2010). Providing a supportive environment for growth must be a precondition for inviting creative entrepreneurs.

Peripheral location

Regardless of distance, rurality implies a distance to urban centres. A peripheral location entails not only geographical isolation but also marginal participation in social, cultural, political, economic, and intellectual issues (Rae, 2017). In its many forms, isolation is a key barrier to entrepreneurial opportunity and business success not only by hindering access to material resources and markets (Sohns & Diez, 2017) but also to information about products and services. In the context of isolation, the success and failure of rural entrepreneurs depends on structural (highway proximity, mobility infrastructure) and interpersonal factors (travel choices, information sources; Gallardo & Scammahorn, 2011; Uparna & Weber, 2016). Since rural areas are more likely to face these challenges, recognizing this location difference can help rural communities better design and implement their entrepreneurial systems. In this regard, we argue that the urban-rural typology of the region, measured by the distance of an area from urban centres, could be integrated as an important spatial construct of the current EE structure.

Rural cultural values

How people interact in rural areas differs from how people interact in urban areas. Literature shows that the rural origin of entrepreneurs, their ethnic and cultural diversity, along with gender (women's roles), influence business creation and survival in rural areas. The rural origin and identity of an entrepreneur influence the likelihood of rural entrepreneurship. Involvement in entrepreneurship from young people in rural areas is demonstrated to be highly influenced by family tradition on entrepreneurship and business (North & Smallbone, 2006; Yu & Artz, 2018). Against the current tendency of young educated people migrating from rural areas looking for job opportunities, some observe that rural areas give rise to innovative entrepreneurs who are 'contravening the basic tenets of the modernisation script' (Milone & Ventura, 2018, p. 1). Young entrepreneurs are increasingly motivated to stay in the rural areas and make their contribution to rural life by creating and developing land-based rural business, often very small (Milone & Ventura, 2018). Similarly, the sense of belonging to a rural community can positively influence intentions even from those born non-locally. Nordbø (2013) argues that second-home owners could help to build a critical mass of rural entrepreneurship and innovation as they demonstrate in different ways the interest and willingness to use their knowledge and competence to contribute to the development of their second-home community and, thus, the local economy.

Another culture-related feature that can enable or inhibit the development of entrepreneurship is ethnic diversity. In countries such as Bolivia, where approximately 60% of the population is indigenous (Aymara, Quechua), the indigenous–non-indigenous (mestizo) dynamics can play a significant role in entrepreneurship development (Padilla-Meléndez & Ciruela-Lorenzo, 2018). Indigenous-based entrepreneurship has its owns actors, institutions, and favourable and adverse mechanisms (Shantz *et al.*, 2018; Widjojo & Gunawan, 2019).

Especially women roles have a great and complex influence on entrepreneurship in rural contexts. Basically, there is a generalized agreement about the disadvantaged position of rural women entrepreneurs linked to the society in which they live. Aiming to become entrepreneurs or already in the field, women are still influenced by societal prejudice such as societal expectations of women, gender inequality, financial limitations, and limited entrepreneurship educational opportunities. Evidence from the rural tourism sector demonstrates that a gendered ideology persists within copreneurial relationships in rural tourism. The term corpeneurship is understood as activities of married couples in business (Bensemann & Hall, 2010). In the case of indigenous women entrepreneurs in South America, the literature still evidences a dependency syndrome, which means that indigenous women are overpowered by male stereotypes (Padilla-Meléndez & Ciruela-Lorenzo, 2018). Therefore, mechanisms like cooperative entrepreneurship and sisterhood among female entrepreneurs provide an environment for repeated affective experience that inspire women (Katre, 2018). Overall, these results reflect those of Malecki (2018) who suggests that EEs may not be gender-blind and seem to be insufficiently supportive of female entrepreneurs.

CONCLUSIONS

Due to the complex attributes of entrepreneurship, current research in this field has strongly focuses on studying diversity with a view of developing more nuanced and sophisticated theories. However, EE models retain a major conceptual flaw in this regard: current approaches intrinsically assume that the factors identified as relevant for some ecosystems are equally relevant for ecosystems in other locations. Suggestions of a system with a fixed structure and composition diminish the importance of the local spatial context in which entrepreneurship actually happens. For instance, ecosystems in rural and predominantly rural areas are largely overlooked by researchers. This study argues that there are contextual factors associated with rurality that affect the functioning of entrepreneurial ecosystems. Therefore, these factors should be integrated into the current conceptualisation of EEs to improve the theory's applicability to rural contexts.

This study aimed to review the emerging literature in rural entrepreneurship and to identify the relevant factors and mechanisms important for developing EEs in rural areas. One of the more significant findings is that there is no specific structure of rural ecosystems for entrepreneurship. Rather, entrepreneurial ecosystems in rural areas consist mostly of the same structural factors from general EEs structure, but there are four specificities of rurality affecting entrepreneurial ecosystems that are novel to the current frameworks: rural poverty, natural resources endowment, peripheral location, and rural cultural values. Poverty persistence is particularly evident in rural areas of developing countries and it has a negative effect on financial capacity of entrepreneurs and the local population's means of consumption. Moreover, in poor peripheral locations the expected outcome of entrepreneurial systems is oriented to poverty alleviation and local development rather than to productive entrepreneurship itself.

Secondly, although rurality poses major challenges for entrepreneurship due to low levels of agglomeration, rural settings also offer some unique opportunities to compensate for these deficiencies by taking advantage of the availability of unique natural and human resources. Local natural resources enable specific business opportunities and foster possibilities for attracting creative entrepreneurs.

Thirdly, rural areas are geographically isolated from bigger populated areas and markets, and this condition of isolation implies not only remoteness but also marginal participation in social, cultural,

economic, political, and intellectual life. Therefore, rurality poses certain specific challenges to business start-ups that are different from central, urban locations.

Fourthly, specific rural values – namely the rural origin of the entrepreneur, the ethnic diversity of the population, and gender dynamics – could also facilitate or prevent business start-ups in rural locations. The conclusion of this study is in accordance with previous findings that have similarly demonstrated the current typology of general EEs offers a generalised model but contextual differences must be additionally considered when attempting to employing these models in a rural context (Miles & Morrison, 2018). A natural progression of this work could involve exploring how these novel elements can be conceptually embedded into current entrepreneurial ecosystems as a spatial condition, and how the effect of rurality on the ecosystem performance can be statistically measured. A limitation of this study is that the sample literature was collected from four databases, therefore relevant studies published elsewhere exceed the scope of this review.

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Author

Evelyn Calispa Aguilar
PhD Candidate in Regional Development at the University of Pécs, Hungary. Master in International Development from the University of Manchester, United Kingdom. Her research interests include rural development, rural entrepreneurship and tourism development.
Correspondence to: Evelyn Calispa, PhD Candidate, Faculty of Business and Economics, University of Pécs, Rákóczi út 80, 7622, Hungary, e-mail: evelyn.calispa@pte.hu
ORCID http://orcid.org/0000-0002-7030-2800

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Exploitation-exploration balance and its performance outcomes: A study of FDI portfolio decisions of new multinationals

Piotr Trąpczyński, Tilo Halaszovich

A B S T R A C T
Objective: The objective of the article is to explore how new multinationals construct their FDI location portfolios and what the performance outcomes of these decisions are.
Research Design & Methods: Building our conceptual framework on the organisational learning theory, we conduct regression analysis based on data from 394 subsidiaries of new Polish multinationals.
Findings: We find that the possession of superior capabilities by new multinationals enhances their ability to reap benefits from investing in more advanced markets in their portfolios and hence engaging in higher ambidexterity, i.e. the combination of exploration and exploitation. This effect is further reinforced by experience with foreign investment.
Implications & Recommendations: Investment in more advanced economies as compared to the home country entails the possession of higher-order capabilities, as it requires higher ambidexterity from new multinationals.
Contribution & Value Added: A lot of existing IB research focused on discrete location choices in internationalisation, remaining oblivious of the broader strategic logic. Moreover, it has been assumed that – particularly for new multinationals from emerging countries – entries into advanced host countries are related to exploration rather than exploitation, whereby the latter is the domain of similar or less developed markets.
Article type: research article
Keywords: new multinationals; location choices; portfolio perspective; firm capabilities; firm performance; Central and Eastern Europe
JEL codes: F23, L25, M16
Received: 29 July 2020 | Revised: 22 April 2021 | Accepted: 4 May 2021

INTRODUCTION

New multinationals, i.e. firms from mid-range emerging economies with an often accelerated speed of internationalisation (García-Canal, Guillén, Fernández, & Puig, 2018; Guillén & Garcia-Canal, 2009; Hoskisson, Wright, Filatotchev, & Peng, 2013; Kumar, Singh, Purkayastha, Popli, & Gaur, 2020; Lee & Fernando, 2020; Polowczyk, Zaks, & Trąpczyński, 2021), have emerged on a global scale, therefore challenging existing academic and practitioner wisdom. Their importance has been continually increasing, even though new multinationals are still in general less known internationally for their brands (Ramamurti, 2012; Maciejewski & Wach, 2019; Barłożewski & Trąpczyński, 2021b). Because of their relatively weaker intangible resource base, new multinationals have been facing a strategic dilemma to what degree host markets that are more advanced than the domestic market should prevail in their foreign direct investment (FDI) portfolios.

Extant research has suggested that firms that cannot "exploit" their existing firm-specific advantages could potentially "explore" for a new advantage in foreign markets (Banalieva & Dhanaraj,

2013; Hernandez & Guillén, 2018; Ramamurti, 2012; Wu & Ang, 2020). However, other scholars have cautioned that learning from sophisticated foreign markets is fraught with uncertainty due to liability of foreignness and highly formalised labour and capital markets with which new multinationals have little, if any, experience (Zaheer, 1995; Zahra *et al.,* 2000). Thus, international exploration may not necessarily lead to success (Hennart, 2012). Indeed, there are signals that early successes of early-stage MNEs (multinational enterprises) can lead to cognitive biases and over-optimism (Thomas, Eden, Hitt, & Miller, 2007). In fact, it has been found that traditional FDI into a developing country can actually create more firm value that strategic asset-seeking FDI into developed countries (Yang, Martins, & Driffield, 2013). Thus, a vital question arises as to the boundary conditions of new multinationals' location choices and their outcomes.

Quite strikingly, a systematically missing feature of existing research on new multinationals (and MNEs in general) is the treatment of location choices as parts of overall global strategy of the firm rather than merely looking at discrete choices (Kim, Hoskisson, & Lee, 2015; Głodowska, Pera, & Wach, 2019). While it has been – quite simplistically – argued that firms choose more advanced countries so as to obtain new assets, and less advanced countries exploit existing ones (Makino, Lau, & Yeh, 2002; Tsang & Yip, 2007), few studies have reached beyond discrete location decisions and viewed the learning process of new multinationals as a phenomenon from a location portfolio perspective (Kim, Hoskisson, & Lee, 2015). While this approach to firm analysis is well known from research on portfolios of strategic alliances (e.g. Asgari *et al.*, 2017), or international equity investments (e.g. Ozmel & Guler, 2015), it is yet to be applied to the location choices and performance of new multinationals.

Thus, drawing insights from the exploration-exploitation literature (Anand, Mesquita, & Vassolo, 2009; Gupta, Smith, & Shalley, 2006; Rivkin & Siggelkow, 2003; Siggelkow & Rivkin, 2006; Tsang & Yip, 2007), we seek to address the aforesaid deficiencies in extant scholarship by exploring the duality of foreign market exploration and exploitation in establishing FDI market portfolios, as most firms do have to engage in both (Miller, Zhao, & Calantone, 2006), and how FDI market portfolio composition can provide a dynamic way to achieve this. This research question is challenging because to date, the exploration-exploitation literature has limited its analysis to a simplified explanation of how intangible resources affect FDI (Makino, Lau, & Yeh, 2002), or how the choice of host market affects firm performance (Kim, Hoskisson, & Lee, 2015), but not both simultaneously. To be best of our knowledge we are the first scholars studying location choices to examine not merely discrete market entry choices, but the prevalence of particular location choices in the overall internationalisation strategy. In doing so, contrary to most studies, we do not look at single decisions to enter a foreign market, but rather at motivations to compose a portfolio of markets of a certain type.

We pursue these objectives based on a sample of new multinationals from a post-transition economy. Due to their early-stage international strategy, managers of new multinationals often insist on establishing overseas operations in the most developed markets like the USA or Western Europe (Khan, 2020). Indeed, a significant part of research on emerging country MNEs has revolved around the still nascent firm capabilities and expansion into more advanced markets as a way of overcoming this weakness (Crescenzi, Pietrobelli, & Rabellotti, 2015).

LITERATURE REVIEW

Locational ambidexterity and firm performance

The perspective of exploitation and exploration has been influential in different subdisciplines of organisation and management (e.g. Lavie & Rosenkopf, 2006; Rivkin & Siggelkow, 2003). These two concepts are originally rooted in the area of organisational learning and their distinction has traditionally relied on the type of learning, or rather presence or absence thereof. While the concepts of exploitation and exploration in organisational studies have frequently been applied to the field of innovation (e.g. He & Wong, 2004; Paliokaite, 2019), particularly, in knowledge-intensive and innovation-absorbing industries (Braja & Gemzik-Salwach, 2020), their application in the context of international business, particularly geographic expansion of firms, has been much more seldom (Rudawska, Frąckiewicz, & Wiścicka-Fernando, 2018; Kim, Mahoney, & Tan, 2015; Makino, Lau, & Yeh, 2002). As international

business research has shifted from a predominantly headquarters-focused perspective to more attention to the significance of foreign affiliates (Rugman & Verbeke, 2001), the issue of explorative rather than merely exploitative FDI has surfaced in a number of studies (Galan *et al.,* 2007).

In reality, international expansion is driven by diverse motivations, which lead to different effects on firm performance (Li, 2007; Verbeke & Brugman, 2009; Verbeke, Li, & Goerzen, 2009; Barłożewski & Trąpczyński, 2021). However, in spite of extant evidence that FDI is driven by bundles of motivations (Demirbag, Tatoglu, & Glaister, 2007; Hennart, 2012; Cieślik & Hien Tran, 2019; Cieślik *et al.*, 2019), most studies have focused either on exploitative or explorative FDI, with few attempts at considering these perspectives jointly (Kim, Mahoney, & Tan, 2015). Meanwhile, scholars have argued that the key to reconciling both perspectives lies in "ambidexterity" (Benner & Tushman, 2003; March, 1991; Stjepić *et al.*, 2020). Ambidexterity as a mechanism of achieving balance is related to achieving exploitation and exploration synchronously through different loosely connected organisational units or individuals, specialising in one of the aforesaid learning modes (Raisch & Birkinshaw, 2008). In the context of location choices by MNEs, the network of foreign affiliates can be considered as a system of differentiated subunits with specialised mandates allocated by the parent firm (Rugman & Verbeke, 2001). Thus, we argue that by constructing geographic portfolios of affiliates, MNEs can seek balance between relying on their experience and exploiting their existing capabilities in less demanding markets than the home country, and upgrading their capabilities by establishing presence in markets that are more challenging. Henceforth, we shall refer to this balance as locational ambidexterity.

As exploitation and exploration cannot ensure sustained performance in isolation, we argue that an excessive focus on explorative FDI can be detrimental to MNE performance insofar as performance, particularly financial, is driven by fundamentals such as market size or cost efficiency (Demirbag, Tatoglu, & Glaister, 2007). We expect that pursuing more developed markets (vs. home country) in location portfolios with a sole focus on exploration is likely to be challenging, as developed countries necessitate regular product upgrades in order to match the requirements of end users (Hamzaoui & Merunka, 2006). Conversely, an excessive reliance on exploitation may result in quick performance gains which persuade managers about the legitimacy of following the same strategy, therefore often leading to the so called "success trap" (Gupta, Smith, & Shalley, 2006). In fact, some new MNEs find it easier to operate in less developed countries (Cuervo-Cazurra & Genc, 2008). These possibilities are available in inmmature markets considering the current state of their regulation (Bilan *et al.*, 2020; Mishchuk *et al.*, 2020). It is conceivable that significant previous success, as expressed by MNE performance, will lead to exploitation of their advantageous position in markets with lower entry barriers (Del Sol & Kogan, 2007). A frequent trajectory of new MNEs is to exploit their successful products in markets at different stages of their industry lifecycle (Kim, Mahoney, & Tan, 2015). However, the sole focus on exploitation may not pay off in the long run (Benner & Tushman, 2003).

Hence, we propose that the more ambidextrous the international expansion is, the better for the performance of new multinationals. While the focus on less developed markets would typically mean a predominance of exploitation, we simplistically assume that as the composition of foreign market portfolios of new multinationals becomes more skewed towards more developed markets, also the extent of the combination of exploration and exploitation increases (Hennart, 2012). Thus, we posit:

H1:   The higher the locational ambidexterity of new multinationals, the higher their performance.

The moderating role of firm capabilities

While exploration and exploitation are both instrumental for performance, they also compete for limited organisational assets, whereby an organisation has to share the available resources between exploration and exploitation (Levinthal & March, 1993; Kim, Mahoney, & Tan, 2015). Yet, whether an organisation is able to reconcile these two learning modes may be contingent upon its knowledge pool or the ability to gain access to new knowledge (Levinthal & March, 1993). Moreover, entering more developed markets that facilitate exploration, requires overcoming entry barriers in the first place (Hymer, 1976).

We expect that new multinationals with stronger capabilities will be better able to address the challenges of more sophisticated markets than their own country (Chan, Isobe, & Makino, 2008). Such

firms are better able to communicate their value propositions to their customers and differentiate from competitors (Kohli & Jaworski, 1990). They can also more easily develop new products, adapt to the more competitive markets in the developed world, and develop product warranties to assure more experienced customers about the quality of their products. Hence, we argue that the appropriability of new knowledge by new multinationals, while simultaneously exploiting existing capabilities, will be more effective for new multinationals possessing superior capabilities. Thus, we propose:

H2: The effect in H1 is stronger for new multinationals which possess superior capabilities.

The boundaries of locational ambidexterity: portfolio management experience and portfolio complexity

Experience in managing FDI portfolios is crucial from the perspective of cross-border learning (Luo & Tung, 2007). Particularly for new MNEs, learning in foreign markets is not necessarily doomed to succeed (Zahra, Ireland, & Hitt, 2000; Zaheer, 1995). If new multinationals enter more advanced markets, they are likely to face some difficulties in coping with these countries' formalised labour and capital markets (Chacar, Newburry, & Vissa, 2010), as well as the reliance on formal written contracts instead of informal arrangements (McMillan & Woodruff, 2002). Experience of operating through FDI, both in similar and dissimilar markets to the ones being currently entered, may be crucial for both explorative and exploitative FDI and its performance (Trąpczyński & Banalieva, 2016).

Furthermore, a rising level of locational ambidexterity may in consequence lead to the dispersion of managerial attention. In fact, particularly for early-stage MNEs making their first genuine decisions about the composition of their geographic portfolios, such a dual focus may be challenging (Luo & Tung, 2007). Previous research has provided evidence for a tendency to rely on established organisational routines established in the course of earlier experience with geographic expansion (Pattnaik, Choe, & Singh, 2015; Perkins, 2014). Indeed, the ability to successfully engage in exploration in foreign markets is typical of more mature, advanced MNEs rather than the entire population of MNEs (Dunning, Kim, & Park, 2008). We argue, accordingly, that the experience of managing FDI projects allows new MNEs to allocate better their managerial capabilities and balance different involvements in their locational portfolios more successfully. Therefore, we propose that:

H3: The moderating effect in H2 is stronger for new multinationals with a higher portfolio management experience.

Figure 1 summarises our conceptual framework.
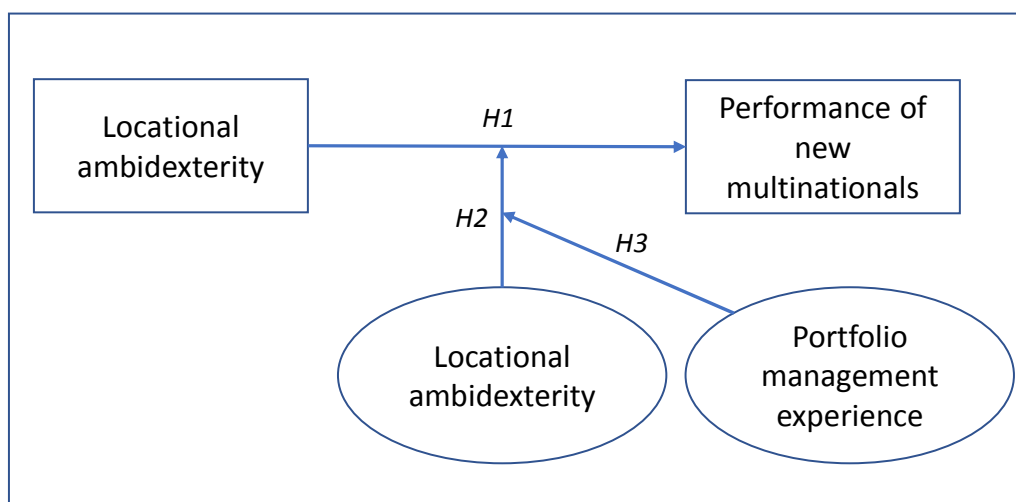
Figure 1. Conceptual framework
Source: own elaboration.

RESEARCH METHODOLOGY

Data and sample

We tested the above hypotheses by using a CATI study of foreign outward investors from Poland (2013-2014). We shortlisted the Polish firms suitable for our survey from a variety of secondary sources (including the Amadeus, BPR Benchmark Poland, and corporate communications). In order to be included in the database, the companies had to be registered in Poland and hold a minimum of 10% of shares in a subsidiary located abroad (Padmanabhan & Cho, 1999). Thus, we obtained a shortlist of 882 Polish firms with actual FDIs in the period under investigation.

A single key informant approach was adopted, by inviting executives directly responsible for the foreign activities of the firm to take part in the CATI study (Sousa, Ruzo, & Losada, 2010). A sample of 100 complete surveys was obtained, corresponding to an effective response rate of 11.3%, which remains in line with prior research on transition economies (Kriauciunas, Parmigiani, & Rivera-Santos, 2011). Accordingly, all the firm-level data are survey-based, except for country-level data. The country-level institutional data come from the World Bank's World Governance Indicators, World Bank's open Database, Hofstede's cultural database, and Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) database of geographic distance (Mayer & Zignano, 2005).

Statistical Analysis

We tested our hypotheses with OLS regression models in Stata/MP 15.1. We estimated OLS regression models because of the cross-sectional structure of our dataset. We started our analysis with a baseline model (Eq. 1). In Eq. 2, we added measures for the economic, institutional and cultural compositions of the MNEs' country portfolios. Next, we tested the interaction between MNE resources and the economic country portfolios (Eq. 3). We estimated the final equation for the full sample as well as for a split of the sample into groups of MNEs with an above (below) average number of FDIs. This sub-group analysis aims to test H3.

$$MNE\ Overall\ Success = Constant + \beta1\ FDI\ Experience + \beta2\ MNE\ Reputation + \beta3\ MNE\ Size + \beta4\ MNE\ Age + \beta5\ MNE\ Capabilities + \beta6\ Industry \tag{1}$$

$$MNE\ Overall\ Success = Constant + \beta1\ FDI\ Experience + \beta2\ MNE\ Reputation + \beta3\ MNE\ Size + \beta4\ MNE\ Age + \beta5\ MNE\ Capabilities + \beta6\ Economic\ Portfolio + \beta7\ Institutional\ Portfolio + \beta8\ Cultural\ Portfolio + \beta9\ Industry \tag{2}$$

$$MNE\ Overall\ Success = Constant + \beta1\ FDI\ Experience + \beta2\ MNE\ Reputation + \beta3\ MNE\ Size + \beta4\ MNE\ Age + \beta5\ MNE\ Capabilities + \beta6\ Economic\ Portfolio + \beta7\ MNE\ Capabilities\ x\ Economic\ Portfolio + \beta8\ Institutional\ Portfolio + \beta9\ Cultural\ Portfolio + \beta10\ Industry \tag{3}$$

Measures

Performance

We captured performance with a subjective measure (see e.g. Brouthers, Brouthers, & Werner, 2008; Brouthers, Nakos, Hadjimarcou, & Brouthers, 2009), MNE overall success. Respondents were asked to evaluate on a 5-point Likert scale (1=we are much worse; 2=we are worse; 3=we are at the same level; 4=we are better; and 5=we are much better) how they perform relative to their closest rival. The aforementioned scale demonstrates a decent level of reliability, with the Cronbach's Alpha=0.84.

Capabilities

Respondents were requested to evaluate on a 5-point Likert scale (1=we are much worse; 5=we are much better) how the capabilities (market adaptation, new product introduction, marketing, managerial, technological and operational efficiency) of their company compare to those of their closest competitor. Capabilities for each firm were obtained by averaging the Likert scores of all five capabilities. For the analysis, we mean-centred the average scores. The construct showed a value of Cronbach's Alpha of 0.88.

FDI Experience

To capture the experience with FDI of our sample firms, we used the maximum number of years each firm was operating any FDI.

Locational ambidexterity

We proxied locational ambidexterity with the economic portfolio composition, using GDP per capita as the measure of economic development. To compute the distance between the home country and each of the host countries of the subsidiaries of the sample firms, we applied the Kogut and Singh (1988) formula, which was rooted in order to account for the direction of the distance. The host country scores were summed up to obtain the FDI portfolio composition and divided by the number of countries in the portfolio in order to eliminate outliers. Thus, more positive values of this continuous index indicate that the FDI portfolio of the Polish firm is dominated by countries more advanced than Poland. Conversely, more negative values of the continuous index indicate that the FDI portfolio of the Polish firm is dominated by countries less developed than Poland. To summarise, this variable can be expressed by the following formula:

$$LocAmb_N = \sum_{n=1}^{N} [\{\sum_{i=1}^{6} (I_{in} - I_{ik})/S_i\}/6]/N \qquad (4)$$

where:

I_{in} - is the economic development score of the i th item for the nth country;

k - is Poland;

S_i - stands for the standard deviation of the i th score;

N - is the number of countries in which the firm has foreign affiliates.

Control variables

For the Institutional Portfolio we computed the institutional development difference for each host country, using the World Governance Indicators for 2011-2012. We performed the same computation for cultural portfolio based on Hofstede's six cultural dimensions. Moreover, we controlled for Industry (equal to 1 for manufacturing, 0 for services, Brouthers, Brouthers, & Werner, 2008); Firm Size (total years of FDI experience); Firm Age (years of operation); Firm Reputation (5-point Likert scale, where 1=we are much worse; 5=we are much better) how the perception and image of the MNE compare to those of their closest competitor).

RESULTS AND DISCUSSION

Common method bias

In order to avoid common method bias, the order of questions and items was varied so that no responses were suggested in the survey. The questions pertaining to the dependent variable were placed in the final part of the questionnaire. To test for common method bias, we conducted a post-hoc Harman's one-factor test (Podsakoff & Organ, 1986). The unrotated principal component analysis showed four factors with eigenvalues greater than 1.0, which collectively accounted for 66.6% of the total variance. The first and largest factor did account 24.1% of the variance.

Descriptive statistics

64% of the sample are made up of companies operating in the manufacturing industry. 47% of the sampled firms have predominantly advanced economies in their FDI portfolios (i.e., FDI Economic Portfolio Composition is positive), giving sufficient variation to test our framework. The average multinational is about 25 years old with an average of 9 years of international experience on a range of 2 to 27.

Table 1 presents the variety of host countries in which the Polish new multinationals invest, and the total subsidiaries per host country in the sample. Overall, the FDI portfolios in the sample are quite heterogeneous: there are a total of 62 different host countries and 394 subsidiaries. The sam-

ple is also dominated by European investments (45 European countries or 72%, and 361 European subsidiaries or 92%), in accordance with earlier studies of European multinationals (e.g., Dikova, 2009; Pollard & Simberova, 2014).

Table 1. The FDI host countries and subsidiaries of the Polish new multinationals

Host country of FDI	Number of subsidiaries per host country	Host country of FDI	Number of subsidiaries per host country
Albania*	2	Macedonia*	1
Argentina	1	Malaysia	1
Armenia*	1	Moldova*	3
Austria*	7	Montenegro*	2
Azerbaijan*	2	Netherlands*	2
Belarus*	7	Norway*	4
Belgium*	2	Panama	1
Bosnia & Herzegovina*	2	Portugal*	1
Brazil	2	Romania*	30
Brunei Darussalam	1	Russia*	30
Bulgaria*	9	Serbia*	2
Canada	2	Singapore	1
China	7	Slovakia*	21
Croatia*	3	Slovenia*	2
Czech Republic*	40	South Africa	2
Denmark*	6	South Korea	1
Estonia*	2	Spain*	7
Finland*	1	Sweden*	6
France*	13	Switzerland*	4
Georgia	1	Tajikistan*	1
Germany*	42	Tunisia	1
Greece*	1	Turkey*	6
Hungary*	15	Turkmenistan*	1
Ireland*	1	Ukraine*	33
Israel	1	United Arab Emirates	2
Italy*	8	United Kingdom*	15
Japan	1	United States of America	7
Kazakhstan*	5	Uzbekistan*	1
Kosovo*	1	Vietnam	1
Kyrgyz Republic*	1	**62 Host Countries**	**394 Subsidiaries**
Latvia*	4		
Lithuania*	13	*indicates the European investments*	
Luxembourg*	1		

Source: survey data.

Econometric findings

Tables 2 and 3 present the descriptive statistics and correlations table. Table 5 show the findings of the different OLS regression models. The direct effect of Economic Portfolio was only marginally significant in Model 3B in Table 5 but non-significant in any other model. Thus, we did not find support for Hypothesis 1 in our sample. Yet, the interaction between the economic composition of the portfolios and the MNEs' capabilities was positive and significant in the full model (Model 2 in Table 5) as well as in the sub-group models of MNEs with high and low FDI experience (Models 3A and 3B in Table 4). This supports Hypothesis 2. Our findings suggest that locational ambidexterity should not be regarded as a capability in its own right but rather as a moderator for the remaining MNE capabilities. This moderating role is further highlighted by the marginal effects graph in Figure 2. For high levels of economic portfolios (dashed line in Figure 2), the effect of capabilities on MNE clearly exceeds the

effect of the same level of capabilities of MNEs with low levels of economic portfolios (solid line in Figure 2). For low levels of capabilities, the graph shows reversed effects, emphasising the relevance of capabilities in FDI portfolios that require ambidexterity.

Table 2. Descriptive statistics

Variables	N	Mean	Std. Dev.	Min	Max
MNE Overall Success	100	3.282	0.743	1	5
FDI Experience	100	9.380	4.947	2	27
MNE Reputation	100	3.413	0.866	1	5
MNE Size	100	6.346	1.654	2.995	10.434
MNE Age	100	25.210	19.862	1	95
Industry	100	0.610	0.490	0	1
Capabilities	100	0.000	0.650	-2.1922	1.474
Locational ambidexterity	100	0.439	2.280	-6.4394	9.776
Institutional Port.	100	-0.939	2.506	-18.7136	2.803
Cultural Port.	100	5.737	6.753	0.4950	34.312

Source: own study.

Table 3. Correlations between key variables

Variables (and their numbers)		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)	MNE Overall Success	1									
(2)	FDI Experience	0.12	1								
(3)	MNE Reputation	0.35 ***	0.11	1							
(4)	MNE Size	0.09	0.31 ***	0.01	1						
(5)	MNE Age	-0.03	0.19*	0.01	0.38 ***	1					
(6)	Industry	0.05	0.27 ***	-0.02	0.28 ***	0.19 *	1				
(7)	Capabilities	0.55 ***	0.09	0.38 ***	-0.02	0.11	0.09	1			
(8)	Locational ambidexterity	0.00	-0.01	-0.07	-0.14	-0.13	-0.03	-0.05	1		
(9)	Institutional Port.	-0.10	-0.22 **	-0.06	-0.23 **	-0.25 **	-0.09	-0.05	0.51 ***	1	
(10)	Cultural Port.	0.16	0.32 ***	0.11	0.38 ***	0.07	0.03	-0.15	0.09	-0.38 ***	1

Notes: ***: $p < 0.01$; **: $p < 0.05$; *: $p < 0.1$
Source: own study.

Jointly, our findings regarding the first two hypotheses provide some additional insights on the mechanisms how locational ambidexterity affects firm performance. While our data confirm that MNEs pursue an international expansion combining exploration and exploitation, or ambidexterity (Raisch & Birkinshaw, 2008), the lack of significant direct effects of locational ambidexterity differs from previous findings such as Kim, Hoskisson and Lee (2015) or Makino, Lau and Yeh (2002). Moreover, our results reinforce previous studies which identified resources and capabilities as crucial prerequisites for successful locational ambidexterity (Kim, Mahoney, & Tan, 2015). In particular, we contribute to previous research by shedding light on the role of experience in managing various, often contradictory, international commitments within a firm's portfolio. This finding strengthens the role the resource-based-view plays in internationalisation processes towards different institutional contexts (Brouthers, Brouthers, & Werner, 2008).
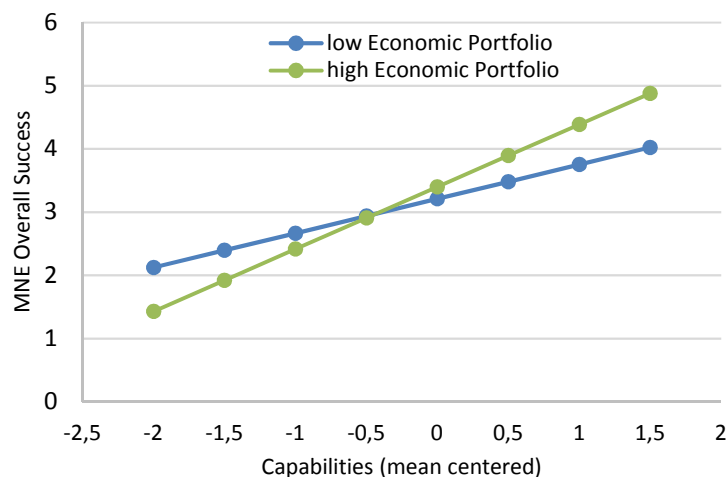
Figure 2. Marginal effects graph
Source: own elaboration.

Table 4. Regression models (MNE performance)

Variable	Base model	Model 1	Model 2	Model 3A (high Exp FDI)	Model 3B (low Exp FDI)
Constant	2.535 *** (0.3600)	2.758 *** (0.378)	2.793 *** (0.369)	3.475 *** (.599)	2.169 *** (0.682)
FDI Experience	0.007 (0.014)	-0.002 (0.014)	-0.008 (0.014)	0.001 (0.022)	-0.006 (.046)
MNE Reputation	0.129 (0.078)	0.099 (0.079)	0.116 (0.077)	0.075 (0.093)	.210 (.131)
MNE Size	0.063 (0.043)	0.029 (0.046)	0.015 (.045)	-0.045 (0.067)	.042 (.066)
MNE Age	-0.005 (0.003)	-0.005 (0.003)	-0.004 (0.003)	-0.004 (0.005)	-0.005 (0.005)
Capabilities	0.581 *** (0.105)	0.634 *** (0.106)	0.668 *** (0.105)	0.827 *** (0.129)	0.599 *** (0.182)
Locational ambidexterity		0.004 (0.034)	0.036 (0.036)	-0.021 (0.039)	0.138 * (0.091)
Locational ambidexterity x Capab.			0.082 ** (0.036)	0.068 * (0.034)	0.240 (0.145)
Institutional Port.		-0.001 (0.034)	-0.036 (0.036)	0.004 (0.036)	-0.142 (0.096)
Cultural Port.		0.024 ** (0.012)	0.021 * (0.012)	0.030 ** (0.012)	0.046 (0.036)
Industry Dummy	yes	yes	yes	yes	yes
N	100	100	100	43	57
Prob. F-test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.018 **
Adj.R2	0.312	0.329	0.359	0.539	0.211

Notes: ***: $p < 0.01$; **: $p < 0.05$; *: $p < 0.1$
Source: own study.

In Hypothesis 3, we argued that the enhancing effect of locational ambidexterity on the performance impact of superior capabilities is stronger for new MNEs with a higher portfolio management experience. To test Hypothesis 3, we split our sample of new MNEs into more experienced MNEs (above average number of years of experience with FDI) and less experienced MNEs (below average number of years of

experience with FDI). For more experienced MNEs we found a significant result (Model 3A in Table 4) whereas the result for less experienced MNEs is only marginally significant (Model 3B in Table 4). Thus, the findings of Models 3A and 3B support Hypothesis 3. These findings highlight the complexity of managing locational ambidexterity. Unexperienced new MNEs lack the competence to pursue a dual strategy and might be better advised to gain experience with a focus on either exploitation or exploration (Luo & Tung, 2007). Enhanced FDI experience, nevertheless, enables new MNEs to exploit their capabilities in more complex country portfolios (Trąpczyński & Banalieva, 2016).

CONCLUSIONS

The added value of our study is that it enhances earlier studies devoted to FDI location choices of multinationals from developed markets (Galan, González-Benito, & Zuñga-Vincente, 2007; Kumar, 2001), newly industrialised countries (Makino, Lau, & Yeh, 2002), or traditional emerging markets like China (Ramaswamy, Yeung, & Laforet, 2012). Conversely, the knowledge about the location choices of new multinationals from mid-range economies has still remained limited. New multinationals' choices about the level of market sophistication in their FDI portfolios differs from the FDI choices other multinationals make due to the different level of factor market development conditions in their home countries (Hoskisson *et al.*, 2013; Kim, Hoskisson, & Lee, 2015).

Our study advanced two key theoretical contributions. First, few studies have adopted an integrative portfolio perspective on geographic portfolio choices, and have instead focused on discrete FDI location choices at a point in time (Nielsen, Asmussen, & Weatherall, 2017). Equally few studies have consistently considered location choices from the point of view of broader corporate strategy, linking location choices to other strategic decisions like, e.g., building intangible resources. Second, while earlier research has conceptualised entry into advanced countries and emerging markets as two mutually exclusive strategic choices, we proposed instead that firms can pursue both at the same time. We believe this approach reflects a more realistic representation of the complex optimisation decisions new multinationals make with respect to the level of market sophistication in their FDI portfolios that has evaded prior research.

Further, there is no direct performance effect of adding more advanced markets to the portfolio, as this relationship depends on the possessed capabilities. Thus, we caution new MNE managers that chasing after the glamour of advanced host countries is a double-edged sword: it can significantly improve firms' intangible resource base, but also significantly hurt performance, at least in the short term. Managers of new multinationals should carefully balance their exploration-exploitation activities so as to reduce the negative effect on performance.

Our research is obviously limited in a number of aspects which nevertheless pose fruitful areas for further efforts. First, consistent with prior quantitative studies on companies' internationalisation (e.g., Carlsson, Nordegren, & Sjoholm, 2005; Hernandez & Nieto, 2015; Liu, Gao, Lu, & Lioliou, 2016), our study relies on a survey-based cross-sectional sample of FDI portfolios. Thus, we were not able to perform panel data regression analysis to test for possible longitudinal shifts in the new multinationals' FDI strategies over time. Thus, future research can test the generalisability of our findings on longer time frames as more data become publicly available. Second, future research can expand ours by analysing larger firm samples. Since we were only able to capture short-term performance, it would be useful for upcoming studies to expand our work by analysing the long-term performance implications from the FDI portfolio optimisation of new multinationals. Third, despite the notable heterogeneity of host country locations in the Polish firms' FDI portfolios (62 countries, 394 subsidiaries), most FDI in the sample was in Europe, hence further research could recur to larger and more diversified portfolios which would help to corroborate our findings.

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Authors

The contribution share of authors is equal and amounted to 50% for each of them.

Piotr Trąpczyński

Associate Professor at the Poznań University of Economics and Business, Department of International Competitiveness at the Institute of International Business and Economics. His research interests include foreign direct investments and divestments, export performance and export exits, along with business models.
Correspondence to: Dr hab. Piotr Trąpczyński, prof. UEP, Department of International Competitiveness, Poznań University of Economics and Business, al. Niepodległości 1, 61-875 Poznań, Poland, e-mail: piotr.trapczynski@ue.poznan.pl
ORCID http://orcid.org/0000-0001-8154-9174

Tilo Halaszovich

Professor of Global Markets and Firms at the Jacobs University Bremen, Germany. His research is mostly focused on quantitative analysis in entrepreneurship and international business. He is especially interested in the competitiveness of foreign and domestic firms in developing countries.
Correspondence to: Prof. Dr. Tilo Halaszovich, Jacobs University Bremen, Business Studies & Economics, Campus Ring 1, Research IV, 28759 Bremen, Germany, e-mail: t.halaszovich@jacobs-university.de
ORCID http://orcid.org/0000-0003-2182-0879

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Stock returns-inflation nexus in Indonesia: Evidence from conventional and Islamic stocks

Yahya, M. Shabri Abd. Majid, Hafasnuddin

A B S T R A C T
Objective: The objective of the article is to empirically explore the effects of actual, expected, and unexpected inflation on conventional and Islamic stock markets in Indonesia.
Research Design & Methods: In the first stage, an auto-regressive integrated moving average (ARIMA) model is utilized to measure expected and unexpected inflations. In the second stage, a dynamic ordinary least squares (DOLS) estimator is used to explore the stock return-inflation nexus over the period from 1999 to 2019.
Findings: The study documented that Islamic stock returns are independent of inflation following the Fisher hypothesis. Meanwhile, a negative relationship between stock returns and inflation is found in the conventional stock market. However, the Fama proxy hypothesis was incapable of describing the negative conventional stock returns-inflation relation in its entirety. However, our findings support the Mundell-Tobin hypothesis.
Implications & Recommendations: Our findings imply that the Islamic stock market of Indonesia provides a full hedge against actual, while the conventional stock market does not.
Contribution & Value Added: This study is the first attempt in the Islamic finance literature to comparatively explore the effects of inflation, expected, and unexpected inflation on conventional and Islamic stock markets from the perspective of the emerging Indonesian economy.
Article type: research article
Keywords: Fisher hypothesis; Fama proxy hypothesis; Islamic stock; hedge
JEL codes: C22, C58, G11
Received: 24 June 2020	Revised: 21 June 2021	Accepted: 15 July 2021

INTRODUCTION

The stock return-inflation relation has been a puzzle in financial economics theory. Some studies found a positive (Durai & Bhaduri, 2009; Li *et al*., 2010; Alagidede & Panagiotidis, 2012; Tiwari *et al*., 2015; Zhao, 2017) and negative (Gallagher & Taylor, 2002; Kim, 2003; Li *et al*., 2010; Aktürk, 2016; Antonakakis *et al*., 2017) association between stock return and inflation, while few others discovered the independence (Majid, 2006; Haniff & Masih, 2018) of stocks from inflation. The nature of the stock return-inflation nexus provides necessary implications for the investors as to whether stocks are a better hedge against inflation or not. A positive or an independent stock return-inflation association implies a better hedge of stock returns against inflation.

Previous studies have proposed various hypotheses to describe the nature of the stock return-inflation relation. The Fisher (1930) hypothesis explains that real stock return is independent of inflationary predictions, while a negative relationship between unemployment and inflation rates – as stated by the Phillips curve (1958) – stock returns are positively associated with inflation. On the other hand, many other hypotheses propose an inverse stock return-inflation relation. These include Mundell's (1963) views, Tobin's (1965) hypothesis, Modigliani and Cohn's (1979) inflation illusion hypothesis, Feldstein's

(1982) tax hypothesis, Fama's (1981, 1883) proxy hypothesis, Bulmash's (1991) quantity of money hypothesis, and Brandt and Wang's (2003) time-varying risk aversion hypothesis. Additionally, to reconcile a negative and a positive correlation in the post-war period, Kaul (1987, 1990) and Hess and Lee (1999) introduce the equilibrium mechanism in the monetary sector to real economic activity. They adopt the two-regime hypothesis and a structural bivariate vector autoregression model, respectively.

Previous studies mainly focus on the actual inflation-stock returns puzzle in the conventional stock markets in developed and emerging economies. These studies explore the inflation-stock returns puzzle in 11 advanced economies (Lee, 2010), the G7 countries (Alagidede & Panagiotidis, 2012), the USA (Gallagher & Taylor, 2002; Antonakakis et al., 2017), the UK (Li et al., 2010), Germany (Kim, 2003), Greece (Floros, 2004), Turkey (Aktürk, 2016), China (Zhao, 2017), India (Durai & Bhaduri, 2009; Jana, 2013), Pakistan (Tawari et al., 2015), Malaysia (Majid, 2002; Haniff & Masih, 2018), and Indonesia (Majid, 2006). Meanwhile, Qizam (2020) found a positive and an insignificant effect of Islamic bond (sukuk) ratings on Malaysian and Indonesian stock returns, respectively.

Even though the previous literature on the stock return-inflation puzzle is voluminous and rich, only Haniff and Masih (2018) investigate the stock return-inflation puzzle for the case of the Islamic stock market in Malaysia over the period 2007-2015 using the wavelet technique. However, none of the earlier studies has investigated the relationship between actual, expected, unexpected inflation and both conventional and Islamic stock returns.

Although the Islamic capital markets have been growing at a remarkable pace since their inception in the 1990s and research on Islamic finance flourished in recent years, the studies considering the actual, expected, and unexpected inflation and Islamic stocks relationships are non-existent. Thus, they fail to provide a far-reaching implication as to whether Islamic stocks offer a good hedge against inflation. Does inflation have a similar effect on both conventional and Islamic stock markets? Does the Islamic stock market provide a good hedge against inflation as its conventional counterparts? These are not trivial questions to be left unanswered due to the different nature and characteristics of Islamic stocks as compared to the conventional ones. Unlike the conventional market, the core business activity of a company listed in the Islamic stock market should comply with *sharia* principles that are free from the elements of interest (*riba*), uncertainty (*gharar*), and gambling (*maysir*).

Thus, to fill the above research gaps, this study explores the relationships between actual, expected, and unexpected inflation and both Indonesian conventional and Islamic stocks using a more extended study period from 1999-2019 (21 years) within the framework of the Fama proxy hypothesis (1981, 1983). Fama (1981, 1983) posits that a negative stock return-inflation relation is explained by a negative inflation-real economic activity and a positive real activity-stock returns nexus.

We hope that our findings will enrich the existing literature on the stock return-inflation puzzle from a new perspective of Islamic stocks. Moreover, the study findings will hopefully shed light on the investors and international fund managers who seek to diversify their investments in the Indonesian stock markets, both the conventional and the Islamic one.

The rest of this study is structured in the following manner. The next section reviews the selected literature on the stock return-inflation puzzle. Then, we provide an empirical framework as the basis for data analysis. The following section discusses the main findings and their implications, and finally, conclusion summarizes the study.

LITERATURE REVIEW

Theories of stock return-inflation nexus

The studies on the stock return-inflation nexus puzzle have recently been extensively explored using various approaches and financial economics theories. Previous studies that investigated the stock return-inflation association in the global capital markets have documented mixed findings. The stock return-inflation relation was found to be positive (Durai & Bhaduri, 2009; Alagidede & Panagiotidis, 2012; Aktürk, 2016; Zhao), negative (Kim, 2003; Lee, 2010; Li et al., 2010; Antonakakis et al., 2017), and independent (Gallagher & Taylor, 2002; Tiwari et al., 2015; Haniff & Masih, 2018). Due to these mixed findings and, consequently, their implications, the stock return-inflation relation has been a

puzzle in financial economics theory. The existence of positive or independent stock return-inflation relation implies a better hedge of stocks against inflation. In contrast, the presence of a negative association between them implies otherwise.

According to the Fisher (1930) hypothesis, real stock returns are independent of inflation, implying that nominal asset returns have to be positively associated with expected and unexpected inflation. A positive stock return-inflation relation could also be explained by Phillips (1958) curve, which shows that a negative unemployment-inflation relationship implies a direct inflation-real economic activity association. Accordingly, stock return positively related to real economic activity is in turn supposed to have a positive relation to inflation.

However, recent empirical findings contradict the Fisher hypothesis and the Phillips curve in which inflation-stock returns are negatively related (Fama, 1981, 1983; Chatrath *et al.*, 1997; Majid, 2006; Lee, 2010; Li *et al.*, 2010; Antonakakis *et al.*, 2017). For example, Chatrath *et al.* (1997), Majid (2006), Gallagher and Taylor (2002), Kim (2003), and Durai and Bhaduri (2009) utilize Fama's proxy hypothesis (1981, 1983) to elucidate negative stock returns-inflation connection. According to Fama's proxy hypothesis (1981, 1983), the negative stock return-inflation relation could be clarified by a negative inflation-real economic activity and a positive real activity-stock return nexus.

Based on the above discussion, the study proposes the following first hypothesis:

H1: There is a negative association between stock returns and actual, expected, and unexpected inflation.

In his proxy hypothesis, Fama (1981, 1983) only hypothesizes the nature of the relationship between actual inflation and stock return. However, this study extends the analysis to include both expected and unexpected inflation and their relationships to stock returns to provide a comprehensive picture of the nature of various types of inflation-stock return nexus.

Moreover, some studies found that the Fama proxy hypothesis fails to explain the negative stock return-inflation relationship (Ram & Spencer, 1983; Majid, 2002; Haniff & Masih, 2018). Instead, as an alternative to Fama's proxy hypothesis, Mundell (1963) and Tobin (1965) explain that the rise in the predicted inflation rate drives portfolio substitutions from money to financial assets and diminishes the real stock returns. The decline in real interest stimulates economic activity. Thus, a positive inflation-economic activity and a negative real stock return-economic activity nexus should be expected (Ram & Spencer, 1983).

Additionally, the negative stock return-inflation relation is explained by Modigliani and Cohn's (1979) inflation illusion hypothesis. This hypothesis states that investors in stocks tend to discount expected future dividends and earnings more profoundly by using higher nominal interest rates when inflation rises. Consequently, stock prices are undervalued when inflation increases and become overvalued when inflation declines, resulting in the negative stock return-inflation relation. Using the theory of rational valuation, Modigliani and Cohn (1982) explain that the low stock values throughout periods of high inflation result from the failure of investors to alter company profits for the inflation premium elements of interest expense – representing a capital return rather than an expense – and from the capitalization of company profits at the nominal rate, instead of the theoretical adjustment of the real rate of interest.

Feldstein (1982) suggests an inverse stock return-inflation relation in the US stock market by using the tax hypothesis. According to him, a significant indirect effect of increased inflation on stock price is caused by essential characteristics of the US tax law, predominantly the remarkable cost depreciation and taxation of nominal capital gains. Using a time-varying risk aversion hypothesis, Brandt and Wang (2003) contend that inflation causes investors to become more risk-averse, steering up the stock premium and the real discount rate, thus reducing real stock returns.

Furthermore, in their research on the stock markets of the USA, the UK, Japan, and Germany, Hess and Lee (1999) offer a two-regime hypothesis that drives the stock return-inflation nexus based on different shocks of aggregate demand and supply in the pre-war period (1926-1944) and the post-war period (1947-1994). They found that the aggregate demand shocks drive a positive relationship in the pre-war period, while the aggregate supply shocks drive a negative relationship in the post-war period.

In the presence of real supply shocks, the estimation of the Phillips curve is to be biased, while during the period of an unanticipated monetary shock there is to exist a positive inflation-real stock returns association. On the other hand, a negative relationship between inflation-real stock returns is to emerge in the short-run due to the dominance of fluctuations in the natural rate of output over the cyclical component of a Lucas-type Phillips curve (Kryzanowski & Rahman, 2009).

Finally, Haniff and Masih (2018) study the stock return-inflation puzzle for the Malaysian Islamic stock market over the 2007-2015 period using the Wavelet technique. They document that the Islamic stock provides a potential hedge against inflation during the normal economic period but not during the 2008-2009 period, following the global financial crisis.

The above-reviewed studies on stock return-inflation relation have proposed and tested various hypotheses, as summarised in Table 1.

Table 1. Summary of various hypotheses on stock return-inflation nexus

No.	Hypothesis	Statement	Author
1.	Fisher (1930) hypothesis	Real stock returns are independent of inflation	Fisher (1930)
2.	Phillips curve	A positive inflation-stock relation.	Phillips (1958)
3.	Proxy hypothesis	A negative stock returns-inflation relation. Explained by a negative inflation-real economic activity and a positive real activity-stock returns association.	Fama (1981, 1983)
4.	Mundell-Tobin hypothesis	A negative stock returns-inflation relation. Explained by a positive inflation-economic activity and a negative real stock return-economic activity relation.	Mundell (1963) Tobin (1965)
5.	Inflation illusion hypothesis	A negative stock return-inflation relation.	Modigliani and Cohn (1979)
6.	Theory of rational valuation	A negative stock return-inflation relation.	Modigliani and Cohn (1982)
7.	Tax hypothesis	An inverse stock return-inflation relation.	Feldstein (1982)
8.	Two-regime hypothesis	A positive stock return-inflation relation in the pre-war period due to an aggregate demand shock. A negative stock return-inflation relation in the post-war period due to an aggregate supply shock.	Hess and Lee (1999)
9.	Time-varying risk aversion hypothesis	An inverse stock return-inflation relation.	Brandt and Wang (2003)
10.	Generalized Fama proxy hypothesis	A positive inflation-real stock returns association in a long run. A negative inflation-real stock returns association in the short-run.	Kryzanowski and Rahman (2009)

Source: own study.

Referring to the above discussion, the study tests a negative stock returns-and inflation relation using Fama's (1981, 1983) proposition in the following second and third hypotheses:

H2: There is a negative association between actual, expected, and unexpected inflation and real economic activity.

H3: There is a positive association between real economic activity and stock returns.

Our hypotheses extend the proxy hypothesis of Fama (1981, 1983) by incorporating not only actual inflation but also both expected and unexpected inflation-stock return nexus to provide an entire nature of relationships between various types of inflation and stock return.

RESEARCH METHODOLOGY

In the first step, this study empirically explored the stock returns-inflation puzzles for the case of Islamic and conventional stocks in the emerging Indonesian market using the Fisher hypothesis.

Meanwhile, the nature of the stock returns-inflation relation was tested in the second step using the Fama proxy hypothesis.

Testing the Fisher hypothesis

This study explored the effects of actual, expected, and unexpected inflation on real stock returns. Therefore, three econometric models were formulated to test both conventional and Islamic stock returns' relationship to each type of inflation. Following the studies by Chatrath *et al.* (1997) and Majid (2006), the following first model was proposed to test the stock returns and actual inflation relation:

$$cSR_t - INF_t = \beta_0 + \beta_1(INF_t) + \varepsilon_t \qquad (3.1a)$$

$$iSR_t - INF_t = \beta_0 + \beta_1(INF_t) + \varepsilon_t \qquad (3.1b)$$

in which *cSR* was the nominal returns of conventional stock, *iSR* is the nominal returns of Islamic stock, and *INF* was the actual rate of inflation over period *t*. The difference, $SR_t - INF_t$ represented real returns, and ε_t was the error random term.

Similarly, to explore the stock returns-expected inflation relation, the following second model was proposed:

$$cSR_t - INF_t = \beta_0 + \beta_2 E(INF_t I\phi_{t-i}) + \varepsilon_t \qquad (3.2a)$$

$$iSR_t - INF_t = \beta_0 + \beta_2 E(INF_t I\phi_{t-i}) + \varepsilon_t \qquad (3.2b)$$

in which $E(INF_t)$ denoted the expected inflation rate at the time *t* and $I\phi_{t-i}$ is the information set accessible to investors at the end of period *t-i*.

Finally, the third model was proposed to test the association between stock returns and both expected and unexpected inflation, as follows:

$$cSR_t - INF_t = \beta_0 + \beta_2 E(INF_t I\phi_{t-i}) + \beta_3 UE(INF_t) + \varepsilon_t \qquad (3.3a)$$

$$iSR_t - INF_t = \beta_0 + \beta_2 E(INF_t I\phi_{t-i}) + \beta_3 UE(INF_t) + \varepsilon_t \qquad (3.3b)$$

in which the unexpected inflation rate, $UE(INF_t)$ was described as the difference between actual and expected rates of inflation $[INF_t - E(INF_t I\phi_{t-i})]$.

For the first two equations (3.1) and (3.2), if the estimated coefficients of β_1 and β_2 equalled zero, they would agree with the Fisher hypothesis, which states that real stock returns are independent of inflation rates, implying a perfect hedge of stocks against inflation and expected inflation, respectively. Meanwhile, the $\beta_2 = \beta_3 = 0$ in equation (3.3) indicated a full hedge of stocks against both expected and unexpected inflation.

Testing Fama's proxy hypothesis

As mentioned earlier, Fama's proxy hypothesis explains that a negative stock returns and inflation relation centres on the inflation-real economic activity and stock returns-real economic activity linkages. Thus, the first proposition of Fama's proxy hypothesis (a negative inflation-real economic activity association) and the second proposition of Fama's proxy hypothesis (a positive real economic activity-stock returns association) could then be separately measured by the following models:

$$INF_t = \alpha_0 + \sum_{i=-k}^{k} \alpha_i REA_{t+i} + \varepsilon_t \qquad (3.4a)$$

$$E(INF_t) = \alpha_0 + \sum_{i=-k}^{k} \alpha_i REA_{t+i} + \varepsilon_t \qquad (3.4b)$$

$$UE(INF_t) = \alpha_0 + \sum_{i=-k}^{k} \alpha_i REA_{t+i} + \varepsilon_t \qquad (3.4c)$$

$$SR_t - (INF_t) = \delta_0 + \sum_{i=-k}^{k} \delta_i REA_{t+i} + v_t \qquad (3.5a)$$

$$iSR_t - (INF_t) = \delta_0 + \sum_{i=-k}^{k} \delta_i REA_{t+i} + v_t \qquad (3.5b)$$

in which REA_t was the real economic activity, while v_t represented the error random term. However, leading, contemporaneous, and lagging values of *REA* were incorporated to capture the entire past and leading information on economic activity changes into our estimated models.

In line with Chatrath *et al.* (1997) and Majid (2006), in Models (3.4) and (3.5), the study included both leads and lags of real economic activity due to lack of prior empirical evidence on the associations

of real economic activity-inflation-real stock returns in Indonesia by using final prediction error (FPE) criteria. Equations (3.4a), (3.4b), and (3.4c) tested the first Fama's proposition. The negative relationship between inflation and real economic activity indicated that some α_i are significantly negative. Equations (3.5a) and (3.5b) were used to test for the second Fama's proposition, in which a positive real economic activity-real stock return relation implied that some δ_i are significantly positive.

Since Fama's proxy hypothesis' explanation was rooted in an indirect real stock returns-inflation connection, a single equation treatment to equations (3.4) and (3.5) could have yielded unreliable estimates (Chatrath *et al.*, 1997; Majid, 2002, 2006). To avoid this inconsistency in the estimates of the association between stock returns and actual, expected, and unexpected inflation, the study employed the procedure of two-step dynamic ordinary least square (DOLS) estimator by using the following equations:

$$INF_t = \mu_0 + \sum_{i=-k}^{k} \mu_i \, REA_{t+i} + \xi_{It} \tag{3.6a}$$

$$cSR_t - INF_t = \delta_0 + \delta_1 \xi_{It} + \sum_{i=-k}^{k} \gamma_i \, REA_{t+i} + \nu_t \tag{3.6b}$$

$$iSR_t - INF_t = \delta_0 + \delta_1 \xi_{It} + \sum_{i=-k}^{k} \gamma_i \, REA_{t+i} + \nu_t \tag{3.6c}$$

$$E(INF_t) = \mu_0 + \sum_{i=-k}^{k} \mu_i \, REA_{t+i} + \xi_{IIt} \tag{3.7a}$$

$$cSR_t - INF_t = \delta_0 + \delta_1 \xi_{IIt} + \sum_{i=-k}^{k} \gamma_i \, REA_{t+i} + \pi_t \tag{3.7b}$$

$$iSR_t - INF_t = \delta_0 + \delta_1 \xi_{IIt} + \sum_{i=-k}^{k} \gamma_i \, REA_{t+i} + \pi_t \tag{3.7c}$$

$$UE(INF_t) = \mu_0 + \sum_{i=-k}^{k} \mu_i \, REA_{t+i} + \xi_{IIIt} \tag{3.8a}$$

$$cSR_t - INF_t = \delta_0 + \delta_1 \xi_{IIIt} + \sum_{i=-k}^{k} \gamma_i \, REA_{t+i} + \phi_t \tag{3.8b}$$

$$iSR_t - INF_t = \delta_0 + \delta_1 \xi_{IIIt} + \sum_{i=-k}^{k} \gamma_i \, REA_{t+i} + \phi_t \tag{3.8c}$$

In equations (3.6a)-(3.8c), real stock returns and inflation were regressed on the lagging, contemporaneous, and leading values of real economic activity. Nevertheless, the difference between equation (a) and (b) or (c) – for example between equations (3.6a) and (3.6b) or (3.6c) – which was where the estimated residual from equation (3.6a), ξ_{It} was incorporated as an independent variable in equation (3.6b) or (3.6c), representing the inflation variable that is purged of the inflation-real economic activity relation. For equations (3.6b), (3.7b), and (3.8b), if the estimated δ_1 coefficient equalled zero, it would agree with Fama's proxy hypothesis: real stock returns and inflation are independent once we control for the influence of inflation on real economic activity. If the negative relationship between inflation and real stock returns still existed after controlling for the inflation-real economic activity relationship, the results would be inconsistent with Fama's proxy hypothesis.

Data

Changes in the quarterly consumer price index (CPI) were used to measure inflation, while the growth of gross domestic product (GDP) was used as a proxy for real economic activity (REA). These data were gathered from the *Statistical Bulletin* of the Central Bureau of Statistics, the Republic of Indonesia. The data for conventional stock return (*c*SR) and Islamic stock returns (*i*SR) were calculated from the Jakarta composite index (JCI) and the Jakarta Islamic index (JII), respectively. These stock indices were gathered from the Bloomberg Database (2020). This study utilized non-seasonally adjusted data over the 1999 to 2019 period. All variables investigated in the study were measured using quarterly data.

Expected and unexpected inflation forecasts

To measure expected and unexpected inflation, this study adopted an auto-regressive integrated moving average (ARIMA) model following the studies by Chatrath *et al.* (1997) and Majid (2006). This model was suitable due to the instability of the inflation rate like in Indonesia. Besides, the model was also able to detect large variability of inflation rates; therefore, it could have achieved greater predictability of the inflation rate (Mestel & Gurgul, 2003) and captured the linear patterns of inflation (Pai & Lin, 2005).

RESULTS AND DISCUSSION

Descriptive statistics

Table 2 reports the descriptive statistics for the investigated variables. As illustrated in Table 2, Islamic stocks offered a slightly higher mean average return (2.10%) compared to their conventional counterparts (2.04%) over the period 2009-2019. Islamic stocks also appeared to be slightly less volatile with a standard deviation of 1.22% compared to the conventional stock, with a standard deviation of 1.31%. The prohibition of Islamic stocks to involve in *riba-*, *gharar-*, and *maysir-*based activities and speculative transactions are believed to contribute to the higher stability of Islamic stock markets (Majid & Kassim, 2015).

Table 2. Descriptive statistics

Variable	Minimum	Maximum	Mean	Standard deviation
*c*SR	-0.0268	0.0527	0.0204	0.0131
*i*SR	-0.0239	0.0531	0.0210	0.0122
INF	0.0473	0.1375	0.0617	0.0527
E(INF)	0.0420	0.1405	0.0634	0.0534
UE(INF)	0.0331	0.1501	0.0665	0.0572
REA (Growth)	0.0372	0.0638	0.0506	0.0460

Note: *c*SR is the conventional stock return, *i*SR is the Islamic stock return, INF is the inflation rate, E(INF) is the expected inflation rate, UE(INF) is the unexpected inflation rate, and REA is the real economic activity.
Source: own elaboration using the E-Views statistical software.

Furthermore, the inflation rate ranged from 4.73% to 13.75% with a mean value of 6.17% and a standard deviation of 5.27%. The expected inflation rate ranged from 4.20% to 14.05% with a mean value of 6.34% and a standard deviation of 5.34%. Meanwhile, the unexpected inflation rate ranged from 3.31% to 15.01% with a mean value of 6.65% and a standard deviation of 5.72%. Indonesia recorded the highest rate of inflation in October 2005 due to an increase in the gasoline price by 105%. The lower rate of inflation was mainly caused by the tight monetary policy imposed by the government during the year 2013.

Finally, the growth in real economic activity ranged from 3.72% to 6.38% with a mean value of 5.06% and a standard deviation of 4.60%. The government policy to provide more micro-financing to small and medium enterprises in the year 2010 boosted economic activity to 6.38%. On the other hand, the highest inflation rate caused by an increase in gasoline price had lowered the economic activity to 3.72% in 2005.

Test for stationarity

Table 3 illustrates the findings of the augmented Dickey-Fuller (ADF) test for the presence of unit root test (non-stationarity) for all time-series data using both constant and no trend and with constant and trend regression models. The inflation (INF), expected inflation [E(INF)], and unexpected inflation [UE(INF)] were found to be stationary in the log level for both models. However, at the log level, the conventional stock (*c*SR) was stationary for the constant and no trend model but was non-stationary with the constant and trend model. Meanwhile, the stock return for Islamic stocks (*i*SR) and the real

Table 3. Augmented Dickey-Fuller unit-root test

Variable	Log level		First differences	
	Model 1	Model 2	Model 1	Model 2
*c*SR	-2.791***	-2.073	-3.863***	-4.015***
*i*SR	-2.102	-2.132	-3.260***	-3.432***
INF	-4.211***	-4.163***	-	-
E(INF)	-4.971***	-4.235***	-	-
UE(INF)	-4.643***	-4.176***	-	-
REA	0.873	1.805	-3.216***	-3.477***

Note: See Table 2. Model 1: constant and no trend, while Model 2: constant and trend. *** represents significance at the 1% level.
Source: own elaboration using the E-Views statistical software.

economic activity (REA) were all non-stationary on the log level. Nevertheless, data stationarity was achieved through the first difference for both models.

ARIMA models for expected and unexpected inflation

As for the ARIMA models, we began with the identification stage, i.e. we identified the exact orders of auto-regressive (AR)(p), integrated (I)(d), and moving average (MA)(q). The unit-root test results (Table 3) showed that the rate of inflation is stationary at the log level; therefore, the order of integration is zero, I(0). Since the inflation series are stationary, only the auto-regressive moving average (ARMA) (p,q) was implemented. After identifying the I(0), the study determined the orders of both AR and MA.

Table 4. ARMA models for expected inflation

Parameter	Expected inflation
AR (1)	0.622*** (4.732)
AR (2)	-0.372** (-2.408)
AR (3)	-0.150 (-0.933)
AR (4)	-0.121 (-0.785)
AR (5)	-0.251** (-1.926)
MA (1)	0.968*** (49.110)
Constant	0.031*** (5.007)
R^2	0.477
Skewness	0.322
Kurtosis	3.263
J-B	2.981
D-W	2.148

Note: J-B indicates the Jarque-Bera test for normality, whereas D-W refers to the Durbin-Watson d test. The figures in the brackets are t-statistics. *** and ** indicate significance at 1% and 5%, respectively.
Source: own elaboration using the E-Views statistical software.

Having identified the appropriate p, d, and q values, estimation and forecasting steps were performed, and their findings were reported in Table 4. Through a diagnostic process, an ARMA (5,1)[1] was identified to best identify the inflation series, as reported in Table 4. The goodness of the chosen ARMA model was shown by the insignificances of Modified Box-Pierce chi-square statistics, showing all residuals from the model were white noise and normally distributed. The other criteria for the fitness of a model were indicated by the computed values of skewness and kurtosis, which were 0 and 3, respectively, for the normal distribution (Gujarati, 2009). The computed values of skewness and kurtosis for the estimated ARMA (5,1) were 0.322 and 3.263, respectively, indicating the normality of the disturbance term. The Jarque-Bera (J-B) value of 2.981 was found, showing a non-rejection of normality assumption for the estimated model. Finally, as illustrated in Table 4, the estimated Durbin-Watson (D-W) value of 2.148 was in the category of non-autocorrelation of the disturbance terms.

Real stock returns and inflation

Table 5 provides the findings for real stock returns-inflation association, thereby testing the Fisher hypothesis, which states that real stock returns are independent of inflation. For the Islamic stock market, the coefficients of actual inflation (INF), expected inflation E(INF), and unexpected inflation UE(INF) were all insignificant, thereby supporting the Fisher hypothesis. These findings were also supported by the insignificance of the F-statistics and the low coefficient of determination, R^2 (0.01%-0.13%), which measured the total variations in real stock returns as explained by the 0.01%-0.13% changes in inflation.

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[1] Box-Pierce chi-square statistics were also computed for ARMA (1,5), ARMA (2,1), ARMA (2,2), ARMA (2,3), ARMA (3,1), ARMA (3,4), ARMA (4,4), ARMA (5,3), and ARMA (5,3). Even though their skewness and kurtosis values were around 0 and 3, but the residuals of all these alternative models are non-normally distributed, indicated by the significance of the Box–Pierce chi-square statistics.

Our findings supported the earlier empirical findings for the cases of the Malaysian Islamic stock (Haniff & Masih, 2018), the USA (Gallagher & Taylor, 2002; Antonakakis *et al.*, 2017), Pakistani (Tiwari *et al.*, 2015), Chinese (Zhao, 2017), Greece (Floros, 2004), and Indian (Jana, 2013) conventional stock markets. The finding of insignificant stock return-inflation relation indicated the better full hedge of Islamic stocks against actual, expected, and unexpected inflation in Indonesia.

As for the conventional stock market, the actual inflation coefficient (Model 1) was negative at the 1% level of significance, a finding compatible with Fama's hypothesis. As for expected and unexpected inflation, only the unexpected inflation was found to have a negative significance with stock returns at the 1% level (Model 3). Hence, unlike the findings of the Islamic stock market that supported the Fisher hypothesis, the conventional stock market did not. This finding was similar to empirical evidence found in the stock markets of India (Durai & Bhaduri, 2009), Malaysia (Majid, 2002), the UK (Li *et al.*, 2010), global economies (Lee, 2010), Canada (Alagidede & Panagiotidis, 2012), and Turkey (Aktürk, 2016). Our finding of a negative stock return-inflation relationship further indicated that inflation is inseparable from the real side of the economy. The economic consequences of changing inflation on the stock market could not be simply ignored and considered in isolation.

Table 5. Real stock returns-inflation relationship

Stock	Model	Constant	INF	E(INF)	UE(INF)	R^2	F	D-W
cSR − INF	1	-1.125** (-1.995)	-2.774*** (-2.515)	-	-	0.1015	5.430***	1.954
	2	-1.364** (-2.116)	-	0.283 (0.158)	-	0.0005	2.245**	2.144
	3	-1.297** (-2.284)	-	0.378 (0.239)	-5.960*** (-3.963)	0.2394	7.165***	2.242
iSR − INF	1	-1.628 (-1.286)	0.870 (0.893)	-	-	0.0001	1.321	2.132
	2	-1.896 (-1.404)	-	0.665 (0.744)	-	0.0006	0.977	2.201
	3	-1. 704 (-1.377)	-	0.397 (0.296)	0.199 (0.118)	0.0013	1.031	2.063

Note: cSR − INF and iSR − INF indicate the real value of conventional and Islamic stocks, respectively. Models 1, 2, and 3 for cSR − INF were estimated based on equations (3.1a), (3.2a), and (3.3a). Meanwhile, models 1, 2, and 3 for iSR − INF were estimated based on equations (3.1b), (3.2b), and (3.3b). D-W refers to the Durbin-Watson d test. The numbers in the brackets are the t-statistics. *** and ** represent a level of significance of 1% and 5%, respectively.
Source: own elaboration using the E-Views statistical software.

Furthermore, as illustrated in Table 5, the *d* statistics of the Durbin-Watson (D-W) were all insignificant, indicating a non-autocorrelation among the disturbance terms. Besides, the estimated R^2 ranging from 0.05% (Model 2) to 23.94% (Model 3) showed the importance of separating inflation into expected and unexpected inflation. The relatively lower values of estimated R^2 in our study were consistent with the findings of Lee (2010) and Zhao (2017). They documented rather low R^2 in their stock return-inflation models although some other macroeconomic determinants were added into the models.

Furthermore, when comparing the impact of actual, expected, and unexpected inflation on the conventional real stock returns, it was interesting to note that the conventional real stock returns were more dependent on actual and unexpected inflation rather than expected inflation. In contrast, the Islamic real stock returns are independent of actual, expected, and unexpected inflation. These findings show that the Islamic stock market provided a perfect hedge towards inflation, while the conventional stock market did not.

The different nature of Islamic stock resided in its activities being free from the components of interest (*riba*), gambling (*maysir*), and uncertainties (*gharar*), thus causing the Islamic stocks to be less susceptible to changes in macroeconomic variables, including inflation. Thus, the framework of the Islamic capital market limits specific business activities with an emphasis on an ethically-oriented

transaction, social-oriented investment, sustainable banking and finance and a highly regulated financial system (Yusof & Majid, 2008; Majid & Kassim, 2015). Thus, Islam prohibits investing in stocks containing elements of interest (*riba*), speculation, and excess risk-related business activities, alcohol, ammunition, and pork-related products (Majid, 2016).

Furthermore, Islamic finance rules limit asset-backed stock and equity participation and asset investment, which complies with the *sharia* injunctions. These characteristics provide a high degree of prudence for Islamic investments, making Islamic finance a promising alternative for improved benefits of investment diversification, particularly in the hyperinflation period. The relatively higher level of inflation in Indonesia (Majid & Mahrizal, 2007), with an average of 13.75% over the study period did not affect the values of Islamic stocks. Islamic stocks' ability to grant a full hedge towards inflation offered a promising alternative for improved benefit diversifications among investors while they were investing in *halal* (permissible) business activities.

Tests for Fama's proxy hypothesis

The first proposition: A negative inflation-real economic activity relation

Table 6 reports the results for the first Proposition of Fama's proxy hypothesis, which tested the presence of a negative relationship between inflation and real economic activity. Earlier, we found that the Islamic stock market provided a good hedge against inflation (Table 5). Thus, the regression results from inflation on real economic activity (Table 6) opposed the first proposition of Fama's proxy effect. Real stock returns were positively related to real economic activity, instead of being negatively related. However, the conventional stock market, which provided some support for the negative relationship between real stock returns and both actual and unexpected inflation (Table 5), did not support the first proposition of Fama's hypothesis.

Table 6. Testing the first proposition of Fama's proxy hypothesis

Inflation	Model	Real economic activity: Coefficients' sum of lead-lag lengths					
		(-3.3)	(-5.5)	(-7.7)	(-9.9)	(-11.11)	FPE
INF	1	0.0010 [0.892]	-0.0001 [0.545]	0.0037 [1.009]	0.0008 [1.129]	-0.0078 [0.943]	0. 0008* [2.497](-1.1)
E(INF)	2	0.0012*** [26.780]	0.0003*** [25.910]	-	0.0022*** [18.910]	0.0023*** [12.884]	0.0018*** [28.279](-7.7)
UE(INF)	3	0.0002 [1.391]	-0.0013 [1.140]	-	-0.0003 [2.240]	0.0033** [3.048]	0.0011*** [3.343](-7.7)

Note: models 1, 2, and 3 are estimated based on equations (3.4a), (3.4b), and (3.4c), respectively. The numbers in [.] are the F-statistics, while the numbers in (.) show the optimal lead-lag length based on Akaike's (1969) final prediction error criteria. These numbers include leading, contemporaneous, and lagging values of real economic activity. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.
Source: own elaboration using the E-Views statistical software.

Table 6 shows that, in the long-time period, there is a positive relationship between actual inflation (Model 1), expected inflation (Model 2), and unexpected inflation (Model 3), and real economic activity. Our study also found that all the estimated FPE based specification models recorded significant F-statistics, thus indicating the models are free from misspecification. It was shown by the positive sum of lead-lag coefficients and significant F-statistics. These findings show that all three types of inflation played a significant positive role in determining real economic activity. This finding contradicts Fama's proxy effect, but it provided some supports to either the Mundell-Tobin hypothesis or the Phillips curve theory.

The second proposition: A positive stock returns-real economic activity relation

Table 7 provides the findings of the relationship between real stock returns and real economic activity. For the conventional stock market, the FPE based specification Model (-12.12) showed a significant negative real stock returns-real economic activity relationship at the 5% level. This finding contradicted Fama's proxy hypothesis but provided some supports to the Mundell-Tobin hypothesis.

Conversely, based on the FPE based specification Models (-1.1), (-3.3), and (-5.5), the Islamic stock market was found to have a positive significant relationship with real economic activity at least at the 5% level; a finding contradicts the second Fama's proxy proposition. However, the positive inflation-real economic activity and real stock returns-real economic activity showed some consistencies with the Phillips curve theory.

Our estimated FPE-based specification models had the significance of F-statistics, thus indicating the models were free from misspecification. Overall, the findings of a positive inflation-real economic activity and a negative real stock returns-real economic activity relationship for the conventional stock market contradicted Fama's proxy hypothesis but provided some supports to the Mundell-Tobin hypothesis. Our findings agreed with the results of earlier studies by Ram and Spencer (1983) and Chang *et al.* (2000), who found the explanation of the Mundell-Tobin hypothesis for negative stock return-inflation relationships.

Table 7. Testing the second proposition of Fama's proxy hypothesis

Stock	Model	Real economic activity: Coefficients' sum of lead-lag lengths					
		(-3. 3)	(-5. 5)	(-7. 7)	(-9. 9)	(-11. 11)	FPE
*c*SR - INF	1	-0.086 [1.168]	-0.193 [1.256]	-0.161 [0.839]	-0.250 [1.671]	-0.206 [1.372]	-0. 234** [2.635] (-12.12)
*i*SR - INF	2	1.979** [2.406]	2.167** [2.280]	2.084 [1.418]	-0.694 [0.581]	-0.505 [0.443]	1.193*** [4.601] (-1.1)

Note: see Table 5; models 1 and 2 were estimated based on equations (3.5a) and (3.5b), respectively.
Source: own elaboration using the E-Views statistical software.

Real stock returns, inflation, and real economic activity

Table 8. Real stock returns, actual inflation, and real economic activity

REA: Lead-lag lengths	Estimated and sum of coefficients	
	Conventional stock market	Islamic stock market
(-3.3)	-0.087 [1.308]	1.862** [1.904]
(-5.5)	-0.206 [1.455]	2.761** [2.378]
(-7.7)	-0.167 [0.999]	0.710 [0.864]
(-9.9)	-0.250* [1.807]	-0.813 [0995]
(-11.11)	-0.206 [1.520]	-0.351 [0.578]
FPE	-0.228*** [2.909] (-12.12)	1.205*** [3.404] (-1.1)
ε_{It}	-2.523** {-1.745}	4.877 {0.974}
	$R^2 = 0.788$; Adj-$R^2 = 0.497$; D-W = 1.751; J-B = 2.177	$R^2 = 0.197$; Adj-$R^2 = 0.189$; D-W = 2.058; J-B = 1.989

Note: these findings were estimated based on equations (3.6a), (3.6b), and (3.6c). ꞮIt is the estimated residuals calculated from equation (3.6a), which are then incorporated into equations (3.6b) and (3.6c). This estimate represents the actual inflation variable that is purged of the actual inflation-economic activity relationships for the conventional (equation 3.6b) and Islamic (equation 3.6c) stock markets. The numbers in (.) show the optimal lead-lag length based on the Akaike's (1969) final prediction error criteria, the numbers in [.] are the F-statistics, while the numbers in {.} are the t-statistics. J-B and D-W represent the Jarque-Bera test for normality and the Durbin-Watson d test, respectively. ***, **, and * denote the significance levels of 1%, 5%, and 10%
Source: own elaboration using the E-Views statistical software.

Even though the finding shows the independence of inflation on real stock returns for Islamic stocks and negative inflation-real stock returns relationship for conventional stocks, so far none of them supports the Fama's proxy hypothesis when both propositions of the Fama's proxy hypothesis are estimated in isolation. Since the framework of Fama's proxy effect is rooted in an indirect stock returns-inflation association, this study further assesses to which extent Fama's proxy effect is consistent and valid to clarify the negative stock returns-inflation relationship for the case of the conventional stock market (Table 5). Tables 8, 9, and 10 report the results from the estimated regression of the real stock returns on purged actual, expected, and unexpected inflation.

As observed from Table 8, the independence of real stock returns from actual inflation for the Islamic stock market (Model 1 in Table 5) still existed even after controlling for the effect of real economic activity on actual inflation. This is confirmed by the insignificance of ε_{It} (Table 8). Since Fama's proxy hypothesis expounds the negative stock returns-inflation nexus; therefore, this hypothesis cannot be used to describe the independence between variables observed for the Islamic stock market.

In the case of the conventional stock market, the results are documented to be inconsistent with Fama's proxy hypothesis where a negative relationship between real stock returns and actual inflation (Model 1 in Table 5) remained persistently significant (Table 8) even after controlling for the inflation-real economic activity relationship; the findings similar to Wahlross and Berglund (1986). The negative relationship between real stock returns and actual inflation is evidenced by the negative significance of ε_{It} at the 5% level. In general, the results from Table 5 (Model 1) and Table 8 were not much different. Actual inflation affected negatively real stock returns, although at a lesser level of significance.

Table 9 further reports the results from the estimated regression of the real stock returns on purged expected inflation. For the case of the Islamic stock market, the independence of real stock returns from inflation still existed even after controlling for the effect of real economic activity on inflation, represented by the insignificance of ε_{IIt}. These findings are compatible with the evidence from Table 5 (Model 2). These findings showed that Fama's proxy hypothesis that delineates the negative stock returns-inflation nexus is unable to describe the independence of Islamic stock returns from expected inflation. Similarly, for the case of the conventional stock market, the independence of real stock returns from expected inflation persisted even after controlling for the influence of real economic activity on expected inflation. This was evidenced by the insignificance of ε_{IIt} (Table 9). These findings further confirmed the inability of Fama's proxy hypothesis to explain the nature of stock returns-inflation nexus for the case of Indonesian stock markets.

Table 9. Real stock returns, expected inflation, and real economic activity

REA: Lead-lag lengths	Estimated and sum of coefficients	
	Conventional stock market	Islamic stock market
(-3.3)	-0.107 [1.178]	0.349 [0.769]
(-5.5)	-0.206 [1.029]	-0.201 [0.572]
(-7.7)	-0.052 [0.827]	0.718 [1.119]
(-9.9)	-0.196 [1.544	-0.048 [0.491]
(-11.11)	-0.573*** [3.301]	0.307 [0.682]
FPE	-0.461*** [4.547] (-12.12)	1.273** [2.163] (-1.1)
ε_{IIt}	3.618 {0.827}	-4.052 {-0.915}
	R^2 = 0.889; Adj-R^2 = 0.682; D-W = 1.485; J-B = 3.283	R^2 = 0.204; Ad-R^2 = 0.197; D-W = 1.708; J-B = 2.640

Note: these findings were estimated based on equations (3.7a), (3.7b), and (3.7c). ε_{IIt} was the estimated residuals calculated from equation (3.7a), which are then incorporated into equations (3.7b) and (3.7c). This estimate represents the expected inflation variable that is purged of the expected inflation-economic activity relationships for the conventional (equation 3.7b) and Islamic (equation 3.7c) stock markets. The numbers in (.) show the optimal lead-lag length based on the Akaike's (1969) final prediction error criteria, the numbers in [.] are the F-statistics, while the numbers in {.} are the t-statistics. Source: own elaboration using the E-Views statistical software.

Finally, Table 10 reports the finding from the estimated regression of the real stock returns on purged unexpected inflation. The study found that the independence of real stock returns from unexpected inflation for the Islamic stock market (Model 3 in Table 5) still existed even after controlling for the effect of real economic activity on expected inflation. This was evidenced by the insignificance of ε_{IIIt} (Table 10). Thus, Fama's proxy hypothesis that explains a negative stock returns-inflation nexus cannot be used to describe the independence of Islamic stock returns from unexpected inflation.

On the contrary, the findings for the conventional stock market were recorded to be inconsistent with Fama's proxy hypothesis, in which the negative real stock returns-unexpected inflation relationship (model 3 in Table 5) remained persistently significant (Table 10), even after controlling for the unexpected inflation-real economic activity relationship. This was confirmed by the negative significance of ε_{IIIt} at the 10% level. In general, the results from Table 5 (model 3) agreed with the findings in

Table 10. Unexpected inflation influenced negatively real stock returns, although at a lesser level of significance. Our findings agreed with Wahlross and Berglund (1986).

Overall, our results showed that Fama's proxy effect framework cannot fully explain the independence of real stock returns on inflation for the Islamic stock market. Moreover, Fama's proxy hypothesis failed to clarify the strong negative real stock returns-inflation relationship for the conventional stock market. Instead, our findings offered some support to the Mundell-Tobin hypothesis. Our findings are similar to earlier studies by Ram and Spencer (1983) and Chang *et al.* (2000), who record that a negative real stock returns-inflation relationship is directly explained by the positive inflation-real activity and the negative real stock returns-real activity relationships.

Table 10. Real stock returns, unexpected inflation, and real economic activity

REA: Lead-lag lengths	Estimated and sum of coefficients	
	Conventional stock market	Islamic stock market
(-3.3)	-0.085*** [2.370]	0.339 [0.740]
(-5.5)	-0.193** [2.186]	-0.372 [0.855]
(-7.7)	-0.150 [1.520]	0.909 [0.529]
(-9.9)	-0.247** [1.902]	0.249 [0.527]
(-11.11)	-0.227 [1.500]	-0.770 [0.409]
FPE	-0.245** [2.807] (-12.12)	1.204*** [2.977] (-1.1)
ε_{IIIt}	-2.342* {-1.556}	3.758 {1.003}
	$R^2 = 0.894$; Adj-$R^2 = 0.697$; D-W = 1.644; J-B = 3.815	$R^2 = 0.210$; Adj-$R^2 = 0.207$; D-W = 1.704; J-B = 2.704

Note: these findings are estimated based on equations (3.8a), (3.8b), and (3.8c). ε_{IIIt} was the estimated residuals calculated from equation (3.8a), which are then incorporated into equations (3.8b) and (3.8c). This estimate represents the unexpected inflation variable that is purged of the unexpected inflation-economic activity relationships for the conventional (equation 3.8b) and Islamic (equation 3.8c) stock markets. The numbers in (.) show the optimal lead-lag length based on the Akaike's (1969) final prediction error criteria, the numbers in [.] are the F-statistics, while the numbers in {.} are the t-statistics. Source: own elaboration using the E-Views statistical software.

CONCLUSIONS

This study empirically explored the effects of actual, expected, and unexpected inflation on conventional and Islamic stock markets over the 1999-2019 period in Indonesia. The study documented that real returns of Islamic stocks are independent of inflation, implying a perfect hedge of the Islamic stocks against inflation, as suggested by the Fisher hypothesis. However, for the conventional stock market, the study documented a negative relationship between real stock returns and both actual and unexpected inflation, implying an inability of conventional stocks to provide a good hedge against inflation.

To further explain the negative relationship between stock returns and inflation, the study examined both propositions of Fama's proxy effect framework, which centres on a negative inflation-economic activity and a positive stock returns-economic activity relationship. For the Islamic stock case, the positive relationships are found both between real economic activity-inflation and economic activity-real stock returns. These findings contradicted Fama's proxy effect but supported the Phillips curve theory. As for the conventional stock case, Fama's proxy effect failed to explain the negative real stock returns-inflation relationship. The study revealed the positive inflation-economic activity and the negative stock returns-economic activity relationships. However, our results support the Mundell-Tobin hypothesis, in which the negative real stock returns-inflation relationship is directly explained by the positive inflation-economic activity and the negative stock returns-economic activity associations.

The reliability of Fama's proxy hypothesis is then subsequently confirmed by establishing a two-step estimation that controls for the inflation-economic activity relationship. The study still found the independence of real stock returns on inflation for the Islamic stock market, consistently against Fama's proxy hypothesis. The negative real stock returns-inflation relationship for the conventional stock market still existed even though at a lesser level of significance.

This study only focused its analysis on the relationships between inflation and returns of Indonesia's conventional and Islamic stocks within the framework of Fama's proxy hypothesis. Future studies should

consider the adoption of alternatives models, such as GARCH and VAR to predict expected and unexpected inflation. Further studies on this issue might also consider the dynamic causal relationship between inflation-stock returns and incorporate relevant control variables to provide more reliable empirical evidence on the nature of inflation-stock return nexus. Testing the nature of the inflation-stock return nexus using various hypotheses and theories would enrich the existing empirical findings. Finally, incorporating more Islamic and conventional stocks from the Asian emerging market, advanced European, and the US stock markets into the analysis, future studies would offer more comprehensive findings.

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Authors

The first author contributed 55% to the manuscript (introduction, literature review, findings, and discussion), the second author contributed 25% to the manuscript (research methods, processed statistical analysis, and conclusions), while the remaining 20% was contributed by the third author (enriching discussion and implications of the study).

Yahya

Associate Professor at the Department of Management, Sekolah Tinggi Ilmu Ekonomi Sabang (STIES), Banda Aceh, Indonesia. Ph.D. in Economics (2016); Master's in Economics (1997); and Bachelor of Economics (1986) from Universitas Syiah Kuala (USK), Indonesia. His research interests include macroeconomics, regional economics, and economic development.
Correspondence to: Dr. Yahya, S.E., M.Si, Department of Management, Sekolah Tinggi Ilmu Ekonomi Sabang (STIES), Banda Aceh, Indonesia, e-mail: yahya_kobat@rocketmail.com
ORCID ⓘ http://orcid.org/0000-0002-9056-3880

M. Shabri Abd. Majid

Professor of Islamic Economics at the Faculty of Economics and Business, Universitas Syiah Kuala (USK), Indonesia. Ph.D. in Financial Economics (2005); Master's in Economics (1998) from International Islamic University Malaysia; and Bachelor of Management Sciences (1995) from USK, Indonesia. His research interests include financial economics, Islamic economics, banking, and finance. He has published more than 60 articles in the Scopus Indexed Journals.
Correspondence to: Prof. Dr. M. Shabri Abd. Majid, Faculty of Economics and Business, Universitas Syiah Kuala (USK), Darussalam, Banda Aceh, 23111, Indonesia, e-mail: mshabri@unsyiah.ac.id
ORCID ⓘ http://orcid.org/0000-0003-3558-8783

Hafasnuddin

Associate Professor at the Department of Management, Faculty of Economics and Business, Universitas Syiah Kuala (USK), Indonesia. Ph.D. in Islamic Banking Marketing (2008) from Universitas Padjajaran, Indonesia; Master's in Marketing (1994) from the University of Illinois, USA; and Bachelor of Management Sciences (1986) from USK, Indonesia. His research interests include Islamic banking marketing, Islamic management, and Islamic economics, banking, and finance. He has published many articles in the reputable international journals.
Correspondence to: Dr. Hafasnuddin, SE., MBA, Faculty of Economics and Business, Universitas Syiah Kuala (USK), Darussalam, Banda Aceh, 23111, Indonesia, e-mail: hafas50@yahoo.com
ORCID ⓘ http://orcid.org/0000-0003-0350-8451

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Economic determinants of total factor productivity growth: The Bayesian modelling averaging approach

Janusz Sobieraj, Dominik Metelski

A B S T R A C T
Objective: : The objective of this article is to use the most recent national-level data (reflecting heterogeneity) to explore determinants of total factor productivity (TFP) growth.
Research Design & Methods: The article examines the performance of a number of potential TFP growth determinants, relying on the Bayesian modelling analysis (BMA) methodology, which allows for isolating key regressors and assessing their actual contribution in relation to the phenomenon under study. As a scientific methodology, BMA is deeply rooted in statistical theory and directly results in posterior and predictive inferences. Moreover, BMA makes it easier to determine the relative impact of examined processes, while taking into account the uncertainty that accompanies the entire regressors' selection procedure (Raftery, Madigan, & Hoeting, 1997; Hoeting, Madigan, Raftery, & Volinsky, 1999; Sala-i-Martin, Doppelhofer, & Miller, 2004).
Findings: We indicate a number of determinants driving TFP growth, *e.g.* inequality measured by the Gini coefficient, the growth of information and communications technology (ICT) assets, logistics performance, the quality of logistics services, and migration.
Implications & Recommendations: We contribute to a more systematised knowledge of the determinants of TFP growth; the data shows that developed economies exhibit variable returns to scale (VRS). More importantly, there is an increasing contribution of ICT assets to economic growth and economies of scale, which is why whole economic systems exhibit increasing returns to scale (IRS). Some of the economic activity remains under-reported, meaning that economies of scale are even greater than the data reveals. In the era of globalisation, it becomes important to support digital technologies, address inequalities, create appropriate logistics infrastructure, and pay attention to mobility factors, *e.g.* labour migration.
Contribution & Value Added: We conduct an overview of the literature so as to better understand the importance of TFP growth. Based on the literature, we identify a number of potential TFP growth determinants and examine their relevance and robustness using the BMA approach, which has become increasingly popular in recent years.

Article type:	research article
Keywords:	total factor productivity; economic growth; growth accounting
JEL codes:	O47, O50, O57, O30, N10

Received: 26 November 2020	Revised: 26 May 2021	Accepted: 29 May 2021

INTRODUCTION

The productivity of global economy has remained relatively low over the last decade. This phenomenon occurred despite significant technological progress, which has even begun to accelerate in recent years at a rapid pace (Watanabe & Ilmola, 2018). There is a particular innovation paradox in that large technological innovations do not necessarily lead to higher levels of economic productivity (Schwab, 2016; Sobieraj, 2019). A similar phenomenon already occurred in the past, shortly before the Great Depression of the 1930s. This is illustrated by the example of the United States of America, where

between 1947 and 1983 labour productivity grew on average by 2.8% per year, while between 2000 and 2007 it rose by 2.6% per year, and between 2007 and 2014 only by 1.3% per year (Sobieraj, 2019). This marked decline in productivity growth – particularly pronounced in recent years – results from technological progress and economies of scale (Schwab, 2016; Watanabe & Ilmola, 2018; Sobieraj, 2019). According to the US Bureau of Labour Statistics, the TFP growth rate in 2007-2014 was only 0.5%, which is much lower compared to 1995-2007. That number could easily be viewed as alarming, especially considering that it occurred at the time when the fifty largest US companies' accumulated assets totalled more than USD 1 trillion while interest rates for many years remained at almost zero (Schwab, 2016; Schwab & Samans, 2016).

In general, TFP growth explains part of the output growth that is attributed to technological progress, which corresponds to the component growth not accounted for by capital or labour. Diewert and Fox (2008) go even further and present evidence showing that technical progress is generally irrelevant, suggesting that contrary to many previous results, economic growth is driven by increasing economies of scale rather than technical progress (Diewert & Fox, 2008). However, as Danquah, Moral-Benito, and Ouattara (2014) indicate, trying to explain such disparities is complicated because, on the one hand, TFP growth is difficult to measure empirically, while on the other hand, the uncertainty that accompanies the construction of scientific models makes it difficult to reach consensus on key determinants of productivity growth. In order to solve both of these problems, Danquah *et al*. (2014) point to a combination of non-parametric measures of TFP growth with Bayesian modelling averaging (BMA) technique. Moreover, Fernandez, Ley, and Steel (2001) employed the BMA method to shw how to model economic growth by taking into account the uncertainties typical for cross-sectional regression models. They argue that BMA gives an advantage over canonical regression models in that BMA averages across a large set of models for a given set of priors. Their predictive (out of the sample) results provide strong evidence supporting their respective arguments. By the same token, Fernandez *et al*. (2001) show which variables represent relevant regressors in explaining cross-sectional growth patterns. We believe that total factor productivity growth is about as important as the growth itself because the prosperity of individual nations depends largely on this factor. Furthermore, the importance of productivity for the whole economy is acknowledged by almost every economist. Some well-known economists such as Paul Krugman believe that the issue of productivity is pivotal for economic development of individual countries. More specifically, Krugman (1991) has repeatedly argued that while there are many important factors other than productivity, *in the long run almost everything depends on productivity*. In this respect, countries seeking to improve the quality of life of their citizens should focus almost entirely on increasing the productivity per capita levels (Krugman, 1991).

In view of the variety of economic considerations there is a number of factors that affect productivity growth measured by TFP growth. Among other things, these include a country's resource endowments, the growth of ICT assets (*i.e.* technology infrastructure), inequality, investment activity (reflected in the form of R&D or total patent applications), fiscal policy, and FDIs, along with barriers to trade, logistics, and migration (Grossman & Helpman, 1991; Baier, Dwyer, & Tamura, 2006; Isaksson, 2007).

In this article, we conduct an in-depth analysis of a large set of TFP growth potential economic determinants and explore their role in explaining productivity growth. To examine their robustness in explaining TFP growth, we use the aforementioned BMA method, which allows for assessing the actual contribution of the proposed exogenous variables in relation to the phenomenon under study. As a scientific method, BMA is an extension of Bayesian inference methods, is deeply rooted in statistical theory, and directly results in posterior and predictive inferences. For example, BMA models are often used for the estimation and interpretation of dynamic stochastic general equilibrium (DSGE) models. They are very useful in explaining and predicting co-movements of aggregate time series over the business cycle (Sobieraj, Metelski, 2021). In other words, Bayesian model averaging provides a coherent and systematic mechanism accounting for model uncertainty (Fragoso, Bertoli, & Louzada, 2018). Moreover, it simplifies the determination of relative impact on examined processes while taking into account the uncertainty that accompanies the entire selection procedure (Raftery *et al*., 1997; Hoeting *et al*., 1999; Sala-i-Martin *et al*., 2004). Over the last few years, BMA has gained in popularity in various types of studies. For the purpose of our study, we built a database

based on various sources such as the Conference Board, WDI, and Eurostat, covering 41 countries and spanning the period of 1998-2015 (18 years in total).

The originality of our article lies in a thorough overview of the TFP growth determinants, the application of an interesting research method such as BMA, and the use of longitudinal data covering a wide variety of TFP growth potential regressors. However, some may argue that the topic of growth accounting and TFP growth research has already been thoroughly investigated. One might indicate the articles by Barro and Sala-i-Martin (1995), Sala-i-Martin *et al.* (2004), Danquah *et al.* (2014), and many others. However, many of these studies are now heavily outdated, and they address a very standard set of variables. Our assumption is that the globalisation processes of the last two decades have accelerated significantly, creating a number of different challenges that well-developed economies must now deal with, *e.g.* growing social inequality, the wealth gap, increased globalisation processes, associated factor mobilities (*e.g.* labour migration), industrial revolution 4.0, and the development of disruptive technologies, almost approaching an economic singularity. The result is arguably an increasing share of ICT in the creation of growth and economies of scale. Many new businesses almost exclusively rely on digital platforms and economies of scale, *e.g.* Amazon, Facebook, Uber, CoinBase. This may result in an even greater returns to scale. The relationship between changes in total factor productivity growth and changes in returns to scale and technologies was explored by Bauer (1990). However, that particular study was conducted more than 30 years ago. Our study includes a set of specific variables that have not been analysed before, *e.g.* ICT assets growth, migration, logistics performance and quality, air transport as passengers carried. More importantly, our study relies on more recent data. For example, the studies conducted by Barro and Sala-i-Martin (1995), Sala-i-Martin (2004), or even Danquah *et al.* (2014) – which are taken as certain benchmarks in the area of knowledge we are exploring – were all based on data dating back to the previous century.

The structure of our article is very straightforward. In the following part, we discuss some theoretical aspects concerning TFP growth. In the subsequent empirical part, we focus on the analytical aspects, data collection, and methodology. The article ends with conclusions.

LITERATURE REVIEW

The analysis of economic productivity constitutes one of the key issues in the framework of the research on growth and economic development, which is conducted at different levels of aggregation. Productivity reflects the value of goods and services per unit of resources utilised for their creation (*i.e.* labour, capital and other inputs), and is a key determinant of countries' wealth and standards of living (Krugman, 1990; Porter & Ketels, 2003). According to Blinder and Baumol (1993), even small positive changes in the levels of productivity significantly translate into an increase in the wealth of a given society in the long term (Blinder & Baumol, 1993). The same applies to interest rates which – like productivity – exert a significant impact on countries' wealth. Considering that the common low interest rate policy adopted by central banks around the world increases poverty of whole societies and causes social stratification – which manifests itself in the shrinkage of the middle class – the emphasis on productivity as a factor that mitigates the process of impoverishment of societies becomes even more important (Schwab, 2016). Blinder and Baumol (1993) argue that increasing productivity not only reduces poverty, but typically also improves the states' ability to finance education, health care, and environmental protection. Labour productivity can be expressed as the total value of production and services provided in relation to the total number of persons employed or total hours worked. To make a comparison of productivity among countries, one can use the ratio of a particular country's gross product value or gross value added to its number of employees or total hours worked (OECD, 2001). However, for the assessment of the performance of individual countries' economies, the TFP appears to be used more frequently (Danquah *et al.*, 2014). It represents the total output of a country in relation to the total input factors utilised to its generation (Samuelson & Nordhaus, 2012).

For years now, economists have been asking the very important question of how much productivity contributes to economic growth. Thus, there appeared attempts to link economic growth with physical and human capital per employee and to find out what part of this growth can be justified by technological

or institutional changes and other factors (Grossman & Helpman, 1991; Senhadji, 2000). From an economic viewpoint, we perceive an output growth as a function of capital: both physical and human. However, we cannot overlook the dynamic development of technology and the changes it causes in terms of conventional perception of productivity (Schwab, 2016; Watanabe & Ilmola, 2018; Sobieraj, 2019).

The economic growth resulting from the growth of physical and human capital can be calculated based on certain assumptions about constant returns to scale and competitive factor markets. However, if we take the output growth rate calculated in this way and compare it with the actual growth rate, there will always be some deviations, which are caused by technological changes and other factors. Scientists try to identify these factors. For example, in addition to the aforementioned technological advancements, Baier *et al*. (2006) point to institutional differences, imperfections in competitive factor markets, instability of returns to scale, and a number of other factors. It is these differences or, rather, deviations from expected output under some specific assumptions that are referred to as the total factor productivity (TFP). We should mention here the theory of growth and the theoretical contribution made by Solow (1956) and Swan (1956), who are considered forerunners of the research on growth accounting. In fact, the literature sometimes calls TFP the Solow's residual (Burda & Severgnini, 2010; Comin, 2010; Ten Raa & Shestalova, 2011). In economics, the Solow's residual is the portion of an economy's output growth that cannot be attributed to the accumulation of capital and labour, which are perceived as conventional factors of production. In the same vein, the TFP concept was addressed by Abramovitz (1956), who studied economic growth in the USA and took a very broad time horizon (*i.e.* several decades long), eventually coming to the conclusion that 90% of the output growth was solely the result of TFP growth. Hence, the impact of productivity factors on economic growth and output growth appears to be of minor importance when compared to TFP growth. Similar findings were observed by Solow (1957), who studied the output growth in the USA in the first half of the twentieth century and came to the conclusion that the share of physical capital in this growth was only 12% while the rest could be attributed to the growth in TFP. In fact, the scientists who studied economic growth in later years confirmed prior findings observed by Abramovitz (1956) and Solow (1957), although in their studies the difference between physical and human capital and that of TFP growth was not as much pronounced as in those earlier studies (Kendrick, 1961; Jorgenson, Kuroda, & Nishimizu, 1987; Angus, 1995; Klenow, 1997; Klenow & Rodriguez-Clare, 1997; Jones, 1997; David, 2000; Denison, 2005). After reading all of the aforementioned authors, one may conclude that a very large part of economic expansion is dependent on TFP growth. Or at least such was the case in the past. Since TFP growth is extremely important for understanding economic growth and the creation of the wealth of nations, the objective of this article is to examine what really influences TFP growth by taking into account a large set of potential variables. However, the question arises why is it even necessary to repeatedly study TFP determinants? The reason is that the economic world is changing, so are the relationships between productivity factors, and therefore also the factors that determine the increase in production of individual nations. Finally, economic growth is obvious in some countries, despite a visible downward trend in TFP, as is the case in the United States.

In Figure 1, we can see that TFP growth typically tends to increase (in short-term) following the periods of major crises (*e.g.* during the recession of 2001-2002 and 2008-2009). However, the general trend remains downward, as shown by the regression line above (Figure 1). Watanabe and Ilmola (2018) notice that productivity of the global economy has declined during last decades and that it is now about half of its peak year in 1973. *In this situation, it is evident that the companies attracting investors are technological and – more importantly – digital companies, which can improve traditional processes with high productivity increases. Moreover, as the recent acquisition activity in the digital market proves, the companies are investing their higher returns in addition to technologies such as artificial intelligence but in buying successful start-ups as well*. Compared to earlier studies, Baier *et al*. (2006) show that when taking into account a larger pool of countries, TFP growth leads only to a small average output growth. According to their findings, the weighted average TFP growth rate for all countries is only 0.22% per year, which can be linked to a mere 14% increase in output growth per employee. These are estimates that differ significantly from those of previous scientist, who attributed more than half or even more of the output growth per worker to TFP growth. However, the study

conducted by Baier *et al*. (2006) shows that an average change in TFP across 145 countries is actually negative and amounts to -0.81% per year. This can be understood as meaning that if we randomly (*i.e.* with the same probability) select a country from the aforementioned pool of countries, we should expect a decrease in TFP of -0.81% per year rather than a growth. Given that there is still intense technological growth, creative destruction, disruptive innovations, it is hard to understand such a decline (Schwab, 2016; Sobieraj, 2019). Baier *et al*. (2006) explain it by what they call institutional retrogression and by events of a destructive nature such as armed conflicts. However, if an ongoing, increasingly rapid technological progress does not bring about significant changes in productivity, further growth in the global economy could be seriously endangered. Therefore, we should address the question as to whether further rapid technological progress and innovations can reverse the negative trend in productivity decline in the global economy. There is no easy explanation to this question. Most innovative products and services developed already during the fourth industrial revolution have much higher functionality and quality (Sobieraj, 2019). They should also make the whole economy more efficient and productive, but so far, this has not proved to be the case (Schwab, 2016). However, as Sobieraj (2019) notices, we should bear in mind that the added value created by these innovative technologies is not always reflected in official statistics. This is due to the fact that many digital products and services are delivered and consumed beyond all recognition, *i.e.* out of the recorded data controls, which means that they are not even included in official statistics, *e.g.* services provided under the shared economy model (Schwab, 2016; Sobieraj, 2019). For example, the drivers working for Uber do not necessarily have to report about their activities to any competent authorities. The same applies to many other services that benefit from the advantages of digital economy, *e.g.* Airbnb or Blablacar. In turn, thanks to the blockchain technology, many transactional exchanges are – or may remain in the future – beyond any control of national governments (Sobieraj, 2019). According to economist Bradford Delong (2015), new digital technologies allow us to produce and consume much more efficiently today than economic indicators may reflect. We may only hope that in terms of efficiency and productivity, the reality looks much better than it is shown in the official statistics. According to Schwab (2016), the advancement of new technologies satisfies many consumer needs earlier unaddressed simply due to the lack of such technologies and appropriate business models such as the shared economy model (Schwab, 2016). Of course, this is beneficial to the global economy, but it distorts the productivity data of many national economies, which may seem less productive than they truly are (Sobieraj, 2019). Therefore, it is possible that the change in productivity growth, which we see in official statistics, is in fact not a decrease but an increase. However, new economic models (beyond official statistics) do not confirm such a state of affairs (Schwab, 2016).
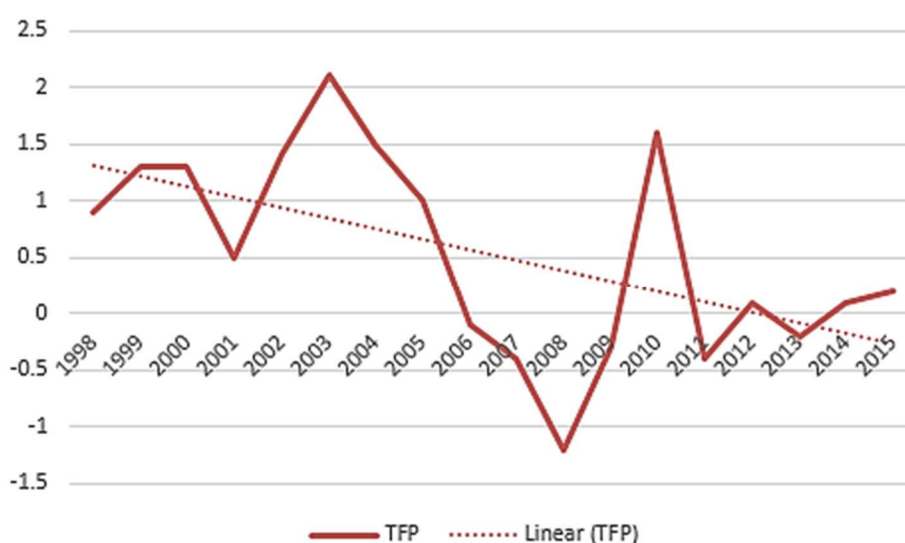

Figure 1. Total Productivity Factor for USA in 1998-2015
Source: own elaboration based on the Conference Board data.

Interestingly, the very differences in economic patterns across countries show a much greater linkage to TFP changes than to changes in physical and human capital (Baier *et al.*, 2006). This is important evidence which proves the purposefulness of conducting research on productivity growth measured by TFP growth, so as to understand and explain changes in economic conditions across countries. If understood properly, the measure of TFP may allow us to better understand the well-being of countries around the world. However, in order to fully understand TFP growth, we should do more than just look for its association with new technologies. Many potential factors must be explored. Although, in order to know which ones are worthy of interest, we must review the literature and collect what other authors have already established.

To identify and assess individual productivity determinants, researchers often rely on the neoclassical aggregate Cobb-Douglas-like production function (Cobb & Douglas, 1928):

$$Y = F(K, L) = AK^{\alpha}L^{1-\alpha} \Rightarrow CRS \tag{1}$$

where:

Y - is a stream of generated products and services (*i.e.* output), expressed as GDP or gross value added;

$Y > 0$ - is the total factor productivity (TFP), K and L correspond respectively to the physical capital resources and labour inputs employed, i.e. the number of individuals employed or the total hours worked;

α - denotes the production flexibility in relation to capital expenditures (capital input);

CRS - means that this type of aggregate production function (AFP) exhibits constant returns to scale (CRS), meaning that the elasticities of all inputs with respect to output sum up to one (AFP is relevant for both the theory of economic growth and empirical research on growth, e.g. in the context of growth accounting and development accounting; Osiewalski, Wróblewska, & Makieła, 2020).

Based on the aforementioned Cobb-Douglas aggregate production function, it appears that productivity is dependent on the capital-to-labour ratio. It results from the accumulation of physical capital, but also from the total factor productivity A. The Cobb-Douglas production function indicates the capital accumulation and total factor productivity as two pivotal factors influencing the level and dynamics of labour productivity; in turn, the interpretation of total factor productivity is no longer as obvious as it might have seemed. The Cobb-Douglas aggregate production function with its constant returns to scale assumption is by far the most restrictive functional specification. Therefore, it should come as no surprise to anyone that all research based on the Cobb-Douglas function and Solow residuals, provide evidence showing a significant proportion of GDP growth associated with TFP growth. On the other hand, there are several research articles in which TFP is not regarded as a mere residual (Färe, Grosskopf, Norris, & Zhang, 1994; Koop, Osiewalski, & Steel, 1999; Benkovskis, Fadejeva, Stehrer, & Wörz, 2012).

It should also be made clear that the idea behind such growth studies, *i.e.* those which rely on the aggregate production function - has received much criticism (Shaikh, 1974; Simon, 1979; Temple, 2006, Osiewalski, Wróblewska & Makiela, 2020; Felipe & McCombi, 2014). Osiewalski *et al.* (2020) note that while from a microeconomic level perspective production functions are well suited to describe the technologies of individual producers, an aggregation of physical capital, labour, and production itself is virtually impossible. There are many contradictions already at the theoretical level that actually preclude any relationship between aggregates (Fisher, 1969), which is due, among other things, to the very specific assumptions of such functions (Jones, 2005; Growiec, 2008, 2013). However, even assuming no microeconomic basis for the aggregate production function (APF), the concept still finds supporters who see its strengths in a well-defined mathematical relation, *i.e.* it is a local first-order approximation of any smooth production function expressed in terms of logs of inputs and outputs (Osiewalski *et al.,* 2020). However, Osiewalski *et al.* (2020) indicate that a more popular form is the translog, which is a second-order local approximation.

The prevalence/popularity of the Cobb-Douglas function and its common application in empirical studies – despite the criticism mentioned above – are determined by its simplicity, historical considerations, and good data fit. The APF can by employed for international comparisons of economic growth

(world technological frontier) and to show the main sources of economic growth through its decomposition (Koop *et al.,* 1999, 2000; Makieła, 2014).

The APF is used to explain economic growth, productivity, and employment. However, this concept is extremely problematic and repeatedly criticised (Shaikh, 1974; Felipe & McCombie, 2014; Temple, 2006; Osiewalski *et al.,* 2020). Felipe and McCombie (2014) criticise the APF because the inputs and outputs used in it are linked through an accounting identity that relates the value added to the sum of wage costs and profits. In their view, a simple comparison of APF-based predictions with actual observations is not sufficient to determine whether the APF concept works. In other words, the restrictive conditions for a coherent aggregation of heterogeneous capital goods, different types of labour, and different productions can hardly be expected to come to life in the real world.

Total factor productivity by definition reflects all the factors affecting productivity, even though they are not directly factored in the production function. In this regard, Mankiw, Romer, and Weil (1992) point to the level of human capital, since it influences technological development, entrepreneurship, and creation of innovations leading to creative destructions and disruptive innovations (Mankiw *et al.*, 1992; Sobieraj, 2019). The theory of endogenous growth contributes to a number of studies, which apart from human capital, indicate research and development (R&D) activities as pivotal factors that influence economic growth (Romer, 1990; Grossman & Helpman, 1991). According to the definition by the Organization for Economic Collaboration and Development (OECD), R&D is defined as the activities involving creative work undertaken in a systematic manner so as to increase knowledge and the use of resources for new applications (Frascati, 2002). As it turns out, R&D significantly impacts productivity since it is accountable for generating innovations and their subsequent transfer. It is also worth noting that there are empirical studies proving bidirectional complementarity between R&D and human capital, which show their importance (Engelbrecht, 2002; Xu & Wang, 1999; Frantzen, 2000; Crispolti & Marconi, 2005; Bronzini & Piselli, 2006). Moreover, other important factors that determine productivity include openness of the economy to capital investment measured by the level of FDI, competitiveness of the economy measured by the level of trade with other countries, along with the level of infrastructure (*e.g.* transport, logistics performance), and the overall conditions ensuring the freedom of doing business, *e.g.* all the factors that prove the quality of democracy in a given country (*i.e.* institutional, political, and cultural). Entrepreneurial freedom can be measured, for example, by the freedom index or doing business index. The role of FDI and trade in driving productivity growth is highlighted by Pietrucha and Żelazny (2020). In turn, Artige and Nicolini (2006) note that factors such as employment, capital levels, R&D, and competitiveness determine productivity levels. They show that these factors influence both the productivity differentiation between regions (they studied regions in different European countries) and individual sectors of the economy (Artige & Nicolini, 2006). By the same token, Decker, Thompson, and Wohar (2009) conducted a study on the comparison of productivity in different states of America so as to identify inter-sectoral specialisation, education level, infrastructure, and population density as the basic determinants of productivity. In turn, in their study on productivity in various Italian regions, Bronzini and Piselli (2006) identify the level of human capital, R&D expenditure, and the quality of public infrastructure as key factors that influence productivity levels. Their research shows that out of all factors taken into account in their model, human capital played the most important role in shaping productivity levels. They use Granger's bidirectional causality concept, thus also indicating the direction of the interaction between individual variables, *e.g.* they prove Granger's causality for human capital, R&D, productivity, and the level of infrastructure and productivity; although they do not find causality in the opposite direction. On the other hand, Di Giacinto and Nuzzo (2005) identify human capital, R&D expenditure, public infrastructure level, public institutions functioning, and the level of financial markets development as key variables that affect productivity (Di Giacinto & Nuzzo, 2005). Moreover, it turns out that globalisation and the accompanying increase in international trade can have a significant impact on productivity. For example, Hung, Salomon, and Sowerby (2004) studied the relationship between foreign trade and productivity to argue that trade could affect domestic productivity through economies-of-scale, competition, reallocation, and spillover effects. Furthermore, Sequeira, Santos, and Ferreira-Lopes (2017) criticise the general lack of empirical research on the causal link between human capital, technology, trade, and inequality. In the same vein, Espoir and Ngepah (2020)

examine whether the growing inequality in income/wages increases total factor productivity. Their research provides evidence on positive spatial interactions with regards to the impact of income inequality on total factor productivity. They show that the estimated direct impact of income inequality on total factor productivity at regional level is negative and statistically significant, although on the other hand, there is also an indirect impact, which in turn, is positive.

When analysing TFP growth, we should also consider the mobility factors viewed as substitutes, which was first raised by Heckscher and Ohlin many years ago, and then revisited in literature by other authors (Markusen, 1983; Schiff, 1994; Metelski & Mihi-Ramirez, 2015). Therefore, given the growing importance of mobility factors in modern economies, we also propose to include FDI, trade, and migration (measured by the Crude Rate of Net Migration) in the set of regressors that can potentially affect TFP growth.

To sum up, the literature argues that the following factors influence productivity:

− the level of human capital that represents the quality of labour in terms of measurement (Grossman & Helpman, 1991; Di Giacinto & Nuzzo, 2005; Bronzini & Piselli, 2006; Fukao & Miyagawa, 2007; Manuelli & Seshadri, 2014);
− *capital's* share (Parente & Prescott, 2002);
− ICT investments and the complementary factors (O'Mahony & Vecchi, 2003; Castiglione & Infante, 2013);
− technological progress as primary driving force of productivity growth (Hamit-Haggar, 2011);
− R&D project activities (Di Giacinto & Nuzzo, 2005; Bronzini & Piselli, 2006);
− innovations resulting from R&D;
− the level of competitiveness (trade- as well as freedom-related);
− the level of education (Bronzini & Piselli, 2006; Artige & Nicolini, 2006);
− the openness of the economy to capital investments, and the transfer of knowledge captured by FDI flows (Grossman & Helpman, 1991; Pietrucha & Żelazny, 2020; Makieła, Wojciechowski, & Wach, 2021). FDI conclusively transmits to growth via input change yet Makieła and Ouattara (2018) notice that statistical evidence lacks to support transmission via the TFP channel;
− openness towards trade (Hung *et al.*, 2004; Danquah *et al.*, 2014; Jorgenson & Vu, 2018);
− transportation infrastructure (Liu, Wu, & Liu, 2010);
− infrastructure and machinery also known as non-ICT (Bronzini & Piselli, 2006; Decker *et al.*, 2009);
− quality of labour infput (Manuelli & Seshadri, 2014);
− inequality (Sequeira *et al.* 2017; Espoir & Ngepah, 2020).

More than two decades ago, Prescott (1998) sought to explain the large differences in income between countries, relying on the theory of total factor productivity. He wondered whether the differences in capital per employee could account for the huge differences observed in production per employee. Eventually he came to the conclusion that such a link is impossible, and that factoring in intangible capital does not make from the model of neoclassical growth a theory explaining international income differences. According to Prectott, only if an investment in intangible capital corresponds to GDP by its scale, differences in saving rates may have significant implications for the output per employee. Moreover, the same applies to the models that take into account human capital. Such models fail for similar reasons. For differences in the rates of investment in human capital to be significant, the fraction of time allocated to strengthening human capital must be considerable enough. The neoclassical model of economic growth takes into account differences between countries only if total factor productivity differs from country to country. Prescott (1998) perceived differences in total factor productivity in the context of a resistance to the adoption of new technologies and the effective use of the newest technologies; according to him, this resistance largely depends on the political arrangements agreed by a society. It can be overcome, depending on the country, by what Mokyr (1990) described as technological creativity.

Some economists prefer to use the term "multifactor productivity" (MFP) instead of total factor productivity. The reason for this is that it is almost impossible to determine all the inputs that explain the residual component of the output growth not directly linked to production inputs. Ayres and Warr

(2005) indicate that one such input may be *e.g.* energy conversion efficiency, but it can also be public infrastructure or some attributes related to labour force that are rarely considered (Schreyer, 2001; Diewert & Nakamura, 2007; Shackleton, 2013). Sickles and Zelenyuk (2019) define total factor productivity as a proportion of an aggregated production in relation to aggregated inputs. On the other hand, Comin (2010) argues that TFP reflects a fraction of output growth that cannot be attributed to labour and capital inputs utilised for production purposes. In this regard, Comin (2010) makes some simplification in terms of production technology. Measured in conventional terms, TFP represents the ratio of the production to the weighted average labour and capital inputs. According to Gordon (2017), the standard share of labour and capital is 0.7 in the case of the former and 0.3 in the latter. Comin (2010) also notes that TFP is a measure of economic efficiency that helps to understand per capita income differences between countries. Technological growth and efficiency performance are often highlighted as the two largest components of TFP. Nonetheless, new technologies have such an important function that they are usually accompanied by positive externalities and creative destructions or disruptive innovations, thereby fueling economic growth (Bower & Christensen, 1995; Christensen & Overdorf, 2000). Moreover, TFP is one of the factors that – apart from human and physical capital and labour input – is associated with economic growth. In classical terms, production growth is explained by the accumulation of production factors (*i.e.* labour and capital inputs). However, it turns out that part of the total growth of domestic production is also attributable to a residual component that cannot be linked in any way to those conventional production inputs (*i.e.*, labour and capital). Total factor productivity is precisely the sought-after residual component that cannot be measured directly yet constitutes certain residual value that affects the growth of total production; but in itself, it is not directly linked to labour and capital inputs. On the other hand, Natividad (2014) demonstrates that TFP is positively associated with business-to-business integration. The higher the integration, the higher the productivity measured by TFP. In turn, Easterly and Levine (2002) find that in an average country, TFP is responsible for about 60% of production growth per worker. Moreover, Manuelli and Seshadri (2014) conducted a study on human capital to show that when analysing TFP, the quality of labour must be taken into account besides labour input. For example, school education can be employed as a proxy indicator for the quality of labour. The number of years of schooling does not address intra-country differences. Upon re-evaluation in this regard, it becomes clear that TFP's contribution is lower than scholars originally thought. However, TFP is criticised for the lack of significant units of measurement (Barnett, 2004). The notion of TFP seems to be only a modelling artifact, whereas in the formula of the above-presented Cobb-Douglas function, the A term has no simple economic interpretation. In fact, there is a lack of statistical evidence showing unit-level measurement of productivity levels as TFP, and what we can rely on are only non-unit-level indicators of output and input growth, including residual value.

We should mention here the article by Fernald (2014) who enumerates a number of relatively high-quality sources of aggregate TFP, including the multifactor productivity measures released by the Bureau of Labor Statistics (BLS), various measures produced by Dale Jorgenson and collaborators, and the EU KLEMS project. Some important knowledge of the productivity measured by TFP is provided in the Jorgenson and Vu study (2018), who point to the example of Singapore, where TFP growth is extremely low (*i.e.* 0.5-0.6 per cent) in relation to its extraordinary output growth. In fact, Jorgenson and Vu (2018) study shows that low TFP growth can go hand in hand with high economic growth, and the causes of low productivity growth can be associated with factors such as the size of the economy, its vulnerability to various types of shocks and turmoil, the size of domestic market (*i.e.* this particularly refers to small countries), and the share of exports in GDP (*i.e.* the economy's dependence on trade). Danquah *et al.*'s (2014) study shows that the strongest determinants of the TFP growth are time-invariance, unobserved heterogeneity, and openness towards trade. Moreover, they indicate the change in efficiency (*i.e.* catching up) and technological advancement as two important components of TFP. Moreover, Fukao and Miyagawa (2007) notice that there is a positive correlation between ICT capital service input growth and TFP growth across countries.

Osiewalski *et al.* (2020) seek to find an empirical substantiation of APF within the framework of modern dynamic econometrics; to this end, they used annual data on total output and two factor aggregates. They capture such dynamics by modelling a three-variable, non-stationary time series, using VAR models

and exploring with them Cobb-Douglas-type relationships in the context of parameter variation and VAR representations in terms of conditional and marginal models for output and inputs. These authors also investigate whether APF is a co-integration type relationship, *i.e.* one that shows a relationship between aggregate outputs and aggregate inputs. However, their results did not confirm any empirical validity of an APF-type relationship in modelling annual inputs and outputs for individual economies.

Makieła (2014) analyses productivity in European countries, USA, Japan, and Switzerland. More specifically, by conducting a Bayesian stochastic frontier analysis and a two-stage structural decomposition of output growth, the authors shows the impacts on economic development of capital accumulation, labour growth, technical progress, and technical efficiency change. Makieła and Ouattara (2018) scrutinse transmission channels of FDI on economic growth. Their results reveal that FDI affects growth through input factor accumulation but not through the TFP growth channel.

Makieła, Wojciechowski, and Wach (2021) study the impact of foreign direct investment on economic growth and productivity in the sectors of the Visegrad Group a decade after their accession to the EU. They rely on a generalized random-effects model with a variable efficiency distribution. Their results show that FDI positively impacts economic growth and productivity – whose efficiency depends, among other things, on the technology gap between the host and home economies – while one of the sources of this positive impact is seen in the higher efficiency component of TFP.

The truth is that productivity allows to better understand the level of resources in each country and, more importantly, to find an answer as to how efficiently and effectively these resources are exploited. Therefore, in order to find out which factors determine the existence of disparities in the levels of development of individual countries and in general, we must take into account the key determinants of productivity (Jarmołowicz & Kuźmar, 2014). Based on the above overview of prior studies and some theoretical considerations, we propose to verify the following selective research hypotheses:

H1: Greater income inequality measured by the Gini coefficient shows strong association with TFP growth.

H2: Growth of ICT assets is an important determinant of TFP growth.

H3: The number of researchers in R&D is an important determinant of TFP growth.

H4: Logistics performance and quality of logistics services are important determinants of TFP growth.

H5: Migration – as a substitute of foreign direct investments (FDI) and Trade (TRADE) – drives TFP growth.

H6: The number of air transport as carried passengers at national levels is an important determinant of TFP growth.

MATERIAL AND METHODS

In this section, we describe our empirical study that applied the same methodological approach as described in Sala-i-Martin (1997) and Fernandez *et al*. (2001). We covered 41 countries (*i.e.* 37 OECD countries plus Romania, Russia, Croatia, and Cyprus), for which TFP growth is computed over the period of 1998-2015. We obtained our data set from the Conference Board, World Bank (WDI), and Eurostat databases. Table 1 and Table 2 specify the variables we used. The data covered 18 yearly observations for 22 selected variables. The full list of sources is showed and charactesised in Table 1.

Our model employed the Bayesian model sampling (BMS) function described by Zeugner and Feldkircher (2015), which implements Bayesian modelling averaging (BMA) for linear regression models. Let us mention that BMS allows for different priors structures, including binomial-beta prior and the "hyper-g" specification for Zellner's g-prior. Furthermore, it allows researchers to specify their own model priors, setting the prior inclusion probabilities at one's own discretion.

Table 1. List of variables used in the analysis

No.	Variable name	Description
y_t	Total factor productivity growth	Growth of total factor productivity, which is GDP growth (log change) minus the sum of the contribution of labor quantity to GDP growth, the contribution of labor quality to GDP growth, and the contribution of total capital services to GDP growth
X_1	Growth of ICT assets	Growth of services provided by ICT assets
X_2	Human capital growth	Growth of labor quality
X_3	Current education expenditure	Total (% of total expenditure in public institutions)
X_4	Government expenditure on education	Total (% of government expenditure)
X_5	School enrollment, tertiary	School enrollment, tertiary (% gross)
X_6	Transport services imports	% of commercial service imports
X_7	Transport services exports	% of commercial service exports
X_8	Air transport	Air transport, passengers carried
X_9	New business density	New registrations per 1000 people ages 15-64
X_{10}	R&D expenditure	Research and development expenditure as % of GDP
X_{11}	Researchers in R&D	Number of researchers engaged in R&D projects (per million people)
X_{12}	Technicians in R&D	Number of technicians engaged in R&D projects (per million people)
X_{13}	Total patent applications	Patent applications are global patent applications filed under the procedure provided for in the Patent Cooperation Treaty or at a national patent office to obtain exclusive rights to an invention, product, or process that provides a new mode of operation or a new technical solution to a problem.
X_{14}	Trademark applications	Trademark applications, total
X_{15}	Quality of trade and transport-related infrastructure	Logistics performance index (transport). Quality of trade and transport-related infrastructure (1=low to 5=high)
X_{16}	Trade	Trade (% of GDP)
X_{17}	Foreign direct investment, net inflows (% of GDP)	Foreign direct investments (FDI) are the net inflows of investment to acquire a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor
X_{18}	Crude rate of net migration	The crude rate of net migration is equal to the difference between the crude rate of increase and the crude rate of natural increase, *i.e.* net migration is considered as the part of population change not attributable to births and deaths.
X_{19}	Competence and quality of logistics services (quality)	Logistics performance index: competence and quality of logistics services (1=low to 5=high)
X_{20}	Quality of port infrastructure	Quality of port infrastructure, WEF (1=extremely underdeveloped to 7=well developed and efficient by international standards)
X_{21}	Logistics performance index (Overall)	Overall performance (1=low to 5=high)
X_{22}	Gini coefficient	Gini coefficient measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution

Source: own study.

Bayesian modelling averaging has an advantage over other econometric techniques in that it consistently and systematically – and more readily – deals with model uncertainty (Fragoso *et al.,* 2018). This method employs Bayesian inference to select the right model, which solves the problem of combined estimation and forecasting. Moreover, BMA adopts a relatively simple criterion for model selection, although the use of this methodology is not necessarily straightforward, and the choice of the final model based on BMA often depends on various aspects and the resulting assumptions and situational choices. Thus, BMA allows one to solve the problem of uncertainty *associated with determining the* appropriate choice of model specification. The problem arises when there are too many potential exogenous explanatory regressors. In other words, BMA is a method that indicates which explanatory

variables should be included in a canonical linear regression model, when there is a choice of many alternative models and potential variables contained in a matrix X:

$$y = \alpha_\gamma + X_\gamma \beta_\gamma + \varepsilon., \ \varepsilon \sim N(0, \sigma^2 I) \tag{2}$$

where:

y - is the dependent variable (*i.e.* TFP growth);

α_γ - is a constant;

β_γ - are the coefficients;

ε - is a normal IID error term with variance σ^2.

When it comes to the number of potential choices there are as many as $X_\gamma \in \{X\}$ variables that a researcher can choose from. Suppose that matrix X contains K potential explanatory variables. This means that there are 2^K potential sets of explanatory variables and thus also 2^K models. The choice with regards to specifications may have a significant impact on the estimated values of parameters for individual variables. On the basis of a single specification of a linear regression model encompassing all variables, the inference cannot be very reliable, and with a small number of observations, it is ineffective or even impracticable. The BMA method solves this problem since it takes into account all possible combinations of $\{X\}$ and establishes a weighted average for all of them. The model weights considered in the averaging method are determined based on posterior probabilities, what can be described with the Bayes theorem (Zeugner & Feldkircher, 2015):

$$p(M_\gamma | y, X) = \frac{p(y|M_\gamma, X)p(M_\gamma)}{p(y|X)} = \frac{p(y|M_\gamma, X)p(M_\gamma)}{\sum_{s=1}^{2^K} p(y|M_s, X)p(M_s)} \tag{3}$$

in which $p(y|X)$ is the probability that is constant for all models and therefore can be perceived as a multiplier term. In turn, $p(M_\gamma | y, X)$ is the posterior model probability (denoted as PMP), which is proportional to the marginal probability $p(y|M_\gamma, X)$ (the probability resulting from the model M_γ) multiplied by $p(M_\gamma)$, *i.e.* the prior model probability. The latter indicates the assumptions made by the researcher about the model M_γ based on one's subjective preferences. The procedure of renormalisation subsequently yields certain posterior model probabilities and model-weighted posterior distributions for every β coefficient. This can be expressed with the following formula:

$$p(\theta | y, X) = \sum_{\gamma=1}^{2^K} p(\theta | M_\gamma, y, X) \frac{p(M_\gamma | X, y)p(M_\gamma)}{\sum_{s=1}^{2^K} p(M_s | y, X)p(M_s)} \tag{4}$$

As a general rule, before estimating BMA parameters, one must make certain assumptions about the model prior $p(M_\gamma)$. In the case when we do not have adequate knowledge about specific model parameters, the most common assumption – also made by us for the purposes of our study – is to assume the uniform probability of these distributions.

The adoption of a specific estimation framework impacts the results obtained, *i.e.* posterior distributions, also known as posteriors $p(\theta | M_\gamma, y, X)$. In our study, we relied on a linear "Bayesian regression" model with the g-prior developed by Zelnner (1986). The Zelnner's g is an objective prior for the coefficients of a multiple regression. The posterior distribution of the coefficients follows a *t-distribution with expected value* $E\left(\beta_\gamma | y, X, g, M_\gamma = \frac{g}{1+g} \hat{\beta}_\gamma\right)$, with Zelnner's g and $\hat{\beta}_\gamma$ denoting the standard OLS estimator.

In essence, the empirical part of our study was based on the model described by (3). Therefore, we made certain assumptions, *i.e.* constant α_γ, error variance σ^2, error distribution described $\varepsilon \sim N(0, \sigma^2 I)$, priors that are evenly distributed in their domain $p(\alpha_\gamma) \propto 1$ and $p(\sigma) \propto \sigma^{-1}$. Naturally, we do not know what these distributions actually are, and therefore their priors are improper (they integrate to infinity and they are σ-finite measures).

Please note that the assumed prior for the errors' standard deviations σ is not uniform. This prior is uniform for $ln(\sigma)$. And from this assumption, we can obtain the prior for σ in the assumed form (i.e. proportional to $1/\sigma$). Such prior follows Jeffrey's rule, and it is often called Jaffrey's prior.

Similarly, we made certain assumptions about the regression coefficients. We assumed that they can be described by a normal distribution with zero mean and a variance, which follows the Zellner's g-prior given by: $g\sigma^2(X_\gamma^T X_\gamma)^{-1}$, $\beta_\gamma | g \sim N\big(0, g\sigma^2(X_\gamma^T X_\gamma)^{-1}\big)$.

In the case of regression coefficients, the assumption that their mean is zero reflected our lack of knowledge about their sign, while variance and covariance addressed the structure of data X_γ. In turn, in so far as our belief about the parameters was concerned, it was reflected by the priors' dispersion. The expected value of the coefficients is a convex combination of that zero mean and the OLS estimator. In turn, the size of the g-priors reflects the researcher's belief about the coefficients themselves. As g increases, so does the variance of coefficients, which in turn reflects one's drop of confidence in the assumptions made about the aforementioned mean (which is assumed to be zero, due to the lack of an a priori knowledge about the coefficients). In general, the more conservative the g-values taken in the assumptions, the greater the relevance of the priors. For smaller values of g, the expected value of coefficients is more likely to converge to the zero mean of the prior. When g-prior increases, the coefficient estimator approaches the OLS estimator. Thus, taking a specific g-prior assumption affects the posterior variance β_γ of the coefficients:

$$COV\big(\beta_\gamma | y, X, g, M_\gamma\big) = \frac{(y-\bar{y})^T(y-\bar{y})}{N-3}\frac{g}{1+g}\left(1 - \frac{g}{1+g}R_\gamma^2\right)(X_\gamma^T X_\gamma)^{-1}$$

From the above formula we can see that the posterior covariance differs from the covariance of the OLS estimator in that it takes into account the g-prior. In turn, the marginal likelihood $p\big(y | M_\gamma, y, X\big)$, resulting from the prior framework, depends on the model size k_γ, which can be expressed in the following way:

$$p(y|M_\gamma, X, g) \propto (y - \bar{y})^T(y - \bar{y})^{-\frac{N-1}{2}}(1 + g)^{-\frac{k\gamma}{2}}\left(1 - \frac{g}{1+g}\right)^{-\frac{N-1}{2}}$$

RESULTS AND DISCUSSION

Given a number of production functions (including Cobb-Douglas production function, partially parameterised Cobb-Douglas and others), when analysing TFP growth it is beneficial to check whether CRS restriction holds, *i.e.* whether or not these functions exhibit increasing returns to scale (IRS), decreasing returns to scale (DRS), or constant returns to scale (CRS). This is important because CRS is a restriction that can significantly decrease a model fit and thereby also exert an impact on the model's residuals (*i.e.* the ones reflected in equation 1 above), very likely making them larger. In other words, returns to scale shows how much the output changes given a proportional change in all inputs, in which all inputs change by the same factor (*i.e.* returns: how much output changes; scale: given a constant proportional change in all the factors.). This can be expressed in the following manner:

$$F(2K, 2L) = A(2K)^\alpha(2L)^{1-\alpha}\begin{cases}< 2Y, & \Rightarrow \text{Decreasing Returns to Scale} \\ = 2Y, & \Rightarrow \text{Constant Returns to Scale} \\ > 2Y, & \Rightarrow \text{Increasing Returns to Scale}\end{cases}$$

Typically, to test a variety of model restrictions, we can use the F-test, which is most commonly used to test for joint significance of a group of variables. However, F-test can also be used to test if CRS restriction applies, whereby a proportional increase in all inputs yields a proportional increase in the output. One example is the Cobb-Douglas production function. A logarithmic representation of the production function (similar to equation 1) can be expressed in the following form (this is only a simplification in which $1 - \alpha$ parameter is replaced by α_2):

$$log\ y_t = \alpha_0 + \alpha_1\ log\ k_t + \alpha_2\ log\ l_t + u_t$$

We can assume that under the null $H_0: \alpha_1 + \alpha_2 = 1$, the CRS restriction holds, whereas rejection of the null is indicative of a variable returns to scale ($H_1: \alpha_1 + \alpha_2 \neq 1$). Consequently, by regressing output on labour and capital inputs (all data taken from the Conference Board Database) and collecting RSS values from both restricted and unrestricted regression specifications, we came up with the F test results. F-statistic $\left(F = \frac{(RSS_0 - RSS)/p}{RSS/(n-p-1)}\right)$ was equal to 0.8459 on 2 and 581 DF (154

observations were deleted due to missingness), with *p*-value=0.4297. Since F-statistic was greater than $F_{critical}$ value, we rejected the null hypothesis of constant returns to scale ($\alpha_1 + \alpha_2 = 1$), concluding that the unrestricted model is best.

We used a specific set of variables to estimate the BMA model. The TFP growth was our endogenous variable in that model. To visualise the characteristics of the data we provide its description in Table 2.

Table 2. Variables characteristics (data description)

Var	Var Name	n	Mean	sd	Med.	Min	Max	Skew	Kurtos.	se
y_t	Total factor productivity growth	738	0.43	3.33	0.38	-18.13	19.43	-0.21	4.75	0.12
X_1	Growth of ICT assets	624	17.33	9.84	15.23	-9.11	54.88	0.83	0.81	0.39
X_2	Human capital growth	684	0.53	0.8	0.42	-5.15	7.23	0.78	14.03	0.03
X_3	Current education expenditure, total	492	91.63	4.03	92.04	63.95	100	-1.48	5.61	0.18
X_4	Government expenditure on education	569	12.3	2.73	12.07	5.98	22.27	0.51	0.17	0.11
X_5	School enrollment, tertiary	663	3.99	0.4	4.07	2.2	4.81	-1.48	3.17	0.02
X_6	Transport services exports	661	27.25	15.3	24.42	0.14	71.74	0.62	-0.33	0.6
X_7	Transport services imports	661	27.53	12.9	24.87	0.29	62.83	0.48	-0.14	0.51
X_8	Air transport passengers carried	695	2.76	0.13	2.76	2.29	2.98	-0.45	-0.15	0
X_9	New business density	374	5.12	4.86	3.96	0.28	39.04	2.69	10.75	0.25
X_{10}	R & D expenditure (% of GDP)	669	1.27	0.86	1.03	0.02	3.91	0.91	0.02	0.03
X_{11}	Researchers in R&D (per million people)	587	7.71	0.73	7.82	4.12	8.99	-1.1	2.79	0.03
X_{12}	Technicians in R&D	467	6.36	0.96	6.35	3.56	8.23	-0.57	0.31	0.04
X_{13}	Total patent applications	688	6.47	2.00	6.57	0.69	10.85	-0.1	-0.07	0.08
X_{14}	Trademark applications, total	682	9.28	1.07	9.16	6.56	11.67	0.29	-0.6	0.04
X_{15}	Quality of trade and transport infrastructure	159	3.23	0.66	3.17	1.78	4.34	-0.01	-1.22	0.05
X_{16}	Trade (% of GDP)	738	4.52	0.44	4.47	3.11	6.01	0.58	0.45	0.02
X_{17}	FDI, net inflows (% of GDP)	582	-0.24	0.64	-0.05	-4.37	0.52	-2.62	10.02	0.03
X_{18}	Crude rate of net migration	725	1.39	6.6	1.2	-46.8	34	-0.57	7.77	0.25
X_{19}	Competence and quality of logistics services	159	3.27	0.58	3.23	2	4.32	-0.08	-1.06	0.05
X_{20}	Quality of port infrastructure	356	4.64	1.19	4.73	1.5	6.8	-0.34	-0.54	0.06
X_{21}	Logistics performance index	159	3.31	0.53	3.26	2.08	4.18	-0.16	-1.09	0.04
X_{22}	Gini coefficient	636	2.6	4.38	2.74	-25.72	19.8	-0.7	4.23	0.17

Source: own elaboration in R-studio.

We modelled the TFP growth results with the use of linear regression as follows:

$$y_i = \beta_0 + \beta_m^T X_i^m + u_i \tag{5}$$

where:

X_i^m - k_m dimensional vector that expresses economic explanatory variables which explain the *total factor productivity growth* (TFP growth) – our dependent variable;

β_m - vector that reflects marginal contributions of the explanatory variables;

β_0 - intercept of the regression;

u_i - error term.

Table 3 below shows the respective results. The posterior inclusion probabilities (PIPs) expressed the posterior probability that a given regressor forms part of the "true" linear regression model. Table 3 also contains the posterior means (Post.Mean) and posterior standard deviations (Post SD). The posterior means informed us about the extent of the determinant's effect, whereas posterior standard deviation assessed its deviation. We assumed that the "true TFP model" can consist of a base specification and a few additional variables. We should remember that national economies typically show some heterogeneity, meaning that a small number of complementary determinants may contribute to the scope of TFP growth. On the other hand, some of the potential TFP growth determinants may turn out to be substitutes insofar as countries' socio-economic interpretation is concerned. Hence, there is a certain probability that characterises situations when we deal with an early inclusion of a regressor/determinant.

Table 3. Coefficient results (BMA)

Var	Var Name	Code	PIP	Post.Mean	Post SD	Cond.Pos.Sign	Idx
X_1	Growth of ICT assets	GICT	0.959	-0.121	0.0405	0.0000	1
X_2	Human capital growth	HCG	0.102	0.0024	0.1272	0.5974	2
X_3	Current education expenditure	CEE	0.281	-0.0247	0.0600	0.0130	3
X_4	Government expenditure on education	GEE	0.182	-0.0039	0.0777	0.4095	4
X_5	School enrollment, tertiary	SET	0.132	0.1039	0.6665	0.8643	5
X_6	Transport services, commercial exports	TSCE	0.191	0.0070	0.0263	0.9165	6
X_7	Transport services, commercial imports	TSCI	0.241	-0.0095	0.0317	0.0868	7
X_8	Air transport as passengers carried	ATPC	0.152	-0.0634	1.2896	0.3894	8
X_9	New business density	NBD	0.327	-0.0223	0.0461	0.0376	9
X_{10}	R&D expenditures	RD	0.191	0.0917	0.497	0.7595	10
X_{11}	Researchers in R&D	RRD	0.231	-0.1678	0.5718	0.1844	11
X_{12}	Technicians in R&D	TRD	0.129	-0.0362	0.2448	0.2325	12
X_{13}	Total patent applications	TPA	0.315	0.0586	0.1554	0.9662	13
X_{14}	Trademark applications, total	TA	0.177	0.0245	0.2367	0.7476	14
X_{15}	Quality of trade and transport infrastructure	QTTI	0.123	-0.1648	0.8634	0.1563	15
X_{16}	Trade	TRADE	0.204	0.0940	0.4870	0.794	16
X_{17}	FDI net inflows	FDI	0.175	-0.0654	0.3209	0.1371	17
X_{18}	Crude rate of net migration	MIG	0.477	-0.0290	0.0379	0.0000	18
X_{19}	Competence and quality of logistics services	CQLS	0.957	-8.7528	3.2009	0.0045	19
X_{20}	Quality of port infrastructure	QPI	0.580	0.4462	0.4863	1.0000	20
X_{21}	Logistics performance index	LPI	0.984	9.4564	3.3889	0.9978	21
X_{22}	Gini coefficient	GC	1.000	0.5107	0.0943	1.0000	22
			1.000	-0.5983	NA	NA	

Source: own study.

Table 3 shows the variables and their corresponding statistics. The fourth column "Post.Mean" shows the coefficients averaged across all models, including the ones wherein the variable was not contained (implying that the coefficient is zero in such case). The following covariates exhibited comparatively large positive or negative coefficients and seem to be relevant: Gini coefficient (GC), growth of ICT assets (GICT), competence and quality of logistics services (CQLS), logistics performance index (LPI), quality of port infrastructure (QPI), and crude rate of net migration (MIG). The third column (PIP) shows the importance of variables in explaining the data, which represents posterior inclusion probabilities, *i.e.* the sum of PMPs for all models wherein a covariate was included. We saw with 100% certainty that all posterior model mass rested on models that included inequality measured by the Gini coefficient (GC). In turn, growth of ICT assets (GICT) had the PIP of appx. 95.96%, competence and quality of logistics services (CQLS) – 95.73%, logistics performance index (LPI) – 94.83%, quality of port infrastructure (QPI) – 58%, crude rate of net migration (MIG) – 47.76%. Other co-variates had corresponding PIP values within the range 10.26-31.56% and seemed to matter less. The coefficient sign could have also been inferred from the sixth column Cond.Pos.Sign, the "posterior probability of a positive coefficient expected value conditional on inclusion" (Zeugner & Feldkircher, 2015). Finally, the last column idx denotes the index of the variables' appearance in the data set, which might be useful when sorting the results by PIP values. Considering PIP values, the variables explaining TFP growth can be generally divided into four groups, which are showed in Table 4 below. Distinguishing our regressors by relevance of provided evidence made it easier to assess their reliability in explaining the variability of endogenous variable. Those with the highest PIP value provided the strongest evidence justifying their inclusion in the true regression model that described the variability of the response variable (TFP growth).

In the next step we checked which models actually performed best. To this end, we used a function that expressed binary representations for all included model specifications. Table 5 below shows the results of the top three models.

Table 4. Division of regressors according to provided evidence

Regressors with strong evidence for which $PIP > 0.5$. This group includes variables that exhibit greater posterior inclusion probability compared to the priors. In the case of these variables, we may conclude that there is strong evidence justifying their inclusion in the true model. In our study, we were able to indicate five such variables that belong to the group of regressors providing strong evidence in explaining the variability of TFP growth, namely the Gini coefficient (GC), growth of ICT assets (GICT), competence and quality of logistics services (CQLS), logistics performance index (LPI), and quality of port infrastructure (QPI).	The second group are **regressors with medium evidence**, in which $0,5 \geq PIP > 0,2$. There are seven such determinants in the case of our TFP gowth analysis, namely crude rate of net migration (MIG), new business density (NBD), total patent applications (TPA), current education expenditure (CEE), transport services – commercial imports (TSCSI), and trade (TRADE).
Regressors with weak evidence $0,2 \geq PIP > 0,1$, *i.e.* those with a relatively low probability of posterior inclusion compared to priors; although it can be shown that they also explain the variability of our exogenous variable: TFP growth. In our quantitative TFP growth study, there were 10 such regressors/determinants, *i.e.* transport services – commercial exports (TSCSE), R&D expenditures (RD), government expenditure on education (GEE), trademark applications (TA), FDI net inflows (FDI), air transport – passengers carried (ATPC), school enrollment tertiary (SET), technicians in R&D (TRD), quality of trade and transport infrastructure (QTTI), and human capital growth (HCG).	**Regressors with negligible evidence** $(PIP \leq 0,1.)$. Regressors belonging to this group provided the weakest evidence that they were in fact true determinants of the endogenous variable under investigation. This group provided little evidence for explaining the TFP growth. None of the regressors included in the study fell into this particular group.

Source: own study.

Table 5. Top three models

Variable	Code	20001b	20000b	20001f
Growth of ICT assets	GICT	1.0000	1.0000	1.0000
Human capital growth	HCG	0.0000	0.0000	0.0000
Current education expenditure, total	CEE	0.0000	0.0000	0.0000
Government expenditure on education	GEE	0.0000	0.0000	0.0000
School enrollment, tertiary (% gross)	SET	0.0000	0.0000	0.0000
Transport services (commercial exports)	TSCSE	0.0000	0.0000	0.0000
Transport services (commercial imports)	TSCSI	0.0000	0.0000	0.0000
Air transport as passengers carried	ATPC	0.0000	0.0000	0.0000
New business density	NBD	0.0000	0.0000	0.0000
R&D expenditures (% of GDP)	RD	0.0000	0.0000	0.0000
Researchers in R&D (per million people)	RRD	0.0000	0.0000	0.0000
Technicians in R&D (per million people)	TRD	0.0000	0.0000	0.0000
Total patent applications	TPA	0.0000	0.0000	0.0000
Trademark applications, total	TA	0.0000	0.0000	0.0000
Quality of trade and transport infrastructure	QTTI	0.0000	0.0000	0.0000
Trade (% of GDP)	TRADE	0.0000	0.0000	0.0000
FDI net inflows (% of GDP)	FDI	0.0000	0.0000	0.0000
Crude rate of net migration	MIG	1.0000	0.0000	1.0000
Competence and quality of logistics services	CQLS	1.0000	1.0000	1.0000
Quality of port Infrastructure	QPI	0.0000	0.0000	1.0000
Logistics performance index	LPI	1.0000	1.0000	1.0000
Gini coefficient	GC	1.0000	1.0000	1.0000
	PMP (MCMC)	0.2416	0.1386	0.0780

Source: own study.

Table 5 also shows the posterior model probability for all three models. As the results showed, thebest of the presented models was characterised by a 24.16% probability of the posterior model and contained five regressors. However, the second best model contains four variables/regressors and had a corresponding PMP of 13.86%.
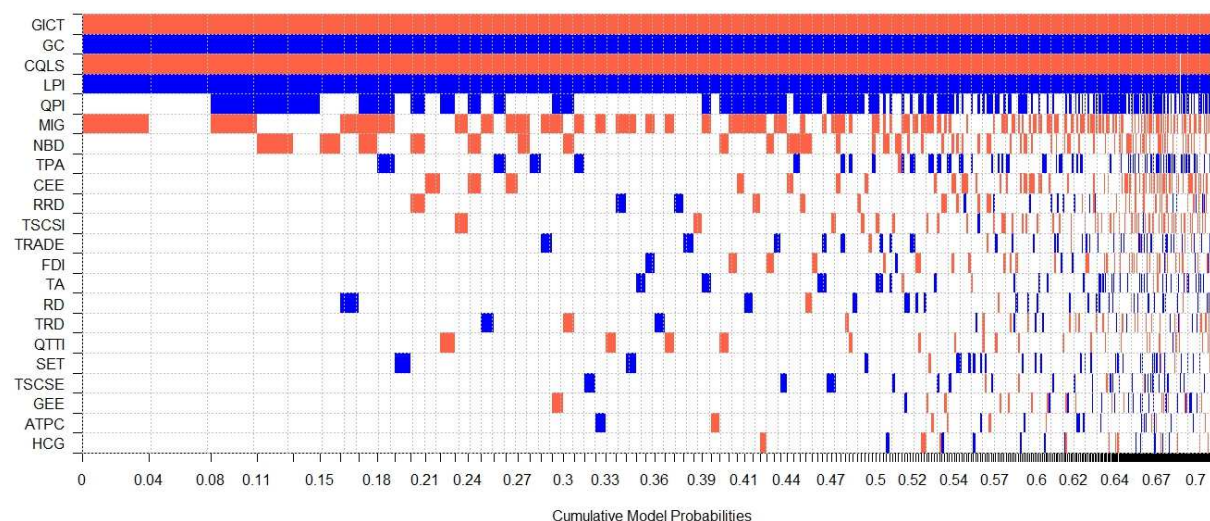
Figure 2. Model inclusion vased on best 500 models
Source: own elaboration.

Figure 2 allowed for a more comprehensive model overview. Positive coefficients were shown in blue and negative ones in red. In turn, white colour indicated zero coefficients, meaning that in this case no specific regressors were included in the real model (*i.e.* non-inclusion). Figure 2 also showed the cumulative probability of the analysed models (*i.e.* best 500 models) scaled by their PMPs. We could see *e.g.* which regressors were more frequently incorporated into the models and even whether they had stable coefficient signs. After all, there were cases when they had positive and negative coefficients, depending on the models. This graphical representation of the problem under investigation allowed us to see that the best model contained the following variables: the growth of ICT assets (GICT), Gini coefficient (GC), competence and quality of logistics services (CQLS), logistics performance index, (LPI), and crude rate of net migration (MIG). Furthermore, we saw that the growth of ICT assets (GICT), Gini coefficient (GC), competence and quality of logistics services (CQLS), and logistics performance index (LPI) were incorporated in virtually all models. In contrast, there were variables/regressors that were included rarely, and their coefficient signs changed according to the model, *e.g.* reserchers in R&D (RRD) or trade (TRADE).

The PIP column represented posterior inclusion probabilities (PMPs), *i.e.* the sum of the PMPs for all models in which the variable was included, thus it captured the importance of the variables in explaining the data. If PIP was 100% – as is the case for the Gini coefficient (GC) variable – it meant that virtually all of the posterior model mass rests on this particular variable. Next in order were the growth of ICT Assets (GICT) with the PIP value of 95.96%, competence and quality of logistics services (CQLS) – 95.73%, logistics performance index (LPI) – 94.83%, and quality of port infrastructure (QPI) – 58%. In turn, the crude rate of net migration (MIG) was present in two out of three top models and had a corresponding PIP of 47.76%.

When considering the inclusion of a number of potential regressors in the real model, we should also analyse the posterior expected model size, *i.e.* the average number of included regressors. When performing a BMA analysis, we can calculate this posterior statistic, which equals the sum of PIP values, and in our case, it was 8.082. This statistic value actually differed from the expected model size, which was calculated for our model sample based on a specific formula. Keep in mind that when dealing with 2^K possible regressor combinations, the theoretical value of the common prior model probability is equal to $p(M_\gamma) = 2^{-K}$. Moreover, the expected model size is $\sum_{k=0}^{K} \binom{K}{k} k 2^{-K} = \frac{K}{2}$. Furthermore, note that there are many combinations of possible models of k_γ-size, thus the uniform model prior makes the intermediate model sizes more robust. The latter will be characterised by a model size of $k_\gamma = 11$

with probability that is equal to $\binom{22}{11} 2^{-K} = 16.81\%$. Figure 3 below illustrates the deviation between the posterior model size distribution and the prior expected model size (K/2).
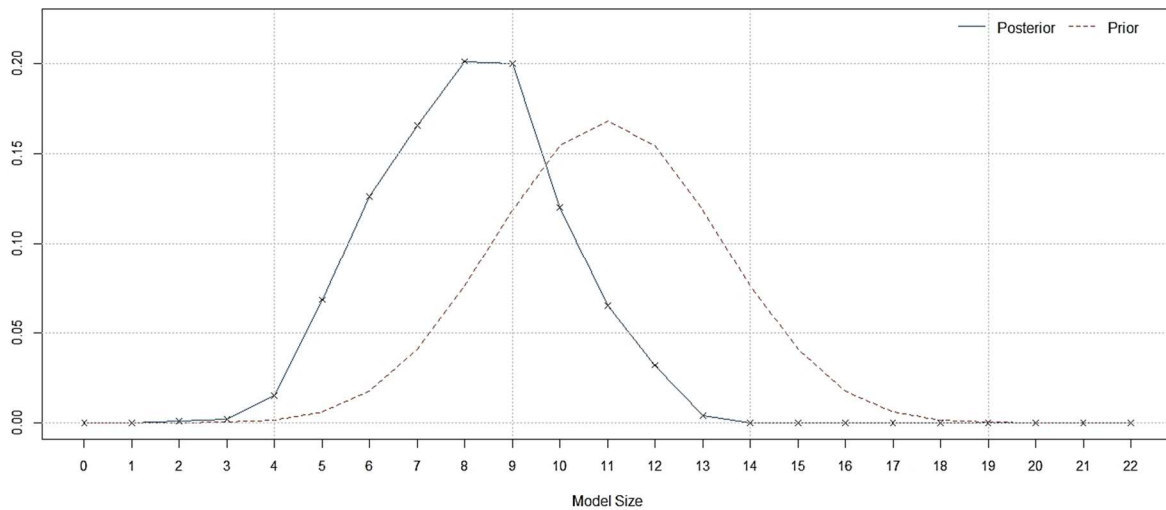

Figure 3. Posterior model size distribution (mean 8.0827)
Source: own elaboration.

Moreover, Figure 3 reveals that the model prior assumes a symmetric distribution around the mean $K/2 = 11$, whereas the posterior provides evidence in favour of the models with fewer regressors.

In the study, we wanted to include as many variables as possible, especially those related to mobility factors. In addition to traditional variables (mobility channels) such as FDI and trade, we included variables related to transport infrastructure, logistics, and mobility, associated with *e.g.* trade and FDI. Such variables were transport services, logistics performance, competence and quality of logistics services, quality of trade and trade infrastructure, quality of port infrastructure, air transport as passengers carried, and net migration. Especially in the context of studies found in the literature, migration can be regarded as a substitute for other mobility factors (*e.g.* FDI or trade). In light of the Hecksher-Ohlin's theory, migration is a substitute to trade and FDI (Metelski & Mihi-Ramirez, 2015).

In sum, the study provided supporting evidence for hypotheses **H1**, **H2,** and **H4**. In contrast, there was no strong evidence supporting hypotheses **H3**, **H5,** and **H6**. There was medium evidence supportive of hypotheses **H3** and **H5** and weak evidence supportive of hypothesis **H6**.

In the context of posterior inclusion probabilities, our study showed that some of the studied TFP growth determinants are indeed meaningful and have corresponding PIP values at a high level, meaning that these variables appear in the majority of models typified as the best of all possible combinations of variables explaining TFP changes: in our case, these variables were 22. In addition to the Gini coefficient and ICT asset growth, we can point to the competence and quality of logistics services (CQLS) with a PIP of 95.73% and logistics performance index (LPI) with a PIP of 94.83%, the quality of port infrastructure (QPI) with corredponding PIP of 58%, and crude rate of net migration (MIG) with a PIP of 47.76% – as the most significant variables. This means that the quality of logistics services – along with migration and the associated "brain drain" – are important variables explaining changes in TFP growth. A good example of the impact of logistics and the quality of port infrastructure on productivity growth is provided by Polish ports, which are striving to improve their position in Europe. This is confirmed by the current state of the port of Gdańsk, which is now a regional player, and one of the biggest in the Baltic Sea; all this happened over the last two decades. In the same way, the quality of logistics services is increasing very significantly in Poland. The conclusion is that productivity can be increased not so much through FDI or trade channel but e.g. by improving logistics services and port infrastructure. The same is true for human capital and migration. In this specific example, we see that productivity can be influenced by migration processes, which have

increased very significantly in the last two decades, as opposed to the improvement in the quality of human capital (which has the lowest corresponding PIP value of merely 10.26%).

However, the study has some limitations. Namely, our general assumptions in the construction of the model (concerning priors) based on Zellner's g-priors are very generic, which actually reflects the lack of specific beliefs of researchers concerning the distributions of models' parameters. When performing BMA, it is necessary to set priors both in the model space and in the parameter space within each model (*i.e.* priors for the regression coefficients and the variance parameter). In this regard, a failure to take an adequate approach when setting a flat prior across all models, may result in significantly different posterior estimates in the PIP for each variable, but also the posterior model size (Eicher, Papageorgiou, & Raftery, 2011). Since our model has 22 variables, this actually results in $2^{22} = 4\,194\,304$ possible regression models. It should be emphasised here that these assumptions are very important, since they are the foundation for posterior inclusion probabilities, based on which we formulate the Bayesian inference.

Moreover, let us foreground that we tested whether the data we employed met the CRS assumption. The results of the F-test showed that the data we used (output as a function of capital and labour inputs) exhibit variant returns to scale. In the theoretical part, we emphasised that modern economies operating in the era of industrial revolution 4.0, more and more often benefit from economies of scale, which should be visible in the data, namely in the form of increasing returns to scale (IRS). In other words, modern economies are supposed to be driven by increasing returns to scale. The industrial revolution 4.0 brings with it new forms of economic activities, meaning that some of the output produced may be outside the reportable sphere, *e.g.* Uber drivers, Youtubers, sellers on Amazon (who may come from different countries), crowdsourcing platforms (*e.g.* Upwork, Fiverr). In fact, some of the output may be either outside of the reportable space or may be driven by entrepreneurs from countries other than those in which their work (output) is reported. On the one hand, modern digital platforms and technologies enable economies of scale (copying and selling additional digital products is esentially cost-free), and the output itself is in reality probably significantly higher than what we see in the data. All in all, our study provides evidence that supports the importance of the growth of ICT information technologies, which to some extent reflects the problem we have described above. This is actually in line with earlier findings observed by Mokyr (1990) or Hamit-Haggar (2011), *e.g.* in that technological progress and technological creativity are the driving forces of productivity growth. In our case, this progress is evidenced in the variable ICT assets' growth, which seems to be present across all model space. The ICT assets can be perceived as an important factor influencing productivity growth via the economies of scale channel. On the other hand, it is also worth recalling Diewert and Fox (2008) study, who argue that economic growth is driven by increasing economies of scale rather than technical progress, and that technical progress itself usually turns out to be insignificant.

CONCLUSIONS

In the article, we focused on the selection of the most robust variables for developing regression models explaining TFP growth. The empirical part of our study relies on the BMA methodology and panel data for 41 developed countries (37 OECD countries, plus Romania, Russia, Croatia, and Cyprus). This framework is rooted both in purely statistical time series analysis of data and in macroeconomic APF theory, which is particularly attractive to those researchers who seek a well-founded framework for modelling aggregate output. Furthermore, since Bayesian model comparison is sensitive to prior distributions, we conducted our study carefully relying on Zellner's g-priors (Zeugner & Feldkircher, 2015). To make the comparison fully operational, reduce the computational burden, and avoid the possibility of criticism from a purely numerical viewpoint, we restricted ourselves to the simplest classes of g-prior distributions. Alongside this, we strived for a reliable review of the literature in the context of the TFP growth by emphasising its importance for the creation of the prosperity of societies. Morevero, we shed light on the importance of BMA models for empirical productivity research, while emphasising the importance of TFP-measured productivity for understanding contemporary economic conditions. Because of the multitude of possible explanatory variables in such regression models (scientists have

been keen to study productivity for years because – to quote Krugman's classic text (1991) – in the long term everything depends on productivity) and a relative lack of guidance from economic theory as to which variables should be contrasted, we decided to analyse the "robustness" of the results from numerous regression models' specifications. Based on this methodology, we indicated a number of variables that are relevant for modelling productivity growth, classifying them as potential regressors. Moreover, we divided the regressors into four groups due to their posterior inclusion probability (PIP) levels and the resulting strength of the regressions, indicating what the optimal number of variables might be when building such models. We managed to confirm hypotheses **H1**, **H2**, and **H4**. In contrast, there is no strong evidence supporting the hypotheses **H3**, **H5** and **H6**. There is medium evidence supportive of hypotheses **H3** and **H5** and a weak evidence supportive of hypothesis **H6**. Such inference is evidenced in the posterior inclusion probabilities (PIPs) showed in Table 3.

With regards to the scientific context, we reviewed the literature that emphasises that a very large part of economic expansion is dependent on the growth of TFP. We indicate a number of determinants that drive TFP growth, *e.g.* inequality measured by the Gini coefficient, growth of ICT assets, logistics performance, quality of logistics services, quality of port infrastructure, and net migration. Finally, a study based on BMA allows for the selection of TFP regressors but ultimately depends on a sample of the data used for its completion. Therefore, a different selection of countries and period under study will probably yield different results. However, BMA as a research method is gaining more and more popularity because it enables researchers to divide regressors into those that are more relevant and stable and those that show less robustness, thus being an important method for developing economic models.

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Authors

Contribution share of authors is equal and amounted to 50% for each of them.

Janusz Sobieraj

Assistant Professor in the Department of Building Engineering, Faculty of Civil Engineering at the Warsaw University of Technology. He is a civil engineer with a degree from the Warsaw University of Technology and holds a PhD in economic sciences in the field of management sciences from the Department of Computer Science and Management of the Wrocław University of Technology. He is an author of several books on construction management, strategic management, and industrial revolution 4.0. His research interests are primarily in the areas of construction management, entrepreneurship, applied economics, mobility factors, productivity, organisations and management, and technologies.

Correspondence to: Janusz Sobieraj, PhD, Department of Building Engineering, Faculty of Civil Engineering, Warsaw University of Technology, Poland, e-mail: jsob@il.pw.edu.pl

ORCID http://orcid.org/0000-0002-0819-7384

Dominik Metelski

Research Assistant in the Department of Spanish and International Economics at the University of Granada (Spain). He is an economist with a degree from the University of Warsaw and holds a PhD in the field of economic sciences from the Department of International Economics of the University of Granada, under the Programme of Studies on Advanced Techniques in Financial and Commercial Planning, Management, and Control. His research interests are primarily related to such topics as productivity, migration, and issues in the areas of entrepreneurship, innovation, real options, and financial markets, with particular emphasis on companies' valuations, portfolio management, and financial options.

Correspondence to: Dominik Metelski, PhD, Department of Spanish and International Economics at University of Granada, Spain, e-mail: dmetelski@ugr.es

ORCID http://orcid.org/0000-0003-0195-0342

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Interdependence between human capital determinants and economic development: K-means regional clustering approach for Czechia and Poland

**Michał Wielechowski, Denys Cherevyk, Katarzyna Czech,
Pavel Kotyza, Łukasz Grzęda, Lubos Smutka**

A B S T R A C T
Objective: The objective of the article is to identify the groups of regions characterised by a similar level of human capital determinants and investigate the relationship between cluster-based human capital determinants and economic development.
Research Design & Methods: We analyse key demographic, health, educational, labour, technological, and cultural determinants of human capital and the level of regional economic development. The research covers the period 2004-2019 for 14 Czech and 16 Polish regions. We apply k-means clustering improved by PCA using data for human capital determinants. To verify significant differences between distinguished clusters, we apply the Kruskal-Wallis test. To assess the interdependence between human capital determinants and regional economic development, we use Spearman rank correlation.
Findings: We distinguish three clusters for Czechia and four clusters for Poland that differ significantly in terms of human capital determinants level. Moreover, we show that both Czech and Polish clusters significantly differ in the median level of GDP per capita. It implies the existence of interdependence between human capital determinants and economic development. We reveal a positive and significant relationship between GDP per capita and life expectancy, higher education rate, economic activity rate, and Internet access, and a negative and significant relationship between the number of library users and the regional economic development. The results are consistent for Czechia and Poland.
Implications & Recommendations: Our study could create a new perspective for discussing similarities and differences in regional human capital development. The results could help decision-makers to identify the regions that need the most to stimulate the human capital determinants to reduce the differences in human capital, and in the long-term perspective, it might contribute to the regional economic development growth.
Contribution & Value Added: Most studies analyse the relationship between human capital and economic growth and development using data for given regions or countries separately. Our contribution is that we first distinguish clusters representing regions with similar human capital levels. Then, based on cluster data, we assess the relationship between the human capital determinants and economic development. To the best of our knowledge, there have been no similar regional research studies conducted to daye, including Czechia and Poland.

INTRODUCTION

Economic development is a topic broadly discussed by numerous economic scholars. Over the years, it evolved into an individual economic discipline. However, according to scholars such as Hicks and Streeten (1979) and Sen (1980), global development goals were connected mainly to economic indicators, including Gross National Product. But the effects of Sen and other thoughts contributed to an update in the meaning of development. Since the 1980s, the development of humans and their capabilities is considered the main objective of development. Amartya Sen's philosophy of human capabilities (Sen, 1980) was widely accepted by the international community and, in fact, contributed to the official UN Human Development Index establishment. Nevertheless, as argued by others (Stewart, Ranis & Samman, 2018), improved human capital is essential for sustainable economic growth.

Although the implementation of human capital into development studies does not have a long-lasting history, the idea of human capital is quite old. Sir William Petty (1623-1687) was the first one who tried to define and measure human capital. He believed that labour as the "father of wealth" should be measured and incorporated into national wealth estimation (Folloni & Vittadini, 2010). Human capital was introduced and popularised as a concept in economic literature by Mincer (1958), Schultz (1961), and Becker (1964). According to them, human capital is created by people equipped with scientific knowledge and skills that can be used to create and use innovations in the economy and to improve practical activity. Others identify human capital as intellectual capital that originates in such attributes as knowledge, skills, relationships, and attitudes (Kianto, Saenz & Aramburu, 2017; Wang & Cuervo-Cazurra, 2017; Yusoff, Jantan & Ibrahim, 2004). Jabłoński (2021) claims that terminological inconsistencies accompanying human capital and appearing among representatives of various economic schools result from different theoretical traditions on which these researchers base their discussions.

Diebolt's and Hippe's (2019) conclusions to a certain extent raise the question whether human capital is the determinant of global growth or is it economic growth that determines human capital development. The endogenous growth theories (Lucas, 1988; Romer, 1986) assume intangible assets to be the fuel of economic growth. However, Mincer (1996) argues that human capital is both the factor and effect of the growth, while Ahmad and French (2011) conclude that an increase in income growth is followed by improved human capital (Ahmad & French, 2011).

Knight, Loayza, and Villanueva (1993) find that human capital positively affects economic growth. Herbst (2009) claims that human capital significantly influences economic development, including by increasing the capacity of regional economies to absorb and generate technological innovations and improving the region's attractiveness. Access to human capital fosters regional economic development and growth (Lucas, 1988). Accumulation and quality of human capital are considered the key factors of economic growth (Mincer, 1981; Lucas, 1988; Barro, 1991; Mankiw, Romer & Weil, 1992; De la Fuente & Doménech, 2006; Erosa, Koreshkova & Restuccia, 2010; Gennaioli *et al.*, 2013a; Manuelli & Seshadri, 2014; Balcerzak, 2016, Grzeszczyk, 2020; Shachmurove & Zilberfarb, 2020).

In the European context, many studies evaluate European regions from the perspective of human capital (Cuaresma *et al.*, 2018; Laskowska & Dańska-Borsiak, 2017; Martín & Herranz, 2004; Pater & Lewandowska, 2015). This article aims to identify the groups of regions characterised by similar human capital indicators for Czechia and Poland separately. We analyse key demographic, health, educational, labour, technological, and cultural determinants of human capital, including migration balance, life expectancy, higher education, economic activity, Internet access, and library users. To our knowledge, there are no other studies using such a broad set of human capital indicators. The literature review presented in the next section confirms that the analysed human capital determinants were properly selected. Based on principal component analysis (PCA) and k-means clustering, we identify the groups of regions characterised by a similar human development status. Moreover, we apply the Kruskal-Wallis test to assess the existence of significant differences between clusters and analysed human capital determinants. Furthermore, we add GDP per capita as a key factor differentiating clusters. Then, based on distinguished clusters, we assess the relationship between analysed human capital determinants and GDP per capita by applying Spearman's rank correlation coefficient.

Most studies analyse the relationship between human capital and economic growth and development using data for given regions or countries separately (Azam, 2019; Egert, Botev & Turner, 2020; Gruzina, Firsova & Strielkowski, 2021; Xu & Li, 2020). Our contribution is that – contrary to those studies – we first distinguish clusters representing regions with similar human capital levels, and then based on cluster data, we assess the relationship between the human capital determinants and economic development, measured by GDP per capita. Tano (2014) claims that regional differences in economic growth and welfare are rooted in the spatial distribution of human capital. To the best of our knowledge, there have been no similar regional research studies conducted yet, including Czechia and Poland.

The article could help decision-makers identify the regions that most need to stimulate human capital determinants.

The agenda of our article is as follows. The next section will present a review of the scientific literature on human capital determinants, research hypotheses. The posterior section will set out the study's aim and desribe the material and research methods used. The subsequent section will present the empirical findings and discussion, and the final section will offer our conclusions.

LITERATURE REVIEW

Regions tend to differ due to the spatial unevenness of economies of scale and market forces, in which agglomeration effects lead to a strong concentration of capital and labour in some regions (Biscaia *et al.*, 2017; Kijek & Matras-Bolibok, 2019). Mitigating economic differences between various regions is not only the task of national and regional governments but also a common approach to regional convergence in the European Union (Alcidi, 2019; Kijek & Matras-Bolibok, 2020). The European Union applies a complex set of measures to improve the European regions' economic performance and limit existing regional disparities. The cohesion (regional) policy targets business competitiveness, sustainable development, job creation, economic growth, and citizen's quality of life (UNESCO, 2017). The policy itself much attention to human capital development support, mainly by employing two main investment funds: European Social Fund and European Regional Development Fund. Scholars continue a heated discussion about whether the cohesion policy has statistically significant impacts on cohesion (Piętak, 2021).

In the first half of the twentieth century, neoclassical economists identified three factors related to growth: land, capital, labour. In the 1950s, the Solow-Swan model identified those factors as insignificant to technological progress (exogenous), which was a pulling factor of US economic growth (Piętak, 2014). The narrow concept with the only important factor of technological advancement was extended by a list of endogenous factors such as education, quality, and diversity of institutions, along with capital flow, technology, ideas, investments, and human capital (Barro & Sala-i-Martin, 1992; Piętak, 2014; Roszko-Wójtowicz *et al.*, 2019). Since the 1980s, human capital has gained importance in neoclassical (Jorgenson & Fraumeni, 1992) and endogenous growth models (Lucas, 1988; Romer, 1986).

The World Bank report (2010) identifies that 60-80% of total country wealth is created by intangible capital, dominated by human capital over the quality of institutions and historical and geographical legacy. In countries that belong to the Organization for Economic Cooperation and Development (OECD), the intangible capital is considered to be the only significant factor of production. Those findings lead to recommendations that human capital investments are a crucial component of the development process.

Since Becker (1964), human capital use and measuring have developed. Currently, the human capital concept is not only used for national growth (at the macro level) but also for corporate purposes (micro-level; Bryl & Truskolaski, 2017; Buzavaite & Korsakiene, 2019; Graczyk-Kucharska & Erickson, 2020). The macro-level measuring methodologies and approaches are divided into two basic categories: direct and indirect measurements. While the indirect approach assumes that current human capital value equals the future discounted value of capital stocks benefits, the direct approach measures stock of human capital based on information on various components via (i) cost-based method, (ii) lifetime income-based method, and (iii) indicator-based method. Alternatively, Liu and Fraumeni (2020) divide human capital measuring methods into monetary- and index-based. The indirect indicator/index-based approach is employed in this article as this approach employs a variety of proxy indicators (United Nations, 2016).

Statistics Poland identifies six groups of human capital indicators: (i) demography, (ii) health, (iii) education, (iv) labour market, (v) culture, and (vi) science, technology, and innovation. Statistics Poland employs a combination of various related groups supported by the literature. Education and health proxies are common and the most popular (Lim *et al.*, 2018; UNDP, 2020; World Bank, 2021). The Global Human Capital Index published by World Economic Forum also includes education (capacity), labour market (deployment), and science, technology (know-how; World Economic Forum, 2017). Demography, including immigration, is considered an important factor by the United Nations (2016) as it defines newcomers as new human capital assets. According to Bucci and Segre (2011), culture belongs to the endogenous drivers of economic growth, being complementary to human capital. We decided to use six group categories (education, demography, culture, labour market, health, science, and innovations) employing six relevant proxies to identify differences in human capital formation and its effects on regional GDP formation.

Migration leads to the inflow of human capital assets, but also on the contrary, it could result in capital outflow (United Nations, 2016). Migration theory by Sjastaad (1962) compares the utility between given locations. The propensity of migration is positively correlated with human capital performance (Faggian & McCann, 2006). The outcome of personal, household, and region of residence characteristics are significant in modelling the decision to migrate (Ritsilä & Ovaskainen, 2001). In this regard some groups of the population are more sensitive to the living and working environment. First of all, it is typical for well-educated youth (Tvaronavičienė *et al.,* 2021) whose perception of well-being should be measured with special attention to prevent the negative consequences in demographic sphere. Human capital migration is most often analysed in terms of push and pull factors (Zikic, 2015). Abel and Deitz (2012) reveal only a minimal relationship between the production and stock of human capital in a region. They argue that it is migration patterns that influence the regional structure of human capital. Other studies' results show that the relationship between internal migration and economic growth and development is ambiguous. Etzo (2008) and Bunea (2012) reveal the significant and positive impact of migration on economic growth, while Kirdar and Saracoglu (2008) and Hierro and Maza (2010) observe the opposite relationship, *i.e.* negative. Each 10% GDP increase could cause a 0.6% decrease in net migration (Simionescu *et al.*, 2016). Moreover, Wolszczak-Derlacz (2009) finds no effect of internal migration on economic development in Poland. Borozan (2017), based on Croatian counties' data, shows that the migration flows do not significantly reduce regional disparities in economic development. Based on the results of the above-presented studies, we formulate the following research hypothesis:

H1: Migration balance is positively correlated with the regional economic development level.

Life expectancy at birth is usually used as a proxy of health conditions (Weinberger, 2014). Sachs (2001) proves that every improvement in the life expectancy of society increases economic growth. Lorentzen, McMillan, and Wacziarg (2008) find that life expectancy improvements lead to faster economic growth. However, Acemoglu and Johnson (2007) show that longer life expectancy trigger more rapid population growth but negatively affects income per capita. Based on the results of the above-presented studies, we put forward the following research hypothesis:

H2: Life expectancy is positively correlated with the regional economic development level.

Many observe direct and indirect relationships between the state of education and economic development (Harbison & Myers, 1964; Wilson & Briscoe, 2004; Shafuda & De, 2020). Using evidence from more than 1500 regions, Gennaioli *et al.* (2013b) conclude that regional education is the only critical determinant of regional development. Bradley and Taylor (1996) show that the easier access to education and training redound to the regional human capital growth. The OECD data leads to conclusions that one year of longer schooling increases GDP by 6% (Bassanini & Scarpetta, 2002). Faggian and McCann (2008), prove on British regional data that higher education is a key factor favouring regional economic development. However, Krueger and Lindahl (2001) illustrate that decreasing returns to education exist in the latter stages of development. Universities and other high educational institutions affect regional economic dynamics, contributing to new ventures and productivity improvements, but only if a region can absorb high-skilled professionals. On the other hand, graduates could decide to migrate out of the

region. Bennett, Glennerster, and Nevison (1995) claim that the inflow/outflow of graduates into/from a given region indicates the extent to which a region is efficient in acquiring the new human capital. Based on the results of the above-presented studies, we formulate the following research hypothesis:

H3: Higher education rate is positively correlated with the regional economic development level.

Indicators of employability or economic activity serve as a labour market proxy. Economic growth and unemployment are interconnected (Soylu, Çakmak & Okur, 2018). Thus, the existence of Okun's law is broadly proved from a regional perspective (Freeman, 2000). Laureys (2014) notes that human capital is eroded in times of high unemployment. Ngo *et al.* (2020) state that human capital and social capital are individual-level important factors affecting employment transition status in rural areas. Based on the results of the above-presented studies, we set the following research hypothesis:

H4: Economic activity is positively correlated with the regional economic development level.

Science, technology, and innovations are proxied by the indicator of Internet access. In particular, the United States of America promote Internet-related human capital, serving as an incubator for new industries and a magnet to attract talents from around the globe (Manyika & Roxburgh, 2011). For developing countries, steep ICT development can enforce new impulses of economic progress (Bilan *et al.*, 2019). Together with the latest available technologies available at schools, ICT development can affect productivity growth (Máté *et al.*, 2020). The World Bank and the OECD argue that the increase of Internet access rate – as a human capital determinant – positively affects GDP growth (Jiménez, Matus & Martinez, 2014). Based on OECD countries in 1996-2007, Czernich *et al.* (2011) find that a 10 percentage point increase in broadband Internet penetration is linked to raised annual per capita growth by 0.9-1.5 percentage points. On the contrary, Diebolt and Hippe (2019) argue that technology is not increasing human capital. Still, human capital shall be understood as a key factor explaining regional disparities in innovation. Based on the results of the above-presented studies, we put forward the following research hypothesis:

H5: Internet access is positively correlated with the regional economic development level.

Sacco and Segre (2009) indicate the lack of research studies focusing on the culture's impact on economic growth. Bucci and Segre (2011) point out that culture may represent an important factor in economic growth. Based on Statistics Poland publication, libraries and reading habits were used as a proxy for the cultural dimension. Using contingent valuation methods, Stejskal, Hájek and Řehák (2019) prove the benefits of public libraries in relation to costs to be fourfold and twelvefold in the case of general libraries and libraries for kids, respectively. Moreover, public libraries often serve as community centres enhancing human capital improvement by facilitating an individual's lifelong learning process (Lo & Stark, 2020). Libraries offer cheap or free of charge access to resources for educational and recreational purposes (Balapanidou, 2015). According to Varheim (2009), Scott (2011), and Ferguson (2012), public libraries develop social capital. Based on the results of the above-presented studies, we set the following research hypothesis:

H6: Library usage is positively correlated with the regional economic development level.

RESEARCH METHODOLOGY

The study aimed to identify the groups of regions characterised by a similar level of human capital determinants and investigate the relationship between cluster-based human capital determinants and regional economic development. We conducted the study both for Czechia and Poland. These two neighbour countries represent CEE post-soviet-satellite economies and are characterised by a similar level of Human Development Index (CZ 0.9 and PL 0.88 in 2019; United Nations, 2021).

Our study could create a new perspective for discussing similarities and differences in human capital development from a regional perspective. The research problem was investigated based on data presenting various areas of the studied phenomenon. The main areas were demographic, health, educational, labour, cultural, and technological determinants of human capital, *i.e.* the balance of migration, life expectancy, higher education rate, employment rate, number of library users, and Internet

access in 14 regions in Czechia and 16 regions (voivodeships) in Poland. The primary initial list of candidate variables contained 15 determinants. Finally, six human capital determinants representing six different categories were used in cluster analysis. They are presented in Table 1 below.

Table 1. Selected determinants of human capital and the categories they represent

Human capital determinant	Category
Migration balance	demography
Life expectancy	health
Higher education	education
Economic activity	labour
Internet access	technology
Library users	culture

Source: own elaboration based on Statistics Poland.

Migration stands for the number of people changing their residence to or from a given area. In our study, *migration balance* refers to the crude rate of net interregional migration plus a statistical adjustment to the average population in that particular year. The value of migration balance is expressed per 1000 residents. *Life expectancy* refers to the average life expectancy at birth of all population members in the particular region. Higher *education* stands for the rate of tertiary education among the population aged 15 and over. *Economic activity* equals the economic activity rate, *i.e.* the percentage of active persons in relation to the total working-age population, both employed and unemployed. *Internet access* refers to the rate of households with Internet access among all the households in the particular region. *Library users* stand for the number of active library readers per 1000 residents. The above-mentioned human capital determinants were selected iteratively to effectively differentiate human capital status in all 14 Czech and 16 Polish regions. Moreover, they belong to the most frequently used by Statistics Poland (GUS, 2019). Furthermore, economic development is measured by Gross Domestic Product per capita.

Data came from the Local Data Bank (LDB) and the public database of the Czech Statistical Office (2021). The LDB by Statistics Poland is Poland's largest database of the economy, households, innovation, public finance, society, demography, and the environment. The LDB offers over 40,000 statistical data and indicators that describe statistical towns, communes, counties, voivodeships, and entire Poland (Local Data Bank, 2020). The Czech Public Database is a unified and basic data source for the presentation of statistical data. It collects all standard statistical outputs of the Czech Statistical Office, but it also stores data from external sources, especially from ministries and other state statistical services.

We standardised the variables to make them comparable between regions of different size and population. We used annual data which are taken from the Local Data Bank and Czech Public Database. The research covered the period 2004-2019, which was as up-to-date as possible.

Clustering is the task of assigning a set of objects into groups (called clusters) so that objects in the same cluster are more similar (in some sense or another) to each other than to those in other clusters (Bagirov, 2008). Interest in regional clusters and their role in economic development has grown substantially among academics, economic development professionals, and firm managers over the last several years. Cluster analysis allows us to draw useful conclusions in economic studies (MacQueen, 1967; Imandoust & Bolandraftar, 2013). Clustering is an important part of data exploratory analysis, using for identity-hidden knowledge from data by group. K-means nearest neighbour is a popular algorithm using for unsupervised learning, based only on input vectors known labels or outcomes. The method is useful in numerical segmentation of economic data and was introduced by MacQuenn (1967).

To cluster Czech and Polish regions according to the human capital performance, we applied k-means clustering developed by Linde, Buzo, and Gray (1980). The number of clusters was identified based on gap statistic (Tibshirani, Walther, & Hastie, 2001). The lowest gap statistic indicates the optimal number of groups that should be distinguished. Then, we segmented regions considering the selected human capital determinants. The goal of the k-means procedure was to find the closest distance of points from the cluster's centre (Ding & He, 2004).

We used the principal component analysis PCA to more effective clusters distinction as Ding and He (2004) and Honda, Notsu, and Ichihashi (2010) suggest. The solution helped mark the largest variations and reduced noise from values for a better-performing k-means algorithm. Finally, clustering was used on the transformed dataset to PCA with dimensional reduction components. The results were presented in the form of a hierarchical analysis dendrogram and PCA figure. The obtained estimations – subjected to a hierarchical analysis based on Ward Criterion's method (Ward, 1963) – were linked threes measure of dissimilarity between two clusters and was defined as the sum of the squared deviations within these clusters.

Moreover, by applying the Kruskal-Wallis test (Kruskal, 1952; Kruskal & Wallis, 1952), we assessed the existence of significant human capital determinants' differences between the distinguished clusters. Furthermore, we investigated whether the selected clusters significantly differ in terms of economic development measured by the GDP per capita.

Then, we applied Spearman's rank correlation coefficients and corresponding significance test to measure the relationship between the analysed human capital determinants and economic development level in each cluster separately.

The entire analysis was performed in the statistical computing environment R.

RESULTS AND DISCUSSION

The research was conducted separately for Czechia and Poland. We present the results in the alphabetical order of the analysed countries' names.

Czechia

We analysed 14 Czech regions. Based on the estimated gap statistics for a different number of clusters, we indicated three as the optimal number of clusters. We performed a cluster analysis based on the k-means algorithm. To check the robustness of the cluster analysis results, we applied a principal component analysis (PCA). The analysis aimed to classify the Czech regions into one of three groups, considering six selected human capital determinants, including migration balance, life expectancy, higher education, economic activity, Internet access, and library users.

Figure 1 below presents the results of the principal component analysis (PCA), which proved the existence of significant differences in the regional clustering of human capital in Czechia. In terms of PCA, some regions appeared closer to each other. Prague region was the farthest from other the 13 regions, *i.e.* the least similar to others. Moreover, Karlovy Vary region, the smallest and the weakest in GDP, had a certain distance from the others.
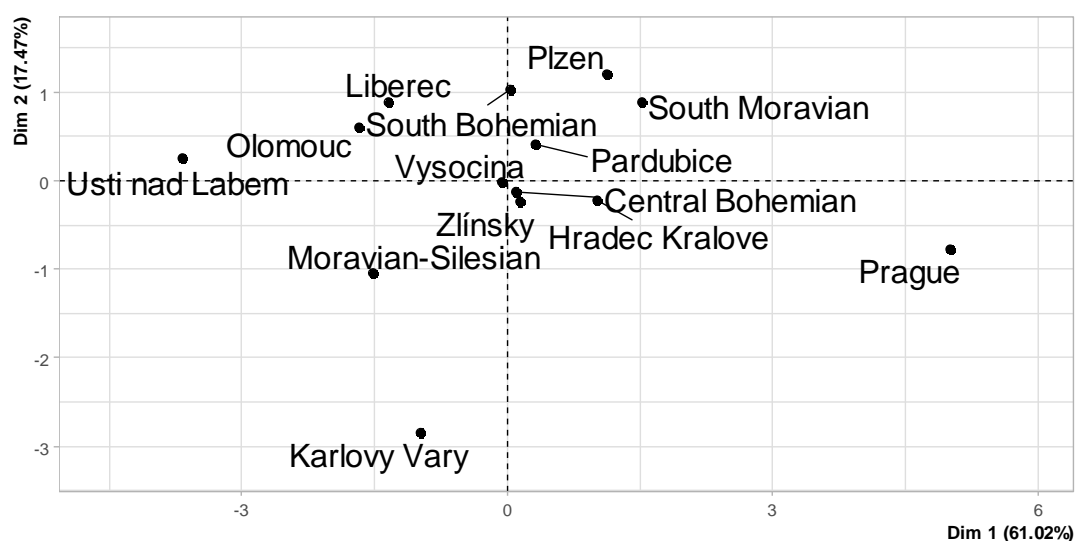

Figure 1. Regional clustering of human capital in Czechia based on PCA
Source: own elaboration.

K-means regional clustering (Figure 2, Figure 3) and principal component analysis (PCA; Figure 1) indicated the existence of significant differences in human capital between the distinguished clusters (groups) composed of Czech regions. The dendrogram revealed clusters in which regions were combined according to their similarity. For example, Olomouc and Liberec Regions were closest to each other, which meant they are also the most similar, while the Prague region was the farthest from other regions, *i.e.* it was the most different.
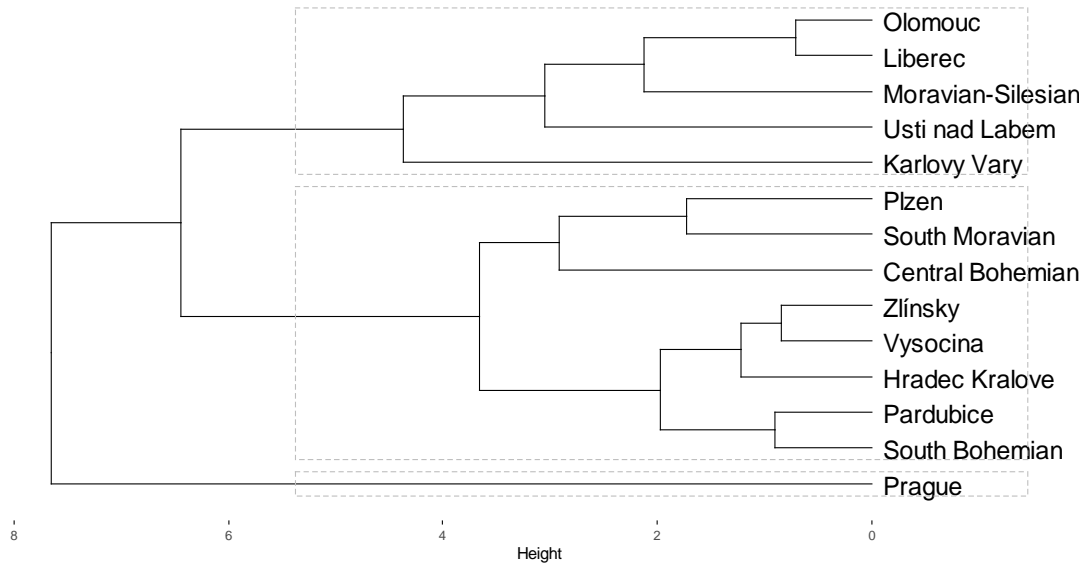
Figure 2. K-means regional clustering of human capital in Czechia
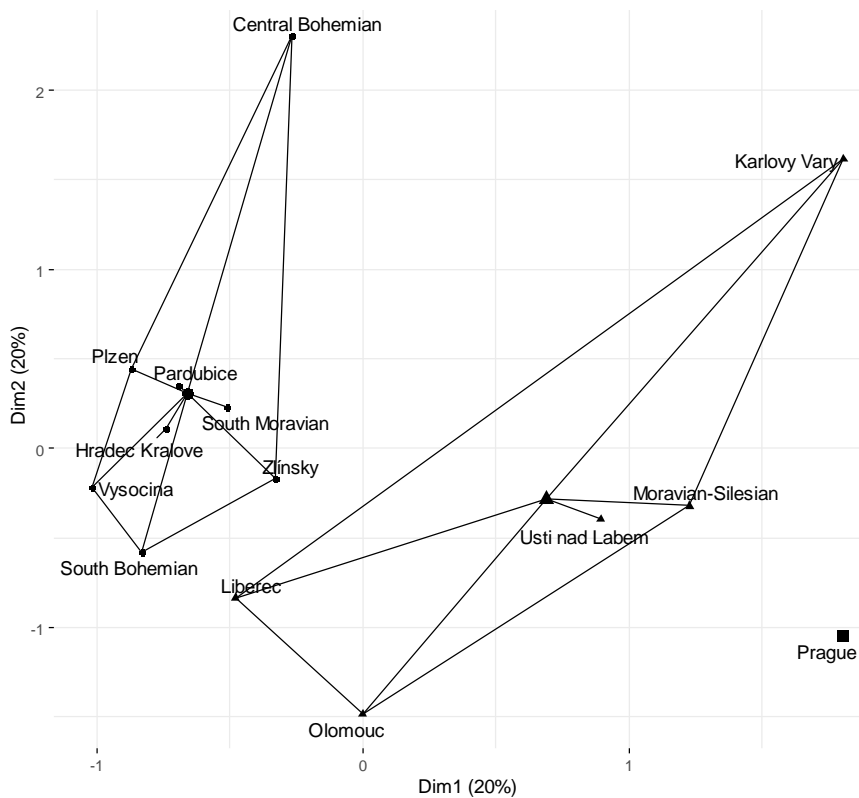Source: own elaboration.

Figure 3. Cluster plot based on k-means clustering for Czechia
Source: own elaboration.

Cluster I represented five Czech regions characterised by the lowest values of all six analysed human capital determinants (see Table 2). Those were considered to be lagging regions, have the weakest economic performance, and many internal problems. Their situation was either related to the transformation phase – as many industries did not succeed – industrial orientation (such as mining), or their geographical location (being in the periphery). Those clusters were expected to be still eligible for EU regional policy funding. Cluster II referred to eight Czech regions with the average values of human capital determinants, apart from migration balance. The positive migration balance resulted from the substantial inflow of people to Central Bohemian region due to its geographical location close to Prague and lower real estate prices, among other things.

Those regions were expected to be phased out of the regional policy funding and moved from less developed to transition ones. In general, those eight regions were not suffering from high unemployment. They were able to attract foreign direct investments (*e.g.* in manufacturing like Hradec Kralove, Plzen, Zlin, or in services like the South Moravian Region) or are closely linked to the capital city as the Central Bohemian Region. Cluster III includes only Prague, the capital city, and it characterises the largest values of analysed human capital determinants (apart from migration balance). The Prague Region is considered one of the most developed regions in the EU measured by GDP per capita to regional EU average. Prague is characterised by a negative interregional migration balance, but on the contrary, a positive migration balance from abroad. It is the administrative centre with the highest number of public universities, public libraries, medical institutions, and a high demand for qualified labour.

Table 2. Mean values of human capital determinants and GDP per capita in distinguished Czech clusters

Human capital determinants	Cluster I	Cluster II	Cluster III	Czechia
Migration balance	-1.94	0.432	-0.59	-0.49
GDP	9963.08	11422.37	29570.95	12197.52
Life expectancy	77.46	78.76	79.93	78.38
Higher education	12.70	15.30	34.10	15.74
Economic activity	0.74	0.76	0.80	0.75
Internet access	67.23	71.17	76.07	70.11
Library users	122.81	138.33	173.46	135.30

Source: own study.

Our next task was to verify whether the differences between the distinguished clusters are statistically significant. For this purpose, we applied the Kruskal-Wallis test.

The results presented in Table 3 implied significant differences in median values of all six analysed human capital determinants between two out of three distinguished clusters. A significant difference between the analysed groups of Czech regions applied to life expectancy at 1% significance level, Internet access at 5% significance level, along with migration balance, higher education, economic activity, and library users at 10% significance level. Moreover, the results of the Kruskal-Wallis test indicated that the distinguished clusters differed in median GDP per capita level at the 5% significance level. It implied that the level of GDP per capita and human capital determinants are linked to each other.

Table 3. Results of Kruskal-Wallis test for Czechia

Human capital determinants	Chi Sq	p-value
Migration balance	4.85	*
Life expectancy	10.03	***
Higher education	5.74	*
Economic activity	5.27	*
Internet access	7.35	**
Library users	5.74	*
GDP per capita	7.97	**

Notes: ***, ** and * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.
Source: own elaboration of the public database of the Czech Statistical Office (2021).

Table 4 contains the estimated Spearman Rank correlation coefficients with corresponding significance tests between human capital determinants and economic development measured by GDP per capita. Our study revealed significant relationships between GDP per capita and five out of six analysed determinants. Surprisingly, we did observe a significant relationship between migration balance and economic development. In the case of life expectancy, higher education, Internet access, and economic activity, the relationship with GDP per capita was positive. Unexpectedly, the cultural human capital determinant (library users) was at the same time negatively correlated with economic development. The results agreed with H2, H3, H4, H5, while contradicted H6. Moreover, we did not find a statistically significant relationship between migration balance and GDP (H1).

Table 4. The relationship between human capital determinants and GDP per capita in Czechia: Spearman rank correlation

Cluster	Migration balance and GDP	Life expectancy and GDP	Higher education and GDP	Economic activity and GDP	Internet access and GDP	Library users and GDP
I	0.533	0.588*	0.564*	0.588*	0.600*	-0.600*
II	-0.567	0.721**	0.709**	0.721**	0.721**	-0.855***
III	-0.167	0.661**	0.648**	0.636*	0.661**	-0.709**

Notes: ***, ** and * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.
Source: own study.

Poland

We analysed 16 Polish regions (voivodeships). Based on the estimated gap statistics for a different number of clusters, we indicated four as the optimal number of clusters. As in the case of the analysis of Czech regions, we performed clustering analysis based on the k-means algorithm and apply a principal component analysis (PCA) to check the robustness of the clustering analysis results. The analysis sought to classify the voivodeships into one of the four groups while considering six selected human capital determinants, including migration balance, life expectancy, higher education, economic activity, Internet access, and library users. The k-means regional clustering analysis grouped Polish voivodeships into four clusters. The results showed significant differentiation of voivodeships based on the determinants included.

Figure 4, presenting the results of the principal component analysis (PCA), proved the existence of significant differences in the regional clustering of human capital in Poland. In terms of PCA, some regions were closer to each other. Masovian voivodeship, including Warsaw, was the farthest from the other 15 regions, *i.e.* the least similar to others. This result is similar to Czechia, in which the Prague Region with the capital city greatly differs from other regions.

K-means regional clustering (Figure 5, Figure 6) and PCA (Figure 4) indicated the existence of significant differences in human capital between the distinguished clusters (groups) composed of Polish voivodeships. The dendrogram below reveals clusters in which regions were combined according to their similarity. According to our study Lublin and Holly Cross were closest to each other, which means they also were the most similar, while the Masovian voivodeship was the furthest from other Polish regions, *i.e.* the latter region differed the most from others and belonged to a homogenous group. The most numerous cluster consisted of seven voivodeships.

Cluster A – the most numerous group – contains the regions characterised by most human capital determinants' mean values that remained below the Polish average and the lowest GDP per capita (see Table 5). Cluster A contains the regions located in the eastern part of Poland. A relatively high level of economic activity could have been explained by the vast majority of this cluster is one of Poland's most agricultural regions, with high hidden unemployment. Cluster B – representing four voivodeships with the most important economic centres (regional capital cities), namely Krakow, Wroclaw, Poznan, and Gdansk – was characterised by positive migration balance and the level of other five human capital determinants over the Polish average. Cluster C – containing four voivodeships – was characterised by the lowest mean levels of life expectancy, higher education, and economic activity among the four distin-

guished groups, along with a negative migration balance. Cluster D – containing only Masovian voivodeship with Poland's capital of Warsaw – was characterised by the largest values of all analysed human capital determinants and highest GDP per capita among the distinguished clusters.
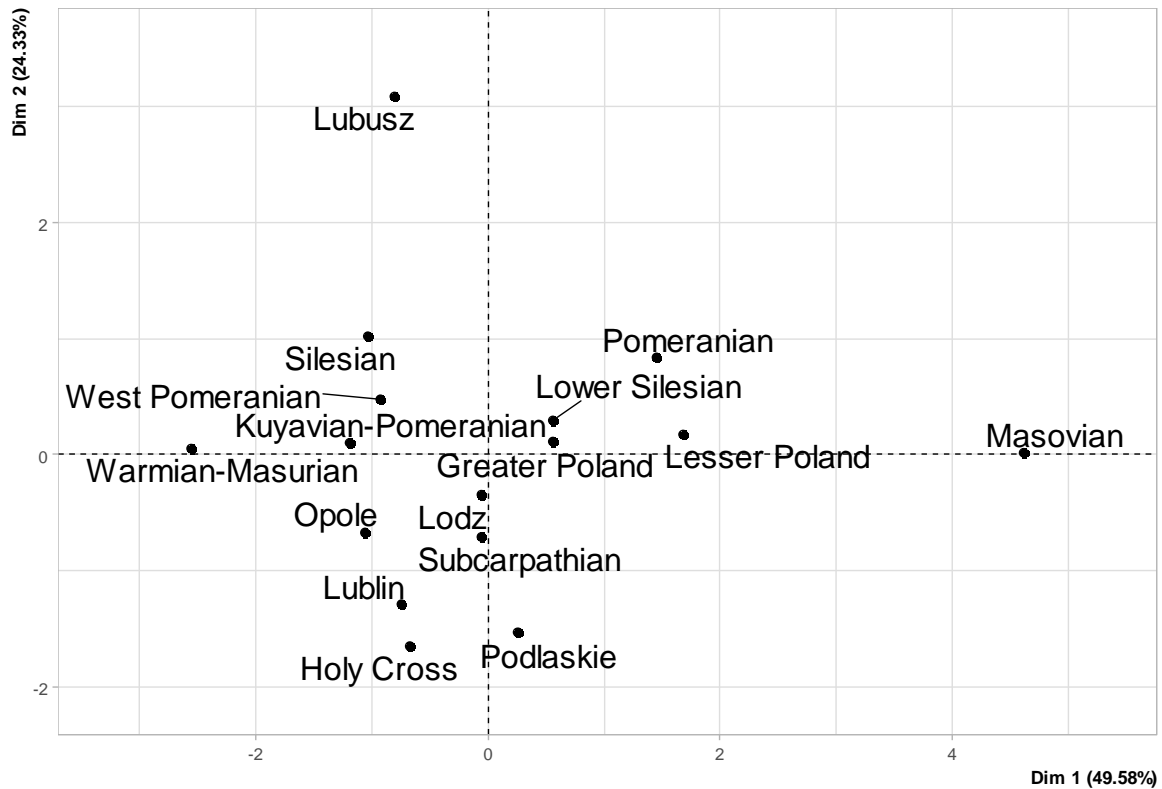

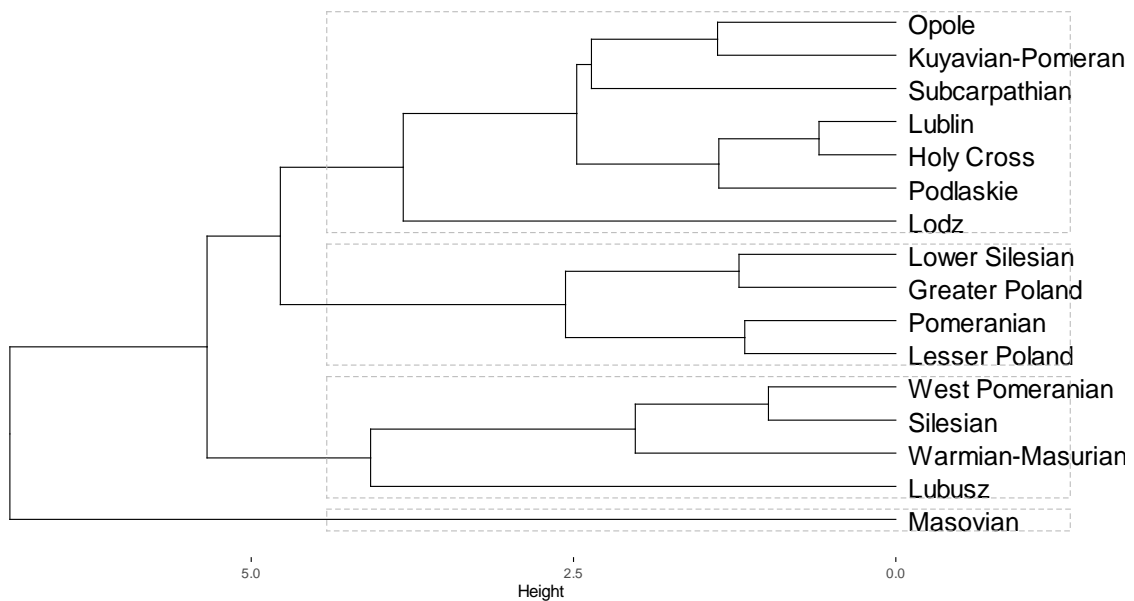**Figure 4. Regional human capital clustering in Poland based on PCA**
Source: own elaboration.

Figure 5. K-means regional clustering of human capital in Poland: a dendrogram based on PCA transforming
Source: own elaboration.
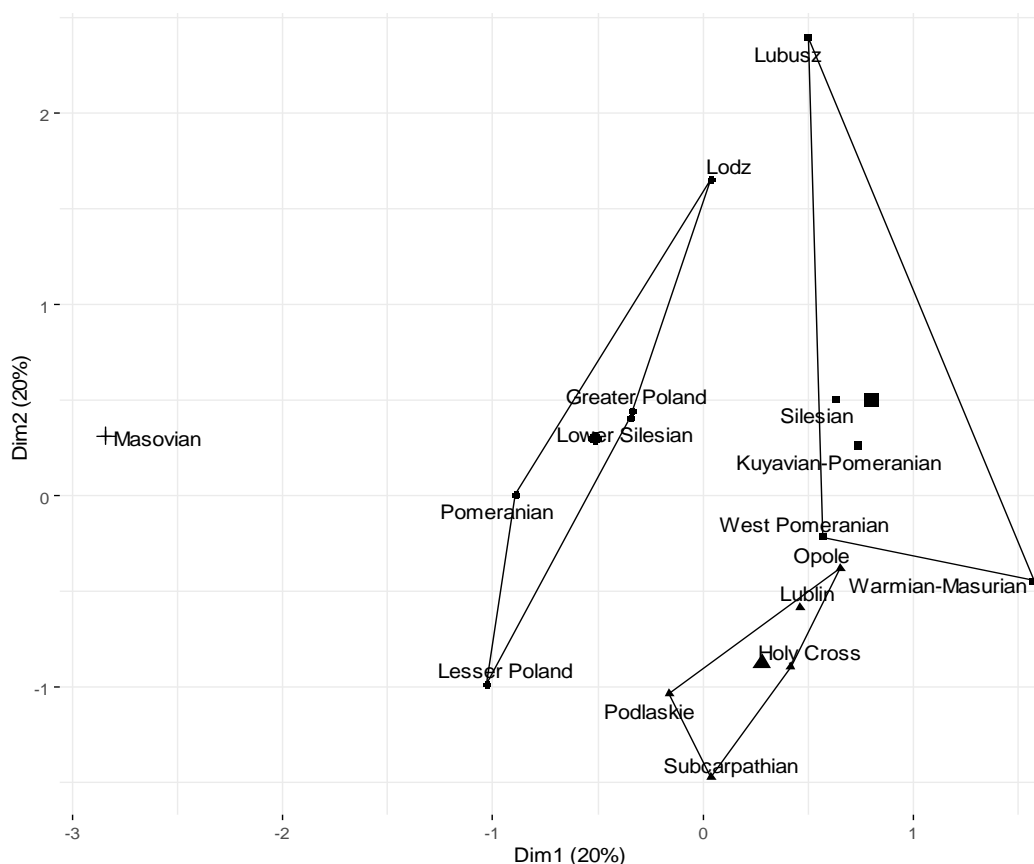
Figure 6. Cluster plot based on k-means clustering for Poland
Source: own elaboration.

Table 5. Mean values of human capital determinants and GDP per capita in Polish clusters

Human capital determinants	Cluster A	Cluster B	Cluster C	Cluster D	Poland
Migration balance	-1.47	0.70	-1.21	2.43	-0.62
Life expectancy	77.16	77.34	76.42	77.46	77.04
Higher education	18.17	20.15	17.62	28.15	19.15
Economic activity	73.49	73.31	70.01	77.88	72.85
Internet access	60.13	65.91	67.37	67.68	63.86
Library users	150.42	169.19	161.60	176.62	159.54
GDP per capita	6588.09	8576.49	7331.02	13456.29	7700.19

Source: own study.

Our next task was to verify whether the differences between the distinguished clusters are statistically significant. For this purpose, we applied the Kruskal-Wallis test.

The results presented in Table 6 indicated that there are significant differences in median values of four out of six analysed human capital determinants between at least two out of four distinguished clusters. A significant difference between analysed groups of Polish voivodeships applied to migration balance at 1% significance level, economic activity at 5% significance level, along with life expectancy and higher education at 10% significance level. However, we did not reveal the significant differences in median values of technological and cultural determinants among distinguished clusters. Moreover, the results of the Kruskal-Wallis test showed that the distinguished clusters differed in the median level of GDP per capita at 5% significance level. Similarly to Czechia, the results implied that the GDP per capita and human capital determinants remain in the relationship. The Kruskal-Wallis test results indicated that migration balance, life expectancy, higher education, and economic activity significantly impacted the regional differentiation of human capital in Poland.

Table 6. Results of one-factor analysis of variance: the Kruskal-Wallis test for Poland

Human capital determinants	Chi Sq	p-value
Migration balance	11.40	***
Life expectancy	7.32	*
Higher education	7.57	*
Economic activity	11.03	**
Internet access	6.19	-
Library users	2.59	-
GDP	11.19	**

Notes: ***, ** and * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.
Source: own study.

Table 7 presents the estimated Spearman rank correlation coefficients with corresponding significance tests between human capital determinants and economic development measured by GDP per capita. Our study revealed significant relationships between GDP per capita and five out of six analysed determinants. However, we did not observe a significant relationship between the migration balance and economic development apart from cluster B. In the case of life expectancy, higher education, Internet access, and economic activity, the relationship with GDP per capita was strongly positive, *i.e.* above 0.7. Surprisingly, the number of public library users negatively correlated with economic development. Table 7 results indicated the similarities between Poland and Czechia. The results agreed with H2, H3, H4, H5, while contradicted H6. Moreover, apart from cluster B, we did not find a statistically significant relationship between migration balance and GDP (H1).

Table 7. The relationship between human capital determinants and GDP per capita in Poland: Spearman rank correlation

Cluster	Migration balance and GDP	Life expectancy and GDP	Higher education and GDP	Economic activity and GDP	Internet access and GDP	Library users and GDP
A	0.143	0.654**	0.753***	0.736***	0.736***	-0.753***
B	0.580**	0.797***	0.863***	0.846***	0.857***	-0.796***
C	0.061	0.659**	0.742***	0.742***	0.736***	-0.740***
D	0.122	0.809***	0.852***	0.843***	0.819***	-0.423

Notes: ***, ** and * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.
Source: own study.

DISCUSSION

The regional cluster analysis and Kruskal-Wallis test results for Czechia and Poland show that distinguished clusters differ significantly not only in terms of the level of analysed human capital determinants but also in the level of economic development. This implies the existence of an interdependence between the above-mentioned variables, which agrees with broad literature base (Mincer, 1981; Lucas, 1988; Barro, 1991; Mankiw *et al.*, 1992; De la Fuente & Doménech, 2006; Erosa *et al.*, 2010; Gennaioli *et al.*, 2013a; Manuelli & Seshadri, 2014; Balcerzak, 2016).

Based on the distinguished clusters, we revealed a significant relationship between GDP per capita and analysed human capital determinants, *i.e.* life expectancy, higher education, economic activity, Internet access, and library users. Naturally, we are conscious that human capital is only a partial determinant of economic growth. Ogbeifun and Shobande (2021) show that, apart from human capital, other important economic development determinants are savings rate and trade openness.

We prove the positive relationship between life expectancy as a proxy of health services and economic growth. Our results are in line with Sachs (2001) and Lorentzen *et al.* (2008). In general, health is understood to have a positive relationship to GDP growth. However, Ogbeifun and Shobande (2021) present that life expectancy has adverse effects on growth. Our sample is rather balanced, and we do

not observe large differences in life expectancy values. This leads us to the assumption that life expectancy is rather a national-wide issue related to the central health system.

Together with health, education is seen as the second most important factor of human capital (Biscaia *et al.*, 2017; Czapiewski & Janc, 2019; Ogbeifun & Shobande, 2021; Ogundari & Awokuse, 2018), which has a positive effect on economic growth. As expected, our results confirm other researchers' findings on the positive and significant relationship between higher education rate and economic development level. Acquired tertiary education differs among regions. It is not only about the availability of tertiary education institutions; the frequent factor for interregional migration towards capital cities is the lack of opportunities. Thus, graduates' inflow or their capturing indicates a regional potential for human capital formation (Bennett *et al.*, 1995).

Migration is the only variable that has a statistically insignificant correlation. Even though it is migration insignificant, we still observe high differences among selected regions. Some are more attractive for national migration flows. Our insignificant results are consistent with other studies, including Derlacz-Wolszczak (2009) and Borozan (2017). However, it is important to note that the immigration of university-educated labour significantly impacts the economic development and competitiveness of territories (Oliinyk *et al.*, 2021) and vice versa high intensity of skilled emigration can cause disastrous effect on country's intellectual potential restoring (Mishchuk *et al.,* 2019). Our statistical insignificance could be affected by several issues, and it could result from data selection: our selected indicator is interregional migration, which does not take into consideration international labour movements.

Economic activity positively affects GDP. Our results agree with our expectations. The more people are economically active, the higher the expected GDP. This assumption is confirmed by Soylu *et al.* (2018). The rate of economically active population differs among selected regions, and it is affected by transition phase, location, or economic focus. Local governments use the opportunities and possibilities they have to improve the values. However, local policy-makers may not have the competencies to start a demographic boom. Nevertheless, they certainly acquire indirect possibilities.

In selected countries, Internet access is a national-wide aspect, although we observed differences among regions. However, the high-speed Internet availability is already sufficient in both studied countries, as both countries are covered by 4G mobile networks. Thus, differences in the Internet penetration are related to other factors than the Internet availability. Although we observe that the rate of Internet access is positively related to the level of GDP per capita – and similar results are confirmed by Jiménez *et al.* (2014) or Czernich *et al.* (2011) – we are sceptical of the view that further increase in the Internet penetration will be massively reflected in GDP per capita growth.

Finally, our results surprisingly indicate that the number of library users is negatively correlated with GDP per capita. The observed relationship contrasts to Stejskal, Hájek and Řehák (2019). The explanation for our results might be rooted in the level of country development level. Both, Czechia and Poland belong to economically developed European Union members, where people purchase books, both in physical and electronic form, instead of borrowing. Wojciechowska (2021) adds that public libraries today provide many services connected to social capital creation apart from access to information. Moreover, public libraries encourage social inclusion, civic engagement, community involvement and promote economic vitality (Scott, 2011). Although the literature supports the role of public libraries in regional development, we do not observe this in our study.

CONCLUSIONS

Our analysis is based on the 2004-2019 annual regional data on key demographic, health, educational, labour, technological, and cultural determinants of human capital in Czechia and Poland. The broad literature review confirmed the validity of using the following human capital determinants in the analysis: migration balance, life expectancy, higher education, economic activity, Internet access, and library users.

When considering analysed human capital determinants, the K-means clustering allowed us to distinguish three clusters for Czechia and four clusters that grouped Polish voivodeships with significant differences. The principal component analysis proved the validity of the conducted clustering. Using

the Kruskal-Wallis test, we observed significant differences in median values of human capital determinants between distinguished clusters for both Czechia and Poland.

Moreover, the results of the Kruskal-Wallis test showed that distinguished clusters significantly differed in the median level of GDP per capita. It implies the existence of economic development and level of human capital determinants interdependence.

Our study revealed a positive and significant relationship between GDP per capita level and the four analysed human capital determinants, *i.e.* life expectancy, higher education rate, economic activity rate, and Internet access. However, we surprisingly found that the number of library users is negatively related to the regional economic development level. We found that the relationship between the migration balance and GDP per capita level is insignificant. The results are consistent for Czechia and Poland and correspond to the results of other studies.

Our research may create a new perspective for discussing similarities and differences in human capital development from a regional perspective. The results could help decision-makers – local and national governments – to identify the regions that most require to stimulate their human capital determinants so as to reduce differences in human capital level among Czech and Polish regions, which in the long term, will contribute to regional economic development growth. This is indicated by our results that confirm the positive correlation between the level of GDP per capita and the four analysed determinants of human capital, *i.e.* life expectancy, higher education rate, economic activity, and Internet access. Our study shows that to ensure a more sustainable development of individual regions and eliminate interregional differences, authorities should pay more attention to and invest in health care, education system, new technologies, and the stabilisation of labour markets.

We are aware that our study has drawbacks. Firstly, the number of analysed human capital determinants and the length of the research period is limited due to data availability. Secondly, the selection of determinants might be viewed as subjective. Thirdly, our clustering regional analysis is based on a limited number of regions, *i.e.* 14 Czech and 16 Polish regions. Fourthly, the analysed data come from regional databases, and there might be differences between local data collection methodologies.

A challenge for future research is to conduct regional clustering analysis based on all European Union countries and, secondly, investigate the economic and social impact of the Covid-19 pandemic on the regional clustering of human capital in Czechia and Poland.

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Authors

The contribution of authors is as follows: MW – 25% (conceptualisation, literature writing, methodology, calculations, discussion, project administration); DC – 20% (conceptualisation, literature writing, methodology, calculations, discussion); KC – 20% (conceptualisation, literature writing, methodology, calculations, discussion, project administration); PK – 20% (conceptualisation, literature writing, calculations, discussion); ŁG – 10% (conceptualisation, literature writing, methodology, discussion); LS – 5% (supervision, project administration)

Michał Wielechowski

PhD in Economics; Assistant Professor at the Warsaw University of Life Sciences – SGGW (Poland). His research interests include macroeconomics, economic analysis, political economics.
Correspondence to: Dr Michał Wielechowski, Warsaw University of Life Sciences – SGGW, Institute of Economics and Finance, Nowoursynowska 166, 02-787 Warsaw, Poland, e-mail: michal_wielechowski@sggw.edu.pl
ORCID http://orcid.org/0000-0002-1335-8971

Denys Cherevyk

MSc; PhD student at the Warsaw University of Life Sciences – SGGW (Poland). His research interests include econometrics, economic modelling, regional analysis.
Correspondence to: Mgr Denys Cherevyk, Warsaw University of Life Sciences – SGGW, Institute of Economics and Finance, Nowoursynowska 166, 02-787 Warsaw, Poland, e-mail: denys_cherevyk@sggw.edu.pl
ORCID http://orcid.org/0000-0001-9744-4502

Katarzyna Czech

PhD in Economics; Assistant Professor at the Warsaw University of Life Sciences – SGGW (Poland). Her research interests include international economics, economic modelling, financial econometrics.
Correspondence to: Katarzyna Czech, PhD, Warsaw University of Life Sciences – SGGW, Institute of Economics and Finance, Nowoursynowska 166, 02-787 Warsaw, Poland, e-mail: katarzyna_czech@sggw.edu.pl
ORCID http://orcid.org/0000-0002-0660-7124

Pavel Kotyza

PhD in Economics; Assistant Professor at the Czech University of Life Sciences Prague (Czech Republic). His research interests include development economics, economic modelling, financial econometrics.
Correspondence to: Pavel Kotyza, PhD, Czech University of Life Sciences Prague, Faculty of Economics and Management, Kamycka 129, 165 21 Praha 6 – Suchdol, Czechia, e-mail: kotyza@pef.czu.cz
ORCID http://orcid.org/0000-0002-7706-7372

Łukasz Grzęda

MSc; PhD student at the Warsaw University of Life Sciences – SGGW (Poland).). His research interests include regional analysis, macroeconomics, human capital analysis.
Correspondence to: Mgr Łukasz Grzęda, Warsaw University of Life Sciences – SGGW, Institute of Economics and Finance, Nowoursynowska 166, 02-787 Warsaw, Poland, e-mail: lukasz_grzeda@sggw.edu.pl
ORCID http://orcid.org/0000-0002-2681-3208

Lubos Smutka

Professor in Economics; Professor at the Czech University of Life Sciences Prague (Czech Republic). His research interests include economic development, international business, international trade.
Correspondence to: Prof. Lubos Smutka, PhD, Czech University of Life Sciences Prague, Faculty of Economics and Management, Kamycka 129, 165 21 Praha 6 – Suchdol, Czechia, e-mail: smutka@pef.czu.cz
ORCID http://orcid.org/0000-0001-5385-1333

Conflict of Interest

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Revolution 4.0 and its implications for consumer behaviour

Wojciech Giza, Barbara Wilk

A B S T R A C T

Objective: The objective of the article is to demonstrate how the achievements of Revolution 4.0 enable the modification of consumers' decision-making process by means of profiling algorithms. We indicate their potential impact – for example manifested in micro-targeting, price discrimination, and filter bubbles – and conclude with a description of the radicalization of views.

Research Design & Methods: The article represents a theoretical study supported by reference to empirical data, the purpose of which is to determine the scale of the impact of IT sector companies on the economy.

Findings: Information Technology tools, available mainly thanks to the achievements of revolution 4.0, allow users to modify the content of information at the level of an individual consumer, thus determining their decision-making process. This may entail a new phenomenon of the individualization of mass consumption.

Implications & Recommendations: The benefits of profiling algorithms largely contribute to the improvement of market efficiencies. Nevertheless, the accompanying threats should be clearly articulated and noticed by policymakers. High-tech enterprises, on the other hand, should assume responsibility for the fair and transparent use of profiling algorithms. Consumer awareness of the use of this technology should also be raised.

Contribution & Value Added: The article constitutes an original analysis of the approach related to the history of economic theory and the analysis of the most recent events and developments of the current fourth industrial revolution. The text examines and shows a holistic approach to the concept of "rationality" from the beginnings of economics as a science until today, along with factors that influence its perception.

INTRODUCTION

The article aims to show the impact of the exogenous factor – Revolution 4.0 – on the perception of economic rationality and the possible consequences of implementing new digital technologies to shape consumer preferences. The article interprets the technical achievements of Revolution 4.0 as a factor modifying our perception of consumer rationality, which is the main assumption enabling us to explain the behaviour of market game participants.[1] Using the demand theory, a rational and sovereign consumer determines indifference curves that form the basis on which individual demand curves are calculated. The shape of indifference curves reflects a consumer's preferences in line with postulates of rational behaviour. This method of reasoning constitutes the essence of neoclassical economics.

In the 1950s and 1960s, Herbert Alexander Simon (1955; 1956) analysed how information deficit affects the rationality of decisions, which challenged the interpretation on which the neoclassical theory of economy is based. This coincided with the third industrial revolution, closely connected with development of information technology and the use of computers.

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[1] We adopted assumptions that limit considerations only to the rationality of a consumer, whose origins should be sought in the neoclassical theory of economics.

This article presents the analysis of the influence exerted by computing technologies on how entities make decision. In order to accomplish this goal, we recall the legacy of Charles Babbage, the mathematician and engineer who designed the Analytical Engine, commonly believed to be the first computer (Babbage, 1973; 2009). The switch from Babbage's Analytical Engine to contemporary digital computers has increased production capacities of contemporary economies, but also activated a series of various processes.

Comparing the evolution in how rationality is perceived in economics and in times of technological transformations, we put forward the following research questions:

RQ1: How has the development of information technology affected the perception of rationality among economists?

RQ2: What possibilities of influencing consumer behaviour were created by the development of technologies in the era of Revolution 4.0??

The novelty of this article lies in combining the approach dominant in modern economics with the consideration of the exogenous factors that cause profound changes in the perception of economic processes. Furthermore, we underline the relationship between industrial revolutions and the evolution of economic thought. The applied research method refers to methodological holism, which we find valuable in the determination of the effects of Revolution 4.0. The holistic approach allows us to limit the so-called fragmentation of contemporary economics presented by Roncaglia (2019).

This article is structured as follows. First, we review the literature on consumer rationality and technological change. Next, we present the development of the concept of rationality in the context of structural changes in economies, which consist in the transition from a society of mass production to a society of mass consumption. Finally, we determine new possibilities of influencing consumer behaviour through tools developed during Revolution 4.0, with reference to the achievements of the modern economy.

RESEARCH METHODOLOGY

The article is a theoretical study supported with references to empirical data, aimed at determining the strength of influence exerted by IT companies on economies. It is a conceptual article, whose research approach relies on the descriptive-analytical method. Our database consists of articles, monographs, and online resources that enabled the combination of the perspectives on the development of economic thought with the current state of knowledge about economic activity conditions in the context of Revolution 4.0. In the research process, we referred to publications from the mid-twentieth century by a Nobel laureate in economics, Herbert Simon (1978), from whose works stems the contemporary understanding of consumer rationality. The literature study combined with widely discussed changes resulting from the implementation of new digital technologies prompted us to recognize technological change as the basic exogenous factor that determines our way of interpreting consumer rationality.

The above method allowed us to interpret the relation between neoclassical understanding of consumer rationality – prevalent in current microeconomics – and its modification within bounded rationality proposed by Simon. Technological changes were selected as variables that modify our perception of rationality on the grounds of theories of economics. We analysed the process in which new technologies influence consumer behaviour in order to present how the achievements of Revolution 4.0 mostly affect the demand side of economies. In order to present the technological development process, we employed the narration typical of economic history. The arguments seek to prove the thesis that IT tools available thanks to Revolution 4.0 allow us to modify the contents of information at the level of an individual consumer, thus determining their decision-making process. This may point to a new phenomenon, namely the individualization of mass consumption.

LITERATURE REVIEW AND THEORY DEVELOPMENT

In presenting the evolution of the concept of bounded rationality, we refer to the classical works of Simon (1947; 1955; 1956; 1978), and their contemporary interpretations developed as part of the international business approach by Verbeke and Greidanus (2009) and Kotlar and Sieger (2018). Assuming that the key exogenous factor influencing how we interpret consumer rationality is technological development that enables the increase in computing power, we refer to the works of Moore (1965; 1975) and Babbage (1973 [1837]; 2009 [1832]). Contemporary interpretations of Babbage's heritage are presented in the works of Wilkes (1977), Bromley (1982), Green (2005), Ozgur (2014), and Dasgupta (2014). Babbage's pioneering achievements paved the way for Revolution 4.0 presented in a broader social and economic context by Schwab (2017). The changes happening today under the influence of Revolution 4.0 are analysed by such authors as Borgesius (2015), Susskind and Susskind, (2015), Ezrachi and Stucke (2016), Wagner and Eldenmuller (2018), Wang and Kosinski (2018), Sieja and Wach (2019), Śledziewska and Włoch (2020), Rymarczyk (2020), and Křenková, Rieser, and Sato (2021).

Historical Perspective on the Change in the Perception of 'Rationality'

Contemporary economics has its roots in the Enlightenment era – an era that considered the mind the main tool for learning reality. Enlightenment thinkers rejected dogmatism and institutionalized authority, contrasting them with the scientific cognition method. They also aimed at depriving scientific discourse of arguments that refer to divine authority, which can be easily noticeable in the research approach adopted by the founding father of economics: Adam Smith.[2] The central place of economics is occupied by the subject who aims at maximizing the goal function by applying rational economic calculation. However, the term 'calculation' evokes another tradition closely related to science, in which the growth of computation power has modified our perception of the decision-making process. The first scientist to identify the benefits resulting from increasing computation power and to relate them to economics was the British mathematician and designer Charles Babbage (1791-1871). He designed a difference engine, which allowed its users to calculate values of polynomial functions, and then the Analytical Engine, a direct forerunner of contemporary computers (Wilkes, 1977; Bromley, 1982; Dasgupta, 2014). The model of an analogue difference engine was developed in the 1820s, whereas the idea of an analogue analytical engine originated in the 1830s.[3] It was the time when the first industrial revolution was ending and scientific inventions paved the way for the second industrial revolution, which brought about mass production.

Babbage, who was a brilliant mathematician, believed that it was absolutely necessary to find practical applications for his inventions.[4] His scientific interests included astronomy, philosophy, engineering, and economics. Ozgur recognizes Babbage's legacy to be an important part of contemporary microeconomics (Ozgur, 2014). In 1832, Babbage presented his views on the modification of production processes in manufactures in his work titled *On the Economy of Machinery and Manufactures* (Babbage 2009).

Comparing scientific approaches of Babbage and H. Simon, we must emphasize that these thinkers did not focus on a narrowly defined single issue but sought possibilities of applying their ideas in various areas of science. The theory of bounded rationality that originated in the 1950s emerged from reflections on the analysis of a decision-making process in public administration. Simon presented his

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[2] In the methodological treaty by Adam Smith, *History of Astronomy* (1795), we find the concept of "the invisible hand of Jupiter." In Smith's later works we only find the term *the invisible hand.* The evolution of Smith's views shows that he wanted to remove the reference to divine authority from his scientific considerations and replace it with motivation of an individual in making economic decisions.

[3] A simplified model of the Difference Engine was presented by Babbage in 1822. It won recognition among members of the Astronomical Society, which helped him obtain funding for building a full-scale version of the Engine. However, the machine was not finished during Babbage's life. In 1837, he presented the description of how the Analytical Engine works (Babbage,1837; Green, 2005).

[4] In 1828–1839, Babbage was the head of the most prestigious department of mathematics in the UK (Lucasian Professor of Mathematics in Cambridge). Other heads of this department include such outstanding figures as Isaac Newton 1669–1702 or Stephen Hawking 1979–2009 (Dasgupta, 2014, p. 10).

views on this topic in *Administrative Behaviour: A Study of Decision-Making Processes in Administrative Organization* (1947). One of the key issues analysed in this book was the rationality of a decision in the context of effective management. Such interpretation of rationality differs from the one developed in neoclassical economics, in which a consumer's rationality is defined on the basis of a set of preference axioms. These include completeness, transitivity, continuity, convexity, and homogeneity.[5] Developing the concept of bounded rationality (Simon, 1955; 1956; 1978), H. Simon was much more sceptical than his predecessors as far as rationality of a managing individual was concerned. His scepticism stemmed both from the limited set of information possessed by an individual initiating a decision-making process and from one's capacity to process this data. It all accounts for the fact that a managing person aims at arriving at a satisfactory rather than an optimal solution.

The development of computers in the 1950s and 1960s enabled their users to gather huge amounts of data and to process them more effectively. In this way, Babbage's idea of an analytical engine combined with the bounded rationality model postulated by Simon to become a tool that allowed to modify the behaviour of consumers of not only economic goods but also political ideas. The above processes were revealed on a large scale in the period known as Revolution 4.0, when the computer became the basic medium of social interactions and a tool steering other appliances used in everyday life. However, before that happened, the second industrial revolution brought about the phenomenon of mass production, encouraging producers to seek methods of shaping the buying preferences of their customers.

From Mass Production to Mass Customization

Industrial revolutions were possible thanks to technological progress, which facilitated profound transformations in production processes (on the supply side of economy). In the technical dimension, the first revolution of 1760-1840 brought a breakthrough in weaving and metallurgy industries, setting machines in motion with energy generated by the steam engine. Its most significant effect in social and economic spheres could be the emergence of a society no longer bound by customs and traditions but by market relations. Within such a social order, economic success allowed its authors to gain promotion in social hierarchy and improvement in the quality of their lives. The second revolution enabled the use of new energy sources, such as electricity and the combustion engine. It was also the time when the chemical industry developed. Transport was no longer exclusively based on railway, as the world witnessed the invention of the car and the airplane. Another invention – the telephone – accounted for a much quicker flow of information, while the development of cinematography created new means of artistic expression, becoming a powerful tool for shaping tastes and opinions of whole societies. By creating mass production, the second industrial revolution also created a mass consumption society. Before this happened, however, significant changes had been implemented in the production organization sphere, best seen in the example of the Ford factory.

In the Ford factory, the key role was played by new production methods that reduced costs per vehicle. As a result, the American car industry product, Ford T, became available to a moderately wealthy American family. Changes in the production process resulting from the introduction of the assembly line in the Ford factory in Detroit drew the attention of economists to economies of scale. They concerned the supply side and enabled a reduction of average costs of production. The strategy of enterprises to increase the scale of production resulted in monopolisation and price fixing. In response to the growing monopolisation of industry, in 1890, the USA Congress passed the Sherman Antitrust Act, which was supposed to block the negative consequences of the process.

The economies of scale became an effective way to reduce production costs. However, they also generated the risk of releasing long series of products that would not attract the interest of consumers, thus resulting in substantial loss. Mass products are more homogenous than products manufactured by nineteenth-century craftsmen in their workshops. Thus, it was important that they met the de-

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[5] The axiomatic presentation of consumer preferences in economics may be treated as an attempt at the methodological unification of economics and physics. The postulate of axiomatization of physics was formulated by Hilbert at the International Congress of Mathematicians in Paris in 1900.

mands of consumers with various tastes. To reduce the risk, companies tried to tailor consumer preferences to the products they manufactured. They started advertising their products to arouse consumer desire to have specific products. The pioneer of marketing was the chairman of A&F Pears, Thomas James Barratt (1841-1914). The promotion of the brand of soap his company produced earned him the title of the father of modern advertising (Coates, 1908, pp. 107-115; Petit, 2014). There also appeared theoretical studies on advertising, such as Henry Sampson's study published in 1874, which presented the significance of advertising from a historical perspective (Sampson, 1874).

The methods used back then to influence potential customers were not complicated. Their main goal was to unify consumer preferences by creating a fashion for a specific product. In the second half of the nineteenth century, visual means were the dominant channel through which potential consumers were to be influenced. These included posters and illustrations in news articles. This is how Barratt advertised his products. Once cinematography became popular, the marketing message was reinforced by film stars, whom all viewers, regardless of their social status, wanted to imitate.[6]

If we compare the means used to shape consumer preferences available in the nineteenth and twentieth centuries and those modern companies possess, we can see a major quantitative and qualitative difference. Big search engine and social media companies extensively use techniques for researching and modifying the preferences of millions of consumers worldwide. However, this would not be possible without advanced algorithms tracking every movement of a potential client in the world wide web. Ford's famous saying that you can choose any colour you like as long as it is black has long lost its meaning. Now, even though corporations do their business on a mass scale, their offering is tailored to consumer needs. This process is accompanied by a phenomenon consisting in the fact that disconnection from the web inevitably leads to social exclusion. In fact, apart from the Internet, there are no alternative communication channels or products to maintain intensive relations and contacts with the world. Therefore, companies like Apple or Microsoft are the medium that we use to communicate with others – like it or not – and in doing so, we provide those companies with huge amounts of data. These data are probably one of the most valuable assets that give competitive advantage over others. Hardware and software companies offer products that enable companies to process such data on an unprecedented scale. This way, they can effectively create what Galbraith – a representative of institutional economics – called the dependence effect.[7] According to this concept, needs do not reflect the autonomous preferences of consumers, but they are created by advertisements and a number of social engineering tools used by producers to trigger new needs. By doing so, entrepreners create demand for the products they make. The dependence effect was formulated by Galbraith exactly at the time when the third industrial revolution began. Its symbol was the computer, which enabled its users to process more and more complicated databases.

Characteristics of the Fourth Industrial Revolution

The transformations of the end of the twentieth century and the beginning of the twenty-first century that we are witnessing have a huge impact on our reality, economic processes, and the forces shaping the basic dependencies in the economy. Schwab (2016, p. 3) lists three main characteristics of the industrial revolution: (1) velocity (the pace of changes that we observe is exponential rather than linear), (2) breadth and depth (the complexity of and relationships between technologies change the entire economic, business, and social paradigm, even who we are as individuals), (3) systems impact (involves transformation of the entire system, both within and across entities).

The nonlinear, exponential pace of transformations related to the development of the Information and Communication Technologies (ICT) sector, is associated with the so-called Moore's law. In 1965 Gordon Moore predicted that approximately every two years the number of transistors in a dense integrated circuit doubles (Moore, 1965, 1975), therefore the computing power of appliances based on such circuits

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[6] The first TV advertisement is believed to be the twenty-something-seconds-long advertisement of Bulov watches broadcast on 1st July 1941 before the baseball game of Brooklyn Dodgers and Philadelphia Phillies.

[7] The term "dependence effect" was used as the title of the eleventh chapter of the book *The Affluent Society* (Galbraith, 1958, pp. 119–125).

will also double, thus increasing their capabilities. Despite negative predictions of its critics, who argued that the law would only work a few years, we can observe that it is still valid. This process translates directly into velocity of the present transformations, changing the economy instantaneously.

Susskind and Susskind (2015, p. 155) define four areas associated with the development of the ICT industry that have (and will have) a huge impact on the further development of the digital sector:

1. Exponential growth in information technology.

The development of the ICT industry is associated with Moore's Law. In 1965 – three years before he co-founded Intel, the world's largest supplier of integrated circuits and microprocessors – Gordon Moore predicted that more or less every two years the number of transistors per integrated circuit would double, which, avoiding technical jargon, simply means that the computing performance of devices based on such circuits would also double. His critics expected that this law would not work longer than for a couple of years. However, observations show that it is still valid. Exponential growth is extremely powerful, and its implications are hard to predict. In the first 50 years following the introduction of computers, the cost of their computing performance was reduced more than 10 billion times. Constant development in this area is accompanied by complementary aspects, such as the increasing throughput of networks and capacity of hard disc drives, which has been growing at a similar pace.

2. Increasingly capable machines.

This is one of the most important contemporary changes in the labour market. It is associated with the thesis that more and more tasks that used to require human labour are now done more effectively, better, faster, and cheaper by machines. Moreover, this is no longer true only for routine tasks. The main reasons are such trends as the use of Big Data pools (which enables us to analyse past experiences and patterns and prognosticate), the development of systems that apparently require human intelligence, progress in robotics, the development of affective computing, namely computers that understand and can express emotions.

3. Increasingly pervasive devices.

Devices are becoming physically smaller, and their prices are dropping significantly, which enables a large part of the society to own various kinds of computers. Some estimate that currently there are more than 6 billion cell phone subscriptions, and more than 2 billion people own smart phones with Internet access (the latter number is expected to double). The internet of things is developing rapidly, and computer systems and the Internet are installed in everyday objects, such as fridges, kettles, lighting, thermostats, and even flowerpots. Moreover, we wear intelligent devices, such as watches that track the activity of our bodies.

4. Increasingly connected humans.

Since the Internet is becoming increasingly available and many processes have moved to the digital world, people do more and more things online: we communicate, research, socialise, share, build communities, co-operate, crowd-source, compete, and trade. This enables the development of business models and platforms that would not yield such economies of scale and would not perform their functions if their users were not connected to worldwide network.

DISCUSSION

Even though we cannot predict the direction in which new technologies will develop, let alone their impact on the socioeconomic environment, we should observe dominant trends and try to draw conclusions from them. Noticing certain trends will at least partly enable a dialogue about the institutional environment, including the direction societies and economies should follow.

One of the main characteristics of contemporary changes is also the growing role of enterprises in the technology sector. Big tech companies – often referred to as GAFAM (an acronym made of the first letters of: Google, Apple, Facebook, Amazon, Microsoft) – are currently not only providers of the latest ICT solutions but also very important players in international relations. Data on the market value of the largest Internet companies and their growing revenues are presented in Figures 1-2.
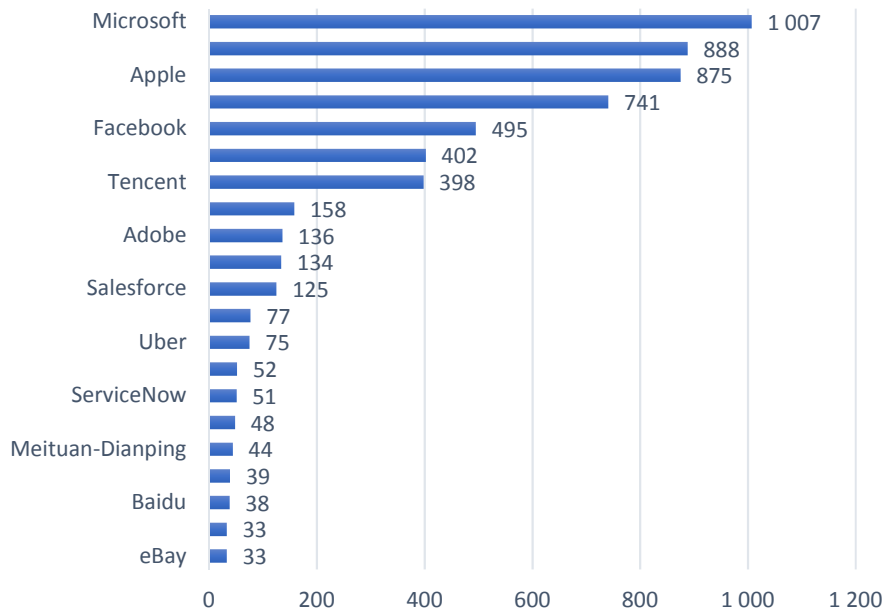
Figure 1. Market value of the world largest Internet companies (June 2019, data in billions of USD)
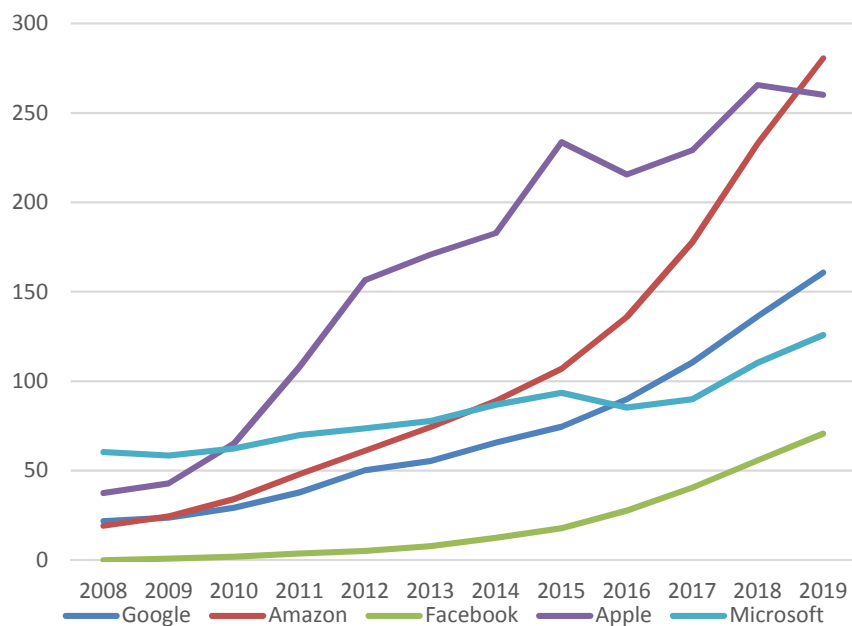Source: Statista (2020d).

**Figure 2. Revenues of Google (Alphabet), Amazon, Facebook, Apple,
Microsoft (2008-2019 data in billions of USD)**
Source: Statista (2020a; 2020b; 2020c; 2020e).

The main arguments against the business model of the above companies and their growing impact on the economic and political situation concern such issues as the use of private information for commercial purposes, excessive lobbying, the lack of responsibility for the social consequences of their actions, and attempts to monitor and control consumer and citizen behaviour (Fontanel & Sushcheva, 2019). The last of these issues in particular has become the topic of heated political and social debates,

following the Cambridge Analytica scandal in which data of nearly 50 million people were used for the purpose of profiling political campaigns (especially the US presidential campaign in 2016).

The data that users leave online are often sensitive and concern such issues as ethnic origin, sexual orientation, religious denomination, or political preferences. The Cambridge Analytica scandal aptly illustrates how sensitive data of millions of users were used to create voter profiles and to employ behavioural marketing (Śledziewska & Włoch 2020, p. 127). During the 2016 presidential election campaign in the USA, Robert Mercer, an American billionaire, supported a project (with USD 15 million) aimed at developing a tool analysing psychophysical parameters of users. Based on this project, the head of the team of marketing experts created appropriate content and media messages, which were then placed in social media and television. They were to influence their recipients' preferences during the election campaign.

In addition to the political and social aspects of the analysed problem, there is an economic dimension that translates directly to shaping the demand structure of the market and consumer preferences. Although, as Mazurek (2006) suggests, the idea of the Internet market is the same as the idea of the market defined in traditional economy – with prices determined by both demand and supply for a given product – the former has certain specific features which, if used by big tech companies, may give competitive advantage over other entities. The development of big data together with advanced algorithms supported by artificial intelligence creates new transaction tools, previously unavailable to companies. Data analysis enables enterprises to profile their consumers, which significantly disturbs the symmetry of information. As a result, companies very often know about consumers more than the latter know about themselves. An example is an algorithm developed by scientists from Stanford and Cambridge. All it needs is ten "likes" to know about a person more than their colleague from work, 70 – more than their friends, and 150 – more than their family members. Notably, a Facebook user on average has given 227 likes. Another example is facial image analysis. Based on 35,326 facial images, an algorithm has learned (with 81% accuracy for men and 71% accuracy for women) to identify whether a person is heterosexual or homosexual. The accuracy increases to 91% and 83%, respectively, if five images of the same person are analysed (Wang & Kosiński, 2018).

Below we present the areas that reflect potential negative effects of the growing importance of technology in daily life. Let us note that apart from the phenomena listed below, there also is a number of positive aspects of digitization. However, the aim of this essay is to draw attention to the increasing advancement of available technologies and profiling algorithms, which leads to changes on the demand side of economy and in shaping consumer preferences.

Powerful knowledge acquired through the use of appropriate data processing is transformed by large technology companies into marketing microstrategies (and also ideological and political strategies, as revealed the Cambridge Analytica scandal), which shape preferences in a way to enable companies to achieve expected (and predicted) results. With this type of tools, companies may personalise the content they produce and profile their users e.g. as "high spenders" (Borgesius, 2015). This is done by analysing the purchase history, based on the basis which one can conclude that a person likes buying expensive products. Within such targeted business-to-consumer (B2C) transactions, Wagner and Eidenmuller (2018) identify three areas that cause serious concern. These include:

– price discrimination,
– exploitation of behavioural biases of consumers,
– using microtargeted advertisements to control preferences in certain ways.

Noteworthy, there are three different types of price discrimination. The first one concerns different pricing based on individual preferences of consumers. The second type refers to different pricing depending on the quantity (e.g. discounts for bulk purchases). The third one involves offering different prices to different consumer groups (e.g. students, old-age pensioners). Price discrimination is nothing new, but digital tools and big data analysis enable its application on an unprecedented scale, especially the first type of price discrimination (Ezrachi & Stucke, 2016).

If price discrimination is to be effective, it must meet three requirements: (1) the company must possess a competitive advantage to be able to set its price above marginal cost, (2) the seller must be

able to differentiate clients to tailor prices appropriately, and finally, (3) the reselling of products must be rather impractical and costly (Varian 1989). In the case of the digital market and internet sales (combined with the dominant position of major players in the market), the above conditions seem relatively easy to be fulfilled. Price personalization is based on the information the company obtains from various sources, such as (Borgesius, 2015):

− voluntary and conscious provision of such information by the client (e.g. when creating an account on a particular Internet platform),
− data left by users after visiting a website (IP address and cookies),
− data obtained from third parties concerning consumer behaviour online and visited websites.

The last two sources of information are mainly used in assessing a particular user's readiness to pay a specific price for the product; e.g. a person residing in a wealthy district is more inclined to pay more for a product than a person from poorer neighbourhood. Obviously, this strategy is not flawless. Many people surf the net e.g. in search of a Ferrari car, even though they cannot afford it.

According to researchers, microtargeted advertisements aimed at steering user preferences online negatively affect individuals, who are trapped in a narrower life. They believe that the choice of an individualised price system should be up to the consumer and that the consumer should be able to withdraw from it at any time. Behavioural biases may also lead users into ineffective transactions and prevent them from experimenting, i.e. doing things that do not match the model of a given user. On the other hand, the use of this type of algorithms may help increase consumer satisfaction and loyalty, while a personalised offer may help prevent decision-making paralysis caused by the availability of too many options, which in turn will increase effectiveness both in the micro (transaction) and macro (social) scale (Wagner & Eidenmuller, 2018). Nonetheless, price discrimination (especially its first degree) makes consumers feel unfairly treated by service and product providers. This may make them try remaining anonymous to companies and has resulted in the emergence of a growing number of tools such as Tor or Anonabox. However, according to Wagner and Eidenmuller (2018), such preventive measures are insufficient, and the regulator's role in the process should be more pronounced. However, this is a major challenge as technologies such as big data or artificial intelligence develop at a very high pace and in a direction that is not quite clear or predictable. Thus, measures aimed at controlling the direction of the further development of innovations and preventing potential threats are important. The most radical regulation would be to put a complete ban on price personalisation that is not justified by cost differences. Less radical solutions would e.g. include increasing consumer awareness so that they make more informed and rational decisions.

Concerning the development of preferences, we should note that measures associated with presenting goods and services purchased by a similar type of user is vital for the idea of choice in itself. This is because they limit the availability of goods and services and offer only selected access to reality. Exposure to constantly personalised information (filter bubble) may influence such important issues as political preferences (leading to views radicalisation) since the stream of news available to a given user becomes very limited. In *Choosing Not to Choose,* Sunstein (2014, p. 44) writes that there is a difference between active and passive choice: "If people have made an active choice, they are more likely to become invested in it, and in a sense to like it. These same effects may not occur when the choice has been made passively and by default." Algorithms that provide adjusted information, consistent with user preferences, discourage a creative approach, limit diversity, and promote a passive attitude to reality.

CONCLUSIONS

Contemporary science and engineering enable us to understand and modify the surrounding world in categories rooted in the idea of rationality. This rational model of science became particularly important in the period of the Enlightenment when economics emerged as an independent branch of science. The central part in the new science was occupied by a rational *homo oeconomicus,* who aimed at maximizing own benefits. Along with economics came new technical inventions which allowed to

increase the productivity of human work. The machine became a tool facilitating the accomplishment of goals set by people. New inventions, whose practical application in industry marked consecutive industrial revolutions, have brought tremendous changes in the supply side of the economic sphere. The above changes have been both admired and feared, as the machine, and the computer in particular, has been replacing human labour. Fears of machines date back to the times of the first industrial revolution. They were analysed by D. Ricardo, who considered the problem of technological unemployment.[8] Contemporary reflections on the Industrial Revolution 4.0 are also accompanied by fears of losing jobs which will be performed by robots and artificial intelligence. What seems of particular importance in Revolution 4.0 – although it is rather neglected by economists who analyse the effects of these changes – is the impact of new technologies on the demand side of economy. When at the beginning of the twentieth century, Ford's assembly line made mass production possible, consumer tastes and preferences were shaped through advertisements addressed at masses. Modern information technologies, the Internet, and profiling algorithms used by big corporations not only to reach potential consumers but also to modify their behaviour far exceed the economic sphere. These activities also concern political elections (as with the Cambridge Analytica scandal) and an area that has been treated as a sphere of individual beliefs. The world in which the Analytical Engine invented by Charles Babbage has adopted the shape of highly efficient computers is characterized by an advanced instrumental treatment of IT tools and our understanding of rationality. New technologies reinforce activities that can be explained in rational categories as well as those which arouse irrational desires of particular individuals and social groups. The main limitation of our study is the generalization of outcomes resulting from the approach referred to as a conceptual study. Our conclusions obtained based on the literature review requires further verification and empirical research. As part of further research directions, we find it important to determine the potential impact of Revolution 4.0 not only on the real economy but also on the perception of this process by the public and regulatory actions taken by individual states. In this regard, it is also crucial to determine whether possible market failures resulting from the implementation of new technologies can be limited by state actions.

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Authors

The contribution share of authors is equal and amounted to 50% for each of them.

Wojciech Giza

Associate Professor at the Department of Microeconomics at the Cracow University of Economics (Poland). His scientific research interests include the development of economics as a science and the analysis of theoretical and methodological foundations of neoclassical economics, especially the issues of market failure. As far as institutional economics is concerned, he conducts research on comparative analysis of economic systems with particular emphasis on ordoliberalism and social market economy.

Correspondence to: prof. UEK dr hab. Wojciech Giza, Cracow University of Economics, Department of Microeconomics, ul. Rakowicka 27, 31-510 Kraków, Poland, e-mail: gizaw@uek.krakow.pl

ORCID http://orcid.org/0000-0002-6773-1372

Barbara Wilk (*born* **Barbara Sztokfisz**)

Chief Strategy Analyst at EXATEL – Polish telecommunication company, since 2021. Previously, researcher at the Kosciuszko Institute, Polish non-governmental think tank and research institute (2017-2021), where she was Chief Editor of the 'European Cybersecurity Journal'. She graduated in International Economics and European Studies at the Cracow University of Economics and French Language and Literature at the Jagiellonian University. She is fourth-year PhD candidate at the Cracow University of Economics with the specialisation in economics of technological change. Her research interests include digital transformation, blockchain technology, and the impact of artificial intelligence on the labour market.

Correspondence to: Mgr Barbara Wilk, Cracow University of Economics, Department of Microeconomics, ul. Rakowicka 27, 31-510 Kraków, Poland, e-mail: barbara.sztokfisz@gmail.com

ORCID http://orcid.org/0000-0002-5615-7571

Acknowledgements and Financial Disclosure

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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