Bánkuty-Balogh Lilla Sarolta

THE INTERSECTION OF GEOPOLITICS AND TECHNOLOGICAL INNOVATIONS: IMPLICATIONS FOR THE CENTRAL-EUROPEAN REGION

GEOPOLITICS AND SUSTAINABLE DEVELOPMENT DOCTORAL PROGRAM

Supervisors: Imre Garaczi, Ph.D., Habil. & Ádám Banai, Ph.D.

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CORVINUS UNIVERSITY OF BUDAPEST

DOCTORAL SCHOOL OF INTERNATIONAL RELATIONS

AND POLITICAL SCIENCE

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IMPLICATIONS FOR THE CENTRAL-EUROPEAN REGION

ARTICLE-BASED DOCTORAL DISSERTATION

Bánkuty-Balogh Lilla Sarolta

Budapest, Hungary

2023

An article-based doctoral dissertation in accordance with § 31 of the Doctoral Regulation of Corvinus University Budapest, September 2022 (JISZ-SZ/2-1/2022), based on the following publications:

Article 1: Balogh, L. S. (2017). Could China Be the Winner of the Next Industrial Revolution? *Financial and Economic Review*, Vol. 16. (Special Issue), January 2017, pp. 73–100.

Article 2: Bánkuty-Balogh, L. S. (2021). Novel technologies and Geopolitical Strategies: Disinformation Narratives in the Countries of the Visegrád Group. *Politics in Central Europe*, 17(2): 165-195. DOI: https://doi.org/10.2478/pce-2021-0008

Article 3: Bánkuty-Balogh, L. S. (2022). A mesterséges intelligencia elterjedésének geoökonómiai hatásai és Magyarország. *Külgazdaság,* 66(7-8): 102–130. DOI: https://doi.org/10.47630/KULG.2022.66.7-8.102

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Abstract

The thesis examines the effects of emerging technological innovations shaping contemporary geopolitics, through their impact on the economy, society, and international relations, with special focus on Hungary and the Central European region. It explores how modern geopolitical theories have evolved over the years and what leading scholars have proposed with regards to the phenomenon of innovation and emerging technologies. The thesis is an article-based dissertation, which includes three published scientific journal articles, that analyse specific findings on subtopics related to the broader scheme of geopolitics and innovation, such as China's growth prospects in the Fourth Industrial Revolution; the phenomenon of disinformation warfare aided by novel technologies in the Central European region; and the potential of Artificial Intelligence (AI) solutions disrupting industries, and creating economic and social inequalities examined in the Hungarian context. The study wishes to make a contribution to the existing body of research by delving into a contemporary and relatively under-explored topic, offering a consistent theoretical and conceptual foundation and applying an innovative research approach. The thesis finds that there is a need to adapt geopolitical narratives to reflect a world system that is moving away from the traditional model of exclusive state actors and is characterised by global interconnectedness and the advancement of technology. The findings of the individual articles in the thesis suggest that this transformation will fundamentally change the way society lives, works, and progresses, and that those who are able to embrace the change will prosper.

1. INTRODUCTION

The role of innovation and emerging technologies are becoming increasingly important in shaping geopolitics and the balance of power in the world. In a knowledge-based economy, innovation and human capital are essential resources for interstate competition. This change in the economic system has led to a relative decline in the importance of traditional factors such as military power, gross national product, population, energy, land, and natural resources, and an increase in the importance of factors such as technological development, educational standards, and the flexibility of institutional arrangements. The networked world system has presented new geopolitical challenges, including nationalization and weaponization of technology, regional fragmentation, and erosion of interconnection, which can lead to higher tensions for a globalised world. In the light of changing circumstances, geopolitical narratives should follow a suitable approach in analysing the changing nature of international relations.

1.1 Research focus of the thesis

The thesis examines the intersection of geopolitics and technological innovations and some of their implications for the Central European region specifically. The analysis defines innovation primarily as the emergence of new technologies, but also the action or process of innovating, and the culture of innovation that facilitates the former two aspects (Kahn, 2018). The main research question of the thesis evolves around what the effects of emerging technological innovations are on the economy and our societies, and how this shapes international relations and geopolitics. The dissertation also examines what are some subsequent trends that affect Hungary specifically, and the Central European region more broadly.

The study provides a uniform theoretical and conceptual framework in the introductory chapter, describing geopolitical and economic theories and concepts that have been instrumental in understanding the role of technological innovations in the geopolitical context. The frameworks that have been most influential in creating the theoretical background of the thesis include the notion of the knowledge-based economy (Moisio, 2018), postmodern geopolitical theories against a spatial theory-based approach (Szilágyi, 2013), the network society model of the globalised world (Castells, 1996), critical geopolitics and the democratisation of geopolitical discourse (Ó Tuathail, 1998; 2005; Dalby, 1998), geoeconomics and new means of conflict resolution (Luttwak 1990; Simai 2014), the phenomenon of the information revolution (Nye at al. 1996; 2002),

characteristics of the knowledge-intensive era of capitalism and innovation-mediated production (Florida, 1995), as well as forces of connectivity affecting geographical reality (Khanna, 2017). The connection and coherence of the referenced theories are explained through a logical sequence that follows the organic development of the field, reflecting on emerging social, economic and technological phenomena of the past decades.

The relevance of the theoretical ambition of the thesis can be described as the significance of emerging technologies from a geopolitical viewpoint, due to these technologies' potential to shape the future of international relations and the global economy. Emerging technologies, such as artificial intelligence, big data, the internet of things, or blockchain have the ability to revolutionise industries and change the balance of power among nations, impacting the geopolitical landscape in the coming years. They are essential from a strategic planning and policymaking perspective, because they influence the economic and social development of nations and their relations with one another.

The thesis contributes to the existing body of research as it (1) explores a contemporary topic that will gain increasing attention in the coming years, and as of today is still relatively under-researched; (2) provides a synthesising framework on relevant theories and concepts from classical to modern geopolitics, that can support further research in the area; (3) performs analysis related to Hungary and the wider Central European region on the topic of emerging technologies and geopolitics; (4) utilises a novel research method within the social sciences, by applying a natural language processing (NLP) algorithm in one of the articles.

While the three articles that form part of the thesis are coherent in terms of their theoretical background and the topics examined, the papers also differ from each other in their specific research focus and applied methodologies:

(i) Article 1 examines China's growth prospects and competitiveness in the shift in production technologies, known as the Fourth Industrial Revolution or Industry 4.0. The research question is whether China can emerge as the main global beneficiary of the transformation of production technologies in Industry 4.0. The article sets out to describe the changing context of the Fourth Industrial Revolution, by clarifying the definitions and gathering information on the technological breakthroughs that are categorised under Industry 4.0. It also examines the megatrends that form the basis of new production methods: physical, digital, and biological innovations. The article looks at the implications of

expected technological changes for China, and concludes that China's comparative advantage from cheap labour-based manufacturing will continue to erode, and that moving up the value chain and creating domestic innovation in high-tech industries will become necessary to maintain long-term competitiveness.

It then assesses China's current innovative capacities, from quantifiable investments in R&D and other developmental indicators, to the structural design of the innovation ecosystem and its institutional background, the role of capital in financing innovation, and finally the potential uptake of a culture of innovation. The article concludes that China is already a world leader in various industrial sectors and could solidify its position also in engineering and science-based sectors. The study also assesses potential risks: the emergence of systemic disturbances and the uptake of a culture of innovation are identified as the two most important influencing factors in creating breakthrough innovation.

(ii) Article 2 examines the use of strategic narratives in disinformation campaigns targeting the Visegrád Group (V4). The analysis aimed at identifying constructed identity claims and positions on specific issues that seek to shape perceptions and actions of domestic and international audiences. The article finds that the use of artificial intelligence, machine learning, and big data analytics is making computational propaganda more sophisticated and effective.

The article also discusses the use of strategic narratives in disinformation campaigns in order to appeal to emotions and engage audiences to become willing but unaware collaborators. By analysing a large amount of textual data extracted from news articles from multiple online sources, using a natural language processing (NLP) algorithm, the study concludes that recurring disinformation narratives are to be found among the news pieces. Furthermore, recurring disinformation narratives revolve around themes of power relations, political order, ideological divisions, historical consciousness, and cultural identity that feed into a coherent disinformation campaign targeting the V4 region.

(iii) Article 3 discusses the potential impact of artificial intelligence (AI) solutions as a general-purpose technology (GPT) on the competitiveness of countries and their likely impact on the labour market. The primary research question is whether the transformation of AI will lead to a more efficient and equitable distribution of wealth and development or whether it will extrapolate

disparities between and within countries. The study concludes that the income and technological advantage generated by the use of innovation, including AI, can disproportionately benefit the leaders of technological progress, resulting in "innovators' rents" where the additional income earned by innovators hugely exceeds the development costs of their inventions. Additionally, the cross-border nature of AI solutions can make it difficult to regulate competition and ensure the healthy redistribution of these rents. The article also highlights the emergence of oligopolistic market structures due to the "winner-take-all" effect and concentration of market power in the hands of a few large global companies.

The article examines the challenges and opportunities for a small, open, middle-income economy like Hungary to compete in technological development, and provides a comparative analysis on Hungary and Estonia in terms of their digital transition. The article concludes that while AI solutions do present some opportunities for local players to directly access global markets or provide high-value added solutions as suppliers to multinational companies, the risks posed to (semi-)peripheral economies to become dependent on the import of AI solutions is far greater. Labour market trends point to the polarisation of jobs and increasing income inequalities among different sectors of the economy.

1.2 Conceptual framing[1]

Socioeconomic changes of the past decades have made the leading edge of the economy interlinked with technologies based on innovation, the use of knowledge and the production and dissemination of information. In this knowledge-intensive phase of capitalism, intellectual value creation is the most important factor of production, knowledge is a key resource and learning is a fundamental process of creation. In a knowledge-based system, where innovation and human capital are crucial resources, geopolitical narratives need to be adapted. A geopolitical assessment of the innovation-driven and knowledge-based economy sheds light on several consequences, like the attention shift from scarce or limited resources to non-rival and non-eroding ones, the increasing importance of regional competitiveness, and the role of global networks. The thesis aims to reflect on these changing circumstances brought forward by emerging technologies and examine their social, economic and geopolitical consequences.

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[1] The introductory chapter is partially based on the authors' earlier publication (Balogh, 2018).

1.2.1 Evolution of geopolitics in a changing world

Geopolitics as a discipline has evolved from a combination of Ratzel's[2] natural science heritage and Kjellén's[3] political science-based thinking. Kjellén himself, who claimed to be a disciple of Ratzel, combined the concept of political geography with his own theory of the state to form a theoretical framework at the end of the 19th century that analysed politics in terms of the geography of space and power. Mackinder's[4] (1904) world policy ideas further strengthened the discourse of geopolitics based on objective strategic considerations, as he analysed the methodology of establishing and maintaining the global balance of power, depending on economic and strategic-geographical conditions. He made pragmatic and region-specific recommendations, including the introduction of the concept of the "heartland", the region of Eastern Europe and Central Asia, rich in natural resources, occupying a central position in the world which he believed to be the key to global dominance (Szilágyi 2013).

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[2] Friedrich Ratzel (1844-1904) German geographer and one of the founders of classical geopolitics.
[3] Rudolf Kjellén (1864-1922) Swedish political scientist and one of the founders of classical geopolitics.
[4] Halford John Mackinder (1861-1947) British geographer, political scientist and advocate of the study of geostrategy.

Figure 1: Mackinder's concept of the Heartland

THE NATURAL SEATS OF POWER.

Pivot area—wholly continental.   Outer crescent—wholly oceanic.   Inner crescent—partly continental, partly oceanic.
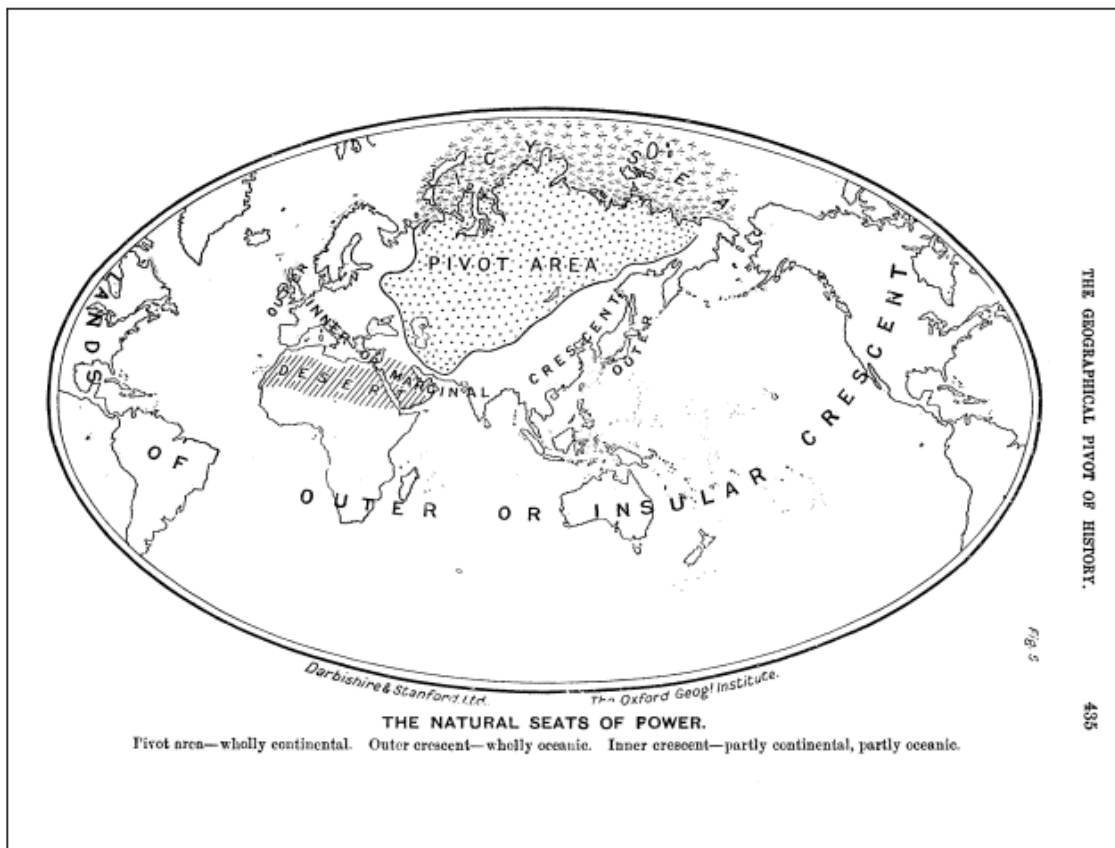
Source: Mackinder, H. J. 1904: 435. In 2004 reprint: p. 312.

In the wake of these thinkers, modern geopolitical theories have developed around the theories of space and the representation of space, which still shapes the way we think about the world and its mechanisms. Together, these theories form the argumentation of modern geopolitics. The spatial thinking and spatial theory-based approach on which modern geopolitics is based is often contested in the academic community today, as the changing world order, particularly as a result of technological and information advances, has pluralized world politics in ways that may render modern geopolitics redundant compared to postmodern geopolitical theories (Szilágyi, 2013).

The acceleration of globalisation and the emergence of a single world economic system has led to an increasing economic and political interconnection of countries over the last century, while the activities and production processes of multinational corporations across countries and continents have created transnational cooperation and networks, increasingly diminishing the importance of national borders (Szilágyi,

2013). In this network-based world, according to the paradigm of Manuel Castells[5] (1996), the world as a system, composed of real and virtual spaces, is moving towards openness as a multi-layered network, and its main characteristics are knowledge-based nature, horizontality, adaptivity, learnability, timelessness, and the emergence of interdependencies (Hendlein & Prazsák, 2005). The networked world is a system that expands organically, through the individuals, organisations and transnational links that are connected to it. This complex system of relations in the information society of the modern age are better described by a *network society* model, which describes the system in terms of dynamic relations and flows, as opposed to the more static traditional conceptions.

Castells (1996), linked the emergence of the information-based network society to the economic restructuring following the oil crisis of the 1970s and the emergence of new identity- and value-based social movements. In this framework, the world is shaped by two main trends: the relationship between the network and the individual, which is the conflict between the global capital and information flows with the individual's ability to realise themselves only locally; and the trend of localities parallel to globalisation, which creates both new opportunities and challenges. In a networked word, convergence and divergence, centralisation and fragmentation are parallel and complementary.

In Castells' view, the technological revolution, accelerated mainly by the development of information technology, has fundamentally reshaped the fabric of modern society. The world's different economic spheres have become increasingly interdependent, creating a new and dynamically changing constellation of states, economies and societies. The original model of capitalism underwent an important transformation, leading to a more flexible, decentralised, and networked system, in which capital gained greater power over labour and competition intensified at the global level.

This transformation of the capitalist system has brought with it the global integration of financial systems, the rise of Asia as a new leading centre of production, the economic integration of Europe and the emergence of a North American regional economic area. The inequalities that were reinforced in the transformation process were no longer specific to regions, but rather to segments within societies around the world, where the area or group in question could not integrate into the new logic dictated by the system and could not benefit effectively from economic growth. In addition, a new global

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[5] Manuel Castells is a Spanish sociologist, one of the most prominent theorists on the impact of technology on social change.

communication system was created, with a universal digital language that integrates the production and distribution of words, thoughts and images on a global scale. These interactive communication networks are growing exponentially, creating new channels of interaction between individuals, groups and organisations that simultaneously shape our lives and are constantly evolving to adapt to our lifestyles (ibid.).

As a result of general technological and particularly information technology achievements, time is shortening and geographical distances are shrinking, which contributes to the emergence of a *global consciousness* and the eclipse of the Westphalian-type international system based on the exclusivity of state actors (Szilágyi, 2013). It is the era of shared sovereignty, i.e. the strengthening of the participation of public actors with different levels of power in the pursuit of various interests. In addition, non-governmental or civil actors, institutions, organisations, and movements are playing an increasingly important role, operating in virtual and real networks, shaping prevailing power relations in the world (ibid.).

Although modern theories of geopolitics may make the vision and framework associated with traditional theories of space seem outdated in the light of advances in communication and digital technology, we must admit that some basic geopolitical assumptions remain just as relevant as ever. Geopolitics' links to geographic spaces cannot be ignored, from the distribution of natural resources to areas of emotional or ideological significance and neighbourhood relations. The world's dependence on natural resources, especially energy, is still a determining factor in the development of political interactions, international relations and interests, and the technological achievements of the 21st century have not been able to change this to this day.

While the 21st century is arguably unprecedented in history, with the emergence of global communication and networks between and across countries, traditional geopolitical factors such as changes in geographic scope, economics, national interests, or demography must be as much part of our argumentation about how the world works as the impact of technological innovation or the emergence of supranational actors or interdependencies. In a meta-geopolitical argumentation, all of these factors together shape the world's balance of power, even if with varying weight, and continue to create opportunities for development or conflicts among geopolitical actors (Al-Rodhan, 2018).

1.2.2 The rise of critical geopolitics and soft power

The emergence of the critical geopolitical movement is associated with Gearóid Ó Tuathail[6], who uses the tenets of classical geopolitical thinking in relation to the international role of states (and specifically examining the world hegemony of the United States), but also pays special attention to the analysis of the related social reality, and thus critically relates to traditional geopolitical narratives (Szilágyi, 2013).

The framework of critical geopolitics is closely related to the constructivist school of international relations and often goes back to classical geopolitical reasoning, however it moves towards a geoeconomic conceptualisation of space, since it also includes the analysis of the global economy and the behaviour of global economic actors. In the critical geopolitical interpretation, the classical geopolitics argument, which examines international relations in a deterministic fashion on the basis of the geographical characteristics of nation states, has become outdated in the wake of economic and technological changes. These changes call for a more complex understanding of international relations and political geography, reflecting the changing geographic position of economic activities and the dynamic use of different human and natural resources, as well as the role of technological innovation.

Mackinder's notion that geography is a major determinant of historical events is a strong idea that has accompanied the geopolitical discourse throughout the Cold War and is relevant in today's geopolitical context. However, the dramatic transformations of the 20th century, both along the lines of war and economic and technological change, seem to be outlining a trend that suggests that a more sophisticated analytical methodology than Mackinder's pivot theory is now needed to understand the global geopolitical arena. In the 21st century, understanding and dynamically tracking the rapidly evolving economic, social, and technological changes may be a more important aspect than dominating the heartland (Dalby, 1998).

In today's *new world order*, the post-Cold War view of the relationship between geography, power and international order is dynamically changing alongside the different approaches of contemporary thinkers. For some, the Cold War has enabled the emergence of a new geopolitical world order, in which the globalisation of economic activity, international trade, foreign direct investment and capital are redefining the meaning of state, rule and geographic structures. According to others, the new geopolitics is no

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[6] Gearóid Ó Tuathail (or Gerard Toal) is an Irish geographer and political scientist, known for his research on critical geopolitics.

longer about competition between states and communities of states, but rather about transnational problems such as terrorism, nuclear proliferation, or clashes of civilisations. Still others, in the relationship between politics and geography, see the degradation of natural resources, pollution and global warming as the most important issues. In this conception, the new understanding of geopolitics is not related to geoeconomics but rather to *ecological politics*, which clearly illustrates the wide range of possible interpretations of the present and future of geopolitics (Ó Tuathail, 1998). It is no coincidence that the critical geopolitical understanding of geopolitics is in a constant state of content expansion and broadening in response to the rapid changes in international relations (Szilágyi, 2013).

According to the typology of critical geopolitical reasoning, we can distinguish three different dimensions; *practical geopolitics is* the tool of state leaders and foreign policy decision-makers, *formal geopolitics is the tool of the* strategic community within states or states, while *popular geopolitics* is the discourse of cross-border popular or general popular culture, which are expressed in mass media products such as cinema, novels or journals (Dalby & Ó Tuathail, 1998).

Figure 2: Typology of critical geopolitical reasoning
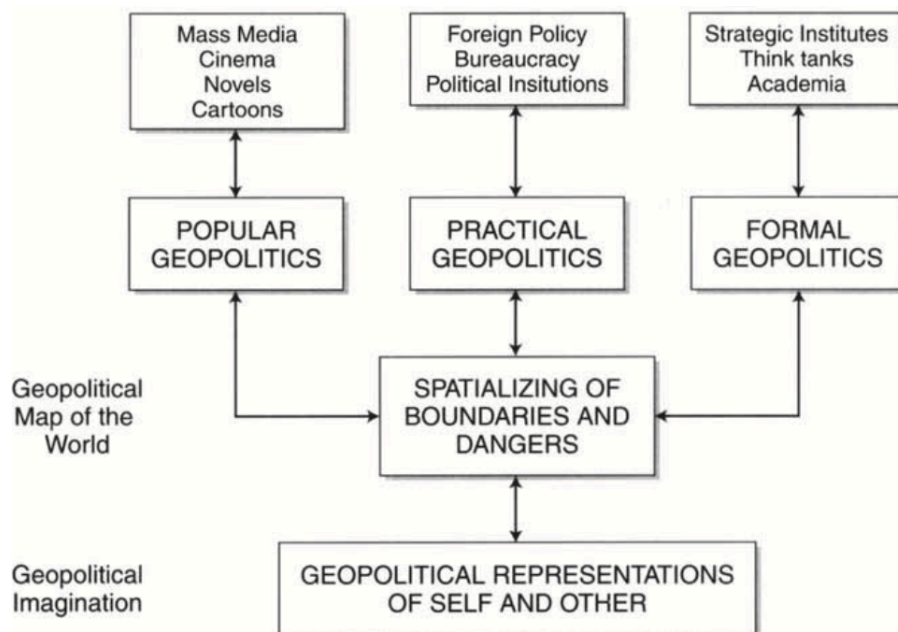
Source: Dalby and Ó Tuathail, 1998:5.

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Each of the three "geopolitics" has a different production, distribution and consumption. Taken together, as illustrated in the accompanying figure, they create the geopolitical culture of a region, state, or state community. It is important to note, therefore, that not only the specialised knowledge and activity of state leaders and experts, but also the national or community identity, security and sense of fear that is built up in the collective consciousness, play a key role in understanding geopolitical thinking and behaviour in a broader sense.

Geopolitics is present in the everyday lives of states and nations and the places where it arises can be many and varied. We can speak of a "high" place of origin, such as a government publication, a "low" place of origin, such as a tabloid magazine cover, a "visual" place of origin, such as a press photograph, a "descriptive" place of origin, such as an official speech, a "traditional" place of origin, such as religious customs, or a "postmodern" place of origin, such as cyber-warfare. Although in people's minds geopolitics is perhaps more associated with big moments, such as the announcement of a military intervention or a spectacular demonstration of state power, in fact the practice of geopolitics is linked to much more everyday events and activities and takes many more forms, all of which shape the evolution of international relations (ibid.).

Much of contemporary geopolitical discourse deals with the changing significance of the classical understanding of geopolitics and the emergence of a new kind of geopolitics, in fact the democratisation of geopolitical discourse. Whether the central theme of the study is the rise of geoeconomics, the clash of civilisations, the analysis of regional differences, the monitoring of demographic change or the exploration of the changing dynamics of globalisation, many studies have consistently found the decline in the importance of the geographic definition of states and the diminishing role of classical warfare in the relations between great powers (Ó Tuathail, 1998).

Nowadays, geopolitics is also increasingly about how the media and mass media frame events and how places and events are or are not portrayed in the daily news and broadcasts (Wark, 1994). The information age has revolutionised warfare but also the ways in which power is exercised. The exercise of soft power, for example, is the ability of a state to achieve its goals in the scene of international relations through the creation of attraction rather than coercion or payments.

Figure 3: The World's leading soft-powers (WEF, 2017)

Top 10 countries that hold the most soft power
Ranking based on global factors, 2017

Country	Score
France	75.75
United Kingdom	75.72
United States	75.02
Germany	73.67
Canada	72.90
Japan	71.66
Switzerland	70.45
Australia	70.15
Sweden	69.32
Netherlands	67.98
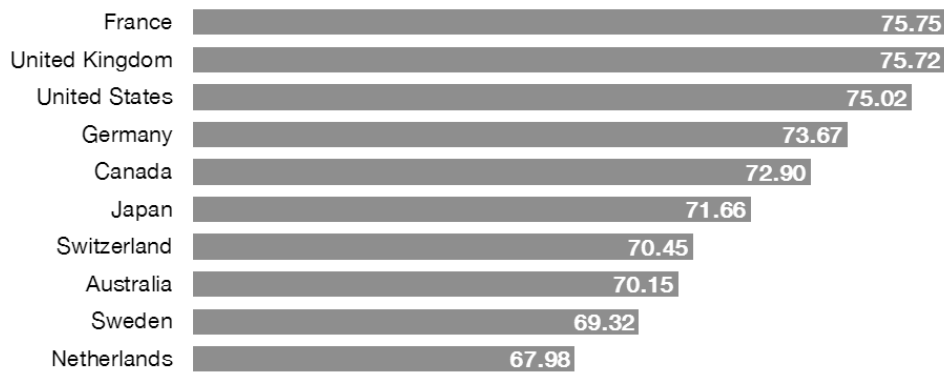
Source: WEF, 2017.

The effect of soft power is based on persuading others to follow our ideas and agree to certain norms and institutional operations, and thus to behave in the way we expect. The source of soft power can be a country's culture, its political ideals and the strategies it employs. If a state is successful in legitimising its power in the eyes of others, it can achieve this by getting other countries to move in a particular direction or constrain its actions without resorting to costly means such as coercion arising from the country's military and economic power (Nye, 2002).

The new political and technological environment favours influential countries, such as the United States, which can exploit soft power to convey their worldview, ideas, ideologies, culture, economic model, social and political institutions and, last but not least, to exploit their international connections in the business world and in global communications (Nye at al., 1996). American *popular culture* dominates the world of film, television, and electronic communication, which primarily conveys equality and liberal ideas as the defining ideals of the United States to the rest of the world. Moreover, the US higher education system attracts nearly half a million foreign students each year, who are able to get a first-hand experience of the ideology represented by the United States. Of course, not all aspects of American culture are universally popular and not in all areas of the world, but the information technology revolution has generally contributed to the spread and acceptance of American ways of thinking and values (Nye et al., 1996).

The globalisation of the international political economy and multilateralism is based on a series of processes such as the internationalization of financial systems, the emergence of market economies, and new patterns of global division of labour and production chains, accompanied by the transformation of global communication networks and the information revolution. New technologies are connecting people in distant parts of the world, both in terms of telecommunications and information technologies and the development of physical infrastructure. Perhaps the most important geopolitical aspect of the fading of borders is the change in the traditional understanding of space. International flows have a deterritorializing and dematerialising effect, from which new universal and individual identities emerge, as anyone anywhere in the world can have access to the same things, markets and values (Agnew & Corbridge, 1995).

1.2.3 The emergence of Geoeconomics as an alternative

The reason for the emergence of the geoeconomic trend can be linked to the spread of globalisation and the changing functions of the state as a result of globalising economic interactions and the reterritorialization and deterritorialization processes linked to integration and disintegration trends, as well as to the changing role of the state. The emergence of subnational and supranational, non-state and non-political actors has changed the composition and functioning of international society, leading to a shift from identity-based and predominantly political approaches to an increasing emphasis on economic considerations. Geoeconomic thinking is explored in terms of the nature and type of state presence, future state involvement and the type of conflicts that can be prognosticated (Szilágyi, 2013).

The international scene is primarily occupied by states and communities of states interested in exploiting revenues and regulating economic activities to provide the resources to deliver public services, develop infrastructure and, increasingly, create new technologies and innovative products. As geographically bounded entities, states cannot ignore their own borders and interests, but they must find new ways of pursuing them in a system of international relations dominated by global economic processes. States are, by their very nature, inclined to seek and exploit comparative advantages in the international scene, even by using force. In other words, nation-states act in geoeconomic interests, as territorially bounded entities competing with one another on the global political and economic stage (Luttwak, 1990). In addition, processes within states play an important role, in which dominant domestic actors have a strong influence on domestic

and, consequently, indirectly, international economic processes, often using geo-economic instruments to balance the declining geopolitical weight of a given country.

Learning from the tumultuous course of the 20th century, it seems that today *economic warfare* is largely taking over from traditional warfare in the assertion of interests between states. Military methods are replaced by commercial methods, firepower capacity by disposable income, extended bases by market share, and the development of military technology by the innovative capacity of a country's business sector. Geoeconomics thus operates following the logic of conflict and using the tools of trade to determine the modus operandi of states on the global economic battlefield (ibid.).

Globalisation driven by transnational corporations and the increased internationalization of financial markets underline the trend towards other *superpowers* joining the world's leading states. There is another very important phenomenon to consider in the analysis of the international geoeconomic landscape, alongside the growing market influence of large financial institutions and transnational corporations, nominally that certain (industrial) lobby groups may seek to manipulate the internal and external behaviour of states for their own ends, often even seeking to establish hostile geoeconomic positions. There is almost no functional area of the state that is free from such potential political interference, since, for example, fiscal policy can be a good instrument to discourage imports, the regulatory environment can favour domestic actors in various ways, the involvement of public resources in development policy and the granting of subsidies or concessions can create a more advantageous position for domestic actors compared to foreign competitors (Luttwak, 1990).

On the other hand, some states can consciously help large domestic companies in the international arena to achieve their geoeconomic goals, especially in strategically important sectors such as finance, energy, transport or defence. This technique is by no means new, as during the 17th century, for example, British, Dutch or Danish East India trading companies often became the chosen instrument of their home countries to achieve international economic-political goals (ibid.). However, we can still find similar, if less spectacular, examples of such practices in both global and regional markets.That is why companies operating in international markets may sometimes find themselves facing foreign competitors that dump prices to make it impossible to operate on market based business terms, as they can finance their otherwise deficit budgets through direct or indirect subsidies or concessions from their home country. This comparative competitive

disadvantage can be particularly significant for companies operating in countries with strict competition rules, such as European Union member states (Kulu et al., 2015).

Geoeconomics has emerged in an era when there is no better available tool in the toolbox of international advocacy than economic warfare (Luttwak, 1990). In recent decades, global elites no longer see warfare as the most expedient way to resolve certain (even military) conflicts, since the advent and spread of nuclear weapons, warfare has become a mutual threat that can keep the parties at bay, creating a sterile and inactive situation. While in the age of mercantilism the means of physical violence could still appear or even dominate in the enforcement of economic interests, in the age of geoeconomics the means of conflict resolution must also be economic. Such instruments of conflict resolution or economic warfare could include, among others, import restrictions, state support for export activities, strategic technological development and, more broadly, targeted development of education in certain sectors of crucial competitive importance.

In today's global economic order, there is an increasingly strong tension between the inherent nature of states as competing and conflicting international relations and the recognition that in a war scenario, by definition, victory for one side can only come at the expense of the other. In contrast to warfare, international economic relations can be mutually beneficial for both sides, and along this logic the rise and success of state action based on the geoeconomic perspective will depend on the extent to which the world's leading powers embrace this logic (ibid.).

1.2.4 The geopolitical conceptualisation of innovation

In the wake of the economic transformations of recent years, numerous academics and experts have concluded that economic growth in developed countries is driven by technologies based on knowledge, innovation and the production and dissemination of information. In a knowledge-based economy, where knowledge, innovation and human capital are the essential resources, the geopolitical narrative should also follow a suitable approach. From the perspective of international relations, this transformation entails, that the role of traditional factors in the balance of power, such as military power, gross national product, population, energy, land, natural resources, are all declining in importance, in contrast to the increasing importance of factors such as technological development, educational standards, or the flexibility of institutional arrangements (Nye et al., 1996). In the next phase of capitalism, the knowledge-intensive era, intellectual

and physical labour will begin to merge, i.e., a synthesis will emerge in which innovation and production go hand in hand. Richard Florida[7] (1995) defines this as the era of *innovation-mediated production*.

The fundamental change is that, in contrast to the economic arrangements of the past (from feudalism to capitalism), the main driving force of economic development is no longer physical strength and human skill, but intelligence and intellectual work. Thus, intellectual value creation replaces physical labour and takes over its role as the main profit generator. Florida argues that this phenomenon represents an epochal shift, as the innovation systems of the twenty-first century will be fundamentally different from those of the twentieth century: the acceleration of the pace of technological development will make innovation uninterrupted and continuous, and knowledge-intensive. Networked organisations will replace vertical bureaucracies.

The transition to knowledge-intensive capitalism goes beyond the strategy or business model of individual firms, and instead calls for the creation of trans-firm production centres along a broader structure, based on cooperation involving the institutional system of the region. In this process, globalisation and the resurgent regionalism are two sides of the same coin, characterised by the transition to a knowledge-based economy. The central claim of the new order, which Parag Khanna[8] in his theory called, *connectography*, is that the forces of connectivity – traffic and transportation, energy networks, innovation ecosystems, global financial markets, international trade or cultural integration - are redefining geographical reality. Khanna argues that as much as state borders have dominated political geography so far, the geography of the future will be rewritten by the power of connectivity. Although the transformation can only be meaningfully understood in relation to the past millennia, we have reached a turning point where regional and global connections become more important than the dividing lines and borders between them (Khanna, 2017).

The interpretation of geopolitics related to the role of technological innovations and the knowledge-based society and economy has necessarily shifted from some of the focus from states to urban regions and spaces, regional hubs, technological clusters, nodes and their global competitiveness (Moisio, 2018).

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[7] Richard Florida is a professor and author known for his work on economic development, urban studies, and creative class theory.
[8] Parag Khanna is a researcher and author on geoeconomics and future trends in technology.

Figure 4: Comparison of territorial geopolitics and the geopolitical interpretation of the knowledge-based economy
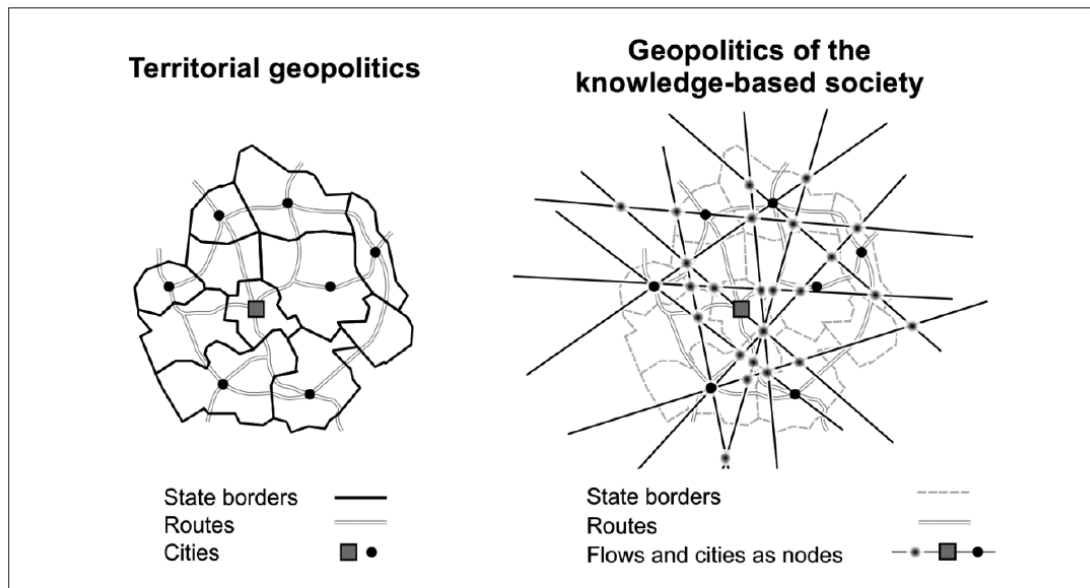
Source: Moisio, 2018:4.

Figure 4 compares the geopolitical understanding organised on the basis of territorial determination with the geopolitical interpretation of the knowledge-based economy. The former traditionally describes the geopolitical space along country and regional borders, cities and the routes connecting them, while the latter depicts a network of which cities are the nodes (nodes or hubs). These nodes can be considered the capital accumulation centres of the future, and the flows of knowledge, labour and capital between them can reduce the importance of state borders (ibid.).

The interesting thing about this theory is that it does not imply that the diminishing importance of political borders will lead to a reduction in the number of security policy problems and international conflicts, but that conflicts will now increasingly develop around access to connectivity rather than borders. This could even lead to more complex geopolitical problems than before. Despite this, Khanna (2017) argues for a positive geopolitical outlook, claiming that none of the war conflicts since the end of the Cold War have escalated into a global crisis or world war, due to the strength of the interconnections that span the globe, and the proximity, trade, and social links between urban regions, all of which are pushing towards more peaceful conflict resolutions.

US foreign policy expert and academic, Walter Mead[9] speaks of the *return of geopolitics*, contrary to the optimistic voices (Mead, 2014). Analysing geopolitical movements in 2014, such as the Russian annexation of Crimea, the conflict over the South China Sea islands or Iran's growing power ambitions, Mead concludes that traditional power struggles have returned to the arena of interstate relations. We can fall into the trap of bias in our interpretation of global processes if we follow European and North American geopolitical thinking. In this paradigm, there is a strong demand to move away from clustered territorial and military geopolitical issues and focus on global governance issues such as the promotion of free trade, nuclear disarmament, the protection of human rights, the guarantee of the constitutional rule of law, or climate change. Conversely, a return to classical geopolitics in the international relations system would mean that, instead of striving for win-win situations, we would once again accept the outcome of zero-sum games, in which one party's victory can by definition only be at the expense of the other.

Mead (2014) argues, that in fact classical geopolitics has never really disappeared from the international scene, but rather that many have misinterpreted the message of the break-up of the Soviet Union. Just because the ideology of capitalist democracy has triumphed over communism, this does not mean that the use of hard power in international relations has disappeared. Since the dynamics of history have not changed much in recent centuries in terms of the Hegelian dialectic, states must continue to seek to develop ideologies and institutions that will enable them to benefit from the new stage of capitalism and from knowledge-based development.

Regardless of whether one theory is more optimistic or more pessimistic about the geopolitical situation, the signs of knowledge-based, innovation-driven economic and social transformation are becoming increasingly clear, both at regional and global level. As the logic of traditional geopolitical thinking seems to continue to prevail in the world, knowledge as a new type of resource needs to be understood in a geopolitical context. A geopolitical understanding of innovation can help us to meaningfully analyse, model and even predict the evolution of recent phenomena closely linked to the knowledge economy, such as the accelerating growth of social inequalities, the widening of the digital divide or the increasing role of education in the competitiveness of states.

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[9] Walter Russell Mead is an American foreign policy scholar and writer.

1.3 Literature review[10]

The intersection of technological innovations and geopolitics is an emerging and rapidly evolving field, as the debate on the impacts of technological change involves ethical, social, economic and legal questions, ranging from issues around market competition and market structure to concerns regarding individual freedoms. The review of the literature aimed to gather theoretical concepts and current developments on some tendencies that are shaping the way we think about the relationship between technological innovations and global politics.

The literature review can be divided into two parts: (i) literature review on the theoretical frameworks applied in the thesis, and (ii) literature review specific to the topics discussed in the individual articles. The latter part is only briefly explained within the scope of this chapter. The detailed literature reviews form part of the articles provided in the Appendix.

The literature concerning the theoretical framework was partially based on the curriculum of the Ph.D. program and previous studies, supplemented by a forward snowballing methodology of sources, primarily textbooks, text collections, book chapters and journal articles. The additional review of the literature on some specific topics discussed in the individual articles was carried out using targeted search, based on relevant topics, key words and authors in the Web of Science database, the EBSCO research platform and Google Scholar. Targeted searches were at times complemented by forward snowballing style collection of sources.

Top keywords of cited sources include: economics, economic, innovation, China, global, growth, world, artificial intelligence, geopolitics, development, economy, industrial, society, technology, revolution, business, digital, national.

A database of the literature has been created, including the name of the author(s), year of publication, title, type of publication, title of journal (if applicable), language and area of focus. The database (N=173) predominantly contains scientific journal articles (N=78); books and book chapters (N=33); conference proceedings, working papers and research reports (N=32); and other articles (N=28).

Working papers include documents published by the National Bureau of Economic Research (NBER), American Economic Association (AEA), Central Bank of Hungary (MNB), European Investment Bank (EIB). Research reports are featured from

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[10] Certain sections of the literature review chapter are cited from the articles that form part of the thesis.

institutes (e.g. Institute for Foreign Affairs and Trade [Hungary], McKinsey Global Institute [MGI]), international organisations (e.g. Organisation for Economic Co-operation and Development [OECD]) and official bodies (e.g. European Parliamentary Research Service [EPRS], Hungarian Central Statistical Office [KSH]). More than 70 percent of sources cited date from the past 10 years.

(I) Some of the most influential works that helped form the theoretical background of the thesis are listed in the following paragraphs. Principles, concepts and history of geopolitical thinking, with special focus on classical geopolitics, were in large part drawn from Szilágyi's (2013; 2018) and Dövényi's (2021) textbooks. The theoretical framework provided by critical geopolitics was instrumental in constructing the geopolitical understanding of contemporary technological phenomena, building on Ó Tuathail's (1998; 2005) and Dalby's (1998) synthesising works, and Luttwak's (1990) conceptualization of geoeconomics, also discussed by Simai (2014).

Individual scientific results that have contributed to the framing of the research questions, included some long established concepts in political science and economics, like Solow's (1956) theory of economic growth; Schumpeter's (1980) model of creative destruction; Rosen's (1981) economics of superstars; Romer's (1986) conceptualization of non-rivalry and innovation; Porter's (1998) cluster theory; Castells' (1996) description of the network society; Florida's (1995) model of learning regions and knowledge-intensive value creation; and Nye's (1996; 2002) work on soft power and information technology advantage. The author believes that these scientific concepts remain valid and relevant, and they are able to provide a robust framework for organising new knowledge gained in the past decades with advances made in technology.

New evidence and theories that are significant from a geopolitical viewpoint on the socioeconomic impacts of emerging technologies, are also incorporated in the thesis, drawing on the work of Brynjolfsson & McAfee (2014) and Brynjolfsson et al. (2018) regarding the "second machine age"; Rifkin's (2015) zero marginal cost society; Korinek's and Stiglitz's (2019; 2021) analysis on artificial intelligence and income distribution; Palotai and Virág (2016) on national competitiveness in the knowledge-intensive economy; Khanna's (2017) connectography hypothesis; Moisio's (2018) conceptualization of the geopolitics of the knowledge-based economy; and Schwab's (2016) description of The Fourth Industrial Revolution.

(II) Further review of the literature has been conducted on some specific topics discussed in the individual articles.

Article 1 from a theory perspective, builds mainly on Porter (1998), Schwab (2016) and Rifkin (2015), and uses contemporary sources to draw data and evidence for the case study approach. Along with journal articles, a relatively high number of research reports from the business sector (eg. McKinsey, Ernst & Young, Citigroup Research) and international bodies (eg. OECD, EC), as well as other official sources, scholar's blogs and government press releases are cited related to China's innovation capacities.

Article 2 contains a targeted literature review on disinformation campaigns and strategic narratives, and how recent studies have used a similar framework when assessing them:

Deverell et al. (2020) have conducted a comparative narrative analysis on how the news platform Sputnik narrated Denmark, Finland, Norway and Sweden between 2014 and 2019, and have found that Sputnik News utilised a mix of standard strategies and tailor-made narratives to destruct Nordic countries. They have been able to identify differences among how Sputnik narrated the countries of the region, with Sweden and Denmark being portrayed more negatively than Norway and Finland. They have concluded that the identified narratives served the purpose of dividing and weakening the Nordics and the EU, as well as undermining the international reputation of the countries involved. A Izak (2019) has focused on the presentation of the European Union in Slovak pro-Kremlin media, with the main objective of identifying basic narratives via qualitative discourse analysis, and has concluded that media manipulation regarding the image of the EU could be considered a tool in a broader scheme of hybrid warfare. Wenerski (2017) examined disinformation campaigns as a method of creating geopolitical influence by distorting public perception of people, events and even entire institutions such as the EU or the NATO. Wenerski argues that an alternative version of events at the Euromaidan, the war in Donbas and Syria has been created by disinformation sources that seek to destabilise the local political situation by supporting one political side and simultaneously discrediting the other. Kuczyńska-Zonik and Tatarenko (2019) have studied the problem of information security and propaganda in Central and Eastern European countries since 2000, and have concluded that information war in the CEE region is not directed toward the countries of the region but rather aims to weaken the West, especially the European Union.

Hinck et al. (2018) examined strategic narratives embedded in Russian broadcast and news media, by analysing 1016 broadcast and online news segments from 17 different sources representing governmental and official news sites, oppositional sites and independent news sources. They have found that narratives help construct Russian identity in building domestic cohesion while fending off criticisms by Western nations. Khaldarova (2016) has concluded that Russia employed strategic narratives to construct activities, themes and messages in a compelling story line during its conflict with Ukraine. She also identified differences in narratives on Russian television when broadcasted to domestic and foreign audiences.

Article 2 also reviews the literature regarding the applied method of using natural language processing (NLP) algorithms in political discourse analysis, disinformation campaigns and in social sciences more broadly:

Zhou et al. (2019) have found that the explosive growth of fake news and its erosive effect on democracy make the study of disinformation an interdisciplinary topic, which requires joint expertise in computer and information science, political science, journalism, social science, psychology and economics. They have approached the problem from the perspective of news content and information in social networks, techniques in data mining, machine learning, natural language processing, information retrieval and social search to devise a holistic and automatic tool for the detection of fake news. Ibrishimova and Li (2020) have likewise used a framework for fake news detection based on a machine learning model to define and automate the detection process of fake news. Díaz-García et al. (2020) have presented a solution based on Text Mining that identified text patterns related to Twitter tweets that refer to fake news, using a pre-labelled dataset of fake and real tweets during the United States presidential election of 2016. Oshikawa et al. (2018) have highlighted the importance of NLP solutions for fake news detection, notwithstanding limitations and challenges involved, given the massive amount of web content produced daily. Farrell (2019) has utilised natural language processing and approximate string matching on a large collection of data to examine the relationship between the large-scale climate misinformation movement and philanthropy. Rashkin et al. (2017) have compared the language of real news with that of satire, hoaxes and propaganda to find linguistic characteristics of untrustworthy text using computational linguistics.

Aletras et al. (2016) have built a predictive model based on natural language processing and machine learning to unveil patterns driving judicial decisions in the European Court of Human Rights cases, based solely on textual content.

Article 3 presents a review of the Hungarian and international literature on the impact of AI solutions on productivity, competitiveness, economic development and the labour market:

In recent years, the discussion surrounding the impact of AI solutions on productivity, competitiveness, economic development, and labour market has received considerable attention in the international literature. Among the most influential works, Agrawal et al. (2018) highlight the productivity-enhancing effects of drastically reducing forecasting costs. Brynjolfsson & McAfee (2014) addressed the paradigm of rising productivity and falling wages. Lee (2018) discussed labour market implications of the US-China AI race. Kurzweil (2005) outlined theoretical perspectives on the use of AI. Acemoglu & Restrepo (2018a; 2018b), Arntz et al. (2017), and Autor & Salomons (2018) drew attention to the labour-saving nature of automation, while Autor et al. (2003), Autor & Dorn (2013) and Michaels et al. (2014) highlighted the phenomenon of labour market polarisation. In the context of the global impact of the shift to AI, the topic has been addressed from a broader geoeconomic perspective, with Korinek & Stiglitz (2019; 2021), Aghion et al. (2017) and Varian (2019) addressing the dynamics that increase inequality between developed and developing countries and between different labour market groups.

In the domestic specialised literature, Szalavetz (2016a; 2016b; 2019; 2020) examined the economic effects of artificial intelligence solutions in the context of Industry 4.0, productivity, and the digital transition. One of their conclusions was that the uptake of AI is slower than previously assumed by researchers, so that cost-saving applications of the technology are likely to face long delays. Another conclusion is that automation not only affects the activities of low-skilled workers, but also transforms the portfolio of activities of the highest paid jobs (Szalavetz, 2016b; Szalavetz & Somosi, 2019). Matolcsy (2020a; 2020b) has described a revolution in artificial intelligence that operates in the background compared to previous technological revolutions. Consequently, it is less perceived by users, but it has cross-sectoral effects and could play an

important role in replacing a shrinking workforce. Boros and Kolozsi (2019) examined the geopolitical aspects of AI development as a technological race in relation to China and the US. Vértesy (2020) assessed the peripheral position of Hungary by quantifying the patents filed in the field of AI solutions. Gulyás (2020) pointed out that Europe is currently losing the war for data assets. The typically monopolistic or oligopolistic market structures of the platform economy make it almost impossible to replace incumbents, namely players already on the market. Dietz (2020) examined competitiveness and labour market issues in the context of the role of AI in education. In this context, he highlighted the need to develop digital competences. Brávácz and Krebsz (2021) showed that the performance of Hungarian SMEs could be enhanced and made competitive through digital solutions.

2. METHODOLOGICAL OVERVIEW

The methodology and applied methods of geopolitics has been largely influenced by the history and the evolution of the discipline itself, and those influential scholars that had shaped geopolitical thinking throughout the past century. There has always been an intimate connection between the field of geopolitics – that belongs to political science - and geography, both in terms of methodology and scholarship. However, while classical geopolitical scholars sought to apply methods from geography and other natural sciences, such as evolutionary biology, to establish *natural laws* that would apply to the behaviour of states, (post)modernist and critical geopolitical scholars opened the scope and methodology of their analysis to incorporate subjects and methods from other social sciences, such as economics, urban planning or environmental policy, in a more analytical and less applied manner.

2.1 The methodological tradition of geopolitics

Contemporary geopolitics also broadened the understanding of space and power, that would incorporate spaces that are not strictly delineated by national borders, such as virtual, cyber or even personal spaces and extended the definition of power relations to include non-formal and non-state actors. Within the scope of the dissertation, a contemporary understanding of geopolitics has been applied, with research methods that reflect the multidisciplinary nature of the field.

2.1.1 The methodology of classical geopolitics

The discipline of geopolitics was born at the end of the 19th century in the intersection of political science and geography – similarly to discipline of political geography - , which to a large extent drew on the approaches, methodological traditions and research questions of these two fields. Geopolitics originally focused on the study of spatial and geographical characteristics of international relations, examining the relationship between politics, geography, the natural environment, demography and state-organised society (Szilágyi, 2018:13). Early scholars of classical geopolitics, such as Friedrich Ratzel, Rudolf Kjellén or Karl Haushofer, aimed at applying experiences and methods of natural science investigations to society and drawing quantifiable laws of motion from observed social phenomena (ibid.). The idea behind this approach was that

a given state's location, space, economic structure can and should be taken into political consideration by applying political-geographic knowledge to the analysis.

Early practitioners of geopolitics believed that the outcome of such analysis could serve as a political map or itinerary to guide daily political processes (Dövényi et al., 2021:13). In this sense, after the First World War, geopolitics was viewed as a scientifically based theoretical construct, that could help determine possible political goals and paths leading to a more successful future, following the recovery from the crisis of the war and the social, political and military collapse that it entailed (ibid:11). Geopolitics provided a unified system of understanding power politics and spatial processes as an applied science, drawing on Kjellén's theory of the state and Ratzel's political geography (ibid:20). The methodology of classical geopolitics therefore consisted of observing spatial development mechanisms and describing them with geographically generalised regularities, abstracting geographic formulas from the individual and seeking universal applicability to them (ibid:28).

Perhaps the degree of freedom of the methodology - stripped of its original scientific rigour – contributed to the possibility for power elites to distort geopolitical terminology into a tool of power ideology and argumentation seeking to remedy national grievances. The embrace of geopolitics, and particularly ideas of social Darwinism and geographical determinism as a tool of political propaganda and foreign policy ideology by the Third Reich has caused the discipline to go into hiding for decades after the Second World War. In Hungary particularly, the study of geopolitics was an outcast in the scientific community up until the change of regime in 1989 (ibid:24).

2.1.2 The methodology of (post)modern and critical geopolitics

It was Henry Kissinger's 1979 book, *White House years*, that brought geopolitics back as a conceptual framework in mainstream Western political thought after the Second World War. Kissinger used geopolitics as a method of analysis to counter the reasoning of liberal idealism and outline structures of the global balance of power versus national interests (Szilágyi, 2018:14). In parallel to the return of geopolitical terminology in the political discourse, there has been a scientific renewal of the field as well. Geopolitics, which originally focused on the geographical aspects of international relations has been broadened to include problems and methodologies from other disciplines such as economics.

In the 1990s critical geopolitics emerged, with notable scholars like Gearóid Ó Tuathail, Simon Dalby and John A. Agnew. Critical geopolitics is characterised by a critical approach to traditional geopolitical thinking and its results, as it states that geopolitical discourse not only describes but produces global political and economic spaces (Szilágyi, 2018:190). In terms of methodology this means that when analysing the political role and influence of a global power, we have to take into account the specific historical situation, political practice, state activity and different areas of power influence. Social realities should be an integral part of the analysis, and the recognition that the political and economic fields are ultimately intertwined and can be expressed in different forms of human activity (ibid:189).

As Tuathail (2005:8) formulates it:

"…histories of knowledge should be situated within the historical and geographical context of the power relations that not only were there when the form of knowledge emerged and consolidated itself as a system of statements and procedures but that also helped give the form of knowledge its very birth and existence. Far from preventing knowledge, power produces it. The very identity of the subject position "geographer," "cartographer," or "geopolitician," for example, the specification of geographical/cartographic/geopolitical objects to be recognized and represented by this subject, and the "geographical techniques" by which these objects are arranged, presented, and projected are all effects of power-knowledge relations."

The field of geoeconomics, which is often categorised as part of critical geopolitics, serves as an important framework for analysis for this thesis. Geoeconomics as a discipline is concerned with "…interstate conflicts related to geographical factors, their management, and the role of economic instruments, the conditions and possible consequences of their applicability and application in the international strategy and foreign policy of states" (Simai, 2014). The term was popularised by Edward Luttwak (1990), who defined it in relation to geopolitics as a new form of competition between states in a globalised world, based primarily on economic power.[11]

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[11] From: Bánkuty-Balogh, 2022:105.

2.2 Synergies of theoretical and methodological approaches

The three articles that form part of the thesis are based on the understanding, that geopolitics today is shaped both by its classical tradition, (post)modern and critical geopolitics, and that it is a multidisciplinary social science that deals with the spatial and partly geographical aspects of the theory of international relations, as a part of political science (Szilágyi, 2018). The subject matter of the thesis, which is the *Intersection of Geopolitics and Technological Innovations*, inherently makes this presumption necessary, as it touches on topics in geopolitics that are relatively new in the literature and require a multidisciplinary perspective in terms of research methods.

The three articles complement each other in terms of theoretical and methodological approaches, as they unfold concepts of geopolitics, geoeconomics and economics that create a bridge between traditional geopolitical reasoning and contemporary socio-economic issues brought to life by the pervasive use of emerging technologies. While the full spectrum of emerging technologies cannot be covered in detail within the scope of three articles, the thesis delivers a focused analysis, and addresses some of the most influential technological trends of the past years from a geopolitical perspective: the advent of industry 4.0, the use of artificial intelligence technologies, and information warfare waged in virtual spaces. Although the individual areas at first glance could seem distinct, it is the same technological shift that enables underlying processes and creates phenomena that gains geopolitical and strategic importance in interstate relations. As such, their joint examination provides a holistic picture on the interplay between the technological and geopolitical, as well as global, regional and local tendencies.

2.3 Applied methods in the thesis

The following section summarises the research methods applied in each paper, while the detailed research structure and datasets are provided in the individual articles included in the Appendix. The first and third articles, albeit both examining a present-day geopolitical topic, follow a more traditional research method: a case study approach and a comparative study based on literature review and analysis of secondary data, forecasting possible outcomes. Article 2 is based on primary data extracted from discourse analysis, aided by a natural language processing algorithm, which makes both the subject and the method of said article novel in the field.

Article 1: Case study approach based on secondary data analysis and literature review

Article 1 assesses China's current position and prospects for growth in the so-called Fourth Industrial Revolution. The article presents an overview on the definitions and main driving megatrends of the Fourth Industrial Revolution, and models some of the possible socioeconomic implications that are already impacting or could potentially impact the country in the future. China's current economic situation and growth prospects are analysed based on publicly available statistical data regarding relevant socio-economic indicators, such as per capita GDP and GDP growth, rate of poverty, industrial output and productivity, levels of debt, economic structure, expenditure on research and development.

China's capability of becoming a technological innovator is identified as one of the key factors in predicting competitiveness within the previously defined framework of the Fourth Industrial Revolution. The theoretical framework of approaching economic development and technological innovation builds on the Solow-model (1956) of economic growth and Michael Porter's (1998) Cluster theory.

The ratio of China's share in the global revenue pool compared to its share of global GDP is used as an indicator to evaluate innovation performance in different sectors of the economy. The study compares this ratio in four industrial sectors based on their relation to innovation: (1) customer-focused, (2) efficiency-driven, (3) engineering-based and (4) science-based industries, and measures China's success in each of these dimensions.

China's capability to create breakthrough innovation in different industrial sectors is examined by gathering and analysing data and information on the science and technology ecosystem:

    i.   the evolution of science and technology programmes implemented in the country,

    ii.   the current state of scientific research and development infrastructure,

    iii.   financial landscape (the role of venture capital and state financed programs) and commercialisation.

Finally, potential factors delaying the global breakthrough of the Chinese high-tech sector are identified.

Article 2: Quantitative discourse analysis and relationship mapping

Article 2 uses quantitative discourse analysis (DA) on disinformation messages to uncover strategic narratives that were spread by pro-Kremlin sources in the V4 region as a part of cyber-warfare activities. The research analysed close to 1000 individual news pieces containing disinformation, which originally appeared in one of the V4 languages in a 5-year time period.

The collection included 458 Czech, 285 Polish, 160 Hungarian and 40 Slovak language articles that appeared between January of 2015 and November of 2020. The news pieces originated from more than 60 different online sources (predominantly news sites and blogs), with the majority of the articles published on Sputnik News Czech Republic, American European News (Czech Republic), Sputnik News Poland, News Front Hungary and Zem & Vek (Slovakia). The articles were collected from the EUvsDisinfo Database (EUvsDisinfo, 2020a).

A natural language processing (NLP) algorithm has been used to analyse the textual data and extract information on recurring topics. The NLP algorithm was programmed to search for specific themes within the data and group them into distinct categories. The categories included people, countries, locations, concepts, organisations, events, and ideologies. The categorization of these themes was based on their relevance for the study and was not meant to be exhaustive.

The NLP algorithm was programmed to return the individual frequency of mentions of recurring topics and their relationship structure, based on co-mentions. This exercise was performed, both on an overall V4 and an individual country level, repeating the process on all four datasets.

The frequency of recurring themes within the articles has then been assessed, and their relative frequency compared among the four data sets to uncover consistent tendencies, as well as outliers in the data. A visual map of the relationship structure of recurring themes based on co-mentions has also been created.

The study employed the strategic narratives framework to make sense of the data and detect constructed identity claims and positions on specific issues that sought to shape the perceptions and actions of domestic and international audiences (Miskimmon et. al., 2013; Livingston et al., 2018). Based on the strategic narratives framework and the quantitative analysis, the research exposed individual storylines and overarching meta-narratives that were present in the four datasets.

Article 3: Comparative analysis based on secondary data and literature review

Article 3 examines the geoeconomic impacts of existing and widely used second-wave artificial intelligence (AI) solutions, with particular emphasis to its aspects affecting economic development and income inequality. The research uses deductive reasoning based on macroeconomic concepts fundamental to digital technologies, such as innovators' rents (Korinek & Sitglitz, 2021; 2019), winner-takes-all markets (Brynjolfsson et al., 2018; Brynjolfsson & McAfee, 2014), economics of superstars (Rosen, 1981), non-rivalry (Romer, 1986), network effects and path dependencies.

After defining theoretical models that serve as framework for the analysis, the study examines the distribution of the benefits from the use of AI technologies and investigates market dynamics, comparing the position of technological centres and peripheries. Based on the perspective of moving from the global to the local, the macro-level analysis is followed by an analysis of the country-level effects of the use of AI, with special emphasis on national economic limits to the redistribution of returns, emergence of oligopolistic market structures, dynamics that reinforce and diverge from the effects of globalisation, and expected labour market trends.

The article presents a comparative analysis on Hungary and Estonia regarding the digital preparadness of social and economic systems. Data from the Digital Economy and Society Index (DESI, 2021) is used for analysis to compare digital development in the areas of (1) human capital, (2) internet access, (3) digital technology integration and (4) digital public services.

Labour market trends are analysed based on the SBTC-theory and the ALM-hypothesis, by applying them to the characteristics of the Hungarian labour market, reflecting on the European centre-periphery geographic relationship in the division of labour.

3. INDIVIDUAL PUBLICATIONS AND FINDINGS

The following chapter provides a short summary of the three articles that form part of the article-based dissertation, focusing on research questions and major findings of the papers. The original articles containing the full analysis are included in the Appendix.

3.1 Article 1: Could China Be the Winner of the Next Industrial Revolution?

Article 1 examined China's growth prospects and competitiveness in the shift in production technologies, called the Fourth Industrial Revolution or Industry 4.0. The technological shift is accompanied by a set of broader socioeconomic, geopolitical and demographic developments, which are crucial in determining whether China can position itself successfully to come out as one of the global winners (if not the winner) of the technological transformation. The main research question therefore reflects the title of the article:

(RQ1): Can China emerge as the main global beneficiary of the transformation of production technologies in the Industry 4.0?

In order to answer the main research question, the study established a framework in which the concepts of the inquiry were outlined more precisely, introducing a secondary research question:

(RQ2): How can we define the changing geopolitical context of the Fourth Industrial Revolution?

One of the article's objectives was to collect and organise information available on the nature of the phenomenon called the Fourth Industrial Revolution. The introductory section clarifies definitions and gathers different technological breakthroughs that are commonly categorised under Industry 4.0. It also presents a framework on the logic of industrial revolutions from the first industrial revolution to the current one.

The nature of the Fourth Industrial revolution has been understood as a technological shift, that is (1) so encompassing that no one country can dominate it completely; (2) linked to the areas of the basic sciences; (3) immediately transferable; and (4) key to leapfrogging for basic industries (Kozmetsky et al., 2004). The velocity, breadth and depth, and systems impact of the changes makes the technological shift "revolutionary". The expected systemic impact has been underlined by three so-called

megatrends, the physical, digital and biological innovations that form the basis of new production methods (Schwab, 2016:3).

(RQ2a): What kind of technological change does the 4th Industrial Revolution entail?

The study progresses with the examination of the three megatrends and looks at some already widespread technological innovations that are utilised in the Industry 4.0 (Schwab, 2016): (1) Physical: autonomous vehicles, 3D printing (additive customised manufacturing), advanced robotics and the use of new materials, such as self-healing and self-cleaning smart-materials, metals with memory or ceramics that convert pressure into energy; (2) Digital: cloud computing, big data analytics, artificial intelligence, machine learning, Internet of Things, blockchain, platforms of the on-demand or sharing economy; (3) Biological: genetic sequencing and engineering, synthetic biology.

(RQ2b): What are the implications of the expected technological change for China?

The article follows by examining possible socioeconomic implications of such technological shift, focusing on the impact of disruptive changes on business models and the employment landscape. It concludes that China's comparative advantage from cheap labour based manufacturing will continue to erode, and moving up the value-chain will become necessary to maintain long-term competitiveness.

Some underlying conditions of the Chinese economy, marked by a slowing down of the Chinese economic growth, with a declining year-on-year GDP growth rate from 2010 (until the publication of the article), could be related to a decline in the construction industry and manufacturing output, but more importantly, the contribution of *total factor productivity* to growth has become difficult to sustain. China has been catching up in technology with the world leaders, reaching a point where productivity cannot be further increased by relying exclusively on technology transfers. There is an imperative to move from an investment-led model to a productivity-based one, by generating domestic innovation.

(RQ1a): Does the Chinese economy possess the necessary capabilities and skills to produce breakthrough innovation?

The article progresses by assessing the current innovative capacities of the Chinese economy by examining and comparing statistical figures, such as yearly expenditure on R&D, number of PhDs, number of patent applications, and relating those to the ability of actually commercialising innovations in global markets. It finds that

despite considerable investments into R&D, the share of Chinese companies in the global revenue pool, comparing to the country's share of global GDP shows, that China has become a leading innovator mostly in industries which grew on the basis of serving domestic demand, while in the more challenging types of innovation, China has yet to become globally competitive.

The article examines the history and the current state of the Chinese innovation infrastructure, by inspecting the role of state programs, public research institutions, business sector R&D, innovation clusters, business incubators and science and technology parks. It also compares the level of venture capital (VC) investment to the most important innovation clusters globally in supporting smaller technology companies. On most measures examined, the research finds that China is already in the frontline of the global technological innovation scene, in terms of human, infrastructural and financial resources invested into creating breakthrough innovation, which leads to the second sub-question of why there is still a lag in technological output.

(RQ1b): Are there any factors interfering with the global success of the Chinese high-tech sector?

In the final chapter possible factors delaying the global success of the Chinese high-tech sector are identified:

- Time component: high-tech scientific developments need longer times to pay off, since lead time for marketing innovations might take up to 10 to 20 years.
- Regulatory environment: slow regulatory processes and questions about intellectual property protection could have a negative influence.
- Local advantage: many domestic companies have little incentive to expand abroad due to the size of the market. However, evidence is mixed, as market size could also aid leap-frog development internationally.
- Network characteristics of the knowledge-based economy: professional and personal networks are crucial for the diffusion of innovation, the creation of which also relates to the time factor.
- Social technologies of innovation: norms and values, organisational forms, incentive systems and public policies, are harder to acquire than the physical ones.

- Cultural tendencies: collectivistic cultures tend to demonstrate higher uncertainty avoidance and lower orientation to entrepreneurship.

The analysis is finalised by weighing identified factors working in favour of or against the competitiveness of the Chinese high-tech sector, reaching the conclusion that the time component and the lacking social technologies of innovation are the most significant ones, and a global breakthrough in engineering- and science-based industry sectors can be expected, as long as no systemic disturbance occurs.

3.2 Article 2: Novel technologies and Geopolitical Strategies: Disinformation Narratives in the Countries of the Visegrád Group

Article 2 set out to uncover the use of strategic narratives in disinformation campaigns targeting the V4 region. The scope of the research was to reveal constructed identity claims and positions on specific issues that seek to shape perceptions and actions of domestic and international audiences.

Based on the examined literature – especially Deverell et al. (2020), Hinck et al. (2018) and Khaldarova (2016) – the hypotheses for the analysis were, that among disinformation news pieces targeted at the Visegrád countries, it would be possible to identify recurring topics (H1a), and that based on these key topics prevailing narratives and meta-narratives of disinformation campaigns targeted at the V4 region could be established (H1b).

The second hypothesis (H2) was that if so – similarly to Izak (2019), Kuczyńska Zonik and Tatarenko (2019) and Wenerski (2017) – it would be possible to structure those narratives and meta-narratives into a coherent system that portrays an underlying logic or world view.

To set the context of examining the hypotheses, the study first defined the concept of *computational propaganda*, which involves the use of social media platforms, autonomous agents, and big data to manipulate public opinion. This can include the spread of disinformation, amplification with bots and fake accounts, suppression of opposition with hate speech and trolling, and infiltration of political groups and events. The review of the literature points to the fact that the use of artificial intelligence, machine learning, and big data analytics is making computational propaganda more sophisticated and effective. The analysis makes a distinction between three categories of information disorder: misinformation, disinformation, and malinformation, based on the dimensions of intention to cause harm and falseness of information.

The article follows by discussing the use of strategic narratives in disinformation campaigns in order to appeal to emotions, and engage audiences to become willing but unaware collaborators in achieving the goals of the campaign. The way that events are framed and presented can determine who has control over how they are perceived. A strategic narratives framework can help understand the purposes and complexities of transnational struggles over the meaning of events.

The article examines recurring narratives and meta-narratives in disinformation news pieces targeted at the Visegrád Group, a region with increased geopolitical importance in the energy and cyber security sectors. By analysing news articles from multiple online sources that originally appeared in one of the V4 languages, the frequency and relationship structure of individual disinformation narratives could be established. The data drawn from the frequency analysis of recurring topics and their relationship structure supported the initial hypotheses (H1a, H1b).

To examine whether narratives fed into a coherent system, the strategic narratives frameworks was applied. The analysis showed that recurring disinformation narratives revolved around themes of power relations, political order, ideological divisions, historical consciousness, and cultural identity which supported the second hypothesis (H2). Polarising framing was used to exploit cultural and historical grievances in order to communicate a grand scheme of global affairs. The meta-narratives described a world view that follows a Cold War-like logic, with the ideological animosity between the United States and Russia being a defining tendency in global affairs.

The predominant narrative concerning Russia in all four countries was not regarding Russia's strength or grandeur but rather depicting Russia as a victim of Russophobia and unfounded aggression originating both from its western neighbouring countries, and, most importantly, directed from the United States. The news pieces were mostly concerned with speculative American interests in reinstating Cold War-like circumstances, where Russia would become economically, politically and ideologically isolated from the West, stating the two-fold argument: both economic interests and ideological animosity between the two powers were identified.

The narratives claimed that according to the American national security strategy, there exists no alternative to the leading role of the US globally, and therefore a multipolar world order shall not emerge. Therefore, the US needs to defend its interests militarily around the globe and cause directed chaos in a number of hotspots worldwide, whenever US supremacy gets questioned. While country-specific narratives identified in the

disinformation news pieces aimed at distinctive vulnerabilities, such as historical remembrance of WWII events in Poland, views on Ukrainian nationalism in Hungary or media independence in the Czech Republic and Slovakia, overarching meta-narratives sought to weaponize emotions exploiting fissures in general attitudes and cultural identity of V4 countries.

3.3 Article 3: The Geoeconomic Aspects of the Emergence of Artificial Intelligence Technologies with Respect to Hungary

Article 3 discusses the use of artificial intelligence (AI) solutions, and their prospective utility as a general purpose technology (GPT), with the potential of disrupting markets and affecting the competitiveness of countries. The article focuses on the impact of innovation on income distribution, the social utility of innovation rents, and the emergence of oligopolistic market structures in relation to globalisation and the labour market.

The primary research question (RQ1) was whether the transformation of AI will lead to a more efficient and equitable distribution of wealth and development, or whether it will extrapolate economic inequalities between and within countries.

The study found that the income generated by the use of innovation, including artificial intelligence, can disproportionately benefit the winners of technological progress. Markets for innovative solutions and technologies are often not perfectly competitive, leading to *innovator rents*, where the additional income earned by innovators largely exceeds the development costs of their inventions. The cross-border nature of artificial intelligence solutions can make it difficult to regulate competition and ensure the healthy use of these rents through provisions such as tax and antitrust policies and intellectual property rights. Technology companies' business models, including the ability to monetize data and operate across sectors and borders, can further exacerbate redistributive issues.

The *superstar* or *winner-take-all* effect refers to the dominance of a small group of market players utilising new technologies, such as artificial intelligence (AI), in industries where shared consumption of goods and services is possible at low marginal cost. This leads to oligopolistic or monopolistic market structures and concentration of market power in the hands of a few large global companies. The COVID-19 pandemic has also highlighted the potential for technology companies to disproportionately benefit from the shift to online activities and raised questions about their social contributions.

Artificial intelligence can lead to discrepancies not only within markets but also between countries, where one country may experience all the benefits of a technological achievement while another bears the negative externalities. The market dynamics that benefit larger players, can lead to the emergence of superstar AI-exporting countries. While there are also diverging trends that facilitate the entry of small players (such as online content sharing or global virtual marketplaces,) the latter are much less impactful than the forces driving market concentration.

The article also examined (RQ1a) how a small, open, middle-income economy like Hungary, can effectively compete with the leading global corporations and countries in terms of technological development.

The economic position of Hungary is strongly influenced by its middle-income status, which means it may struggle to catch-up to leading AI developer countries. Hungarian businesses, particularly small and medium-sized enterprises (SMEs), have lower innovation capacity and operate at lower value-added levels, leading to overall economic performance below the EU average. Advanced technologies are often found in sectors dominated by foreign capital, while domestic companies have lower productivity. This dual economic structure can exacerbate income inequality.

A comparative analysis on Hungary and Estonia in terms of the digital transition has been performed, which described that Estonia underwent significant deindustrialization after the change of regime and focused on improving its service sector, particularly in the field of information and communication technology, together with developing a flexible and adaptable workforce, demonstrating an advantage in many aspects with respect to Hungary.

Given the first-mover advantage enjoyed by technological leaders (companies and countries alike), if a country becomes an importer of AI, the consequences are likely to be felt both in terms of the level of costs to the economy (Vértesy 2020), and along the strategic and security dimension (DJP, 2021). The study concludes that it would be crucial for Hungary (1) to develop a strong digital infrastructure, (2) necessary expertise and (3) access to high-quality digital data assets, in order to provide conditions which will allow for the development of own AI solutions in the future.

The secondary research question (RQ2) studied the disruptive potential of AI solutions on the labour market.

The article established that the adoption of artificial intelligence can have disruptive effects on the labour market. The labour-saving nature of AI disproportionately

affects different occupations and sectors of the economy. The adoption of digital technologies is allowing more stakeholders to participate in cross-border economic relations and is shifting the focus from low-cost production to the exploitation of new digital technologies. There is a trend towards market concentration, but digital solutions are also increasing global access for smaller players. The overall impact on the labour market is complex and goes beyond traditional specialisation based on competitiveness.

The article examined (RQ2a) whether the labour-saving nature of AI solutions is mainly limited to lower-skilled jobs.

The study examined different theories and evidence on the impact of new technologies and particularly AI on the labour market, with special emphasis on skill-biased technological change (SBTC), the ALM-hypothesis and job polarisation theories. The literature and secondary data suggest that, the impact of technology on the labour market is more complex and will be divided along the routine or non-routine nature of jobs, leading to a polarisation of demand for both non-routine manual and cognitive jobs at the high and low ends of the wage scale, and a decrease in demand for jobs requiring routine manual and cognitive tasks. Evidence from the US, Japan, and nine European countries supports this polarising impact of technology on the labour market, with demand shifting towards highly skilled workers in sectors at the forefront of technology development. Jobs requiring the handling of unstructured problems and processing of novel information have increased in importance, while routine cognitive and manual tasks and non-routine manual tasks have decreased in importance. Non-routine manual tasks are less threatened by automation as they require complex optical recognition and fine motor skills that are difficult to achieve with current technology.

The article also investigated (RQ2b) what some expected implications of AI solutions on the Hungarian labour market are specifically.

The analysis concluded that the expected transforming potential of AI solutions on the Hungarian labour market are intimately connected to the traditional hierarchical structure of the European industry, with a geographic centre-periphery relationship between the German-French core area and the assembly centres of Southern and Central and Eastern Europe, both in terms of the products manufactured and the added value of the company functions. This peripheral exposure means that the rise of automation, AI solutions, and digitization associated with Industry 4.0 is reducing the competitiveness of manufacturing based on low-cost labour, and the ability to adapt to technological changes will be crucial. The outsourcing of innovative solutions with high added value can provide

opportunities for local companies to participate in technology change. However, SMEs may struggle to adopt new technology due to a lack of funding and a shortage of skilled labour.

4. CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The thesis set out to examine what the effects of emerging technological innovations are on the economy and our societies, and how this shapes international relations and geopolitics, with a particular focus on Hungary and the Central European region. The framework of the analysis focused on the leading edge of the economy becoming interlinked with technologies based on innovation, the use of knowledge, and the production and dissemination of information.

The introductory section explored how classical and contemporary geopolitical theories have evolved over the years and what modern scholars have proposed regarding the phenomenon of innovation and emerging technologies. The study then moved on to analysing specific findings on subtopics related to the broader scheme of geopolitics and innovation, described in the three individual articles that form part of the thesis. The individual articles examined China's growth prospects in the Fourth Industrial Revolution, the phenomenon of disinformation warfare aided by novel technologies in the Central European region, and the potential of AI solutions disrupting industries, polarising the labour market and creating inequalities, globally and in the Hungarian context specifically.

The review of the literature revealed that there is a need to adapt geopolitical narratives to reflect a world system that is moving away from the traditional model of exclusive state actors exercising power, and is characterised by global interconnectedness and the advancement of technology. The discipline of geopolitics has developed significantly over the last century. Early geopolitics was a combination of the theories of a natural science background, theory of the state, political science and political geography, which analysed interstate politics in terms of the geography of space and power. Modern geopolitical theories have developed from these early ideas and continued to focus on theories of representation of space. However, spatial thinking and theory-based approach has been challenged in academic circles as the changing world order, particularly as a result of technological and information advances, has led to a pluralization of world politics. In this view, the traditional geopolitical argument that examines the determination of international relations based primarily on the geographical characteristics of nation states has become partially outdated due to economic and technological changes.

Globalisation and the emergence of a single world economic system have led to an increasing economic and political interconnection of countries. The activities of

multinational corporations have created transnational cooperation and networks, decreasing the ability of nation states to control cross-border processes. The knowledge-intensive and technologically-driven transformation of global capitalism leads to a more flexible, decentralised, and interdependent networked system, with greater power for capital over labour. It also means increased competition at the global and regional level. Models based on dynamic relations and flows are better suited to describe the network-based world, as opposed to more static classical conceptions. This transformation has created new inequalities, as well as new opportunities, and challenges for individuals, organisations and nation states, some of which have been investigated in the individual articles:

Article 1 discusses the fourth industrial revolution and its impact on China. It discusses that this transformation will fundamentally change the way society lives, works and progresses, and that those who are able to embrace the change will prosper. It suggests that China is currently in a transition period, moving from years of strong economic progress to a slower growth and weakening future prospects. The study examines the possible implications of the fourth industrial revolution on China and assesses the country's ability to position itself as a beneficiary of the transformation by leveraging its unique economic and social characteristics. It also analyses China's current economic situation and evaluates its success in leveraging innovation across different sectors of the economy. The study concludes that while Chinese companies are already world leaders in some sectors, there is room for improvement in science and engineering-based industries. The evidence indicates that if China does not experience systemic disruptions and can continue to support innovation at current pace, tackle challenges in regulatory processes, intellectual property protection, and most importantly human resource development, Chinese firms could become world leaders in high-tech sectors in the near future.

Article 2 argues that the projection of strategic narratives through disinformation campaigns is an important geopolitical tool in the global competition for power. It explores that in the current media environment of growing information disorder and social media being primary sources of news, the spread of disinformation is becoming increasingly easy and cost-effective. The study uses a natural language processing algorithm to analyse a large database of news pieces from online sources containing disinformation in the V4 languages, to uncover individual storylines and overarching disinformation narratives spread in the region. It found that five key meta-narratives were

present in all Visegrád countries, feeding into a coherent system of beliefs, such as the envisioned collapse of the European Union or the establishment of a system of Neo-Atlantism that would divide the continent. The research suggests that disinformation and deception can influence people to accept and share content that is based on emotions rather than facts, and that understanding the storytelling tools used to create powerful messages that incite certain group behaviour and exacerbate societal grievances could help protect against malevolent disinformation campaigns. The articley concludes that the Visegrád Group should expect to become a target of disinformation campaigns aimed at manipulating public opinion.

Article 3 examines the impact of artificial intelligence (AI) on wealth distribution and considers how it may affect existing developmental gaps between regions, countries, and social groups, with special emphasis on Hungary. The study finds that while technological progress can lead to Pareto improvements at the global level, the use and diffusion of AI can have different impacts on different economic actors and countries. It may create new opportunities to compete globally, but it may also put regions that rely heavily on AI imports in a difficult position or even drive them towards relegation. The study also notes that AI's operating logic allows for the emergence and persistence of winner-take-all market dynamics that benefit larger players, which can contribute to growing inequalities. Additionally, it points out that Hungary faces a difficult competitive environment due to its size, economic weight, semi-peripheral location, and medium level of development. Also, Estonia, a small country with similar characteristics to Hungary, has been able to successfully transform its economic structure to be able to join the next wave of technological change. The study concludes that Hungary has untapped potential in integrating digital competences more strongly into education curricula and lifelong learning, which would enable the acquisition of user skills for AI solutions that increase the efficiency of business processes. It also indicates that Hungary should exploit the high-quality digital data assets generated in certain public administrations, which could)

serve as input for domestically developed AI solutions.

The novelty of the thesis, its impact on the analysis of the research question and contribution to the existing body of literature consists in delving into a current subject that will become more significant in the near future, and which has not been extensively studied yet. It presents a synthesis of theories and concepts from traditional to contemporary geopolitics, which can support further research. It also examines Hungary and the Central European region specifically in the context of emerging technologies and

their impact on geopolitics. The research gap identified in Article 1 is the need for a comprehensive analysis of China's position and prospects for growth in the Fourth Industrial Revolution, including an evaluation of the country's innovative capacities and the potential impact of socioeconomic factors on its growth. Article 2 provides a systematic analysis of the mode of operation of disinformation campaigns, and describes specific disinformation narratives spread in the V4 region. Article 3 contributes to the literature by delivering an analysis on the impact of AI on the gap between developed and developing economies and on income inequality within countries, particularly in the context of Hungary and its labour market trends.

Limitations of the thesis include that part of the research is restricted by its reliance on secondary data and specialised literature sources. A targeted primary data collection and evaluation on the topics discussed would lead to a more accurate analysis. Also, as sections of the articles deal with emerging or future-oriented phenomena, the findings can be interpreted primarily as the modelling of expected outcomes. It should also be noted that the case study approach and the comparative analysis performed, present snapshots of the temporary status of certain socio-economic phenomena within a defined timeframe, which can limit the validity of some of the findings, were circumstances to change drastically.

Further research directions in the intersection of geopolitics and technological innovations in the Central-European region include the impact of global power shifts and possible regional fragmentation in shaping innovation ecosystems and economic development. As well as the investigation of the potential economic and geopolitical implications of how countries in the region are currently addressing the challenges of the digital transformation and the transition to renewable energies. Regarding the specific research directions put forward within the individual articles, Article 1 designates the societal uptake of a culture of innovation and systemic challenges pertaining China's growth prospects as a further research direction. Article 2 calls for more research to determine the efficacy of disinformation campaigns in changing citizens' attitudes, including the role of education in enhancing critical thinking and providing people with the means to identify disinformation. Article 3 suggests that further research should explore the potential of AI solutions for environmental sustainability and national strategy, as factors that will shape the nature and speed of AI transformation.

A contemporary understanding of geopolitics means both broadening the topics examined and applying a more sophisticated analytical methodology to understand the

global geopolitical arena in the 21st century. Geopolitics is constantly expanding and adapting to the rapid changes in international relations, with an emphasis on the democratisation of geopolitical discourse and changing ways of displaying power. The development of geoeconomics as a subfield, can be linked to the changing functions of the state as a result of globalising economic interactions. The emergence of subnational and supranational, non-state and non-political actors has changed the composition and functioning of international society, leading to a shift from identity-based and predominantly political approaches to an increasing emphasis on economic considerations. While a contemporary understanding of geopolitics builds on the increased role of non-state actors and the emergence of networks and virtual spaces, it also recognises that traditional geopolitical factors such as resource distribution, national interests, and geographic location remain important considerations in understanding the world's balance of power.

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Statement of authorship

DECLARATION
related to the independent intellectual property and form, for submission of the Ph.D. dissertation

I the undersigned **Lilla Sarolta Bánkuty-Balogh**, Ph.D. candidate of the **Doctoral School of International Relations and Political Science** (Program/Specialization: **Geopolitics and Sustainable Development Doctoral Program**) hereby declare that **the Ph.D. dissertation** I submitted to the Doctoral Office of the Corvinus University of Budapest

at the **date**: 17 July, 2023.

with the title: **THE INTERSECTION OF GEOPOLITICS AND TECHNOLOGICAL INNOVATIONS: IMPLICATIONS FOR THE CENTRAL-EUROPEAN REGION**

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Balogh L.

Lilla Sarolta Bánkuty-Balogh

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Could China Be the Winner of the Next Industrial Revolution?

Bánkuty-Balogh Lilla Sarolta

Could China Be the Winner of the Next Industrial Revolution?

Balogh Lilla Sarolta

Abstract

This paper attempts to give a comprehensive picture of China's current position and prospects for growth in the next industrial revolution, assessing whether the country can emerge as one of the "global winners" of the coming transformation. We provide an overview based on a review of the literature on the main driving megatrends of the so-called Fourth Industrial Revolution and present the most important socioeconomic implications affecting China. We progress by analysing China's current economic situation and growth prospects, reviewing secondary data. We find that to ensure a positive grow path, there is a need to enhance productivity via innovation, and we thus evaluate the innovative capacities of Chinese industry. We conclude that China is already a world leader in various industries based on consumer-focused, efficiency-driven innovation, and while Chinese players have not attained global competitiveness yet in engineering and science-based industries, if the country can follow its current path of development in promoting R&D, with no major systemic disturbances, it is only a matter of time before Chinese players will also emerge as world leaders in high-tech sectors.

1. Introduction

China is at a crossroads, but this time it is not about taking the right or the wrong path, but rather about connecting roads in the coming industrial revolution. We are witnessing the dawn of a new era that will fundamentally change the way we live, work and progress together as a society, and the individuals, communities and nations who are able to embrace this change will be the ones to prosper, as has been the case throughout history. The technological revolution is accompanied by a set of broader socioeconomic, geopolitical and demographic developments, impacting all regions of the world and all aspects of our lives. China is facing the winds of change, passing through a challenging transition from decades of unparalleled economic progress and social development to a recent slow-down and weakening prospects of future growth. In this paper, we would like to assess whether China can position itself in this global transformation, building on its unique economic and social characteristics, to come out as one of the winners of the next industrial revolution.

We begin with an overview of the main trends of the next industrial revolution, to demonstrate the gravity and expected impact of the coming transformation. We also present the most important socioeconomic implications of the fourth industrial revolution, with special emphasis on megatrends directly influencing China. We move on to inspecting China's current economic situation and give a short explanation of some of the underlying conditions of the recent economic slowdown, with special emphasis on the declining contribution of multifactor productivity to GDP growth.

Once we have established that – in order to ensure a positive grow path for China – there is a need to enhance productivity via innovation, we progress by inspecting the different sectors of the Chinese economy and evaluating their success in leveraging innovation. We find that many Chinese players in consumer-focused, efficiency-driven innovation-based industries are already world leaders in their respective sectors, while in industries founded on engineering and science-based innovation, the picture is rather mixed. We further our investigation by exploring possible reasons for the lower levels of competitiveness of Chinese companies operating in science and engineering-based industries and by assessing whether China's efforts in research and development (R&D) are up to global standards. We conclude that China is already one of the world's leading powers in terms of R&D expenditure and related institutional support, and if the country can keep following the same path of development, supporting innovation and tackling challenges in the regulatory processes, intellectual property protection and human

resource development, the emergence of Chinese firms as world leaders in sectors driven by science and engineering-based innovation is only a matter of time, and its velocity is mostly dependant on the societal uptake of a culture of innovation, provided that there are no major systemic crisis radically affecting the current economic development of the country.

2. What is the next or fourth industrial revolution?

The term 'fourth industrial revolution' became widely known at the Hannover Fair in 2011 (*Eckart 2016*) referring to the *Industry 4.0* or *Industrie 4.0* strategic initiative of the German government as part of the country's *High-Tech Strategy 2020*, to establish itself as an integrated industry leader and market provider. The *Industry 4.0* programme put forward a plan to redesign manufacturing and production processes, which would move from a centralised to a decentralised model, where ICT-based systems and networks could independently exchange information (M2M)[12] to more efficiently manage production processes[13]. As communicated by the European Commission (EC), the term *Fourth Industrial Revolution* refers to technologies and concepts of value chain organisation, as the EC is setting a path to digitise European industry. As stated by the Commissioner for Digital Economy and Society, Guenther Oettinger: "*Digital is transforming European industry. It's changing the way we produce cars or chemicals, and how banks deliver financial services. Our challenge is to turn the Fourth Industrial revolution to our advantage, to reap opportunities it brings,*" (*EC 2016*).

In a broader context, the Industry 4.0 programme also has implications for the competitiveness of the economy and nations at large, as it is based on the goal of maintaining technological leadership in industrial production and R&D (*Eckart 2016*). This broader understanding of Industry 4.0 or the Fourth Industrial Revolution brings us closer to the theme of wide socioeconomic transformation engendered by the digital age, a topic which many world leaders, politicians and industry experts have been referring to in recent years.

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[12] Maschine-zu-Maschine or Machine-to-Machine.
[13] Kagermann, H. – Wolf-Dieter**,** L. (2011): Industrie 4.0: Mit dem Internet der Dinge auf dem Weg zur 4. industriellen Revolution, VDI Nachrichten. http://www.vdi-nachrichten.com/Technik-Gesellschaft/Industrie-40-Mit-Internet-Dinge-Weg-4-industriellen-Revolution. Downloaded: 14 August 2016.

Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, argues that "*We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society,*" (*Schwab 2016*).

The notion of a paradigm shift has also been put forward by economist Jeremy Rifkin, the bestselling author of several books on the impact of scientific and technological changes and lecturer at the University of Pennsylvania. In his most recent book (*Rifkin 2015*), he goes as far as anticipating the emergence of a new economic model "*in the twilight of the capitalist era*", that is *"better suited to organize a society in which more and more goods and services are nearly free*" (*Rifkin 2015:11*). As the title of his book "Zero Marginal Cost Society" suggests, he predicts that due to the advances in technology and the *internet of things (IOT)*, or the *internet of all things*, the communications, transportation and energy industries will change to an extent that will most likely bring down the marginal cost of production to a near zero level in the not-too-far future and trigger a paradigm shift in our existing socioeconomic models (*Rifkin 2015:18*). The question remains as to which technological advances have the power to change the processes of manufacturing and production with such magnitude that it would have a deep, systemic impact on the economy and society at large.

The term Industrial Revolution was introduced by French economist and political activist Auguste Blanqui in 1837 (*O'Brien et al. 1993*), to highlight some parallels between the economic and social changes arising from the transition to industries with power-driven machinery in the late 18th and early 19th century Britain, and the sudden redistribution of political power in contemporary France. As in France the transition of the political system has been named a "revolution", the changes in Britain, that could be seen as equally fundamental, created an *industrial revolution* (ibid.). The term became widely publicised with the book by British economic historian, Arnold Toynbee, first published in 1884, entitled "The industrial Revolution" (*Toynbee 1884*). Toynbee, however, focused more on the changes in the control of production and the distribution of wealth, rather than the revolutionary nature of the transition itself (ibid.). As John Komlos, Emeritus at the Chair of Economic History at the Ludwig-Maximilians University of Munich, pointed out, the apparent contradiction between the evolutionary

nature of economic development and the discontinuity in the growth rate of output per capita during the industrial revolution can be resolved by viewing the industrial revolution not as a structural break, but as an integral part of the economic experience of the previous millennia (*Komlos 1989*).

From the creation of the first mechanical loom in 1784, we can distinguish four waves of industrial revolution. The first industrial revolution at the end of the 18th century was characterised by the use of water and steam power to industrialise mechanical production, the second industrial revolution at the beginning of the 20th century combined the use of electric energy and new production methods, such as the introduction of the conveyor belt to support mass production, while the third industrial revolution automated production through the use of digital technologies and computing power (*Bloem et al. 2014*).

Whether the current transformation can be considered the fourth industrial revolution or simply an acceleration of third industrial revolution and the digital conversion started in the 1960s is still up to debate. Walt Whitman Rostow, American economist and political theorist, was already talking about the concept of the fourth industrial revolution, in the 1980s. In his view, the fourth industrial revolution is characterised by industries based on revolutionary technologies that are just moving from invention to innovation and that share the following four traits[14]:

- They are so encompassing that no one country can dominate them completely.
- They are linked to the areas of the basic sciences that also are undergoing revolutionary changes.
- They are immediately transferable to rapidly industrialising nations.
- They are key to leapfrogging for basic industries.

Klaus Schwab, in his recent book, the *Fourth Industrial Revolution* (*Schwab 2016:3*), argues that indeed we are witnessing a revolution, which "*entails nothing less than a transformation of humankind*" (*Schwab 2016:1*). Schwab bases his assumption on the velocity, breadth and depth and systems impact of the changes, that derive from the combination and interplay of different megatrends (*Schwab 2016:3*). He identifies the

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[14] Rostow, W. W.: The Fourth Industrial Revolution and American Society: Some reflection on the Past for the Future. In: Furino, A. (Ed.): Cooperation and Competition in the Global Economy: Issues and Strategies, Cambridge, Mass.: Ballinger, 1988, pp. 172–181. (*Kozmetsky et al. 2004*)

drivers of technological change based on three such megatrends: physical, digital and biological (*Schwab 2016:14–21*). The physical manifestations of the technological changes are primarily linked to the debut of autonomous vehicles, 3D printing (additive customised manufacturing), advanced robotics and the use of new materials, such as self-healing and self-cleaning smart-materials, metals with memory or ceramics that convert pressure into energy.

The collection of data using sensors, cloud computing, big data analytics and the application of artificial intelligence and machine learning links the physical side of technological advancements to the digital, making the Internet of Things transformative across all industries. The digital manifestation of the fourth industrial revolution is also the basis for technology-enabled platforms which connect individuals and institutions in new ways, such as blockchain (a digitally distributed ledger mostly known from Bitcoin) and the platforms of the on-demand or sharing economy, such as AirBnb or Uber (ibid.).

The societal effects of these technologies are apparent. As Tom Goodwin wrote in his famous TechCrunch article in 2015: "*Uber, the world's largest taxi company, owns no vehicles. Facebook, the world's most popular media owner, creates no content. Alibaba, the most valuable retailer, has no inventory. And Airbnb, the world's largest accommodation provider, owns no real estate. Something interesting is happening,*" (*Goodwin 2015*). More than just "interesting", the biological megatrends of the fourth industrial revolution are turning into reality innovations that would have seemed plausible only in the realm of science fiction only a couple of decades ago: cheap genetic sequencing and synthetic biology will revolutionise not only the healthcare and life sciences industry but also agriculture and the production of biofuels (*Schwab 2016:14–21*).

3. Socioeconomic implications of the fourth industrial revolution

The implications of the next industrial revolution for businesses, governments, media, civil society organisations and the people themselves are just as wide-ranging and complex as the breadth and depth and systemic nature of the underlying megatrends. The implications range from practical to ethical considerations, monetary to societal consequences. The fourth industrial revolution could improve the lives of billions of people around the world, but at the same time generate some grave challenges and risks, that must be mitigated in order to ensure inclusive growth.

One of the most apparent effects of the next industrial revolution will be the profound impact of disruptive changes on business models and the employment landscape (*WEF 2016*). We have already experienced major dislocations in labour markets over past decades with production and workplaces shifting to low-cost manufacturing locations in developing countries from more advanced economies[15]. Nowadays, as production is becoming more and more automated through the use of intelligent machines, the advantage related to low-cost human labour supply is declining. This means that a share of jobs is becoming obsolete or is increasingly re-shored to its original location, causing a shift that has a negative effect on labour-intensive-production based economies. As is the case for China as well, the comparative advantage from cheap labour based manufacturing will not serve sustainable development, and moving up the value-chain will become necessary to maintain long-term competitiveness.

According to the "Future of Jobs Report" (*WEF 2016*) of the World Economic Forum, the labour market transformation is expected to result in heightened productivity levels and widening skills gaps, displacing jobs to a considerably larger extent than creating new ones. About two thirds of disrupted job families will be in routine white collar office functions, which raises the need for governments, businesses and individuals to anticipate changes and prepare for the skills requirements of the future. By one estimation, 65 per cent of children entering primary school today will ultimately end up working in completely new job types that don't yet exist (ibid.), which underpins the importance of education systems embracing technological advancements to effectively contribute to social development.

One often cited example regarding the returns to scale and labour intensity of production compares Detroit of 1990 with Silicon Valley of 2014 (*Schwab 2016:10*). About two decades ago, the three biggest companies in Detroit, a traditional industrial centre, had a total market capitalisation of USD 36 billion, revenues of USD 250 billion and 1.2 million workers. In 2014, the three biggest companies in Silicon Valley had a market capitalisation of USD 1.09 trillion, generated roughly the same revenues (USD 247 billion), but with about one tenth of the number of employees (around 137,000).

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[15] Wladawsky-Berger, I. (2016): Preparing for the Fourth Industrial Revolution. The Wall Street Journal Online. Februar 26. http://blogs.wsj.com/cio/2016/02/26/preparing-for-the-fourth-industrial-revolution. Downloaded: 15 August 2016.

The changing patterns of manufacturing, as discussed above, will disrupt the labour market, but will subsequently also open up previously unknown opportunities for companies to foster efficiencies and improve product and service offering, which is expected to boost consumption in a more sustainable manner. Companies will be able to enrich customer experience through digital technologies, enhance products via the use of sensors, data analytics and connectivity, bring more collaborative innovations, involve start-ups and research institutes in their design process and invent organisational forms which can better serve and suit a knowledge-based society (*WEF 2016*).

Sustainability is a key theme of the next industrial revolution, since the improvement of energy efficiencies and increasing reliance on green technologies and renewables in production may not only deliver a productivity boost to nations that are heavily reliant on the consumption of fossil fuels, such as China, but may also enhance global resource security and mitigate risks related to climate change. Of course, the creation of a green infrastructure requires high levels of initial investment from governments and companies, but can yield significant returns in terms of direct and also indirect effects.

At a broader level, the fourth industrial revolution and the embeddedness of the internet in all aspects of our lives will most probably enhance and accelerate existing socioeconomic trends, such as the growing level of inequality (*OECD 2011*). More than one half of the world's population has no internet access and almost twenty per cent of the world's population lack access to electricity (Schwab 2016:8). If the diffusion of innovation is not governed adequately, the "digital divide" will continue to widen between nations, communities and individuals, resulting in uneven trajectories of development, especially in countries that already experience significant regional divides, such as China. As stated in an OECD report (*OECD 2007a*), much of the rise in living standards is due to innovation since the First Industrial Revolution, and innovative performance is central to competitiveness and national progress. It still holds true today, maybe more than ever, that the extent to which society can embrace technological innovation will be a major determinant of future progress (*Schwab 2016:8*).

Finally, there are a number of other implications of the fourth industrial revolution, such as the shifting relative power between governments and citizens, questions involving the protection of privacy and information security or the ethical use of artificial intelligence and biological engineering just to mention a few, which are equally significant and would be worthy of investigation, which however cannot form

part of this paper, as its primary scope is limited to factors related to sustainable economic development and competitiveness.

4. China at a crossroads

China is entering the turbulent times of this coming industrial revolution after experiencing a long and unparalleled period of economic development in the last thirty years. Since the start of the *Reform & Opening up* programme introduced by the Communist Party in 1978, the country has posted an average yearly GDP growth rate of close ten per cent until recent years, raising the per capita GDP more than 50-fold, from USD 155 in 1978 to USD 7,920 in 2015, lifting 800 million people out of poverty and accounting for more than three quarters of global poverty reduction between 1990 and 2005 (*Eckart 2016*). It is however worth mentioning that this development has been driven mainly by the eastern coastal regions, creating an imbalance with the rural inlands of the country.

As often referred to, the last couple of years have seen a slowing down of the Chinese economic growth, with a declining year-on-year GDP growth rate since 2010, totalling 7.3 per cent in 2014 and 6.9 per cent in 2015 respectively, according to the statistics of the World Bank[16]. Although these numbers are still well above the world average for annual GDP growth (2.6 per cent in 2014 and 2.5 per cent in 2015), they do show a declining trend which may be related to both external factors, as well as to internal structural problems. There has been a decline in the construction industry and manufacturing output, two of the most important drivers of the Chinese economy, but it has been suggested that the contribution of total factor productivity to growth, which has been on the rise since 1978, has become difficult to sustain in recent years (*Xu 2011*). The contribution of multifactor productivity to GDP growth has fallen from nearly 50 per cent between 1990 to 2000, to about 30 per cent in the past five years (*MGI 2015*), hindering GDP growth.

As described by the Solow-model of economic development, the three main drivers of long-term economic growth are population growth or labour, capital accumulation and increases in productivity (*Uppenberg 2009*). Mainly due to China's birth control campaigns and the introduction of the one-child policy, the country's

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[16] World Bank database: http://data.worldbank.org/.

population growth has slowed down notably since the 1970s, gradually affecting the size of the labour force, which can no longer drive economic growth. More pressingly, high levels of gross capital formation as a percentage of GDP (almost around 50 per cent) may not be sustainable with the level of total debt having quadrupled from USD 7 trillion in 2007 to USD 28 trillion in 2014, thus amounting to more than 280 per cent of the country's GDP as of today (*Dobbs et al. 2015*). Finally, as China is catching up in technology with the world leaders, it is approaching the innovation frontier, where productivity cannot be further increased by relying exclusively on FDI and technology transfers, and there is a need to generate domestic innovation. There is an imperative to move from an investment-led model to a productivity-based one, to further drive development (*Eckart 2016*).

According to one estimate (*MGI 2015*), in order for China to reach its average annual GDP growth target of 5.5 to 6.5 per cent for the next 5 years, multifactor productivity growth will need to contribute as much as 35 to 50 per cent of total GDP growth, or two to three percentage points per year. Therefore, without labour force expansion and investments to fuel growth, China will have to rely heavily on its innovative capacity to improve productivity. A study led by Jonathan Woetzel (*MGI 2016*), a partner at McKinsey & Co. China, published in June 2016, advocates the case for China to transition to an economic model centred around growth grounded in productivity, to regain economic dynamism and potentially deliver an additional USD 5.6 trillion of GDP expansion by 2030.

According to the study's findings, by seizing five major opportunities to boost productivity, the country could combat slowing growth, deteriorating capital productivity and falling corporate returns, and thus achieve sustained economic progress. The authors of the study warn that delaying the restructuring of the Chinese economy could become expensive, as the ratio of non-performing loans could reach 15 per cent in 2019, from today's official figure of 1.7 per cent. According to their calculations, every year following the current path of development could increase the costs of dealing with bad debts by USD 300 billion to USD 450 billion, potentially causing a substantial slowdown, if not a systemic banking crisis, that could obstruct economic progress.

The five major opportunities for China to move toward a productivity-based economic growth model identified in the study (ibid.) are the following: increasing consumption by better serving middle-class consumers; enabling new business processes through digitisation; moving up the value chain through innovation, especially in R&D-

intensive sectors; improving business operations through lean techniques and higher energy efficiency; strengthening competitiveness by deepening global connections, potentially raising productivity.

At least three opportunities of the five identified above are directly related to China's capability to innovate, such as the digitisation of business processes, moving-up the value chain, or increasing efficiency through lean techniques. The remaining two – better serving middle-class consumers and strengthening global competitiveness – also have important indirect connections to improving productivity by deploying knowledge and using new technologies.

5. The innovative capacity of the Chinese economy

The capability to innovate and to successfully market innovations will be a critical determinant of the competitiveness of nations for the coming decades, as stated by an OECD report (*OECD 2007a*) as well. According to the study, there is a growing awareness among policymakers regarding the impact of innovative activities on long-term economic progress and prosperity. Since advances in new technologies enabled new forms of competition and opened up new markets for the creation and delivery of innovative products, there has been a broad increase in R&D efforts in a number of economies, outside the OECD area as well, and a universal realisation that co-ordinated, coherent, "whole-of-government" approach is required to ensure the central role of innovation in the economy. These trends indicated by the OECD very much coincide with China's ambitions and policies to boost the innovativeness of the economy, but the question remains as to what extent quantifiable indicators of supporting innovation via policies and investments actually translate into measurable impact and tangible results.

China is already a world leader in the promotion of innovation based on numbers. The country has a yearly expenditure of more than USD 300 billion on research, slowly but steadily catching-up behind the United States. It turns out almost 30,000 PhDs in science and engineering per year and leads the world in patent applications with almost a million patents filed in 2014 (*WIPO 2015*). However, Chinese companies commercialising innovations and competing in global markets do not always reflect the potential for success implied by the levels investment and the promotion of R&D in the country.

Figure 1: Gross domestic expenditure on R&D (USD million)
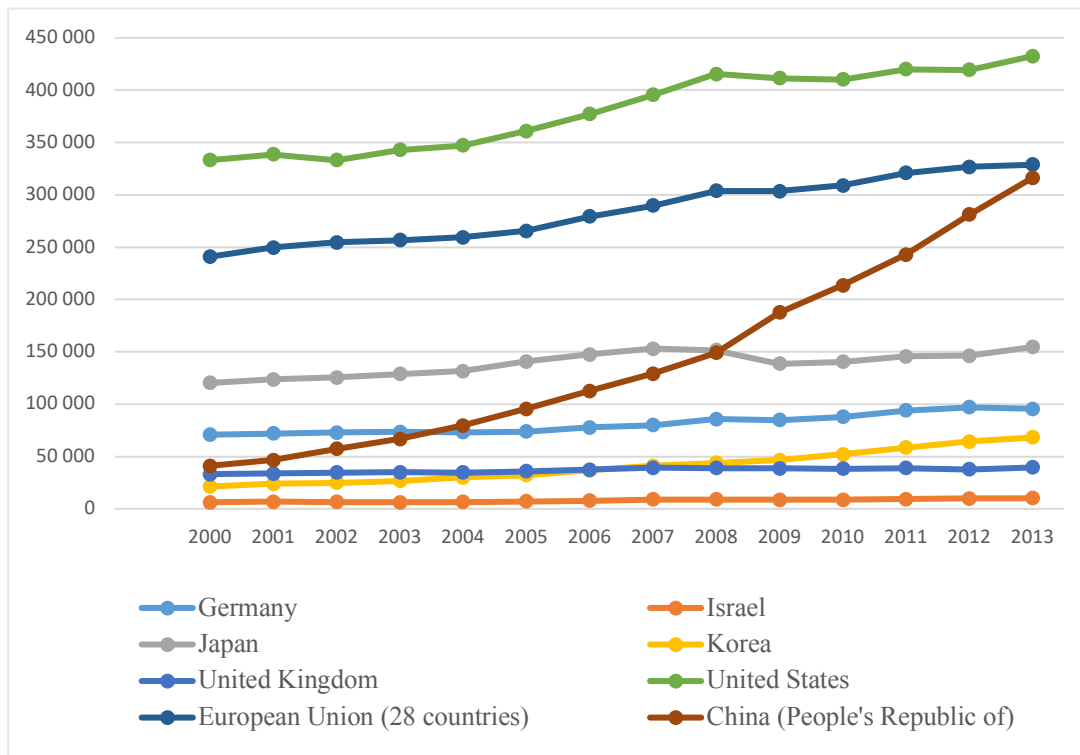
Source: OECD (2013).

A 2008 study (*Altenburg et al. 2008*) analysing China's and India's transition from production-based to innovation-based economies sheds light on some of the major difficulties involved in assessing the innovative capabilities of the two countries. The authors claim that indicators of innovative capabilities tend to focus on the input side, and therefore it becomes increasingly difficult to assess whether the gap between effort and achievement is due to the normal maturation time for innovations, or whether it should be explained by inefficiencies in the emerging innovation system. In an attempt to come to an overall judgement, the authors concluded that separate analysis of specific industrial sectors is needed in order to evaluate innovation performance, since analysis based on overall indicators yields poor results (ibid.).

In assessing the innovative capabilities of the electronics industry in China, the authors found that China's success in building the world's biggest electronics production hub for global markets is strongly associated with foreign direct investment (FDI), as showcased by the examples of Huawei Technologies, Lenovo, and the Haier Group. Regarding the automotive industry, the other industrial sector investigated in the study,

they concluded that although domestic innovation still lags behind that of leading nations, the path of development has been remarkable, as China became the fourth largest producer in the automobile industry worldwide, from having no relevant production capacities only twenty years ago. They also suggest that, with national programmes targeting cutting-edge innovations in fields such as the development of hybrid cars and hydrogen fuel cells, global leaders might increasingly shift their automotive engineering R&D activities to China as an off-shore destination. By examining the industry-specific examples both in China and India, the authors concluded that in all cases reviewed, the two countries have managed to significantly narrow the technological gap, and even though they have not yet seriously challenged global technological leaders, the prospects for catching up remain firm, as long as they manage to mitigate certain economic and political risks (ibid.).

A study conducted last year by the McKinsey Global Institute (MGI) followed a very similar logic in assessing the innovativeness of China's economy. To evaluate innovation performance, the authors developed a framework which analyses industries by their "innovation archetype", rather than using national level metrics, in order to obtain a better understanding on the role and level of innovation by sectors. The four archetypes of industry innovation identified in the study are: *customer-focused, efficiency-driven, engineering-based, and science-based*. To measure China's success in each of these dimensions, the authors compared the revenue of Chinese players in certain industries in relation to their expected share of global sales, based on China's share of Global GDP (*MGI 2015*).

Figure 2: Ratio of China's share in the global revenue pool to its share of global GDP

Science-based
0 of 4 above GDP line

Biotechnology
Semiconductor design
Speciality chemicals
Branded pharmaceuticals
Household appliances
Internet software
and services
Internet retailing
Consumer electronics
Home entertainment
software
Smartphones
Consumer packaged goods

Solar
panels
Generic
pharmaceuticals
Steel
Textiles

Costumer-focused
3 of 7 above GDP line

Commercial aviation
Medical devices
Oil and gas engineering and
equipment manufacturing
Application and system software

Engineering-based
3 of 8 above GDP line

Automotive (cars and parts)
Communications equipment
Wind turbines
Railroad equipment
Paper and forestry
Semiconductor foundry
and back-end engineering
Industrial machinery
Oil and gas upstream
and downstream
Commodity chemicals
Electrical equipment
Construction machinery
Construction materials

Efficiency-driven
9 of 12 above GDP line

Revenue fair share of Chinese companies, 2013 | Index: 1 = GDP share

Source: MGI 2015, pp. 5.

As revealed by the share of Chinese companies in the global revenue pool, China has become a leading innovator mostly in industries which grew on the basis of serving domestic demand, while in the more challenging types of innovation, such as branded pharmaceuticals, biotechnology or the automotive industry China has yet to become globally competitive. The authors used a multifactor productivity approach in the analysis, inspecting growth that derives from factors of production excluding labour and capital investment, to establish a proxy that would signal the macroeconomic impact of

innovation defined broadly, including productivity gains both from pushing the innovation frontier and from knowledge transfers or technological catch-up.

Looking at the overall results of the analysis, it becomes clear that Chinese companies are more successful in archetype industries in which they were able to take advantage of certain characteristics unique to the Chinese economy, such as the size of the customer basis, the extensive manufacturing ecosystem or favourable local government regulations, which helped accelerate innovation by creating local demand. As seen in the figure, Chinese companies are doing particularly well globally in industries based on *customer-focused innovation*, where they have captured more than their expected share of global sales as compared to China's share of global GDP, in three out of seven sectors analysed.

The Chinese experience in customer-focused innovation originates primarily from the appliance manufacturing sector, where Chinese companies started serving the growing consuming middle class of the rapidly urbanising nation, offering white goods at a comparable quality level but considerable price discount compared to global competitors. Continuously meeting consumer expectations has led to the emergence of companies such as Xiaomi, smartphone and electronics producer, following a "cheaper but better" strategy vis-à-vis global competition (*MGI 2015*). Tapping into the massive consumer base poorly served by the traditional Chinese retail, services and media sector also made it possible for companies such as Tencent, Alibaba, Baidu or NetEase to grow from the grassroots and become some of the world's largest internet companies by market capitalisation[17].

The Internet Plus action plan announced by Premier Li Keqiang in March 2015, at the 12th National People's Congress (*The State Council of The People's Republic of China 2015*), is aimed at further promoting the application of internet technologies in conventional industries, nurturing business development by improving broadband access and e-commerce in rural areas. Overall, high customer expectations and domestic competition in consumer-focused innovation-based industries in China are likely to continue pushing Chinese companies to compete more fiercely at home and to further expand also internationally, utilising their acquired knowledge in the global arena, particularly in emerging markets.

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[17] Market capitalization of the biggest internet companies worldwide as of May 2016 (in billion U.S. dollars). http://www.statista.com/statistics/277483/market-value-of-the-largest-internet-companies-worldwide/. Downloaded: 4 September 2016.

As for *efficiency-driven industries*, the sheer size of the Chinese workforce and the modern supply-chain infrastructure concentrated in industrial zones specialised in flexible manufacturing and mass production provides an unrivalled environment for process innovation. The China effect on global innovation report (*MGI 2015*) finds that, in efficiency-driven industries China achieved more than its GDP-based share of global revenues in 9 out of 12 sectors analysed. The role of government policy interventions is accentuated in some of the sectors analysed, where intentionally boosted local demand has driven supply and subsequently also efficiencies in production. This is the case for the production of solar panels, where China has become such a strong player over the years that it captured more than half of the revenues globally.

With growing competition from South-East Asian nations as off-shoring destinations for cheap-production, China is now projecting the move to the next-generation manufacturing model, by upgrading its existing ecosystem. The *Made in China 2025* initiative, drafted by the Ministry of Industry and Information Technology (MIIT) over two and a half years, with input from 150 experts from the China Academy of Engineering (*Kennedy 2015*), is aimed at comprehensively upgrading Chinese industry, also by fostering collaboration with the German government's 'Industry 4.0' programme (*Yang 2016*). The *Made in China 2025* programme focuses on the transformation of Chinese manufacturing, based on innovation-driven, "quality over quantity" and green technologies production. The goals put forward by the programme include raising the domestic content of core components and materials to 40 per cent by 2020 and 70 per cent by 2025, and supporting the creation of manufacturing innovation centres (15 centres by 2020 and 40 by 2025) (*Kennedy 2015*). The core of the plan is built around developing cutting-edge technologies, accumulating intellectual property and leveraging access to the Chinese market in exchange for foreign technologies (ibid.). Aside from the far reaching technological goals, it also promotes the development of traditional industries and a modern services sector, letting market mechanisms play a more prominent role in its deployment. If China is able to execute its plan to upgrade its manufacturing capacities in a digital ecosystem, serving global customers with a massive supplier base, rapid and flexible manufacturing and modern logistics, it could become the virtual manufacturing powerhouse for companies and even individual consumers around the world, by some estimates expanding its GDP growth potential in manufacturing by 10 to 20 per cent through to 2025 (*MGI 2015*).

While China is already a world leader in several industries based on *consumer-*

focused and *efficiency-driven innovation*, so far the country has achieved mixed results in *engineering-* and *science-based innovation* (*MGI 2015*). While China has realised a superior share of global revenues related to its share of the global GDP in businesses such as railroad equipment, wind power and telecommunications (also largely influenced by favourable government policies), in other sectors, such as commercial aviation or the automotive industry, it has not yet benefited from the knowledge transfer in production to the extent to be able to develop globally competitive products and services. In the science-based archetype industries analysed in the report (such as branded pharmaceuticals, biotechnology, semiconductor design and specialty chemicals), the picture is even more consistent, with the total global revenue shares of Chinese companies operating in these sectors ranging only around 1 to 3 per cent (ibid.).

6. Is China ready to create breakthrough innovation?

China's commitment to move to the forefront of global innovation is even more apparent now, as President Xi Jinping has highlighted science-based innovation in the government's 13th Five-Year Plan (NPCC 2016), as one of the core points on the national agenda. However, the promotion of science and technology is not a recent direction in Chinese economic development policy. As described by Steve Blank, consultant and guest lecturer on entrepreneurship at U.C. Berkeley and Stanford University, China already started its series of science and technology programmes in five areas (support of basic research, high technology R&D, technology innovation and commercialisation, construction of scientific research infrastructure, and development of human resources in science and technology) in the 1980s. In parallel with the initiative, for the last 25 years, expenditure on R&D as percentage of GDP has almost quadrupled, reaching more than 2 per cent in 2013, according to OECD statistics.
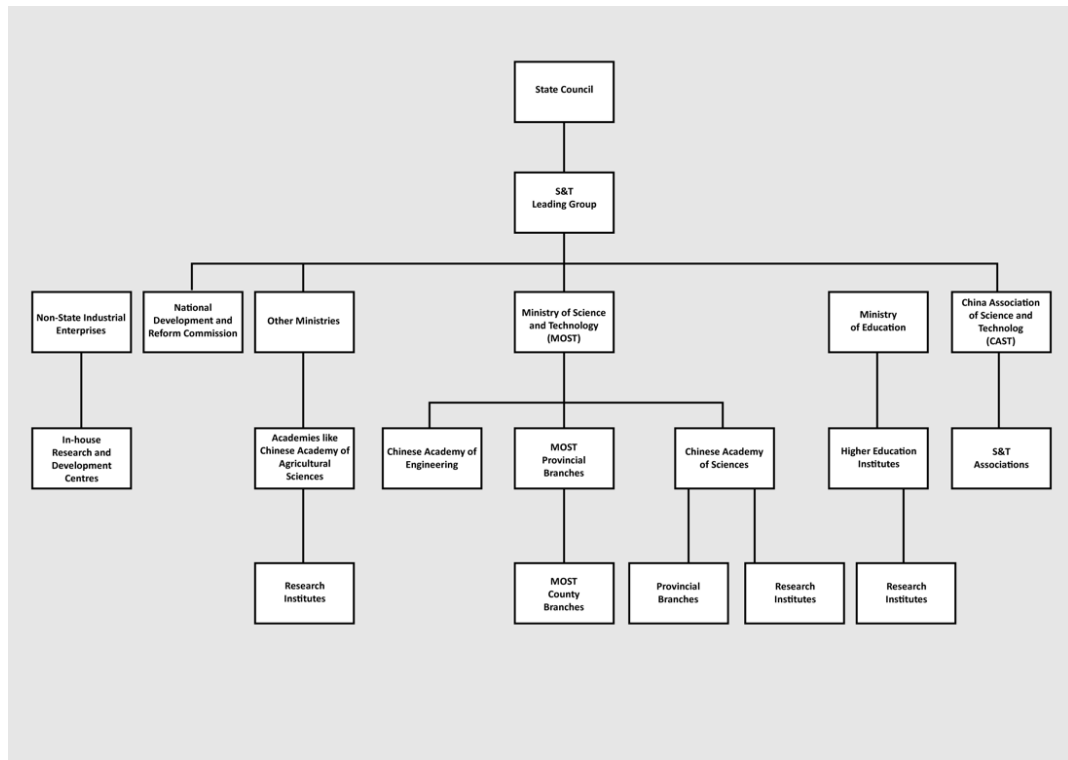
The history of the Chinese National Innovation System is characterised by a tendency of gradual alterations from a largely state-regulated model, to a hybrid, relatively market oriented one. The State Science and Technology Leading Group (STLG) was established in 1981, as the highest body for the direction of the science and technology system in China, as per the modernisation initiative of Deng Xiaoping. By forming a supra-ministerial body, the leadership wished to bring scientific development under the Premier's direct control, where policy would be set at the highest level possible, coordinating between ministries and provinces. The group was later reorganised, under the name State Leading Group of Science and Technology (SLGST), with Premier Li

Peng as its head, building "socialist science and technology" with Chinese characteristics (*Dolla 2015*).

Parallel to the STLG and SLGST, the State Science and Technology Commission (SSTC) was re-established in 1977, after the shut-down during the Cultural Revolution, with the aim of securing a separate (although coordinated) status for scientific research and technological development in the central economic planning. The STC managed the operational network, implementing policy and monitoring activities and resources, at the national and provincial levels. The STC later on transformed into the Ministry of Science and Technology (MOST), the leading organ of Chinese science and technology institutions operating today (ibid.).

Within the network of organisations, it is worth mentioning two significant entities in the Chinese science and technology landscape: the Chinese Academy of Sciences (CAS), operating research institutes throughout the country, and the China Association of Science and Technology (CAST), a professional association involved mainly in consultation, bringing together scientists and administrators, as an umbrella organisation at the national, provincial prefectural and municipal levels. As for the state funding of research activities, the National Natural Science Foundation (NSFC) is the largest agency for the support of basic and application-oriented research in natural sciences (ibid.).

Figure 3: Organisational structure of the Science and Technology system in China

Source: Dolla 2015, pp. 170.

Along with the transformation of some of the entities in the Chinese National Innovation System, the entire institutional framework has undergone fundamental changes over the last 25 years. The business sector has become the leader in R&D performance, from having a share of less than 40 per cent at the beginning of the 1990s. The share of public research institutes in R&D has declined by almost one half, while the stake of higher-education institutions remained mostly even. Enhancing the innovation capability of the business sector has been a deliberate and challenging undertaking, involving the "mechanical" conversion of public research institutes into business entities (*OECD 2007b*).

Although state influence remains strong, the overall Chinese science and technology landscape today displays a hybrid system, in which government, business enterprises and academia coexist not too differently than they do in other parts of the world. If we look at the sources of R&D funding by sector, based on the data of the

UNESCO Institute for Statistics[18], we find that ten years ago about 70 per cent of funding originated from business enterprises, 20 per cent from the government and 10 per cent from universities. Today this ratio is around 75 per cent, 15 per cent and 10 per cent respectively, showing a similar pattern to Western countries and underlining the growing market orientation of R&D activities.

It is now widely accepted that universities and public research institutes have played a pivotal role in the development of many high-tech regions in the world (*Gregersen et al. 2000*), and contributed to the advancement of technological capabilities. It is worth mentioning that most R&D-intensive firms in China have usually emerged from the public research sector, such as Legend, the predecessor of Lenovo, which was established in an institute of the CAS. Today these innovative firms are investing in R&D abroad and are facilitating the technological catch-up process, by channelling knowledge back to China (*OECD 2007b*).

Perhaps one of the most interesting areas in Chinese science and innovation policy is the structured support for small technology-based firms. The majority of these centrally planned science and technology support programmes have been driven by the by Ministry of Science and Technology (MOST) and the National Natural Science Foundation (NSFC). One prime example is the Torch Programme, arguably one of the most successful entrepreneurial programmes in the world, which is managed relatively independently from central planning (*Blank 2013*). The Torch Programme has four pillars: Innovation Clusters, Technology Business Incubators (TBIs), Seed Funding (Innofund) and Venture Guiding Fund, providing a comprehensive support ecosystem for high-tech companies and start-ups, in order to help them develop and bring innovations to the market (ibid.).

As seen also through the Torch Programme, the Chinese state has made substantial investment in the development of science parks and incubators. While many small technology-based firms remain dependent on public support from some level of government, or as tenants of science and technology parks, we can also witness the emergence of purely market-based innovative networks of small firms in some regions such as Zhejiang, Jiangsu and Guangdong, creating a cluster effect (*OECD 2007b*). As reported by the National Bureau of Statistics of China (NBSC) in 2013, the regional cluster effect is highlighted, as the R&D expenditure of industrial enterprises in the top

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[18] http://data.uis.unesco.org/.

three regions (Jiangsu, Guangdong and Shandong) accounted for more than 40 per cent of the total (*NBSC 2014*).

As Michael Porter described in his epoch-marking article, "Clusters and the New Economics of Competition" (*Porter 1998*), the economic map of the world is dominated by clusters, "critical masses- in one place- of unusual competitive success in particular fields", that "affect competitiveness within countries as well as across national borders". The impact of clusters on competitiveness derives from the fact that, clusters are characterised by their capability to generate breakthrough innovations that can create new industrial domains and redesign value chains (*Ferrary et al. 2009*). Therefore, clusters can be crucial components in the creation and dissemination of innovation in the economy.

As stated by researchers at Stanford University (*Ferrary et al. 2009*), the competitive advantage of an innovative cluster is based on its capability to nurture the founding of start-ups developing breakthrough technologies. Silicon Valley is the most famous innovation cluster in the world, home to the semiconductor, computer software, and related electronics industries (*Citi GPS 2016*), attracting the largest amount of venture capital (VC) investment, having reached almost USD 25 billion in 2014 (ibid.). What is not so widely known is that currently the second largest amount of VC investment goes to the city of Beijing, which has increased its VC investment share from USD 0.9 billion in 2009 to a remarkable USD 7.7 billion in 2014 (ibid.).

Figure 4: VC investment in different regions (USD billion)
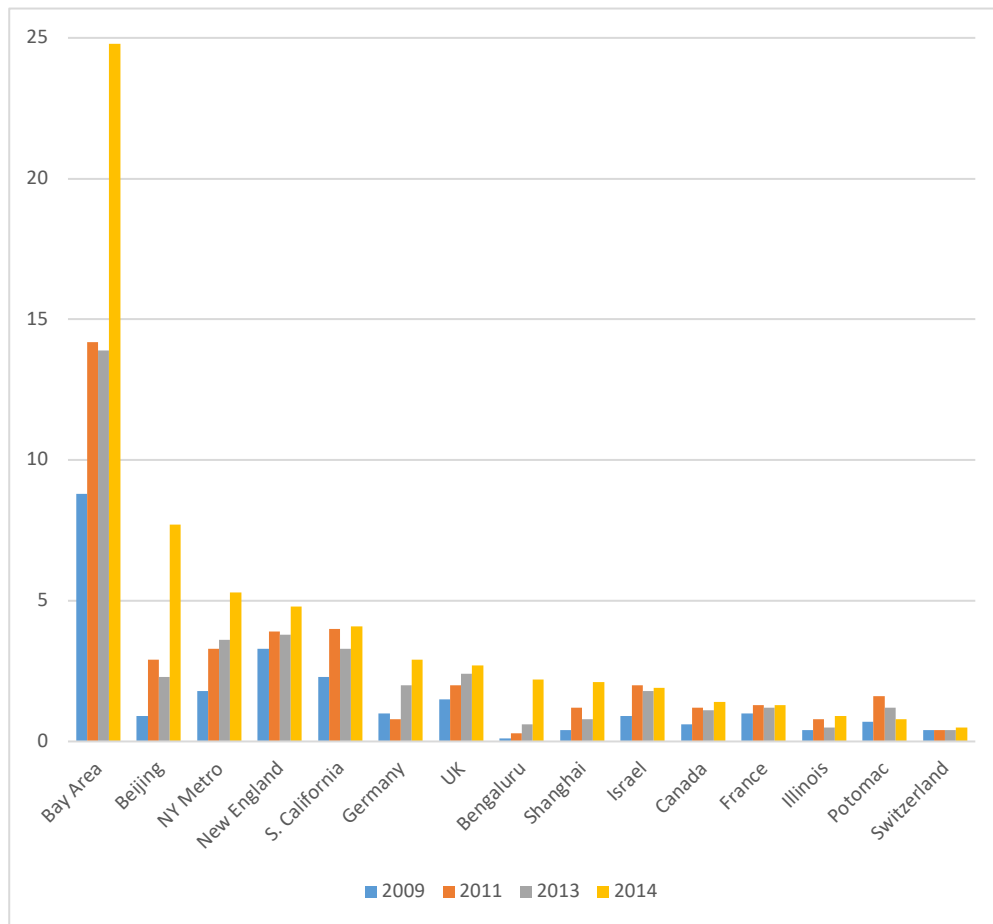
The role of venture capital in supporting smaller technology companies in China is important, since the largely state-owned banking system, mostly provides loans to bigger corporations, especially stated-owned enterprises (SOEs) (*OECD 2007b*). Therefore, the source of financing for small enterprises can either stem from government funds, through the previously mentioned programmes, or from private investors. Further examining the role of venture capital in promoting innovation, researchers at Stanford University found that venture capitalists are a major (and underestimated) source of robustness of the innovation network. The authors applied complex network theory to analyse the innovative capability of the Silicon Valley, viewing the economy as a

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[19] Ernst & Young, Venture Capital Insights – 4Q14, Global Investment Landscapes, January 2015 (*Citi GPS 2016*:8).

complex network, defining entrepreneurship and innovation as a result of interactions of numerous economic agents. According to their findings, VC-s contribute to the innovation system not only through financing and selecting start-ups, but also by enhancing collective learning, embedding social ties within the network and signalling levels of risk (*Ferrary et al. 2009*).

Similarly to the case of science and technology support programmes, VC investments have also come a long way in China: in the first wave of start-up funding in the 1990s, 85 per cent of start-up funds of new technology companies in Beijing originated from the research centre or university were they had been created. The second wave of technology investors were Chinese banks, mostly providing financing through the Torch Programme. Science and Technology Industrial Parks were the third source of support for new ventures, also through Torch Technology Business Incubators, licensed by the local governments (*Blank 2013*). Today, there are more than 1,000 Private Equity and Venture Capital firms operating in China, taking advantage of the introduction of the "Renminbi (RMB) funds", that can invest with fewer restrictions regarding industries, less regulatory oversight and better access to listing a portfolio company. RMB funds can be set up both via domestic funds (fully owned by Chinese investors) or foreign-invested funds (partially or fully owned by non-Chinese investors) (ibid.).

According to a report published by Ernst&Young on Chinese venture capital in 2015 (*Ernst&Young 2015*), the top five investors by number of deals carried out were mostly North American firms, completing almost 300 deals during the year. Beside private sector investors, as communicated by Bloomberg magazine, the Chinese government has decided to bolster innovation and reduce dependence on heavy industry by raising more than USD 200 billion in 2015 for government-backed venture funds, an amount unprecedented worldwide. The 780 funds nationwide that receive financing for investment from this amount should help promote the surge in entrepreneurship in the country, according to the government's plans (*Oster et al. 2016*). Although the efficiency and possible negative side effects of this initiative are yet to be experienced, the scale of investment shows a level of commitment from the government, that makes this experiment unique globally.

While the initiative is supposed to spur entrepreneurship throughout the country, the centre of the Chinese start-up ecosystem remains in Zhongguancun in the Haidian District of Beijing. This technological cluster is primarily focused on the Technology, Media and Telecommunications (TMT) segment, with about half of the investment deals

going into the internet businesses. The area brings together start-ups and global technology leaders as Nokia, Motorola, Sony Ericsson, Microsoft, IBM, Sun, Oracle or Google, and is located close to some of China's best universities such as the Peking University, Tsinghua University, the University of Science and Technology of Beijing and the Beijing Institute of Technology, creating ideal conditions for innovation to flourish (ibid.). Although there is no exact recipe for creating a truly innovative economy, all of the factors mentioned above, such as the solid institutional framework, attractive research systems, accessible financing and technical support to entrepreneurs and businesses, are some good proxies for describing the density and quality of relationships existing within the innovation system, and they can serve as a starting point to also examine missing competencies that could enhance the overall robustness of the system.

7. Factors delaying the global rise of the Chinese high-tech sector

With about one hundred National High-tech Industrial Zones (MOST 2010) and numerous technology specific clusters such as Donghu, Wuhan (optoelectronics), Zhangjiang, Shanghai (integrated circuits and pharmaceuticals), Tianjin (biotech and new energy), Shenzhen (telecommunications) and Zhongshan (medical devices and electronics) (Blank 2013) operating in the country with extensive R&D expenditure, accounting for 34 per cent of all corporate R&D expenditure in 2010 (MOST 2010), the question remains why China is seemingly lagging behind on engineering and science-based innovation-driven industries, despite all the efforts of both the government and the private sector to develop high-tech industries.

Some researchers (MGI 2015) argue that this kind of scientific work simply needs longer times to pay off, since high-tech industries such as pharmaceuticals often require periods of 10 to 20 years of development and testing before launching a product on the market, therefore it is only a matter of time before China's R&D efforts translate into globally competitive innovative output in terms of marketable products and increased revenue streams. Notwithstanding the previous observation, they also find that slow regulatory processes, questions about intellectual property protection and inefficient allocation of government research funds could also play a role as underlying factors, delaying success. Other studies have also identified the central challenges facing China as the strengthening of intellectual property rights protection, along with the construction of innovative cultures and incentive systems, and the development of human resources (*Xie et al. 2008*). Another possible explanation that has been proposed is that the Chinese

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market is so large that many domestic companies have little incentive to expand abroad, as certain local advantages are difficult to replicate elsewhere, together with the familiarity of the domestic environment (*McKinsey 2012*).

Some authors (*Altenburg et al. 2008*) make an opposing argument, suggesting that the combination of size and fast growth makes a difference in the case of China, and that it will most probably facilitate leapfrog development. According to their explanation, since capital accumulation is possible on a much larger scale, it enables the country to keep investing heavily in R&D, buy embodied technology even in the form of acquiring entire firms and hire leading international scientists and managers on an unprecedented scale. Furthermore, by leveraging its purchasing and political power, China can make deals that give access to its market only in return for access to technology, making it plausible for the country to leapfrog certain steps of the technological development process.

Aside from the time factor, another underlying reason could be that the application of advances in technology, entrepreneurship and innovative approaches – resulting in the creation and delivery of goods and services – is strongly related to the diffusion of knowledge and technology in society, which could be influenced by cultural factors. An OECD study (*OECD 1996*) that explores the network characteristic of the knowledge-based economy has recommended the substitution of the traditional linear model of innovation for a new model centred around the flows and relationships between industry, government and academia that better characterise the development of science and technology in society. Within this system, knowledge distribution power holds crucial importance, and R&D efforts are just the first indicators to map the diffusion of knowledge and innovation in the economy. In this view, investment in R&D is just as important as investment in education, in talent development and in developing managerial skills to successfully utilise innovation.

It has been observed, that the *social technologies* of innovation, embodied in norms and values, organisational forms, incentive systems and public policies, are harder to acquire than the physical ones (*Altenburg et al. 2008*). Studies have examined the role of culture in firms' propensity to innovate, and they found that autonomous, risk-taking, innovative, competitively aggressive and proactive entrepreneurs and firms depend strongly on their cultural foundation. In short, countries with specific cultural tendencies engender a strong orientation to entrepreneurship, hence experiencing more global competitiveness in the long run (*Lee et al. 2000*). Economic reforms and policies of

opening up have reshaped the value system in China, but Chinese culture can be described as more collective and with higher uncertainty avoidance compared to Western countries (*Fan 2000*), which suggests that instilling a culture of risk taking and promoting cross-company collaboration could probably enhance Chinese firms' innovative capacity and overall competitiveness (*McKinsey 2012*). Related to social values, beliefs and norms, it is a common misconception that countries operating in a democratic political system, should by definition become more successful economically. In an analysis conducted in 115 countries (*Fagerberg et al. 2007*), the authors found that the character of the political system is not closely correlated with levels of economic development; therefore, there is no evidence to conclude that the insufficient or deferred results of the innovation system of the Chinese economy can be directly related to the nature of the Chinese political system.

Instilling a culture of innovation is strongly related to the build-up of entrepreneurial capabilities and the development of professional and personal networks. It has been observed (*Altenburg et al. 2008*), that strong professional and personal networks that have developed between the new innovative regions in China and India and the old innovative regions in the United States, have helped the mobility of technically skilled entrepreneurs, engineers and scientists, mostly of Indian and Chinese origin. These professionals, with substantial research and work experience in the United States, applied their skills in their country of origin, creating an effect of "brain circulation" between China, India, Korea and Taiwan (ibid.).

The Chinese government has recognised the need to support the build-up of entrepreneurial capabilities and improve the diffusion of innovation by enhancing talent. The government recently launched the *National Medium- and Long-term Talent Development Plan* (*2010–2020*) and the *Thousand Talents Plan* (*Wang 2010*), both aimed at nurturing domestic talent, as well as recruiting talent from abroad, to supply the economy with "rencai", or educated and skilled individuals (ibid.). The development of domestic talent, the inflow of foreign talent, and the stream of "sea turtles", Chinese who have studied or worked abroad returning home (*Blank 2013*)*, is already slowly changing the Chinese talent pool and will most probably have a transformative effect on Chinese society and economy in terms of entrepreneurial spirit and creative thinking, which may be the missing piece in the puzzle to convert the last bits of R&D ambition into tangible results.

Finally, China's ambition to make its R&D activity "go global" is opening new

horizons not only for the country itself, but also for the rest of the world, which is witnessing China emerge as a major source of global foreign investment in R&D operations. Chinese companies have been setting up laboratories and research centres around the globe at a record pace over the past few years, as reported by the Financial Times[20], and announced the opening of nine new overseas R&D centres in 2016 alone, with an estimated capital expenditure over USD 220 million. With research giants such as Huawei expanding their R&D operations abroad, China became the world's largest greenfield foreign direct investor, for the first time overtaking even the United States (*Dettoni 2016*). These efforts to increase innovation capabilities could aid Chinese development not only internally, but also externally, by making China attractive for multinational corporations as a destination for R&D and other knowledge-intensive services, creating a virtuous circle of technological catch-up (*Altenburg et al. 2008*).

8. Summary

Change is coming, whether we are prepared for it or not, and our ability to embrace this change will be the determinant of whether we will be able to prosper as individuals, communities or nations during the fourth industrial revolution. The new environment created by the coming industrial revolution will fundamentally change our ways of working and co-existing together, bringing along broad socioeconomic, geopolitical and demographic impacts.

China is confronting the arrival of this turbulent era, after passing through a phase of challenging transition, leaving behind three decades of remarkable economic and social development and entering a stage of weakening growth and increased uncertainty. As it is the case with all changes, the next industrial revolution will present challenges to tackle and opportunities to take advantage of, and it seems that China's capacity to diffuse innovation throughout its industry will be a key influencer for the country's path of future development.

Based on our analysis, China is already the world leader in various industry sectors based on consumer-focused and efficiency-driven innovation, while it is still to experience growing competitiveness in the engineering- and science-based sectors. After examining China's commitment to the promotion of R&D and the existing ecosystem

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[20] Dettoni, J. (2016): *Chinese R&D goes global*. Financial Times Online.
https://www.ft.com/content/ded25056-6f64-11e6-9ac1-1055824ca907#axzz4KGU4aK97. Downloaded: 4 September 2016.

that supports technological and innovative firms, we are confident that if the country can follow its current path of economic development, continuously supporting the diffusion of innovation in the economy and instilling a culture of innovation, China could become one of the winners, if not the winner of the next industrial revolution.

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Novel technologies and Geopolitical Strategies: Disinformation Narratives in the Countries of the Visegrád Group

Bánkuty-Balogh Lilla Sarolta

Novel technologies and Geopolitical Strategies: Disinformation Narratives in the Countries of the Visegrád Group

Bánkuty-Balogh Lilla Sarolta[21]

Abstract

In the current media environment of growing information disorder and social media platforms emerging as primary news sources, the creation and spread of disinformation is becoming increasingly easy and cost-effective. The projection of strategic narratives through disinformation campaigns is an important geopolitical tool in the global competition for power and status. We have analysed close to 1,000 individual news pieces from more than 60 different online sources containing disinformation, which originally appeared in one of the V4 languages, using a natural language processing algorithm. We have assessed the frequency of recurring themes within the articles and their relationship structure, to see whether consistent disinformation narratives were to be found among them. Through frequency analysis and relationship charting, we have been able to uncover individual storylines connected to more than ten overarching disinformation narratives. We have also exposed five key meta-narratives present in all Visegrád Countries, which fed into a coherent system of beliefs, such as the envisioned collapse of the European Union or the establishment of a system of Neo-Atlantism, which would permanently divide the continent.

Key words: novel technologies, geopolitics, disinformation, strategic narratives, Visegrád Group

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[21] Lilla Sarolta Bánkuty-Balogh is a Ph.D. candidate at the Corvinus University of Budapest, Doctoral School of International Relations and Political Science, in the Geopolitics and Sustainable Development Doctoral Program. She holds a BA degree in Economics from the Corvinus University of Budapest and an, Msc. degree in Inter- national Management from the Vienna University of Economics and Business and the Bocconi University of Milan. Her current area of research focuses on the intersection of geopolitics and the use of emerging technologies. Email: lilla.s.balogh@gmail.com.

Introduction

Political polarisation, opinion echo chambers and filter bubbles seem to have become the buzzwords of the past years, not only in the political conversation but also within the popular discourse. The widespread interest in documentaries such as "The Social Dilemma" (Orlowski 2020), a movie premiered in 2020 that takes a critical look at technology platforms influencing human behaviour, showcases the simultaneous fascination and concern over political and social trends enhanced by digital technologies increasingly shaping our realities. The Oxford English Dictionary chose the word *post-truth* as the word of the year in 2016 (OUP 2016). The selection seeks to represent the "*ethos, mood, or preoccupations of a particular year*" that has "*lasting potential as a word of cultural significance*" (OUP 2020). The term post-truth has gone from being a peripheral term to a widely recognised notion in headlines, publications and the cultural mainstream within the course of a year, largely in relation to the Brexit referendum in the United Kingdom and the 2016 United States presidential elections, with the most important association of the term being *post-truth politics*. The "post" prefix in the expression "post-truth" articulates the meaning of truth as a concept becoming unimportant, dated or irrelevant in the contemporary political context (ibid.).

Critics of data-centric technologies claimed already more than a decade ago that *ideological silos* (Sunstein 2007) could be created through growing personalisation powered by digital technologies. The increasing authority of the consumer to filter what kind of information they encounter on a daily basis has the potential to skew people's perceptions regarding tendencies in news and public affairs. Simple search engine results can vary by personal and regional (location-bound) characteristics, while social media platforms such as Facebook, Twitter or Reddit operate custom newsfeeds to enhance user experience. Internet users – through algorithmic decision making and as a result of personal network connections – increasingly only encounter information that does not challenge their original beliefs but typically reinforces their pre-existing convictions (EPRS 2019a). Such digitally enabled distortion of shared realities can result in voices gradually becoming more radical.

This leads us to the so-called (social media) *echo chamber* phenomenon or the emergence of homophilic clusters of individuals who reinforce and amplify each other's opinions, creating a bubble where no opinion challenge can occur (Garret 2009). Echo chambers can come to life thanks to the human tendency to seek information adhering to pre-existing opinions and values, generally referred to as an unconscious exercise of

confirmation bias. Confirmation bias is the human tendency to seek information that one considers supportive of their favoured hypotheses or existing beliefs, and to simultaneously interpret information in ways that are partial to those (Nickerson 1998). Such selective exposure to opinions and the (self-)isolation from a diverse range of arguments naturally pushes people toward more extreme attitudes (Sunstein 2007). Polarisation of views may account for growing partisan divides among political affiliations and ever greater ideological gaps being created within society (ibid.). Social media network dynamics therefore play a crucial role in influencing political processes as social platforms have become the agorae of not only political campaigning but also of sharing information (EPRS 2019a). According to Sunstein (2007:8-9), the growing power of consumers to filter what they see and hear decreases the probability of unplanned, unanticipated encounters that constitute shared experiences in an otherwise heterogenous society. If such tendencies exceed a certain threshold, they could inhibit the creation of a general consensus on core questions that are central to addressing social problems and the functioning of democracy itself (ibid.).

Although the extent to which consumer selection and algorithmic decision-making respectively contribute to the creation of social media echo chambers and filter bubbles is still debated in the literature, we find ourselves in a chicken-and-egg situation where regardless of the exact structure of causalities, the human-machine interaction seems to create a mutually reinforcing dynamic. Zimmer and others (2019) make a point about human accountability when they argue that algorithms and their mechanisms to form filter bubbles, do not create online communities on their own, but rather amplify users' existing behaviours. They reflect on cognitive patterns, such as non-argumentative or off-topic behaviour, denial, moral outrage, meta-comments, insults, satire, and creation of a new rumour that could all contribute to the emergence of echo chambers. John and Dvir-Gvirsam (2015) also point to the human factor, when presenting empirical evidence that politically motivated unfriending on Facebook became a common practice in the Israel-Gaza conflict of 2014. Such ideologically-based unfriending affected weak ties in the network, which are precisely those connections that would with a higher probability expose users to a diverse range of opinions. On the other hand, Cinelli et. al. (2021), by analysing the interactions of more than one million active users on Facebook, Twitter, Reddit, and Gab, have concluded that while the former two platforms presented clear-cut echo chambers, the latter two did not, suggesting that different platforms offer different interaction paradigms to users, triggering different social dynamics. Particularly,

platforms organised around social networks and news feed algorithms, seem to favour the emergence of echo chambers (ibid.). Cohen (2018) makes a similar observation, stating that algorithm-based personalised feeds create an immersive media environment that permits users to consume unique media feeds that may affect civic actions and democracy by tailoring cultural artifacts to the individual user. Irrespective of the exact share of human and machine bias in the equation, as automation and algorithms become more embedded in civic life, we have to assess the role of technology in deepening social divides and how we might be able counter undesirable tendencies (EPRS 2019a). Responding to the effects of social media enabled polarisation could entail a top-down approach of interrogating digital media structures, platform capitalism, algorithm design and methods of data collection, as well as a bottom-up move from the consumers' perspective, to transition beyond traditional media literacy, understanding the multiple ways user actions are converted into algorithmic decision making (Cohen 2018).As automation and algorithms become more embedded in civic life, we have to assess the role of technology in deepening social divides and how we might be able counter undesirable tendencies (EPRS 2019a).

Computational propaganda and disinformation campaigns

Not long ago, most academic research and public attention on cyber power focused on the possibilities of affecting the physical world via digital threats, such as cybercrime, data theft or damage to critical infrastructure. Today computational propaganda is gradually taking centre stage (Bradshaw - Howard 2018). Computational propaganda as defined by Howard and Woolley (2016:4886) is "*the assemblage of social media platforms, autonomous agents, and big data tasked with the manipulation of public opinion*". The blueprint of computational propaganda entails autonomous agents acting based on big data collected on people's behaviour in order to advance certain ideological projects. Computational propaganda, therefore, can be regarded as a technical strategy to use information technology for social control (ibid.). Cases such as the Cambridge Analytica scandal have shown the vulnerabilities of social platforms and how their business model could be exploited in order to manipulate citizens (EPRS 2019a). Computational propaganda, as known from everyday life, includes the spread of disinformation, automated amplification with bots and fake accounts, the suppression of opposition with hate speech and trolling, and the infiltration of political groups and events (ibid.). Social media manipulation is already available to a large proportion of internet

users at relatively low costs; however, as innovations in artificial intelligence, machine learning and big data analytics advance, weapons of computational propaganda will become even more effective and sophisticated (Bradshaw - Howard 2018).

Current levels of online mis- and disinformation, commonly described as "fake news", already pose serious threats to the workings of democracy by casting a shadow of doubt on democratic election outcomes. Although, we have to point out that we still lack a thorough understanding on how much impact computational propaganda has on actual voter behaviour. Recent examples of disinformation campaigns undermining public trust and impeding the formation of a general consensus on election outcomes include the UK Brexit referendum and the 2016 United States presidential elections (EPRS 2019b), which shows that the actual or perceived effects of computational propaganda are already manifesting themselves in real life outcomes.

In order to maintain clarity of terminology, it is important to distinguish between distinct categories of information disorder used in computational propaganda, and define mis-, dis- and malinformation, instead of vaguely referring to them collectively as "fake news". According to the classification used by Wardle and Derakhshan (2017:5), differences among the three categories are to be found along the dimensions of *intention to cause harm* and *falseness of information*. As stated by their definition, *misinformation* refers to false information being shared, where no harm was meant, while *disinformation* refers to false information being shared knowingly, with the precise intention to cause harm. Conversely, *malinformation* refers to genuine information being shared to intentionally cause harm, by spreading private information in the public space. The European Parliamentary Research Service (EPRS 2019b:1) has identified five key drivers behind the rapid and pervasive spread of online mis- and disinformation campaigns in recent years:

- *Online propaganda and for-profit websites* that specifically spread disinformation with the goal of deepening societal divides and influencing political outcomes based on a particular ideological stance.
- *Post-truth politics*, whereby politicians and political parties propagate misleading claims to frame key public issues in a way that is beneficial politically, ignoring factual evidence.

- *Partisan media and poor-quality journalism,* which is aimed at feeding echo chambers, by using highly divisive language and partisan reporting, often overlooking factual inaccuracies.

- *Polarised crowds* created through personal selection of content and extrapolated by algorithmic decision making, which are characterised by biased content sharing and the creation of hyper-partisan groups.

- *Technological particularities* of advertising algorithms and the business model of social platforms, which can contribute to the promotion of online misinformation through search engine optimisation, personalised social feeds and the monetisation of micro-targeted advertising.

Online misinformation and disinformation are not limited to Facebook and Twitter, but affect all social media platforms and even mobile applications, with the most prominent ones being YouTube, Reddit, 4Chan, 8Chan, WhatsApp, Discord and Telegram (EPRS 2019b). The logic of the disinformation lifecycle is built around a self-reinforcing dynamic, whereby the creation and propagation of disinformation is supported through intentional amplification strategies. Successful disinformation campaigns tend to build on the emotive power of stories and images that have the capacity to invoke emotional response in readers and boost online engagement. Disinformation campaigns often aim to harness the power of a network of websites that post similar distortive content to reinforce each other and enhance credibility. The impact of disinformation is ensured by its "shareability factor" on social media, meaning that the content by itself has the ability to become trending due to its sensationalist or emotionally charged nature. Such targeted disinformation news pieces typically play on social divisions, such as political or religious beliefs and include digital elements that increase visibility and engagement through the use of memes, false images, false footage and misleading content (ibid.).

Along with genuine propagation, artificial amplification and spread of disinformation through fake profiles and groups also play a crucial role in heightening perceived importance. Artificial propagation of content can include the use of bots, trolls, sockpuppets or even simple targeted advertisement (Bastos - Mercea 2018). *Bots* are automatic posting protocols that scrape data from internet sources and post them via social media platforms to artificially inflate popularity of certain content. *Trolls* are (semi-

automated) supervised accounts, commonly understood as hostile, malign actors on social media, who promote extremist opinions, disseminate fake news or distort conversations. *Sockpuppets* are fictitious online identities used to manipulate public opinion through deception (ibid.). The wide spectrum of coordinated inauthentic behaviour on social platforms serves the purpose of steering and shaping public conversation in a desired way. *Astroturfing*, in particular, is a technique to mimic grass-roots initiatives in online communities to create the appearance of a genuine group of people who provide credibility to a certain cause. Such fake groups are used to lure unsuspecting users, who will be presented information that purposefully distort facts to fit specific narratives, display a biased view of events or even express a specific call to action (Kovic et al. 2018).

Disinformation and strategic narratives in the V4 region

Successful disinformation campaigns are often targeted at existing societal grievances and fissures to create discord among the members of a group or society (Jankowicz 2020). Storytelling, based on narratives coloured by emotions, has great potential to incite certain group behaviour, create new social identities and drive polarisation (Rosulek 2018). Miskimmon et. al. (2013) argue that the study of strategic narratives is necessary in the novel media environment to understand complexities of international politics. Discursive framing of local, regional and global occurrences can determine who gets to construct the *experience of international events* (ibid:103). Livingston et al. (2018) also argue that a strategic narratives framework is key to capturing the complexities and purposes of transnational struggles over meaning. The study of strategic narratives has been applied to wide-reaching topics from analysing public support for the deployment of military troops by national governments (Ringsmose - Børgesen 2011; Dimitriu - de Graaf 2016; Coticchia - De Simone 2016), mitigating the effects of climate change (Bushell et al. 2017; Bevan et al. 2020), construing the international system from emerging countries' perspective (van Noort 2017) and even in the realm of business, regarding how managers can construct future-oriented narratives for companies (Kaplan - Orlikowski 2014; Bonchek 2016).

Purposeful deception and disinformation campaigns in the international media space can be effective through the use of narratives, because engaged audiences become willing but unaware collaborators who help achieve fraudulent campaigners' goals (Bastos - Mercea 2018). When analysing disinformation campaigns in the V4 region, we

have decided to focus on recurring narratives and meta-narratives potentially emerging from individual disinformation news pieces in order to distil information that could be considered supportive of a coherent system of beliefs or a certain world view. We know that the Visegrád Group has managed to profile itself internationally as a significant collective actor, both through its individual member states being NATO and EU members and the group itself, as a region that holds increased geopolitical importance from a perspective of security, primarily in the energy sector and recently also in cyber security (Cabada - Waisová 2018). This gives reason to believe that the Visegrád Group and its member states could be worthy targets of disinformation campaigns aimed at manipulating public opinion. When seeking out inherent strategic narratives in disinformation news pieces targeted at the region, we relied on Miskimmon and others' (2013) definition on identifying constructed identity claims and articulated positions on specific issues that seek to shape perceptions and actions of domestic and international audiences.

Recent studies conducted on disinformation campaigns in the countries of the V4 region and beyond have used a similar framework when assessing the role of narratives communicated. Deverell et al. (2020) have conducted a comparative narrative analysis on how the news platform Sputnik narrated Denmark, Finland, Norway and Sweden between 2014 and 2019, and have found that Sputnik News utilised a mix of standard strategies and tailor-made narratives to destruct Nordic countries. They have been able to identify differences among how Sputnik narrated the countries of the region, with Sweden and Denmark being portrayed more negatively than Norway and Finland. They have concluded that the identified narratives served the purpose of dividing and weakening the Nordics and the EU, as well as undermining the international reputation of the countries involved. A Izak (2019) has focused on the presentation of the European Union in Slovak pro-Kremlin media, with the main objective of identifying basic narratives via qualitative discourse analysis, and has concluded that media manipulation regarding the image of the EU could be considered a tool in a broader scheme of hybrid warfare. Wenerski (2017) examined disinformation campaigns as a method of creating geopolitical influence by distorting public perception of people, events and even entire institutions such as the EU or the NATO. Wenerski argues that an alternative version of events at the Euromaidan, the war in Donbas and Syria has been created by disinformation sources that seek to destabilise the local political situation by supporting one political side and simultaneously discrediting the other. Kuczyńska-Zonik and Tatarenko (2019) have studied the problem

of information security and propaganda in Central and Eastern European countries since 2000, and have concluded that information war in the CEE region is not directed toward the countries of the region but rather aims to weaken the West, especially the European Union. Hinck et al. (2018) examined strategic narratives embedded in Russian broadcast and news media, by analysing 1016 broadcast and online news segments from 17 different sources representing governmental and official news sites, oppositional sites, and independent news sources. They have found that narratives help construct Russian identity in building domestic cohesion while fending off criticisms by Western nations. Khaldarova (2016) has concluded that Russia employed strategic narratives to construct activities, themes and messages in a compelling story line during its conflict with Ukraine. She also identified differences in narratives on Russian television when broadcasted to domestic and foreign audiences.

Hypotheses

Based on the examined literature – especially Deverell et al. (2020), Hinck et al. (2018) and Khaldarova (2016) –, our first hypothesis for the analysis was, that among disinformation news pieces targeted at the Visegrád countries, we would be able to identify recurring topics, and that based on these key topics it would be possible to establish prevailing narratives and meta-narratives of disinformation campaigns targeted at the V4 region. A topic would be considered *recurring* based on its relative frequency of mentions and its overarching presence in various or all four datasets. Our second hypothesis was, that if so – similarly to Izak (2019), Kuczyńska-Zonik - Tatarenko (2019) and Wenerski (2017) –, we would be able structure those narratives and meta-narratives into a coherent system that portrays an underlying logic or world view.

Data and methodology

In order to investigate potential disinformation campaigns directed at the V4 region, we have gathered and analysed close to one thousand individual disinformation news pieces from over 60 different sources collected from the EUvsDisinfo Database (EUvsDisinfo 2020a). This database is an open-source repository that has been created by and is under the curatorship of the EUvsDisinfo Project, established in 2015 by the European Union External Action Service's East StratCom Task Force. The East StratCom Task Force supports EU efforts at strengthening the media environment, particularly in the Eastern Partnership region of the Union, by publishing reports and

analyses regarding disinformation trends affecting the European Union and its Member States (EEAS 2018). The EUvsDisinfo Project has the core objective of exposing disinformation narratives and media manipulation, with special focus on messages in the international information space that are identified as *"providing a partial, distorted, or false depiction of reality"* (EUvsDisinfo 2020b). Although, the aim of the EUvsDisinfo Project is to increase public awareness particularly around misleading content that could be classified as disseminating pro-Kremlin disinformation narratives, it is important to note that their selection of news pieces *"does not imply, that a given news outlet is linked to the Kremlin or editorially pro-Kremlin or that it has intentionally sought to disinform"* (ibid.). Within the scope of our analysis, we have accepted the classification used by the EUvsDisinfo Database in determining whether a certain news piece contained disinformation, and have not performed further evaluation regarding the accuracy of claims presented in the articles.

The EUvsDisinfo Database (EUvsDisinfo 2020a) is compiled through media monitoring performed in 15 different languages and is updated on a weekly basis. At the time of the retrieval of the data, the Database contained more than 10,000 pieces of individual news items, with 943 news pieces that originally appeared in one of the V4 languages. The collection included 458 Czech, 285 Polish, 160 Hungarian and 40 Slovak language articles that appeared between January of 2015 and November of 2020, which we have retrieved and saved for the purpose of our analysis. The news pieces have originally been compiled from more than 60 different online sources (predominantly news sites and blogs), with the majority of the articles originating from Sputnik News Czech Republic, American European News (Czech Republic), Sputnik News Poland, News Front Hungary and Zem&Vek (Slovakia). The rationale behind selecting news pieces that first appeared in one of the V4 languages was to identify pieces of disinformation that were specifically targeted at the internet users of the V4 countries. Although, there are limitations to that assumption, as news pieces published in other widely spoken second languages in the region – for example English or German –, could also be targeted towards V4 countries, it is a reasonable assumption to part from, that those news pieces that were originally published in one of the four languages were the ones that have been specifically directed towards V4 readers. By retrieving the 943 news items, we have created our own database, which contained the publication date of the articles, the original language of publication, the titles of the articles, the URL or place of publication, and the summary of the contents of each news item. Both the titles of the

articles and the summary of contents were provided in English language in the repository, which we have used for the purpose of our analysis.

In order to perform content analysis on such a large amount of natural language data, we have used a Natural Language Processing (NLP) algorithm to extract information and categorise recurring topics within the individual news pieces. The use of NLP algorithms in (political) discourse analysis and specifically misinformation campaigns or 'fake news' is a field within social sciences that has been gaining increased attention in recent years. Zhou et al. (2019) have found that the explosive growth of fake news and its erosive effect on democracy make the study of disinformation an interdisciplinary topic, which requires joint expertise in computer and information science, political science, journalism, social science, psychology, and economics. They have approached the problem from the perspective of news content and information in social networks, techniques in data mining, machine learning, natural language processing, information retrieval and social search to devise a holistic and automatic tool for the detection of fake news. Ibrishimova and Li (2020) have likewise used a framework for fake news detection based on a machine learning model to define and automate the detection process of fake news. Díaz-García et al. (2020) have presented a solution based on Text Mining that identified text patterns related to Twitter tweets that refer to fake news, using a pre-labelled dataset of fake and real tweets during the United States presidential election of 2016. Oshikawa et al. (2018) have highlighted the importance of NLP solutions for fake news detection, notwithstanding limitations and challenges involved, given the massive amount of web content produced daily. Farrell (2019) has utilised natural language processing and approximate string matching on a large collection of data to examine the relationship between the large-scale climate misinformation movement and philanthropy. Rashkin et al. (2017) have compared the language of real news with that of satire, hoaxes, and propaganda to find linguistic characteristics of untrustworthy text using computational linguistics. Aletras et al. (2016) have built a predictive model based on natural language processing and machine learning to unveil patterns driving judicial decisions in the European Court of Human Rights' cases, based solely on textual content.

After examining analytical methods utilised in the cited literature, we have decided to perform a text mining exercise on our database containing all 943 news items. We have instructed the NLP algorithm to return the individual frequency of mentions of recurring topics and their relationship structure, based on co-mentions. We have

performed this exercise, both on an overall V4 and an individual country-level for the datasets of the four languages. The frequency analysis method helped us unify insights and uncover tendencies and outliers in the datasets. To optimise search results, we manually incorporated theme-specific expressions and keywords into the NLP algorithm, and created custom queries to search for specific themes within the textual data. We used data-labelling connected to the custom queries to establish categories among the recurring topics, to group them into distinct subject matters and compare their relative frequency among the datasets of the four countries. Some custom queries required only a few keywords to maximise search accuracy (e.g., in the case of a renowned persons' name), while some other themes appeared in the news articles in various and often imprecise contexts. In these cases, relevant expressions had to be collected and incorporated into the NLP algorithm manually, as mentioned above.

Table 1.: Categories and custom queries created for the algorithmic analysis

Data labels	Custom queries (examples)	Keywords / Context for custom query (examples)
Person	Vladimir Putin	Putin
	Donald Trump	Trump
	Angela Merkel	Merkel
Country	Russian Federation	Russia, Moscow, Kremlin
	United States	United States, The US, USA, Washington, America, White House
	Germany	Germany, Berlin
Geographic location	Eastern Ukraine and Crimea	Eastern Ukraine, Donetsk, Donbass, Luhansk, Crimea, Crimean
	Nagorno-Karabakh	Armenia, Azerbaijan, Nagorno-Karabakh, Nagorno
Concept	Information War	disinformation, fake news, information war, hybrid war, propaganda, fake news, hybrid threat
	Gas Market	gas, pipeline, Nord Stream, LNG, energy, Gazprom

Organisation	EU	EU, Schengen, EP, Brussels, European Council, European Parliament, European Union, Council of Europe
	Deep State	deep state, global capital, shadow state, shadow government
	CIA	CIA, Central Intelligence Agency, American Intelligence Agency, American foreign intelligence
Event	MH17	MH17, Boeing, Crash, MH-17
	Brexit	Brexit
Ideology, Belief	Russophobia	anti-Russian, Russophobia, anti-Russia, against Russia, against Slavs, anti-Slav, war with Russia
	Bolshevism	Bolshevism, Bolshevik

Source: Own elaboration.

As seen in Table 1., we have ordered the queries into seven main categories according to their context of use within the articles. The defined categories were: Person; Country; Geographic location; Concept; Organisation; Event; and Ideology, Belief. We must highlight that the categorisation of themes and keywords used for the custom queries within the scope of this study have been established exclusively based on their fit with the original language used in the articles, in order to optimise search results and uncover their frequency of mentions. Accordingly, categories and keywords used do not represent a statement of value or opinion in any way, but merely serve analytical purposes. The context of certain expressions and synonyms used within the articles predefined how these same expressions could be identified algorithmically within the analysed texts. For example, countries tended to be represented as individual actors, and as such, were often referred to by their capital city (e.g., "Berlin" in order to denote Germany) or iconic place (e.g., "White House" to refer to the United States). Similarly, geographic locations (e.g., Europe) were often used interchangeably with an acting organisation (e.g., European Union). In order to resolve this inconsistency, we created two separate categories: "Country" and "Geographic location". In the former, we listed themes that referred to countries as *actors* in the international arena, while in the latter we compiled *locations*,

where particular events have taken place. "Organisation" by itself is a dual category, as the articles tended to refer to both legitimate international organisations, such as the NATO and unclear actors such as the "Deep State" in an equally axiomatic way. Therefore, in order to maintain the logic of the analysis, we had to include these qualitatively different concepts under the same category, as an organisation or group of people independently acting within the international space. In certain cases, we had to accept loose wording among synonyms for the queries to find relevant mentions in the text, as, for example, the European Union as an acting entity has been referred to in the articles in various ways, from "Schengen" to "Brussels" and "EP"; of course, these denominations technically cannot be considered correct terms for representing the EU, however, from specific textual contexts, their intended meaning was clear. Such ambiguities in wording within the queries performed – some of which have also been listed above –, are entirely attributed to using wording from the articles for the sake of finding relevant mentions within the data. Certain categorisations may seem arbitrary as global events, such as the Cold War in specific contexts could also be considered a concept rather than an event (e.g., "Cold War logic"). Conversely, Crimea, primarily a geographic location, could be paraphrased as an event (e.g., "the Crimean crisis"). Perhaps the most controversial ones are the themes within the "Ideology, Belief" category as they include both religious beliefs (e.g., Islam), sentiments (e.g., Russophobia) and political ideologies (e.g., "Nazism") that are difficult to delineate precisely. It is important to note that the reason for creating a categorisation of themes was primarily to be able to perform comparative analysis on their frequency of mention, and uncover hidden trends within and between datasets. For this purpose, we have decided to use the predominant textual contexts of themes as they originally appeared in the articles, without evaluating other possible interpretations of wordings that were not relevant for the scope of our analysis.

Results and discussion

To establish recurring narratives and uncover outliers among the results returned by the NLP algorithm, we have first looked at the distribution and frequency of mentions of the seven categories. We found the that the category *Country* among the seven main categories showed overwhelming frequency both on a V4 average and an individual country level. On an overall V4 level, news items featuring countries made up 79% of the selection, showing a strong bias towards narratives that depict countries as main actors in

the international arena and personifying nation states as entities that have their own will and act on their own motivation. The second category in terms of frequency on a V4 level was *Organisation*, with 37% of mentions, followed by *Concept* with 30%, *Geographic location* at 26%, *Ideologies and Beliefs* at 22%, *Person* at 15% and *Event* at 14%. Please note that the sum of individual category frequencies exceeds one hundred percent, as naturally there were co-mentions in the text among the different categories. By contrasting the frequency of mentions of the different categories among the four datasets, we were able to identify where we should look for discrepancies, as an excess or lack of mentions of a certain topic. Based on the outliers in data, we could identify both common themes and country-specific differences regarding narratives unfolding from the articles. We ordered our investigation around narratives pertinent to the seven main categories, moving from the most significant category in terms of frequency of mentions, which was *Country*, to the least cited one, *Event*.

Table 2.: Frequency of mentions of the seven main categories on an individual country and V4 average level

Category	Polish language (%)	Hungarian language (%)	Slovak language (%)	Czech language (%)	V4 average (%)
Country	92%	74%	75%	73%	**79%**
Organisation	29%	36%	50%	41%	**37%**
Concept	21%	33%	20%	36%	**30%**
Geographic location	22%	37%	15%	26%	**26%**
Ideology, Belief	30%	17%	23%	19%	**22%**
Person	12%	13%	8%	19%	**15%**
Event	27%	12%	3%	9%	**14%**

Source: Own elaboration

News articles corresponding to the *Country* category made up 73-76% of the selection for Hungarian, Czech and Slovak language items respectively, while 92% of Polish language articles contained country-related mentions. The distribution of specific

countries mentioned within the different datasets showed some commonalities but also considerable differences. Among country mentions for all V4 countries, we found both Russia and the United States in the top-three of countries cited for every data set, with numerous co-mentions of the two countries. Narratives concerning Russia showed significant commonalities in the four countries. The predominant narrative was not regarding Russia's strength or grandeur but rather depicting Russia as a victim of Russophobia and unfounded aggression originating both from its western neighbouring countries, and, most importantly, directed from the United States. We found that the majority of news articles described the deterioration of relations between Russia and the US, the EU, Poland, the Baltic States and Ukraine. The articles were mostly concerned with speculative American interests in reinstating Cold War-like circumstances, where Russia would become economically, politically and ideologically isolated from the West. The underlying argument was two-fold: both economic interests and ideological animosity between the two powers were identified. The mentioned economic interests involved European defence industry purchases from US suppliers and the promotion of Liquefied Natural Gas (LNG) imported to Europe from the United States. According to the identified narrative, this entails pushing Russia out of the European gas market and obstructing the Nord Stream 2 project, a system of offshore natural gas pipelines connecting Russia with Germany. The ideological hostility, as stated by the news pieces, manifests itself in attempts to defame Russia by fuelling anti-Russian sentiment through disseminating fake information.

The main focus of supposed western disinformation campaigns against Russia involved the Skripal and Navalny cases, insinuating Russian involvement in the United States presidential elections, and *re-writing* or *falsifying* Second World War history in a way that depicts Russia as an aggressor. Narratives identified from the articles concerning Russia were overarching for all V4 countries, however, differences could be found in the frequency of mentions among them on a country-to-country basis. For example, the narrative regarding the *falsification of WWII history* was particularly strong among Polish language articles, where more than 50 articles of the 285 analysed occurred with such mentions, compared to a total of 8 articles in the other three languages combined. The articles claimed that the *liberation* of Poland by the Red Army is being increasingly narrated as an *invasion* by contemporary Polish politicians who actively serve US interests. Furthermore, the articles stated that Red Army monuments in Poland were at threat of being vandalised or destroyed as a sign of growing Russophobia in the country.

Comparatively, in the Hungarian language articles concerning Russia, country-specific emphasis was on the instances of Ukrainian aggression towards Russia and the Navalny case, as a theoretically CIA-led operation to sabotage Russian access to the European gas market through the provocation of economic sanctions. Czech and Slovak language articles frequently featured alleged FBI and CIA involvement in manipulating local media to spread anti-Russian sentiment with particular focus on the Skripal case.

Examining the articles mentioning the United States, we were also able to uncover a consistent geopolitical strategy narrative present in all four datasets. To a varying degree, the articles conveyed that the United States is gradually preparing to engage in economic warfare or even armed conflict with the Russian Federation in order to eliminate its rival and eventually gain access to Russia's natural resources. The United States, theoretically, is increasing its political influence, secret service operations and military presence in Europe, particularly in the Eastern and Baltic States. According to the related narrative, the US is actively supporting the creation of a North-South belt of federal states between Germany and the Russian Federation, which would be both anti-Russian and Eurosceptic. This would divide spheres of influence between the West and the East, and restrict both the expansion of Russia and the creation of a strong and united Europe. The tools for achieving this goal, according to the news pieces, range from underground operations of destabilising Post-Soviet territories, for instance by supporting the protests in Belarus or provoking conflicts such as the Ukrainian Maidan and the Nagorno-crisis, to performing false-flag operations, including the Skripal and Navalny cases, and even the Malaysia Airlines Flight 17 (MH17) disaster over Ukraine.

The narrative concerning the United States, claims that according to the American national security strategy, there exists no alternative to the leading role of the US globally, and therefore a multipolar world order shall not emerge. Therefore, the US needs to defend its interests militarily around the globe and cause *directed chaos* in a number of hot spots worldwide, whenever US supremacy gets questioned. The idea of a North-South cooperation among countries in Central Europe is, of course, nothing new under the sun. The current Three Seas Initiative (TSI), which brings together 12 states across Central and Eastern Europe and the Balkans in the area between the Black, Baltic and Adriatic Seas can be seen as the modern embodiment of the pre-WWII concept of Międzymorze (Intermarium) introduced by Józef Piłsudski in the interwar period (Gorka 2018). However, the articles suggest that recent American support for the TSI could be key to transforming Euro-Atlantic relations. The construction of the Via Carpathia North-South

highway and the creation of Liquefied Natural Gas infrastructure, with sea terminals in Poland and Croatia connected via pipeline, could advance American interests in the region while hindering Russia's influence. Within the grand scheme of creating a federal group of Central European states to counter Russian power and simultaneously weaken the EU, Poland is portrayed as a *vanguard of American interests*, which is why Poland's leadership role in the TSI project is crucial from an American standpoint, according to the news pieces.

This brings us to the rationale behind why country-related mentions were so overrepresented in the case of Polish language articles. The excess of country mentions – more than 20% difference compared to other V4 countries – in the case of Polish language articles was largely a result of mentions concerning Poland itself. Most of the narratives we have identified fed into previously listed topics, however, they occurred with a higher frequency, and they focused on Poland's role as a *vessel for US interests* in Europe and the country's strategic position in a system of *Post-Atlantism* or *Neo-Atlantism*. Poland's intended role within the geopolitical meta-narrative would entail the obstruction of Russian-European energy cooperation. There were several mentions of assumed Russophobia among the Polish political elite and the intentional *falsification of WWII history*, along with the *war on (Red Army) monuments*. The articles showed particular concern regarding Poland's role in the Belarusian protests, stating that Polish political elites try to interfere with Belarusian domestic affairs, supporting the Belarusian opposition in order to extend Poland's sphere of influence and destabilise the post-Soviet region. Another segment of Polish language articles introduced a different narrative which we have not found in the other datasets. This line of narrative stated that Polish nationals were increasingly dissatisfied with their own country's leadership due to economic problems, and that recent pro-choice demonstrations in Poland had been, in reality, anti-government protests, exposing growing political discontent among Polish citizens. Articles concerning Poland that originally appeared in Polish language made up 60% of the respective dataset, compared to only 21% of articles on the Czech Republic that appeared in Czech language, 13% on Slovakia in Slovakian and merely 3% on Hungary in Hungarian. Regarding the latter three, common recurring narratives included threats posed at the countries by the European migration crisis and foreign (Western) secret service operations, as well as the oppression and economic exploitation of the states in the *second tier of Europe* by *Brussels*, but we have not identified anti-government narratives as in the case of Poland. We have, however, identified a unique same-language

country discourse concerning the doubted independence of Czech media from foreign influence.

A further instance of overrepresentation in the frequency of mentions of a specific country was the case of articles on Ukraine in Hungarian language news. More than one third of the Hungarian dataset contained mentions on Ukraine, making it the number one country cited in the dataset (before even the United States and Russia, with 32% and 28% of mentions respectively). In comparison, only 17% of Polish, 14% of Czech and 5% of Slovak language articles contained news on Ukraine. Common narratives for the four countries included the hypothesised role of the United States in organising the Euromaidan, a wave of demonstrations in Ukraine which began in Maidan Nezalezhnosti (Independence Square) in Kyiv, later on followed by the Crimean crisis. The supposed rationale of the US was the provocation of Russian involvement in the Crimean crisis and ultimately the incitement of economic sanctions against Russia as well as nurturing Russophobia in neighbouring countries. The MH17 disaster was also linked as a planned incident to *punish* the Russian Federation for the annexation of Crimea. In both Hungarian and Czech language news, the Nagorno-crisis has been connected to Ukraine as well, with the alleged support of Kyiv to Azerbaijan during the conflict. It was described as a gesture to Turkey, an ally of Azerbaijan, for opposing the Russian annexation of Crimea. In Hungarian language news specifically, we found mentions of adverse economic and living circumstances in Transcarpathia – the bordering Ukrainian region with a significant Hungarian ethnic minority –, as well as the envisioned disintegration of Ukraine and the annexation of its territories to neighbouring countries.

The second most frequently mentioned category on a V4 level was *Organisation*, with 50% of mentions in Slovak language articles, 41% for Czech, 36% for Hungarian and 29% for Polish. The top two organisations mentioned for all four datasets were the European Union and the North Atlantic Treaty Organization. The EU was mentioned in 20% of Slovakian, 18% of Czech, 14% of Polish and 13% of Hungarian language articles. Common V4 narratives regarding the EU included the suspected manifestation of vested American interests behind the EU instituting sanctions against Russia – and particularly the Russian gas business –, as well as an unrealistic fear of Russia stemming from the leaders of the European Union. It has been stated multiple times in the articles that the EU is not a democratic institution but a *club led by Germany* or *Berlin ruling the continent*, always in accordance with US interests. Brussels' role in *forcing* and *organising* migration to the continent has also been a common V4 narrative as well as the

exploitation of Eastern European countries by old member states and the intentional conservation of a *two-speed Europe*, which is economically un-beneficial for newer members and weakens the integrity of Central Eastern Europe. The EU was named an *imperialistic regime* that would soon dissolve, as showcased by its *inability* to deal with the Coronavirus epidemic. Country specific narratives regarding the EU were found in the case of Poland and Hungary. In Polish language articles, we found references of Poland losing its sovereignty to the European Union and claims that recent Polish protests had been supported by Brussels in order to remove the conservative political elite, who refused to act in line with United States interests. Hungarian language articles contained mentions of EU leaders supporting Ukrainian aggression towards Russia.

Mentions of the NATO were present in 18% of Slovakian, 11% of Polish, 10% of Czech and 9% of Hungarian articles, which presented a consistent narrative overarching all four datasets. The NATO was described as a *Cold War relic* that is a *tool for US interventions* around the globe and an *ally of the American military-industrial complex*. The NATO supposedly continues to see an enemy in Russia and, therefore, is preparing for war at Russia's western borders by deploying military bases and equipment in Central Europe and the Baltics as well as expanding its operations to countries such as Ukraine, Georgia and Moldova, despite earlier consensuses. Central European states, according to the narrative, serve as *stationary aircraft carriers of the NATO* and shall be involved in anti-Russian provocation. The NATO, therefore, is a threat to the national security of Central European states, as according to the articles, these countries would be sacrificed by Western powers in a (nuclear) confrontation with Russia.

The third most important organisation in terms of frequency of mentions was the Islamic State (ISIS), which has been cited in 13% of Slovakian, 8% of Hungarian and 5% of Czech language articles. Interestingly, only 1% of Polish articles cited the ISIS. We could not identify a cohesive narrative, except for the United States being behind the creation or supporting the Islamic State. Although, the alleged reasons for doing so varied from hindering the peace process in Syria in order to destabilise the Commonwealth of Independent States (CIS), and trying to destroy Europe by fuelling the migration crisis, to buying cheap oil from the ISIS, with Turkey and the NATO acting as intermediaries. Further organisations mentioned in the articles with an average of 1-4% frequency included the CIA, the FBI, "the West", "NGOs", the United Nations, the White Helmets and the "Deep State". These organisations did not carry a particular narrative, but were

rather mentioned in connection to previously described discourses, as a reinforcement regarding theories on alleged underground operations.

The category *Concept* has been established to be able to identify narratives around phenomena that cannot be linked to one particular event, specific country or geography, but hold significant importance in constituting narratives. Such concepts have been mentioned in 36% of Czech, 33% of Hungarian, 21% of Polish and 20% of Slovak language articles. "Terror" has been the number one concept for the Hungarian, Slovak and Czech language datasets, with a relatively consistent distribution of mentions, at 16%, 15% and 11% respectively. In Polish language articles, terror was not among the top three concepts, with merely 1% of mentions. The prevailing narrative around "terror" in all datasets concerned the United States allegedly managing global terrorism, and recent terrorist attacks in Europe being staged. The supporting arguments and rationale for the account remain unclear, except for the supposed desire of the US to exercise power around the globe and further its geopolitical strategies. The Hungarian dataset, in particular, contained a number of mentions on "terror" in the context of Ukraine. However, we could not establish a specific narrative in this case, as the term "terror" and "terrorist" have been used to describe both a pejorative propaganda term allegedly used by the Ukrainian leadership to label pro-Russian separatists, as well as to denote the Ukrainian regime as a form of *state terrorism* itself. Juxtaposing the different meanings, we have concluded that the mentions on "terror" in the context of Ukraine in Hungarian language articles, albeit numerous, were mostly used as a tool to express offensive language and no clear narrative could be established from it.

"Migration" was mentioned in 11% of Hungarian and 10% of Czech news pieces, making it the second most frequently cited concept in the two languages, while we have found only one pertinent article in the Polish and Slovakian datasets. The focus was on the European migration crisis, which was described as a planned operation of the United States in order to undermine the European Union, transform its demographics and eventually destroy European culture. The articles contained references to the economic burden of supporting refugees, the prospects of refugee family reunification and deteriorating crime rates in Western Europe. In comparison, the second most frequently cited concept in Polish and Slovak language articles was "information war", with 4% and 5% of mentions respectively, mainly referring to anti-Russian propaganda and attempted falsification of WWII history performed by the "the West". Distinctively, the number one concept for Polish language articles was "gas" with 5% of mentions, which was not a

frequently cited concept in other datasets. The emphasis again was on Poland's strategic position in advancing American economic interests and pushing Russia out of the European gas market, feeding into previously mentioned narratives. The Skripal and Navalny cases were linked to the matter, as well as claimed CIA involvement in them. "Coup d'état" was another mutual theme, with 2-4% of mentions, ranking third or fourth place among concepts in Czech, Polish and Hungarian news. The articles identified the United States as the suspected organiser behind the recent upheavals in Ukraine, Turkey, Syria and the Greek coup of 1967 as well as a planned take-over of power in the Czech Republic and Armenia.

Within the *Geographical location* category, we have gathered localities that do not belong to the *Country* category because they tend to denote a specific location where events have taken place, rather than representing an acting entity. Geographical locations have been mentioned in 37% of Hungarian, 26% of Czech, 22% of Polish and 15% of Slovakian articles. The top three locations mentioned in the four datasets were Europe; Eastern Ukraine and Crimea; and the Middle East. The narratives around "Europe" included both narratives on the European Union and on Europe's geopolitical situation (vis-à-vis the United States) that have already been described above. The term "Europe" has been used rather freely in the articles to refer to both the continent, the people of Europe and the European Union, which is why mentions of "Europe" as a geographic location is difficult to strictly outline.

The Middle East was cited in a relatively high percentage of Hungarian and Czech language articles, with 14% and 11% of mentions respectively, while it was quoted in only 5% of Slovakian and 1% of Polish language articles. Narratives on the Middle East were consistent among datasets. The American involvement in the Syrian civil war was portrayed as an instance of *directed chaos*, which is supposed to be a tool to justify the presence of the United States as *world police* in the region. Whereas, according to the articles, it is indeed the US who is behind supporting terrorists in the Middle East with the help of the White Helmets, a volunteer organisation of Syrian civil defence. It was stated that while Russia propagates peace, American interests lie in maintaining an *impenetrable zone of conflict* even at the price of risking the outbreak of a third world war. We found a unique line of narrative in Czech language articles that stated that the European Union is preparing the establishment of a *European Empire*, which would spread to North-Africa and the Middle East, which is why European leaders are supposedly facilitating migration to Europe from countries in the region.

References to Eastern Ukraine and Crimea were found in 15% of Hungarian, 5% Polish and 4% of Czech news pieces, while no relevant mentions were identified in Slovakian articles. Common narratives emphasised the democratic legitimacy of the 2014 Crimean status referendum, assessing the local population's political will whether Crimea should join the Russian Federation as a federal subject. It was also expressed that ever since its annexation to Russia, Crimea supposedly enjoyed greater infrastructural and economic development than the rest of Ukraine, and could provide better quality of life for its citizens. This piece of information was presented as evidence regarding the assumption that sanctions against Russia due to the Crimean Crisis had been purely based on excuses. In Czech and Hungarian language news, we found mentions of supposed groundworks of planned NATO bases in the Donbass region of Ukraine, specifically in Sievierodonetsk and Mariupol, with the aim of threatening Crimea and the Russian Federation itself. In Hungarian articles, Crimean events were linked to the Nagorno-Karabakh Conflict, with an expected Ukrainian-Turkish alliance against Russia and the support of the Crimean Tatar autonomist ethnic minority by Turkey.

The category *Ideologies and Beliefs* has been established jointly, as the articles convoked ideological and religious beliefs in similar contexts. They were presented as governing world views that can explain certain events and underlying motivations both in domestic affairs and international relations. Ideologies and religions were mentioned in 30% of Polish, 23% of Slovakian, 19% of Czech and 17% percent of Hungarian articles. "Russophobia" came up as the most often cited ideology in Polish, Czech and Hungarian language news with 18% and 6-6% of mentions respectively, while it reached second place in Slovakian articles with 8% frequency. A sentiment of increasing Russophobia was cited in connection to a previously mentioned geopolitical meta-narrative of Neo- or Post-Atlantism, and the economic sanctions introduced against Russia after the Crimean Crisis. The media campaign against Russia concerning the Navalny case, as well as inferred censorship efforts of Russian news sites on American social media platforms were linked to anti-Russian attitudes as well. Russophobia was described as a form of xenophobia and intentional dehumanisation of a group of people because of their nationality. Russophobia was a very important meta-narrative in constituting the general world view expressed by the articles. It was connected to the falsification of WWII events, destruction of Red Army monuments, and the retrospective portrayal of Russia as an aggressor in the Second World War. Russophobia, along these lines, was linked to Nazism, the second most cited ideology with 10-10% of mentions in

Polish and Slovak language news and 4-4% percent frequency in Czech and Hungarian articles. "The West", the European Union and Ukraine were all labelled Fascists or Nazis in their adversarial tendencies with Russia. Russophobia and Nazism were co-mentioned as two sides of the same coin.

In comparison, "Islam", the third most frequent topic in the category was featured only in 5% of Slovakian, 3-3% of Hungarian and Czech and 1% of Polish language articles. It was referred to in relation to the migration crisis, as a threat to European culture. Other ideologies mentioned included "multicultural", "open-society", "gender", "capitalist", "democratic", "socialist" and "anti-establishment", albeit with a very low incidence. The gap in the frequency of mentions among Russophobia and Nazism contrasted with all other ideologies cited showcases where the dominant dividing lines lie according to the meta-narratives outlined by the news pieces.

Person-related narratives were featured with a noticeably lower frequency than narratives concerning nation states or organisations. This underlines the inherent geopolitical thinking behind notions unfolding from the narratives and meta-narratives uncovered above. The *Person* category reached 19% of mentions in Czech, 13% in Hungarian, 12% in Polish and 8% in Slovak language articles. Articles featuring renowned people tended not to carry specific storylines related to the persons quoted, but rather, individuals mentioned were linked to previous narratives and allocated to the righteous or sinister side of events, as an indication of their character, or more precisely of how they were intended to be portrayed. It is also interesting to note that those news pieces that were more openly citing conspiracy theory-like ideas were overrepresented in this category. In Czech, Hungarian and Polish articles, Vladimir Putin consistently ranked among the top people quoted, with 3-4% of mentions. The Russian president was described as someone, whose main aim is to protect peace, while being under constant threat from foreign powers and secret services as well as a victim of bad publicity directed towards him from international media. Among American politicians, we predominantly found mentions of Hillary Clinton, Barack Obama and Donald Trump, albeit with a generally lower frequency of below 3%, and with no mentions in the Slovakian dataset. While all three politicians were linked to some extent to furthering American geopolitical strategies with potentially devious tools, President Trump was occasionally also portrayed as someone open to establishing friendlier relationships with Russia, however, unfortunately being controlled by the "Deep State". Polish president Andrzej Duda were mentioned uniquely in Polish language articles, with a comparable frequency of mentions

to President Trump, at 2% within the respective dataset. President Duda was linked to Poland serving US and NATO interests in Europe. George Soros received a noticeable share of mentions in Slovakian, Hungarian and Czech news, with 5%, 3% and 2% respectively. Soros' name was brought up in relation to non-governmental organisation activities in Europe, reportedly supporting anti-establishment protests in Central Europe and managing organised migration. Angela Merkel received 1-3% of mentions across the four datasets, mostly referring to American geopolitical grand strategy in Europe. Alexei Navalny was mentioned in the Czech, Hungarian and Polish datasets with 1-2% frequency, in relation to the poisoning being faked with possible CIA involvement, in order to create an atmosphere of international distrust towards Russia.

Events or occurrences have been cited with the lowest frequency among all categories, with 27% of Polish, 12% of Hungarian, 9% Czech and only 3% of Slovakian articles. This tendency underlines the logic of unfolding meta-narratives that mainly focus on actors in the international arena and their general, rather static stances towards each other. This gives little attention to passing events and expresses a logic of Cold War-like frozen conflict, where animosity seems constant. Nevertheless, we have found some distinct tendencies among countries, with the Second World War as an event being overrepresented at 20% of mentions in Polish language news, compared to 1-3% in the other three datasets, and the MH17 disaster cited with a salient 9% frequency in Hungarian articles, compared to 0-1% in other languages. Both of these themes respectively account for the higher share of events mentioned in Polish and Hungarian language news. A common occurrence brought up in the Polish, Czech and Hungarian datasets, albeit with a fairly low frequency of 2-4%, was the Coronavirus epidemic. The relatively low rate of mentions is, of course, also due to the fact that references to the Coronavirus appeared only in 2020, while articles in the dataset include news pieces starting from 2015. Articles on the COVID-19 pandemic mostly focused on the *inability* of the European Union to deal with the epidemic that puts an end to *500 years of global domination of Europe*. The dissolution of the European Union was envisioned following the crisis caused by the pandemic. There were references to attempts in worldwide media to create bad publicity for the Sputnik V vaccine developed in Russia as well as to undervalue international aid provided by Russia to other countries during the crisis. The creation of the Coronavirus itself has been occasionally linked to the United States, according to the narrative, as an attempt to defame China.

Narratives and Meta-narratives

By systematically examining the narrative structure outlined by the thematic analysis of the close to one thousand news pieces examined, using frequency analysis and mapping relationship structures among topics, we were able to uncover not only overarching narratives but also meta-narratives unfolding from the articles that were present in multiple datasets. Meta-narratives provide larger explanations to individual narratives and construct a big picture view of the world organised around questions concerning power relations, political order, ideological divisions, historical consciousness and cultural identity. They play an integrative role in structuring individual occurrences and socio-economic contexts into a universal pattern of understanding, that can shape people's views and attribute meaning to their subjective experiences. As Jankowicz (2020) points out, the most successful narratives in disinformation campaigns, are the ones that are grounded in 'truth' – whether objective facts or perceived realities of life – as they can effectively sow doubt, distrust and discontent in targeted groups of society. While country-specific narratives identified in the disinformation news pieces aimed at distinctive vulnerabilities, such as historical remembrance of WWII events in Poland, views on Ukrainian nationalism in Hungary, or media independence in the Czech Republic and Slovakia, overarching meta-narratives sought to weaponize emotions exploiting fissures in general attitudes and cultural identity of V4 countries.

Table 3.: Narratives, meta-narratives and supporting discourses identified from the thematic analysis

Meta-narratives	Narratives	Supporting discourses
GROWING RUSSOPHOBIA	• Falsification of WWII history events • Destruction of Red Army monuments • Disinformation campaigns directed by the US to defame Russia	• Anti-Russian sentiments growing in neighbouring states • Ukrainian involvement in Nagorno-crisis • Turkey supports Crimean Tatar autonomy • Czech media is being influenced by the CIA

		• Navalny and Skripal cases were staged
THE US AND THE NATO PREPARE FOR WAR WITH RUSSIA	• Crimean crisis was provoked intentionally • NATO bases being established in Central and Eastern Europe • Destabilisation of the CIS region	• Ukrainian Maidan organised by the CIA • Legitimacy of the Crimean referendum • Living conditions in Crimea have improved • MH17 disaster was a false flag operation • US wants to get hold of Russia's natural resources • Intentional creation of zone of conflict in the Middle East
AMERICAN GLOBAL HEGEMONY	• A multipolar world order cannot emerge • The US wants to keep Russia in isolation • The US wants to destroy Europe • The US wants to defame China	• The US manages global terrorism • Hot-spots of US intervention around the globe • The US organises coups against democratically elected governments • The US and the NATO buys oil from the ISIS • Organised migration supported by the US • Coronavirus invented by the US
POST- / NEO-ATLANTISM	• American support for the TSI project • Poland is a vanguard of American interests • Fight over access to the European gas market	• North-South belt of Central European States to divide the continent • Polish involvement in Belarusian affairs • Skripal and Navalny cases fabricated to uphold sanctions against Russia

| THE EUROPEAN UNION IS DISMANTLING	• The EU is unable to deal with the COVID-crisis • Two-speed Europe • EU leaders support organised migration	• Brussels bureaucracy hinders member states • The EU is a club led by Germany • Economic exploitation of newer member states • Central European states loose sovereignty • Western culture is under attack

Source: Own elaboration.

As described in Table 3., we have identified 5 meta-narratives that united 16 standalone narratives in an umbrella-like fashion that were reinforced by about 25 supporting discourses. The five meta-narratives identified were: (1) growing Russophobia in the West; (2) the preparation of a war against Russia by the US and the NATO; (3) the United States seeking global hegemony; (4) the establishment of a system of Post-/Neo-Atlantism by dividing Europe; and (5) the envisioned collapse of the European Union. Meta-narratives used polarising framing to play on deep-rooted issues like V4 nations' preference for a strong NATO presence in the continent, the legacy of Soviet geopolitical dominance in Eastern Europe and its interplay with Euro-Atlantic relations, or the Visegrád countries' position on economic sanctions against Russia. We can also recognise emphasis on potential pain points around the economic centre-periphery relationship and balance of power among the Franco-German EU core and newer member states, as well as the debate on moving toward a less integrated Europe with stronger nation states and emerging regional alliances. Meta-narratives recognisably used these existing cultural-historical references as groundworks to communicate a grand scheme of affairs that reaches beyond the Central-European region. These five meta-narratives described a coherent system pertaining to a world view that follows a very much Cold War-like logic, with the long-standing ideological animosity between two great powers, the United States and the Russian Federation being the most important defining tendency in the current state of global affairs. All other "circumstantial phenomena", such as the dismantling of the European Union, the war in the Middle East, the migration crisis, the Coronavirus epidemic essentially somehow play into the meta-narrative of a frozen but now reheating conflict, where everything happens for a reason

that can be linked to the geopolitical motives and ideological convictions of great powers luring in the background.

According to the meta-narratives, the United States seeking global hegemony seems to be the root cause of Russophobia being fuelled in the West, that can serve as rationalisation for the intentional isolation of Russia, and in the longer-term war against Russia led by the NATO. Meta-narratives point at a divide-and-conquer strategy employed by the US in the European continent, through the establishment of a Post-/Neo-Atlantist system that would inevitably entail the break-up of the European Union, and at the same time present an opportunity for the creation of an anti-Russian stronghold in Central and Eastern Europe. To illustrate the interplay among topics, we have generated a network displaying pro-Kremlin disinformation narratives affecting the V4 countries, which seeks to visualise the connections between the most important meta-narratives and narratives that create a system of mutually reinforcing storylines.

Figure 1: Network of potential pro-Kremlin disinformation narratives in the V4 region
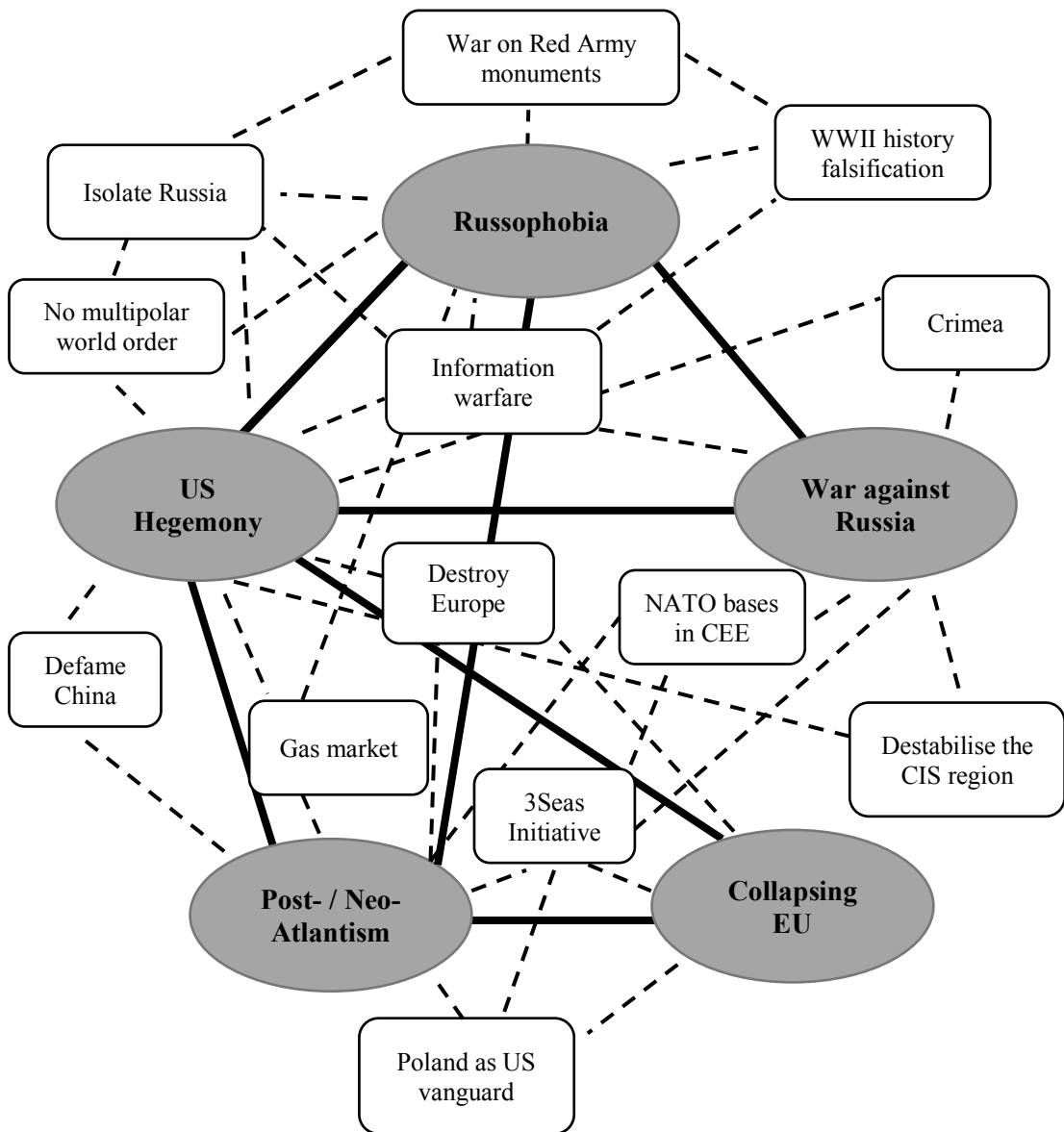
Source: Own elaboration.

While we have no evidence to assume any coordination of efforts or clearly defined motivations behind narratives being communicated through possibly pro-Kremlin disinformation news sources in the V4 region, it calls for further investigation to uncover what benefits could be attributed to the spread of these particular narratives and meta-narratives in relation to the Visegrád Countries. Overall, the framing of events, even if it mostly employs a victim narrative (e.g., Russophobia), calls attention to

Russia's grandeur as the sole true enemy of the most powerful country in the world, the United States. We could argue that it also seeks to plant seeds of discontent and suspicion among citizens of V4 countries, in some cases toward their own country's leadership (e.g., in the case of Poland), toward their neighbouring countries (e.g., in the case of Hungary and Ukraine) and in general toward the leadership, institutions and older member states of the European Union. Finally, it also questions the motives behind the grand strategy of the United States in the continent and the long-term faith of the Central European region as hypothetically devised by the US. To appreciate the significance of disinformation narratives being planted via computational propaganda, further research directions should focus on uncovering the actual effects that these narratives have on people's perceptions and attitudes in the V4 region, and how it might be possible to combat such effects.

Conclusions

Selective exposure to news content facilitated by modern digital technologies has the potential to drive people toward more extreme attitudes and increase the polarisation in our societies (EPRS 2019a, Rosulek 2018, Sunstein 2007). As automation and algorithms become more embedded in day-to-day life, we must make sure that we can maintain our capacity to establish a general consensus on questions pertinent to a healthy functioning of democracy (Sunstein 2007). Disinformation and purposeful deception work through the unwitting participation of individuals who readily accept and share content that seeks to influence based on instinctive emotions instead of rational arguments or scientific facts (Bastos - Mercea 2018). If we can identify tools of storytelling used to create powerful messages to incite certain group behaviour and aggravate existing societal grievances, perhaps we will be better equipped to protect ourselves from malevolent disinformation campaigns intentionally targeted to create discord (Jankowicz 2020, Rosulek 2018). The Visegrád Group has managed to profile itself internationally as a significant collective actor (Cabada - Waisová 2018), and as such, should expect to become the target of disinformation campaigns aimed at manipulating public opinion. Within the scope of this study, we have employed a sophisticated research design on a large amount of textual data, using a natural language processing algorithm to examine the frequency and relationship between recurring topics in disinformation news pieces and identify overarching narratives and meta-narratives communicated through them. By analysing close to one thousand disinformation news pieces from more than 60 different

online sources that originally appeared in the languages of the V4 countries, collected by the EUvsDisinfo database (2020a), we were able to identify consistent narratives and meta-narratives that feed into a coherent system of beliefs. We have uncovered 5 meta-narratives: (1) growing Russophobia in the West; (2) the preparation of a war against Russia by the US and the NATO; (3) the United States seeking global hegemony; (4) the establishment of a system of Post-/Neo-Atlantism by dividing Europe; and (5) the envisioned collapse of the European Union. These meta-narratives were constructed through 16 standalone narratives and supported by around 25 individual discourses. While we cannot assume coordination or intentionality behind the narrative structure unfolding from the news pieces analysed, further research might be able to unveil the potential consequences of what could be understood as a possible endeavour to create discontent and suspicion among citizens of the V4 countries toward the current European political and economic system, particularly the European Union, and the stance of the United States and the NATO in the continent. Information warfare is a powerful geopolitical tool that could negatively affect any Central European state or the European Union itself, and it remains a challenge to protect our societies from it. The evaluation of the effectiveness of such disinformation campaigns in transforming citizens' attitudes calls for further research, including how education plays a part in improving critical thinking and providing tools for people to recognise intentional disinformation patterns.

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The Geoeconomic Aspects of the Emergence of Artificial Intelligence Technologies with Respect to Hungary

Bánkuty-Balogh Lilla Sarolta

The Geoeconomic Aspects of the Emergence of Artificial Intelligence Technologies with Respect to Hungary

Bánkuty-Balogh Lilla Sarolta[22]

Abstract

The hype-cycle surrounding new technologies is characterised by the public overestimating the disruptive nature of an innovation in the short-term, while underestimating it in the long run. The emergence of artificial intelligence is the advent of a general-purpose technology similar to the invention of the steam engine, electricity or the internet, that has the potential to reshape our current socio-economic systems. However, its impact will not necessarily be felt through its spectacular, human-surpassing capacities, but rather its many direct and indirect effects affecting our societies. The present study aims to give an overview of some of the global and local effects of the use of AI mainly from a geoeconomic perspective, and to assess risks and opportunities posed to Hungary specifically, with an emphasis on job market trends.

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[22] *Bánkuty-Balogh Lilla* Ph.D. student, Department of Economic Geography, Geoeconomics and Sustainable Development, Corvinus University of Budapest; master lecturer, MNB Institute, John von Neumann University. E-mail: lilla.balogh@stud.uni-corvinus.hu

Introduction

According to Schumpeter "…it is not the owner of stage coaches who builds railways" (Schumpeter, 1980: 112). The father of the theory of disruptive innovation thus described the phenomenon whereby new combinations and innovative solutions in economic activities are not usually created by the same people who dominated the old structures. Even centuries ago, business logic dictated that railroad companies were not created by the operators of horse-drawn stagecoach networks because it was not in their interest to liquidate their own profitable businesses (Bőgel, 2008). There have been many counterexamples since then, but perhaps the most well-known is the case of Apple Inc., where a company itself used the methodology of creative destruction against its own products. Nevertheless, the Schumpeterian finding carries the universal message that innovation per se is not clearly positive or negative but can have different effects on different economic actors. While an innovation in a technology or business model may open new opportunities for some, for others it may lead to a decline or eventual obsolescence, depending on the prevailing circumstances and the response to the innovation (Bőgel, 2008). This is precisely the kind of radical transformation that is taking place at the dawn of the widespread adoption of Artificial Intelligence (AI) solutions. As a *General-Purpose Technology (GPT)*, AI is radically transforming entire sectors of the economy and could reshape the structures that currently dominate the global economic system.

The study builds on the European Parliament's Science and Technology Panel's (EPRS, 2020:1) definition of artificial intelligence, which brings together relevant definitions from the literature. Accordingly, systems that show intelligent behaviour by analysing their own environment and acting with a certain degree of autonomy to achieve specific goals can be considered artificial intelligence. The framework (EPRS, 2020) distinguishes chronologically three AI waves, which also indicate the level of development of AI solutions. The term *symbolic artificial intelligence* or *expert systems*, which describes the first wave of AI, refers to old-fashioned AI solutions. In these, programmers define a set of rules, i.e. algorithms, that contain precise steps, which the computer follows and makes decisions based on predefined protocols in response to a given situation.

The second wave of AI solutions involves *data-driven approaches* (EPRS, 2020:3) that automate the machine learning process, reducing or completely replacing human intervention. Second-wave AI solutions also enable most of the applications

known today. They include web browsing, navigation and transport planning systems (Google Maps, Waze), transport services and car-sharing (Uber, Bolt, GreenGo), face recognition (Face ID), natural language processing (NLP algorithms, chatbots), some smart home solutions, online banking applications, digital personal assistants (Siri, Cortana, Google Assistant, Alexa) and social media message newsfeeds (Facebook, Instagram, Twitter, Reddit, TikTok). In *machine learning (ML)*, the algorithm improves itself using available data. Given input information, it generates useful output results over time. This is not a novel solution from a theoretical point of view. Over the last two decades, the availability and accessibility of high quality data has led to a large breakthrough in the field.

Second-wave artificial intelligence solutions are associated with neural networks inspired by the structure of the human brain, in which data is processed in parallel within layers of artificial neurons. This allows more complex tasks to be performed, in particular *deep learning*, which represents systems with at least two hidden layers of artificial neurons. Training neural networks is primarily performed via feeding them with high-quality, labelled data. This is called *supervised learning*, a well-known example of which is algorithmic image recognition. In practice, supervised learning is often combined with *unsupervised learning*. This is typical when a good quality database is not available. Common examples are algorithms used by online content providers and streaming platforms (Netflix, Amazon Prime, HBO Go, YouTube Premium) to generate personalised recommendations. Neural networks can be taught partly using traditional calculus methodology and partly using other methods, such as those modelling natural evolution.

The so-called third-wave artificial intelligence, unlike the first two, allows for not only limited applications, but is moving towards general intelligence. At the current state of technological development, this involves solutions that are still only speculative. Third-wave AI solutions include, among others, the symbiosis of robotics and AI, the use of quantum computing, digital mapping of the human mind, biologically-based AI, and ultimately technological singularity (EPRS, 2020:13). Although third wave applications currently seem futuristic and it is not certain that all these directions will prove useful or even materialise, the aforementioned phenomenon of technology sensation cycles warns that in the long term the subversive nature of AI may be underestimated.

The *relevance* of the study is given by the rapid development of artificial intelligence, as well as its diverse and expanding applications and fields. Based on the presented conceptual system, its *focus* is the geoeconomic[23] impacts of the existing and widespread second-wave artificial intelligence solutions, with particular emphasis to its aspects affecting economic development and income inequality. The *main research question* is whether the transformation of AI will lead to a more efficient and equitable distribution of wealth, or whether, on the contrary, it will extrapolate wealth and development disparities between and within countries, which are already stark today. By examining the distribution of the benefits from the use of AI and analysing the market dynamics that follow, the article seeks to answer the question of whether the AI transformation can help narrow or close the gap between developed and developing economies, or whether it will further widen the gap between technological centres and peripheries.

Another aspect to consider is how this affects Hungary. In the context of the impact of innovation on inequalities within countries, between social groups and geographical regions, the paper primarily analyses trends in the labour market. It examines whether the common belief that the labour-saving nature of AI solutions are mainly limited to lower-skilled jobs. It discusses the implications of these trends for Hungary in different sectors and fields of activity, in particular regarding the division of labour in the European centre-periphery structure and the development of long-term competitiveness.

The method used is predominantly a literature search, which involves the collection, processing, systematisation, and analysis of international and national literature on the subject. This is complemented by the analysis of publicly available statistical data. Bearing in mind the specific characteristics of the domestic economy, the study draws conclusions from these concerning Hungary.

In connection with the use of artificial intelligence, this study primarily discusses phenomena at the macroeconomic level and, moving from the global to the local, reviews and analyses the effects affecting Hungary, the impact of innovations on income distribution, the social utilisation of innovation rents, the national economic

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[23] [1]Geo-economics as a discipline is concerned with "...inter-state conflicts related to geographical factors, their management, and the role of economic instruments, the conditions and possible consequences of their applicability and application in the international strategy and foreign policy of states" (Simai, 2014). The term was popularised by Edward Luttwak (1990), who defined it in relation to geopolitics as a new form of competition between states in a globalised world, based primarily on economic power.

limitations of the redistribution of returns, the formation of oligopolistic market structures, the emergence of dynamics that strengthen the effects of globalisation and those that differ from it, with particular regard to labour market trends. Drawing on these phenomena, it seeks to approach the transformation of AI in a systemic way, using pertinent economic concepts. By taking a comprehensive approach to the interrelationship between global and domestic trends, it aims to contribute to the academic literature that address specific sub-themes covered in this study.

The structure of the study is as follows: After presenting the conceptual frameworks, it reviews relevant MI-specific economic concepts based on international literature of the past years, regarding the global distribution of benefits from the use of MI. Then it discusses some characteristics of digital technologies, grouping the message under the concepts of "winner takes all" economy and "superstar countries". The analysis of domestic implications of MI based on the perspective of moving from global to local is carried out, with special emphasis on the global and domestic context of the labour market. The article concludes with a summary and conclusions section. It presents pro and con arguments regarding the different levels of economic development associated with the use of artificial intelligence and income inequality and outlines potential development paths.

Conceptual framework

In recent years, the discussion of the impact of AI solutions on productivity, competitiveness, economic development, and labour market has received considerable attention in the international literature. Among the most influential literature, Agrawal et al. (2018) highlight the productivity-enhancing effects of drastically reducing forecasting costs. Brynjolfsson & McAfee (2014) addressed the paradigm of rising productivity and falling wages. Lee (2018) discussed the labour market implications of the US-China AI race. Kurzweil (2005) outlined theoretical perspectives on the use of AI. Acemoglu & Restrepo (2018a; 2018b), Arntz et al. (2017), and Autor & Salomons (2018) drew attention to the labour-saving nature of automation, while Autor et al. (2003), Autor & Dorn (2013) and Michaels et al. (2014) highlighted the phenomenon of labour market polarisation. In the context of the global impact of the shift to AI, the topic has been addressed from a broader geoeconomic perspective, with Korinek & Stiglitz (2017, 2019, 2021), Aghion et al. (2017) and Varian (2019) addressing the dynamics that increase

inequality between developed and developing countries and between different labour market groups.

In the domestic academic literature, Szalavetz (2016a, 2016b, 2019, 2020) examined the economic effects of artificial intelligence solutions in the context of Industry 4.0, productivity, and the digital transition. One of his conclusions was that the uptake of AI is slower than previously assumed by researchers, so that cost-saving applications of the technology are likely to face long delays. Another conclusion is that automation not only affects the activities of low-skilled workers, but also transforms the portfolio of activities of the highest paid jobs (Szalavetz, 2016b; Szalavetz & Somosi, 2019). Matolcsy (2020a, 2020b) has described a revolution in artificial intelligence that operates in the background compared to previous technological revolutions. Consequently, it is less perceived by users, but it has cross-sectoral effects and could play an important role in replacing a shrinking workforce. Boros & Kolozsi (2019) examined the geopolitical aspects of AI development as a technological race in relation to China and the US. Vértesy (2020) assessed the peripheral position of Hungary by quantifying the patents filed in the field of AI solutions. Gulyás (2020) pointed out that Europe is currently losing the war for data assets. The typically monopolistic or oligopolistic market structures of the platform economy make it almost impossible to replace incumbents, namely players already present on the market. Dietz (2020) examined competitiveness and labour market issues in the context of the role of AI in education. In this context, he highlighted the need to develop digital competences. Brávácz & Krebsz (2021) showed that the performance of Hungarian SMEs will be enhanced and made competitive through digital solutions.

The global distribution of goods from the use of artificial intelligence

In the case of Hungary, it is worth analysing the semi-peripheral economic position in light of the middle-income trap, because the ability to innovate and adapt to technology is closely related to economic catching-up. Although there is no uniformly accepted academic literature definition for defining the middle-income trap (Csath, 2019), a common observation is that for some low-income countries, after a period of rapid economic development - when the country has already reached a middle-income level - there may be a slowdown, making it difficult to catch up with higher-income countries (Csath, 2019). The example of countries that have successfully caught up, such as the Republic of Korea, Ireland, and Finland, shows that there is no single

successful recipe for leaving the middle-income bracket. The break-out process may be the result of different natural conditions, institutions, and political systems in different countries. Yet, in all cases, socio-economic stability and investment in human and physical capital play a central role. The capacity to innovate and adapt technology is of paramount importance for successful participation in global competition (Palotai & Virág, 2016: 27-58).

When comparing with Central and Eastern European competitors, Hungary's position is relatively favourable in terms of corporate research and development and innovation capabilities, but domestic companies, particularly SMEs, operate at lower value-added levels, so the overall economic performance still lags behind the EU average (Kolozsi, 2017). It is characteristic that advanced technologies are found primarily in sectors dominated by foreign capital, while productivity of domestic companies is at a lower level. This points to the preservation of a dual economic structural pattern (György, 2015; Győrffy, 2021).

In the context of income distribution, Korinek & Stiglitz (2019) have pointed out that, as a general trend, the income from the use of innovation, including the results of artificial intelligence, can result in quasi rents that benefit the winners of technological progress to a greater extent than their contribution would justify. In contrast, the losers of progress bear all the negative effects of change. The inequality-increasing effect of innovation has been attributed to two mechanisms: the additional incomes earned by innovators, and the totality of direct and indirect effects on other stakeholders. Since the markets for innovative solutions and technologies are not necessarily, or typically not perfectly competitive, the additional income earned by innovators usually exceeds the development costs of the given invention, which is called *innovator rents* (Korinek & Stiglitz, 2021). This, in and of itself, is not objectionable because the pursuit of innovation rents encourages economic actors to create new inventions. However, the healthy social utilisation of these rents is normally ensured by provisions regulating economic competition – tax and antitrust policies, intellectual property rights – the implementation of which is greatly difficult or even rendered impossible due to the cross-border nature of artificial intelligence solutions. Business models based on artificial intelligence solutions are further sharpening the redistributive issues that are familiar in the operation of large global companies. Companies such as Facebook and Amazon can separate the physical and legal boundaries of their operations quite easily because of their business models. They can

also do business and make profits in countries where they have no physical presence or location. They can move company intellectual property freely between geographic locations, taking advantage of differences in national tax systems. A good example in Europe is Ireland, where most overseas technology companies have regional headquarters. A further feature of AI-based digital services is that they enable parent companies to monetise their business across services or sectors, for example by linking the advertising space they sell to free email accounts or social media newsfeeds or optimising their recommendations through user profiling. In the transaction, the value-creating activity, i.e. the collection of information on social networks and the resulting revenue, are generated in different channels. The cross-sectoral use of the data collected distorts market conditions from a competition and antitrust perspective. The situation created by the coronavirus pandemic resulted in a unique situation in the social role of technology companies, with a significant portion of everyday activities shifting to online platforms. The extra profits realised by technology companies raise the question of whether these companies have taken enough responsibility for shouldering the social burden of mitigating the consequences of the pandemic, especially outside of their home country.

Like other innovations, of course, the return on capital created by innovative AI solutions are quasi rents, i.e., only available in the short or medium term. However, it can result in an outstanding return, which can cause a significant difference between the effects of artificial intelligence on a given country and its global effects. While at the global level, Pareto improvements could be achieved through the diffusion of a new technology, national governments currently benefit from only a fraction of this through their tax systems. Thus, the redistribution of the outstanding returns at the level of the national economy is not efficient. Extreme cases can be imagined where one country enjoys all the positive benefits of a particular technological achievement while another country bears all its costs or negative externalities (Korinek & Stiglitz, 2021). Well-known examples of such discrepancies include the effects of social media manipulation, misuse of personal data, any discrimination resulting from algorithmic bias, but more broadly include the subversive effects of market volatility caused by stock market trading algorithms and the practice of algorithmically supported investment decisions that ignore environmental and sustainability concerns.

In many respects, the effects of the spread of AI are similar to the feature of globalisation where the benefits, profits, capital gains and tax revenues associated with

a given economic activity, and its negative externalities such as environmental degradation or labour exploitation, occur in different geographical locations (Korinek & Stiglitz 2019). The negative effects on the labour market and the increase in inequality between and within countries are central to the critique of globalisation (Lund & Tyson, 2018). In the case of artificial intelligence, these trends can also be tracked, as in addition to the aforementioned differences between countries, the labour-saving nature of artificial intelligence can negatively affect certain groups of workers, typically those with lower education, while demand for and pricing of higher-skilled employment may relatively appreciate (Korinek & Stiglitz, 2019; Lund & Tyson, 2018). At the same time, the efficiency of global value chains optimised for low production costs is now quite difficult to increase. While there is still a process of exploiting increasingly low-cost production capacities, such as the relocation of manufacturing plants to Vietnam or Bangladesh from other Southeast Asian countries, this mostly only leads to changes in bilateral trade relations. While the previous phase of globalisation was dominated by the West, the diffusion of digital technologies is now slowly taking the lead with China and several other catching-up countries (Lund & Tyson, 2018). This is shifting the focus from low-cost production to the exploitation of new digital technologies, allowing more stakeholders to integrate into cross-border economic relations. In addition to large global corporations, so-called *micro-multinational companies* - typically technological and internet-based SMEs that have adopted a global strategy from the outset to access markets more effectively -, can now also engage in international trade through digital marketplaces such as Amazon and Alibaba. Traditional SMEs can also open up new domestic and foreign sales channels. This trend may affect a numerically larger segment of workers than the structural changes in the economy experienced in earlier stages of globalisation (Lund & Tyson, 2018).

In the 1990s, the regional differences that emerged as a result of globalisation were traditionally characterised by the sharp income gaps and contrasts in foreign capital flows between between, on the one hand, the triad of North American, European, and the Pacific economic regions, which accounted for almost 80 percent of global economic output, and, on the other, the sub-Saharan African and South Asian ones (Castells, 1996:106). In addition, there have been distinct developments within countries in different sub-regions, as exemplified by the economic divergence between China's coastal and inland regions, and even the divergence in developed economies

such as the United States, between its coastal and inland regions (O'Brien & Leichenko, 2000). So far, the winners of globalisation have been seen as multinational corporations and developed economies. However, the dynamics between countries, between sub-regions within countries and between social groups may change with the spread of artificial intelligence. The "winner-take-all" dynamic is leading to an increase in market concentration, while at the same time, and somewhat counter-intuitively, digital solutions are increasing global access for smaller players. The overall impact on the labour market is complex in terms of the division of labour between social groups and regions, going beyond the traditional specialisation based on competitiveness. While the drivers of development are still advanced economies, semi-peripheral and developing regions like Hungary may have the opportunity to catch up with the centre, or otherwise risk falling behind irreversibly.

Digital technologies and the "winner-takes-all" economy

Korinek & Stiglitz (2021), as well as Brynjolfsson & McAfee (2014) refer to the phenomenon of "superstar effects" or "winner-takes-all markets" that arise around market players that are leading in the use of artificial intelligence. The naming of this phenomenon refers to Rosen's (1981) Economics of Superstars and Frank & Cook's (1995) description of the winner-take-all social functioning that emerges from the combined effects of globalisation and technological development. These theories argue that the modern world is increasingly dominated by the phenomenon of superstars, whereby a small group of market players exert a dominant influence on almost the entire market for their activities, generating huge profits. Rosen (1981) cites the markets of full-time comedians, classical music performers, elite sportsmen and artists as examples. In each case, a small number of highly talented individuals can serve the entire market, i.e. the overall social demand for, for example, humour and entertainment. The explanation for this phenomenon, however, is not to be found in outstanding individual talent, but rather in the opportunities offered by new technologies that make the collective consumption of goods possible. At the time of Rosen's (1981) observation, such a role was played by television programmes, radio broadcast, or the printed press, but today, for virtually any digital content, it is possible to serve an almost unlimited number of consumers simultaneously at almost zero marginal cost. In a market situation where there is no perfect substitute, technological solutions allow for shared consumption. At the same time, the legal framework allows

operators to reap the benefits (e.g. through access, subscriptions, patents and licences). Thus, a very large market can be covered by a very small group of providers. The more efficient (more talented) the providers are, the smaller this group will be. The superstar effect is very strong using ICT and AI, as AI solutions can be used to perfect mass customisation. Algorithmic solutions and machine learning can be used to maximise customisation at negligible marginal cost. Technology not only enables the almost complete servicing of certain markets, but can also create cross-border or global oligopolies and natural monopolies (Korinek & Sitglitz, 2021). Examples of this are the technology giants (FAANG: Facebook, Amazon, Apple, Netflix, and Alphabet), which serve consumers globally and have a dominant influence on the markets of social media, content provision, e-commerce, business and consumer software and other related services.

Artificial intelligence as a product is an information good, that is, its value comes from the source of information (Korinek & Sitglitz, 2021). In economic terms, this means that, to use Romer's (1986) terminology, AI is a non-rivalrous good, i.e. it can be consumed by several people at the same time without eroding it, and its marginal cost of use is practically zero. Therefore, players offering AI solutions that are already present in the market enjoy a significant positional advantage over new entrants.

The development of AI solutions typically involves high initial fixed costs. Due to the particularities of data management, however, network effects appear during their use, which also favour incumbents, i.e. players already present in the market.

The food of AI algorithms is the input data, which must be in a structured, cleaned, and possibly labelled form, as inaccurate, incomplete or inherently biased databases can lead to faulty algorithmic solutions (Dietz, 2020). Therefore, having a larger quantity and higher quality of available data typically results in the creation of more effective AI algorithms, providing an advantage for companies that have entered the market earlier, with a larger user base and, as a result, well-maintained data assets.

These factors - the nature of AI as an information good, its near-zero production marginal cost, the high initial fixed costs, and the network effects – all contribute to the rise of market entry barriers. This favours the emergence of oligopolistic or monopolistic market structures and their longer-term persistence (Korinek & Sitglitz, 2021). Brynjolfsson & McAfee (2014) describe the same dynamics in winner-take-all markets, where the producers of the products that best resonate with consumer needs gain the bulk of market share, while the other players - even the second-best supplier -

can no longer gain any meaningful share, even if they could be very competitive by objective criteria. This is particularly the case with digital products, where ubiquitous operators can distribute their services globally at minimal marginal cost.

Superstar countries

The tendencies that favour the creation of natural monopolies could lead to the emergence of not only superstar companies using AI, but also superstar countries where AI developments are geographically concentrated. It is enough to refer to the race between China and the USA in the field of artificial intelligence. While basic research has traditionally been characterised by strong public involvement and sharing of research results within the scientific community, AI solutions, apart from open-source technologies, typically involve private companies seeking to maximise the innovator rents through trade secret clauses, patents, and licensing. China is following a slightly different path in this respect, as, unlike the prevailing view in the West, Chinese state-owned enterprises and research institutes are taking the lion's share of AI development. However, the results achieved are not targeted at a wider scientific audience but typically remain within the country's borders.

Monopolising knowledge can widen the gap between developed and developing or middle-income countries and hinder economic catching-up. Vértesy (2020), looking at nearly 150,000 patent families related to AI and robotisation and the companies that registered them, pointed out that Hungary is on the periphery of the AI geography, as domestic companies currently lack the technical capabilities to be at the global forefront of AI development, even in narrow market segments. Patent trends and venture capital investment over the past two decades show that Japan and the US, and more recently China, have emerged as the leaders in AI solutions, while the European Union[24] remains at a significant disadvantage (Vértesy 2020). Moreover, the number of EU patents has grown more slowly than the global average. In addition to the different rates of development in AI in the dominant economic areas, there are also significant differences between countries within the EU. In the period studied by the author, between 2000 and 2016, nearly two thirds of AI patents were filed in Germany, France, and the UK, while the Central and Eastern European countries accounted for only about 5 percent of total EU patent applications. Of this, Hungary only received

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[24] Although Vértesy (2020) refers to Europe in her article and does not specify the exact definition of the region, the original study reviewed by the author (Van Roy et al., 2020) examines the European Union.

half a percent. While the number of patents filed does not in itself give a complete picture of the uptake of AI, if a country becomes an importer of AI in the absence of its own technological solutions, the consequences are likely to be felt both in terms of the level of costs to the economy and in the forced export of personal and public data (Vértesy 2020). As the Hungarian government's Digital Agenda for Prosperity (DJP, 2021) puts it, "...digitisation is as much a sovereignty issue as a competitiveness issue", that is the management of digital data assets has not only an economic, but also an important strategic and security dimension.

When examining the import of services using artificial intelligence solutions, it is worth looking at the list of the most popular smartphone applications. Globally, the number of app downloads has increased to 115 billion in 2019. Four of the top five spots belonged to the California-based Facebook group. Together, Facebook, Messenger, WhatsApp, and Instagram have been downloaded 16 billion times worldwide, while Chinese-based TikTok, which debuted in 2017, reached 700 million downloads (Növekedés.hu, 2020). According to a study specifically looking at Hungarian users, the most popular apps among Hungarian users showed a similar pattern: Facebook, Messenger and Instagram were the most popular apps, while TikTok gained a larger user base especially in small cities (Pénzcentrum, 2020). The increasing concentration of the global market for AI and robotisation is also indicated by the trend that the number of patents in the US and China has grown faster than the number of patentees over the last decade (Vértesy, 2020). New developments have thus increasingly been concentrated in companies with established businesses, rather than being registered by new entrants. Restricted access to innovative technologies and the concentration of market-leading algorithms in the hands of global companies could lead to an irreversible lag for those market participants and, more broadly, countries that do not enter the race at an early stage of AI development.

Hungarian chances in the AI competition

The question arises as to how a small economy open to the world economy, like the Hungarian one, potentially struggling with the middle-income trap, can effectively compete with global corporations and keep up with the AI superpowers behind them in terms of technological development. A frequently cited positive example is Estonia, with a population of just 1.3 million, where an intensive and centrally led digital transition has enabled an economy traditionally based on timber, to become known for

technological start-ups, such as Skype, TransferWise or Bolt, and Tallinn to become a popular destination for digital nomads (Lund & Tyson, 2018). Estonia underwent significant deindustrialisation after the change of regime. Low productivity was addressed through improvements in the service sector, with a particular focus on ICT. For example, under the Tiger Leap (Tiigrihüpe) programme launched in 1996, almost all schools were connected to the Internet. IT labs were set up to integrate digital literacy into the curriculum at an early stage, in parallel with the development of entrepreneurial skills. Central to the digital transition has been the e-Estonia programme, which allows citizens to vote, pay taxes and even attend court hearings online, using only digital identification (Lund & Tyson, 2018). In terms of GDP per capita at purchasing power parity (PPP) relative to the EU average, Estonia and Hungary started from almost the same level at the beginning of the 2010s, but the gap is now more than 10 percentage points in favour of the Baltic country (Győrffy, 2021). Institutional reforms, including the e-Estonia programme, have been crucial in this respect, helping to reduce transaction costs and thereby increase the efficiency of the economy. According to some estimates, in ten years, the newly implemented IT systems have saved thousands of years of transaction time for various economic actors (Lund & Tyson, 2018). Today, nearly five percent of Estonian employment is in high-tech services, putting the country among the EU leaders in the field, along with Ireland, Finland, and Sweden (Lund & Tyson, 2018). The Estonian example illustrates the central role of the education system and, more broadly, the health care system in supporting human resources in developing a flexible and adaptable workforce that can harness artificial intelligence. Their efficient and modern functioning is essential to achieving the desired productivity growth rate and to improve competitiveness on the long term (Palotai & Virág, 2016: 27-58).

Figure 1: Hungary's digital development compared to the EU average and Estonia, based on the 2021 DESI Index
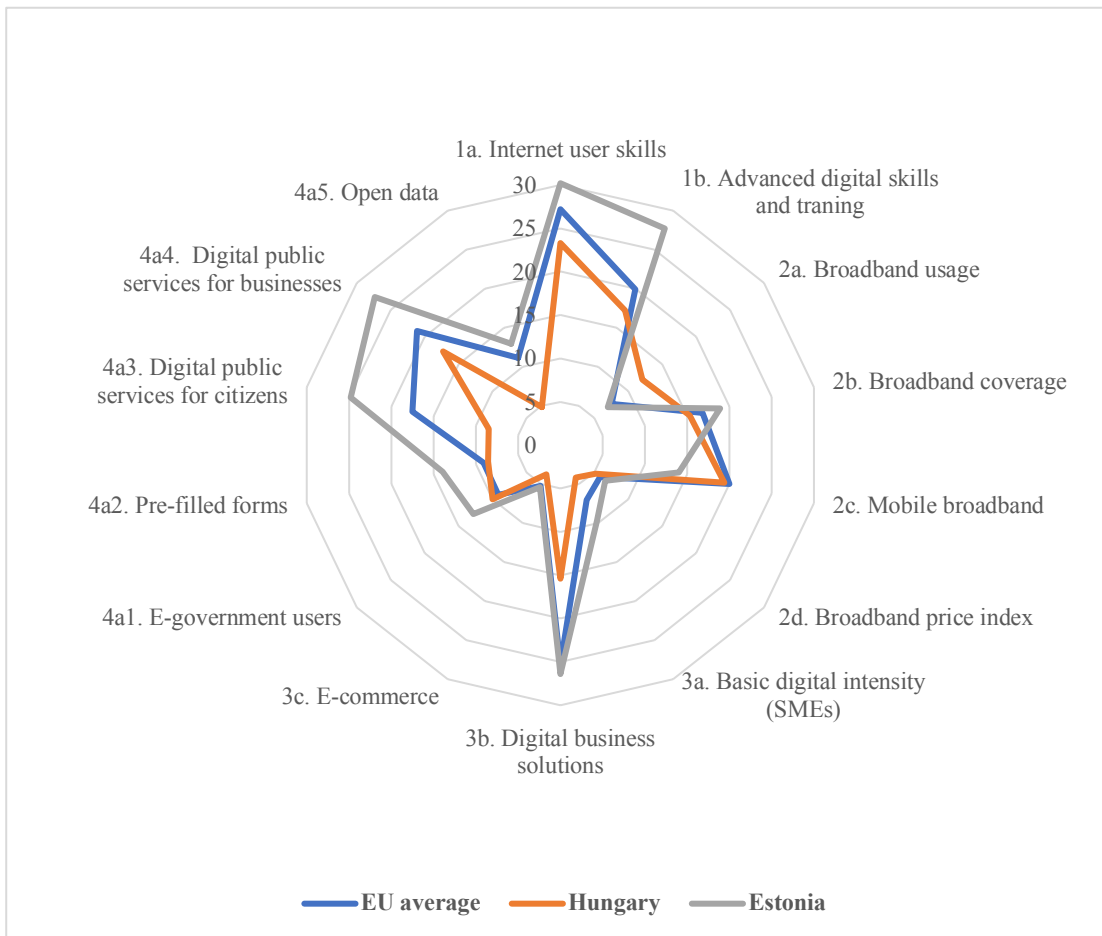
The Digital Economy and Society Index (DESI, 2021), published annually by the European Commission, measures the level of digital development in EU countries based on a weighted average of four dimensions - human capital, internet access, digital technology integration and digital public services. Hungary is ranked in the bottom third of countries in the aggregate, but its level of development in each dimension varies significantly. *Figure 1* illustrates Hungary's digital development compared to the EU average and Estonia, based on the indicators that make up each DESI component.

While Hungary is close to the EU average in internet access and digital infrastructure, and well above average in broadband usage, there is a significant lag in digital skills of citizens, digital public services and most importantly in the digitisation of the business sector. It is also worth looking at the example of Estonia, where the

measured figures reflect the exceptionally high achievements in digital competences and digital public services. Advanced digital skills and further training are in the same category, indicating the importance of lifelong learning in digital development, where Hungary is also lagging. A key indicator for the AI transition is the availability of good quality open access data, which is even lower in Hungary than the EU average. The importance of the latter two indicators, digital skills, and access to data, may be crucial for the future AI intensity of the economy, as it can provide the basic commodity and expertise for developing own AI solutions.

In the field of AI, perhaps the most effective antidote to being pressed to the innovation periphery is the development of a broadly understood digital infrastructure and the simultaneous provision of the expertise necessary for the utilisation of new technologies. This, if not necessarily leading to AI developments per se, paves the way for joining the global AI circulation. A necessary (but not sufficient) condition for a country to be at the forefront of the development of AI solutions is the availability of the technological and professional background and high-quality digital data assets that will allow the development of its own AI solutions in the medium to long term. In Hungary, there are some good examples of digitisation of public administration and public services, such as the digital registry and online administration system of the National Tax and Customs Administration, the public administration infrastructure of the Client Portal and the Electronic Health Service Space. The future value of the data assets generated by these systems may not yet be fully appreciated, as big data analytics can help to identify connections, trends and resulting solutions in public services and healthcare that are currently unknown. It may also be possible to use appropriately anonymised data for commercial purposes, subject of course to ethical guidelines.

An important initiative is the Artificial Intelligence Coalition, which brings together nearly 400 business, research, academic and social organisations and more than 900 experts in the domestic AI, automation and robotisation ecosystem (AI Coalition, 2022). The Artificial Intelligence Coalition has set a common goal of digitally transforming society and businesses and shifting the production of higher value-added products and services (Trautmann & Vertetics, 2020). The Artificial Intelligence Coalition also launched the AI Challenge, which aims to ensure that at least one percent of Hungarian society acquires basic knowledge about artificial intelligence through a free online course. In total, they aim to reach at least one million

citizens through educational materials and events on the topic, thus promoting the importance of digital literacy (Artificial Intelligence Coalition, 2022).

The impact of artificial intelligence on the labour market

The impact of new technologies on the labour market has been at the centre of economic thinking from the beginning of the field. According to some economic historians, the debate around the first industrial revolution and mechanisation has been central to the development of economics as a discipline (Card & DiNardo, 2002). Today, the emergence of new technologies and their labour market implications are analysed mainly in terms of the emergence of income inequalities. For years, the so-called skill-biased technological change (SBTC) theory[25] has been widely accepted, according to which technological progress leads to a steady increase in the demand for workers with higher education (Bördős & Major, 2017). However, despite its popularity, the SBTC theory has proved insufficient to support some empirical observations, such as the stabilisation of income gaps with gradual technological progress, or the differences in average wages between genders, ethnic groups, and age cohorts (Card & DiNardo, 2002). Based on this traditional view, it is argued that it is mainly medium- and low-wage, routine, typically manual jobs that are threatened by computer automation and robotisation, while high-skilled workers who solve complex problems requiring human judgement, analytical thinking and soft skills are not. The spread of artificial intelligence solutions now seems to be changing this paradigm (Acemoglu & Restrepo, 2018a).

The ALM-hypothesis developed by Autor et al. (2003) and the so-called job polarisation theory specifically examine the effects of the diffusion of computer-based solutions on the labour market, and conclude that contrary to the SBTC hypothesis, which suggests that demand for high-skilled jobs will increase to the disadvantage of unskilled labour, the technological effect instead will influence jobs in a more complex way, mainly based on their routine or nonroutine nature. The phenomenon of labour market polarisation predicts that demand for both non-routine manual jobs (e.g. cleaning, maintenance) and non-routine cognitive jobs (e.g. senior management), typically at the two ends of the wage scale, will increase, while employment in average jobs requiring largely routine manual and cognitive tasks, i.e. jobs that can be protocolised and automated, will decrease. These factors will lead to a polarisation of

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[25] For a detailed discussion of the SBTC theory, see Katz & Autor, 1999.

labour market demand, concentrated on both sides of the wage scale. Michaels et al. (2014) found empirical evidence of the polarising impact of ICTs on the labour market, based on more than two decades of data from the US, Japan and nine European countries. In sectors at the forefront of ICT development, demand has shifted towards highly skilled workers at the expense of medium-skilled workers. Overall, a quarter of the increase in demand for higher skilled workers can be directly attributed to technological progress.

Levy & Murnane (2013), examining changes in the US labour market between 1960 and 2009, identify five types of job functions, two of which have increased in importance and three of which have clearly decreased in importance over the period. The first two dynamic areas were, on the one hand, the handling of unstructured problems, i.e. working on tasks to which no regular solutions can be assigned (e.g. complex medical diagnostics or car assembly), and, on the other hand, the processing of novel information (e.g. management tasks, complex engineering decisions, motivation and teaching methodologies). By contrast, routine cognitive tasks (e.g. administrative and back office functions), routine manual tasks (e.g. repetitive physical tasks on production lines) and non-routine manual tasks (e.g. truck driving, cleaning) have also lost importance. However, non-routine manual tasks are much less threatened by automation. Their replacement would require the combined use of complex optical recognition and fine motor skills, which is difficult or costly to achieve at the present level of technological development.

Figure 2: Changing of job functions in the USA between 1960 and 2009
(Index value 1960=50)
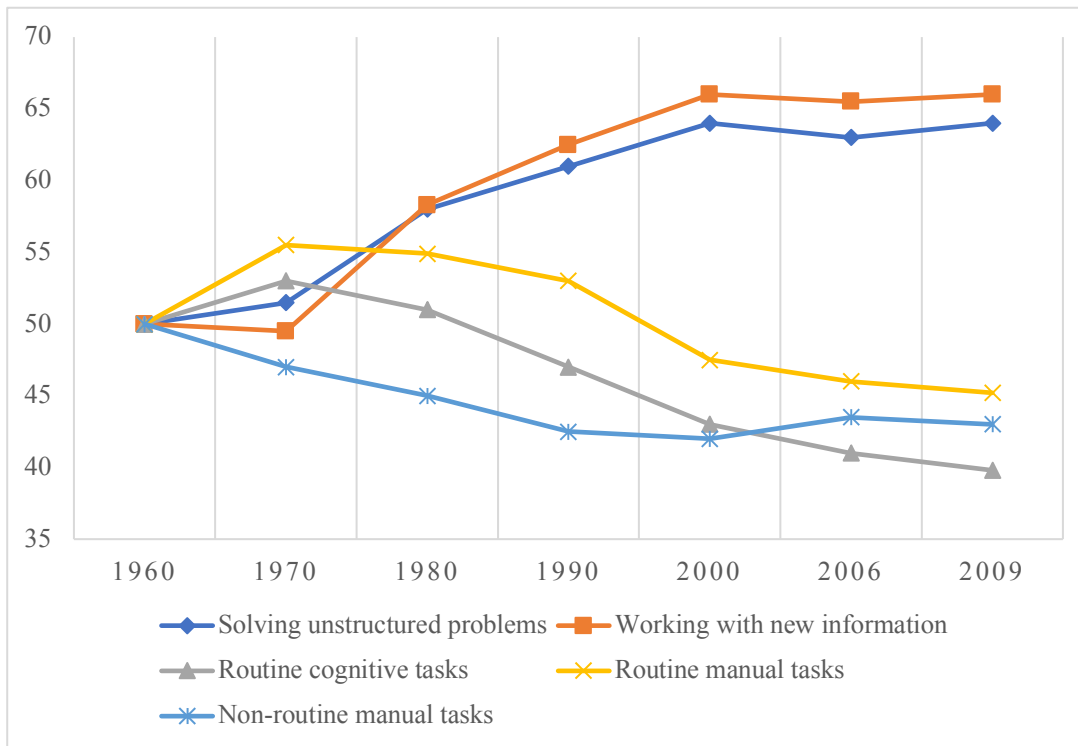
Source: Own editing based on Levy & Murnane (2013).

Since industry in Hungary has a greater role in the production of the national gross product than the EU average, the next wave of automation can be expected to have a greater impact (Dietz, 2020). As can be seen from the above, artificial intelligence can also replace some of the intellectual labour, therefore the resulting impacts may be more diversified than simply changing the labour demand for industrial production. The combination of artificial intelligence, big data and robotics is also threatening, in whole or in part, jobs (such as credit appraisal, business consulting, financial planning, legal assisting, and some medical specialties from radiology to surgery) that would have been previously unthinkable (Acemoglu & Restrepo, 2018a). Machine learning, in particular deep learning powered by neural networks, enables machines to reach or exceed human cognitive capacity in areas such as speech recognition, natural language processing and analytics-based prediction. Almost all jobs contain tasks that can be automated, but few jobs are fully automatable (Brynjolfsson et al., 2018). It is therefore useful to understand each job in the context

of a set of different subtasks with different automation potential. A general-purpose technological innovation such as the introduction of artificial intelligence may change the composition or relative proportion of services offered in a given package (Autor et al., 2003; Korinek & Stiglitz, 2019). This would mean, in practical terms, that a given job function does not disappear, but would be transformed in such a way that it can be combined with digital solutions to provide the highest efficiency.

Labour market prospects in Hungary

As the potential of AI to disrupt the labour market is expected to have uneven effects across jobs and sectors, the reorganisation of economic activities will play a central role in maintaining competitiveness (Brynjolfsson et al., 2018). Over the past decades, foreign companies have typically relocated assembly to Hungary, while higher value-added activities have remained in the home country (MNB, 2020). As a result, there is a higher share of routine manual tasks that are easier to automate than complex cognitive tasks. The rise of robotisation, AI solutions and digitisation associated with Industry 4.0 reduces the competitiveness of manufacturing based on low-cost labour (Szalavetz & Somosi, 2019). An often-cited example in the context of automation is the road vehicle industry, which doubled its direct employment in ten years to nearly 100,000 people by the second half of the 2010s (Túry, 2020). The automotive industry is also characterised by a hierarchical structure in Europe, with a geographic centre-periphery relationship between the German-French core area and the assembly centres of Southern and Central and Eastern Europe, both in terms of the models produced and the added value of the company functions. This peripheral exposure may be mitigated by strategic partnerships with Chinese automotive suppliers, mainly for the domestic production and investment in components for electric cars. Collaborations with Chinese companies are also relevant for AI solutions, as they may provide opportunities for knowledge transfer in the future.

More important than the increasing automation potential of traditional car assembly in the automotive transition may be the ability to adapt to the overall technological changes affecting the industry. While Western Europe's share of the global automotive industry is already declining, mobility is currently shifting away from conventional technologies towards battery electric cars. The related IT services, such as self-driving, connectivity and car sharing, form an increasingly large proportion of the sales value of a vehicle (Szalavetz & Somosi, 2019). The outsourcing of

innovative solutions with high added value can provide an opportunity for local companies to engage in technological change. A good example is the self-driving vehicle cluster and test track in Zala, established in 2018, which provides a common platform for business development and supplier companies to share the development and physical testing of innovations (Szalavetz & Somosi, 2019).

A separate group of service sector automation are Shared/Business Service Centres (SSCs/BSCs), which provide back-office services to large international corporations and employ nearly one tenth of the graduate workforce in Budapest (HIPA, 2019). Although business service centres are characterised by high value-added intellectual work, the standardised and protocoled nature of back-office services means that they could be significantly impacted by the automation of routine cognitive tasks in the future. A wave of automation in business service centres would have a wide-ranging impact on the capital's ability to attract graduate labour, but also on the office market.

Small and medium-sized enterprises account for almost two-thirds of employment at national level, including almost 95 percent of micro-enterprises with fewer than 10 employees (KSH, 2018). In this segment of the business sector, the changes resulting from the spread of artificial intelligence are not so much related to the automation of jobs, but rather to the profit-generating capacity of new technology. The low productivity of the SME sector is a long-standing problem, which has resulted in domestic value added per worker lagging behind both large companies and Western competitors (MNB, 2020). In the period 2017-2019, nearly two-thirds of economic growth was driven by improvements in labour productivity, with the SME sector playing a key role (Szoboszlai, 2020). Nevertheless, joining international value chains is likely to become more and more difficult for businesses that do not take advantage of the opportunities provided by new technological innovations. At the same time, this makes it possible to catch up with the international leading edge or threatens a permanent separation.

A specific area of the artificial intelligence's impact on the labour market is the broadly defined public sector. While automation in manufacturing is well known, public involvement in education, health, law enforcement and other public services is a priority, and therefore, with well-targeted government programmes (see the previously analysed example of Estonia) the public sector can be a catalyst for the AI transition in the economy. Public sector involvement is also of particular importance

from another perspective: it can compensate for the reduction in wages caused by automation across sectors through wage levels (Korinek & Stiglitz, 2019). In a historical perspective, automation-enhancing technologies have generally led to productivity gains, but they have also changed labour market conditions and drastically changed overall wage levels (Brynjolfsson et al., 2018). As innovations affect the demand for factors of production: capital and labour, their market pricing may change. This may further exacerbate inequalities between economic agents that benefit from labour wages and other types of income and may shift the redistribution of wealth from the employed to the owners of capital. The extent and effectiveness of state compensation implemented in order to ensure the general balance of the labour market can therefore be crucial (Korinek & Stiglitz, 2019). Another important feature of the digital economy is that productivity may become increasingly decoupled from labour, which in developed countries will exacerbate the impoverishment of a weakening middle class and a widening precariat. This trend may also have a significant impact on political systems based on traditional representative democracy in the medium to long term (Brynjolfsson & McAfee, 2014), illustrating the broad spectrum of social consequences of the AI transition.

Summary, conclusions

The study examined the question of whether the transformation of AI will lead to a more efficient distribution of wealth, or whether it will further widen existing wealth and development gaps between regions, countries, and social groups. It also analysed what factors play a role in this and how it all affects Hungary. The review of the literature shows that there is no economic law, and consequently no consensus, that technical, and technological progress for general growth would have an equally beneficial effect for everyone. The use and diffusion of artificial intelligence and, more broadly, automation can lead to Pareto improvements at the global level. However, this is likely to have different impacts on economic centres and peripheries, on multinational companies and national economies, and on specific groups of workers. While exploiting the potential of new technologies, the effects of AI as an innovation are not in themselves clearly positive or negative. AI has different implications for different economic actors and different countries, and it creates new opportunities to compete globally, but it may also put regions relying heavily on AI imports, in a difficult position or even drive them towards relegation.

Some of the specificities of the operating logic of artificial intelligence allow for the emergence and persistence of "winner-take-all" market dynamics that benefit larger players. The non-rivalrous nature of information goods, the near-zero marginal costs, the high initial fixed costs of AI development and the network effects arising from data ownership and management all contribute to raising barriers to market entry. It allows for the emergence of oligopoly and monopoly market structures on a global scale and the emergence of superstar companies and AI-exporting countries. However, there are also diverging trends that facilitate the entry of small players. These include online content sharing, global virtual marketplaces, new distribution channels, and the opportunities offered by productivity-enhancing AI solutions. In terms of their ability to influence economic performance, the latter are much less important than the forces driving market concentration. At the same time, the scope for social redistribution and rebalancing, traditionally at the level of the national economy, is shrinking. Technology superstar firms can easily separate the physical and legal frameworks in which they operate, so they can take advantage of the differences between tax systems and monetise their business activities across services or sectors. This also fuels the rise of inequalities.

In the light of these factors, Hungary faces a difficult competitive environment due to its size, economic weight, semi-peripheral location, and medium level of development. The study referred to Estonia as a small country with similar characteristics to Hungary, which has been able to successfully transform its economic structure to be able to join the next wave of technological change. In the case of market dynamics favouring incumbents resulting from the use of artificial intelligence solutions, entering the competition as early as possible can be of critical importance. The Estonian example also shows that the ability to profit from AI solutions requires as a minimum condition the development of digital infrastructure and a labour force that can adapt quickly. While Hungary is above the EU average in terms of digital infrastructure, there is a significant gap in the digital competences of citizens, digital public services and, most importantly, in the digitalisation of the business sector and SMEs. There is therefore untapped potential in integrating digital competences more prominently into education curricula and lifelong learning. This would, among other things, enable the acquisition of user skills for AI solutions that increase the efficiency of business processes. It is also of particular importance to exploit the high-quality digital data assets generated in certain public administrations, which can serve as input

for domestically developed AI solutions. Hungary is lagging behind the EU average in the availability of open access data, so significant progress could be made in this area.

A specific area of the impact of AI-driven technological innovations on economic development and inequalities is the labour market and automation. According to the ALM hypothesis and labour market polarisation discussed in this study, the automation potential of certain jobs depends crucially on their routine and protocolable nature and contrary to popular belief, will not necessarily affect low-skilled jobs to the greatest extent and in the largest proportion. From an AI point of view, each job can also be seen as a package of subtasks with different automation potential. Consequently, there are few jobs that can be fully automated, but many that are likely to need to be transformed to provide the greatest efficiency when combined with digital solutions.

In Hungary, because of the European centre-periphery division of labour, there is a higher proportion of routine tasks that are easier to automate than complex cognitive tasks. This is a risk from both a competitiveness and an employment perspective. At the same time, the growing trend towards outsourcing of high value-added, innovative technological solutions may create opportunities for Hungarian firms to become more integrated into value chains. Building complementary capabilities through the use of algorithms can enable Hungary to be a proactive participant in the AI transition, rather than a passive actor, which also leads back to increasing digital competences.

Due to the nature of the study, the research is limited by its reliance on secondary data and academic and professional literature sources. A targeted primary data collection and evaluation on the topics discussed would lead to a more accurate analysis. As the study also deals with phenomena that are unfolding or pointing at the future, the findings can be interpreted primarily as the modelling of expected outcomes. Beyond the geoeconomic and inequality questions of AI diffusion, a further research direction identified by the study could be the role of AI solutions in environmental sustainability and national strategy, which will determine the character and pace of AI transformation.

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