



## Article

# Zombification and Industry 4.0—Directional Financialisation against Doomed Industrial Revolution

Olivér Kovács

Department of Economics and International Economics, Faculty of Public Governance and International Studies, University of Public Service, 1 Ludovika sq, H-1083 Budapest, Hungary; kovacs.oliver.Istvan@uni-nke.hu

**Abstract:** This contribution addresses the puzzle of whether Industry 4.0 is able to autochthonously bring back the real economy (non-financial corporate sector) into the consciousness of the financial sector. It is all the more important since the conventional wisdom over financialisation says that it cannot be reversed without re-establishing the command of the social and collective over the private and individual for the modern era. Our paper argues that a healthy diffusion of Industry 4.0 is doomed unless some directionality is set within the financialisation process. To this end, by building on the relevant lessons of complexity science, it investigates the complex nexus among financialisation, zombification and Industry 4.0 development, an aspect which is not even sporadically examined in the literature. After presenting a short stock take on excessive financialisation, the paper deciphers the main systemic channels of zombification affecting negatively the outlooks of Industry 4.0. Some important policy recommendations are drawn as well.

**Keywords:** disharmony; complexity; Industry 4.0; zombification; financialisation; real economy



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## 1. Introduction

One of the most intriguing paradoxes of today is the fact that despite all the perceptible and well-documented local and global challenges developed countries are facing<sup>1</sup>, it is like there is no bad news at all for the financial universe (e.g., since 2019, S&P 500 has registered an unstoppable upswing whose index could book a 71 per cent win rate after weekly losses of 2%), and still, economic growth is not high, inclusive or green.

It is all the more surprising since what has become crystal clear for us today is that the financial sector and stock markets in particular face radical uncertainty given by the cascade of unforeseeable events generating nonlinear changes in expectations and narratives about future returns in the socio-economic innovation ecosystem. And such unpredictable events are in blossom right now, such as the pandemic, unprecedented stimulus programme in the US, supply chain disruptions, the sneaking need for remote life (working, commerce, etc.) driven by the digital revolution and Industry 4.0 developments, oil wars, creeping inflation presumably triggering some tapering, etc. All these events are happening in the context of the backlash against globalisation which has been developing endogenously due to its dispiriting distributional consequences<sup>2</sup>, against the democratic and liberal order. Electoral turnout rate has been secularly declining by reaching approximately 70% in the developed world, including the European core countries, from the heights of 80–95% in the 1950s–1970s.<sup>3</sup> In short, it seems that the financial universe has, by and large, remained intact and has become the “*ruhenden Pol*”.<sup>4</sup>

Notwithstanding the above, the financial sector is doing well and is capable of unprecedented performance; thus, in principle, the financial universe should be an efficient servant of the real economy in supporting, for instance, the fast diffusion of Industry 4.0, that is, the next production revolution. Still, most of the heightened ideas about the impressive transformative power of Industry 4.0 have been so far mirroring some sort of dreamlike naivety.

Thus, something beyond peradventure deeper is amiss since the dynamism of the socio-economic innovation ecosystem has been hampered, i.e., the healthy market entry and exit of companies and thus Industry 4.0 developments that are productivity- and inclusive-growth-congruent are inhibited. In other words, either the self-movement of the financial sector is such that it deliberately forgets the service of the real economy, or something diverts it from that purpose. *State-of-the-art* literature on Industry 4.0 mainly focuses on its impacts on various domains either in the real economy (e.g., servitisation, see: [Frank et al. 2019](#); energy efficiency, see: [Nota et al. 2020](#); Education 4.0, see [Sharma 2019](#), etc.) or in the financial sector itself ([Machkour and Abriane 2020](#), etc.) without considering the link between these two worlds and its influencing power on how I4.0 enhances. This paper addresses the issue of whether Industry 4.0 is able to autochthonously bring back the real economy (non-financial corporate sector) into the consciousness of the financial universe. It asks whether there is an intimate link between *zombifying financialisation* and Industry 4.0 development. To this end, it incorporates the phenomenon of zombification accompanied by financialisation with the aim of pinpointing the crucial need for making the financial universe directional in the interest of the healthy diffusion and development of Industry 4.0.

The implicit, still humble goal of the present paper is to contribute to the start of pioneering work in identifying and opening up a new field of research with respect to the systemic consequences of a disharmony between the financial sector and the real economy in the context of the unfolding Industry 4.0. It is an effort to better understand many particular phenomena the literature tried to address so far but only without deciphering the complex context.

## 2. Materials and Methods

We form a verbal model by relying on quantitative as well as qualitative data and information from a wide array of domains (e.g., data from OECD, the World Bank, Eurostat, etc.). As for methods, we shed light on the complex nexus between Industry 4.0 and the disharmony between the financial universe and the real economy interspersed with zombification, considered as an analytical conceptual framework. The paper defines zombie firms as companies aged  $\geq 10$  years supported by the state or the financial sector (including the banking sector) to stay alive despite their inability to realise enough earnings before tax to cover their interest expenses (i.e., interest coverage ratio  $< 1$  over three consecutive years). The paper aims at touching upon the complex context by not focusing only on one or two particular factors with an econometric arsenal but by digging deeper by building on all the publicly available and still reliable data sources and empirical backing. In this way, it becomes clear that the intimate link between zombifying financialisation and Industry 4.0 development is not merely a superficial conjecture but a well-founded reality.<sup>5</sup>

## 3. Industry 4.0

### 3.1. *Sweet Dreams?*

Since the midst of the 2010s, with the appearance of Industry 4.0 (henceforth, I4.0), mankind has been experiencing a new era of industrial development.<sup>6</sup> The *raison d'être* of I4.0 is the creation of self-optimising *cyber-physical systems* by building upon various technologies, such as the wide application of Information and Communication Technologies (ICTs), sensors, robotics, additive production, Internet-based uninterruptible communication and interaction, simulation and virtual modelling, cloud-based services, augmented reality, data mining and artificial intelligence, as well as machine learning. The prevailing literature attributes at least two features to the nature of Industry 4.0. First, it generates and satisfies old as well as new needs via various positive effects (e.g., by leading to energy- and resource-efficient operation, shorter innovation cycle even for more complex products, generation of large amounts of valuable data for production management, customization in all sectors); second, and related to these impacts, it will lead to a spectacular productivity boom while offering a fertile ground for greening the economy out via efficiency increases—

which is of particular importance in a time of climate breakdown.<sup>7</sup> It is therefore widely expected that Industry 4.0 will enhance the circular character of the economy as well as a means of mitigating climate change. The broad concept of the circular economy includes increasing the capacity of the corporate sector to design, reuse, improve, remanufacture or recycle products as efficiently as possible in order to promote sustainable development. Industry 4.0 can propel such economic paradigm as well.

Observers tend to expect the spread of I4.0 and digitalisation in general to be spectacular and fast. This belief omits incorporation of two major intertwined and interrelated trade-offs and uncertainties that are looming around Industry 4.0 manifesting as a great deal of inertness within the socio-economic innovation eco-system questioning the magnificent productivity-boosting character of such process. In addition, evaluating the usage of I4.0, especially in the case of SMEs as a hotbed for wide application, does also convey that it was naive to hope for a spectacular diffusion. Let us briefly recall our previous views (Kovács 2019) on processes bringing a plenitude of inertness into the development and diffusion of Industry 4.0.

First, there is a *trade-off between fast diffusion and stable social trust* simply because Industry 4.0 improvements are hurting the trust infrastructure (i.e., re- and upskilling, necessitated by automation and robotisation coming with Industry 4.0, in an effort to be successfully absorbed elsewhere in a sustained way seems to be much harder than ever before in history) by leading to disappointment of many, a significant loss of confidence and a more cautious attitude towards I4.0.<sup>8</sup> If it holds, the indebtedness of the corporate and household sectors will do nothing but deteriorate further by aggravating inequalities (possibly undermining political stability and legitimacy). Undoubtedly, due to hyper-connectedness and the emergence of cyber-physical systems, to date, vulnerability of cyber-physical systems is an unresolved and risky area. Thus, the still interruptible and destructible character of I4.0, mainly due to the problematic cybersecurity, manifests as another trust-demolishing channel. It fuels an increasing fear in the society regarding how fast we should desire a fully digitised and interconnected industrial ecosystem and a digital economy as a whole.<sup>9</sup> Fast diffusion may exacerbate mental diseases since ever-more digitalisation is often triggering negative impacts on people's mental and physical conditions (e.g., non-stop availability and ICT-based monitoring increase workers' stress level and upset the work–life balance, competing with robots is disruptive, etc.).<sup>10</sup> Thus, direct, remarkable and permanent policy support in speeding up digitalisation and the enhancement of I4.0 may depreciate the social trust infrastructure towards both the transformation itself and the state.

Second, there is a *trade-off between flexible labour markets and inclusive Industry 4.0*. Today, the profession believes that the more flexible the labour market, the easier it is to hire the right professionals and get rid of the underperforming ones, thus contributing to innovation dynamism and productivity growth (this is the way to incentivise workers to seek out efficiency-increasing opportunities with innovations and smart adaptations while getting higher and higher wages and salaries). This is of key importance in a time of a digital revolution and that of the improvement of I4.0 as well.<sup>11</sup> However, if one takes a mere glimpse, for instance, at the US, having one of the most flexible labour markets around the globe (i.e., relatively low level of employment protection regulation; see: OECD (2004), p. 47), it can be seen that the workers' real wages in the US economy have been almost stagnant for decades; plus, the income of the middle class did not increase either during the period 1979–2013—and it has been accompanied by lowering productivity growth (less innovation dynamism).<sup>12</sup> A more flexible labour market is therefore by no means a granite solid basis for innovation dynamism especially when the financial universe forgets about the real economy. Studies even estimated that introducing a US-like labour market flexibility in Europe would cause a decrease even in the share of highly skilled employees within the total employment.<sup>13</sup> And considering the job losses effect of rapid automation and robotisation (e.g., in OECD countries, the job replacement rate is approximately 57%, 47% in the case of the US, while 54% in the EU and 77% in China),<sup>14</sup> inclusive growth can

be hacked, especially when stagnating real wages, dispiriting productivity growth and chronically increasing inequalities are an integral part of our everyday life.

Paradoxically, wage increases are required to motivate workers for innovation (to bolster productivity); however, it would mean a significant increase in corporate costs and would force companies to choose cost-cutting measures such as intensified automation and robotisation. Such a direction would be stimulated even more with the making of more flexible labour markets.<sup>15</sup> Since the principle of inclusiveness has become one of the focal points, not only in the EU<sup>16</sup> but also in the view of other international organisations,<sup>17</sup> there is an inherent counterincentive to the rapid diffusion of Industry-4.0-related technologies, not to mention that the existence and needs of European welfare states mean that the rapid job savings resulting from Industry 4.0 and digitalisation should not happen too soon. One can also say that Industry 4.0 is in the pallet of the welfare state itself. All in all, expecting the spectacular return of productivity growth via extensive deregulation of EU labour markets in a one-size-fits-all manner is just a forlorn hope.

### 3.2. Cumbersome Diffusion of I4.0: Dreaming No More

Readiness surveys<sup>18</sup> convey that although awareness over I4.0 has been growing, the lion share of companies has been still looking at this phenomenon as the sheer observers of it (e.g., Deloitte's Industry 4.0 Readiness Report of 2020 suggested that nine per cent of companies surveyed had performed some sort of business update to be in line with the needs of Industry 4.0 introduction and utilisation, while none of the firms in question chose it as a crucial priority).<sup>19</sup> To get a more nuanced picture, in 2018, 86% of C-suite company representatives across 19 developed countries thought that their organisations were on the right track to provide and create the appropriate workforce for I4.0, while, one year later, that share plummeted to merely 47%.<sup>20</sup>

One of the latest far-reaching I4.0 mapping projects (4STEPS, Interreg, Central Europe) did also confirm the impression that the spread rate and intensity of use of I4.0-related technologies fall short of expectations.<sup>21</sup> The project was a transnational analysis of 355 SMEs with respect to Industry 4.0 development throughout seven EU countries (Austria, Czech Republic, Germany, Hungary, Italy, Poland and Slovenia), of which almost 60% were operating in industry (metal products, machinery and equipment). There were at least two important insights obtained in the research by the end of 2020: (i) innovations at SMEs are typically driven by customers as opposed to larger ones where the internal resources and processes are the backbones of innovation; (ii) SMEs do typically show a rather limited adaptation in nine critical areas of Industry 4.0 development and digitalisation considering the shares of those SMEs whose number of persons employed goes up to 49: cybersecurity (28%), augmented reality (38%), simulation (28%), industrial Internet of things (28%), cloud technologies (27%), autonomous robots (33%), additive manufacturing (24%), system integration (23%), big data analytics (33%). Despite the growing efforts to support the investments in, further developments and the wider usage of Industry-4.0-related technologies<sup>22</sup>, the shares of SMEs using Industry-4.0-related technologies very intensively are infinitesimally low and were as follows: cybersecurity (2%), augmented reality (0.3%), simulation (1.3%), industrial Internet of things (1.0%), cloud technologies (1.3%), autonomous robots (1.78%), additive manufacturing (0.3%), system integration (1.7%) and big data analytics (1.0%). For instance, in the case of Austria, a country ranked 18th among the 49 high-income group economies in the Global Innovation Index<sup>23</sup> or ranked 11th among the 39 economies in Europe, most of the suppliers do not use I4.0-related technologies at all (92% of suppliers do not use cloud technologies or additive manufacturing, while the volume of those not applying augmented reality or cybersecurity is also high with 83% and 79%, respectively); in the case of Austrian end-users, that share is also high (autonomous robots, 58%; augmented reality, 84%; IoT, 48%; additive manufacturing, 48%), while the share of those using some I4.0-related technologies very intensively is merely 9.6% in the case of simulation and 12.9% for cybersecurity. Even in Germany, often considered as the growth engine of Europe, it is not necessarily obvious

that the prevalence and intensive use of I4.0 technologies are outstanding (e.g., in the case of suppliers, 73% of companies did not use autonomous robots, 82% of them were not engaged in cybersecurity at all, 90% of them were not applying additive manufacturing, and 59% of them did not use big data analytics, either; in the case of end-users, the share of companies that were not engaged in such technologies at all was still relatively high: autonomous robots, 60%; additive manufacturing, 60%; augmented reality, 75%; and merely 5–10% of them were using simulation, system integration, cybersecurity and additive manufacturing intensively). For comparison, Italy, a country that is one of the top four European economies having a surpassing amount of high-tech manufacturing companies (e.g., 5400, according to Eurostat), has been struggling to increase the activity of firms in Industry 4.0 developments (e.g., 40% of companies screened were primarily using and concentrating on additive manufacturing, while firms surveyed quite often did not plan to use cybersecurity, cloud technologies, augmented reality or big data analytics either since only 4–6% of them were going to initiate actions towards that direction).

An important implication of the above is that the absorption capacity of market actors (e.g., SMEs) in the socio-economic innovation ecosystem has many shortcomings becoming systemic patterns. In principle, the financial sector would be in a good shape to support the spread of I4.0. For instance, the annual average real return on the S&P index was –0.2 per cent between 1901 and 1921, 0.4 per cent between 1929 and 1949 and 1.9 per cent between 1966 and 1986. Since then, such returns started to soar. In the period of 2011 to 2021, S&P 500 offered a real annual return of 13.6 per cent, even through 2021, which was still a COVID-19-ridden year, and the index has booked a return of 10.5 per cent. Yet, as we indicated, I4.0 development falls short. One can reasonably state that I4.0 per se seems to be unable to autochthonously bring back the real economy into the very consciousness of the financial universe. The self-movement of the financial sector (excessive financialisation), being influenced by economic policy measures too, diverts it from that purpose.

There might be an intimate and still neglected linchpin between financialisation and cumbersome I4.0 development. To this end, it incorporates the phenomena of zombification accompanied by financialisation with the aim of pinpointing the crucial need for making the financial universe directional in the interest of the healthy diffusion and development of Industry 4.0.

#### 4. Financialisation and Its Landmines

One way or another, *modo palpatim, modo saltatim*<sup>24</sup> refers to the phenomenon of financialisation when increasing attention is devoted to financial activity within the non-financial sector (i.e., financialisation is meant to follow a more financial income-seeking activity rather than pursuing productivity-increasing innovation/investments, whereby growing a proportion of financial assets within the total assets, cash-flow-exceeding income from financial activity and escalating payouts to stockholders compared to equity are in the cards, etc.).<sup>25</sup> The early stages of financialisation were already recognisable during the first half of the 20th century (Fasianos et al. 2018), while it really accelerated from the 1980s onwards with the deregulation of financial markets and the intensifying globalisation driven by the development of ICT as general-purpose technology. Although there is no single definition, financialisation essentially means that, along that course, debt-to-equity ratios started to increase, whereby the share of financial services relative to other sectors within the national income followed a continuously growing path. However, the state-of-the-art literature is non-conclusive on whether financialisation is a drag on economic growth and development or not; economic and financial history suggests that, in line with one of the most prominent researchers of industrialisation, Alexander Gerschenkron, there were discontinuities in the development of the financial sector when its rate and scale changed rapidly (great spurts) by triggering instabilities and, most importantly, slow and fragile growth.<sup>26</sup>



After 2008, yet another financialisation era gained momentum when making money by money has heightened a lot: with booming stock as well as real estate markets by also approaching negative returns in government security markets, there were also negative returns for retail clients (in fact, COVID-19 generated negative oil prices). The zeitgeist has embraced the motto of “In Investing We Trust”.<sup>27</sup> Thus, the scale of the financial universe outgrew the real economy (Sawyer 2017) by triggering a record high reliance on debt financing as well as by debunking the long-standing empirical fact that real wage growth is entangled with productivity growth.<sup>28</sup> And, most importantly, it does not seem to be shaken by bad news. For example, the price earnings have been growing as the famous Shiller PE Ratio was above USD 40 in early January 2022 (being the second highest rate since 1870 after the value of USD 44 in 1999).<sup>29</sup> Of course, the widely used Warren Buffett indicator, measured as the ratio of the total United States stock market valuation to GDP, has also reached its all-time high value of 218% since 1950 by the end of 2021, which is 70% higher than its long-term trend.<sup>30</sup> Unsurprisingly, the financial sphere has not been so attractive to the younger generation since the 1990s as of today.<sup>31</sup> There must therefore be a firm belief that governments end up intervening and helping out, not leaving anyone on the side of the road.<sup>32</sup> As a consequence, there is no adjustment or reversal in the process of financialisation in plain sight, which already hides a number of systemic landmines as a harbinger of future uncertainties or, in some cases, serious crises.

#### 4.1. General Landmines of Financialisation

In the following, by transcending the state-of-the-art literature, we purport to illustrate that the socio-economic configuration of the financial and real economy has evolved into complex nexuses due to financial exuberance in the developed countries over the last decades. In doing so, the following six dimensions are considered briefly and succinctly as important positive and negative feedback (landmines) of the ongoing financialisation: (i) expanding markets of corporate and sovereign debts; (ii) rising credit flow without spectacular productivity improvements; (iii) increasing socio-economic divergences (i.e., increasing inequalities, big concentrations, etc.); (iv) financial exuberance as a cushion in a time of a black swan event (COVID-19); (v) encoding critical instability and distrust via unresolved cybersecurity; and (vi) altered economic wisdom.

- (i) Expanding markets for corporate and sovereign debts with shifting mindsets: Debts have always served as a kind of refuge for societies sometimes to survive, sometimes to develop further. With hyper-globalisation partly driven by the ICT revolution of the 1980s–1990s as well as the worldwide deregulation of financial markets in parallel, the market for corporate and sovereign debts has become solidified by feeding back to the rise of the international financial universe. In doing so, the prevailing credo changed course by shifting from the sentiment of “rescuing indebted countries” to ever-more preferring “saving (foreign) creditors’ portfolios” in stabilising the global market for sovereign debt. At another level, it is also true that with excessive financialisation in a time of continuous challenges, the tolerance level of financial markets (as well as regulators)<sup>33</sup> of unsustainable sovereign public finances has softened, i.e., debt rates did not need to be strongly stabilized and moderated as it was the case previously; they could have reached higher levels without causing more serious economic vulnerability. The crisis of 2008, but also COVID-19, must be seen as a turning point in this respect, as debt service (interest payment) has not grown at the pace we expected in line with soaring debt levels. With the financial and real economic crisis of 2008, and especially with the aftermath of the eurozone crisis, developed countries sought to stimulate their economies by increasing debt and raising money in a “relatively coordinated manner” with the underlying aim of demonstrating their ability to act and control the processes, i.e., to legitimize their existence. The global financial crisis of 2008 reinforced the view that indebtedness does not necessarily lead to automatically escaping inflation, low interest rates and fiscal crises. We should not be surprised,

then, that the public health emergency caused by the coronavirus epidemic, which began in 2019 and then became global, which in a sense can be apostrophized as a war for the survival of the present generation, has led to an increase in debt rates (e.g., eurozone's average debt-to-GDP rate was above 100% of the GDP by 2021), with the world now collectively turning a blind eye over moral hazard (e.g., Germany has suspended the debt brake rule and reached a deficit of 4.2% in 2020). Economic history teaches us that financial crises were, by and large, followed by rises in debt-to-GDP ratios of at least 20% of GDP in the OECD countries (European Commission 2021) simply because of a learning process: future uncertainties required larger and larger fiscal space (buffer) to intervene and to calm the markets. The only question is whether the currently observable more permissive attitude towards increasing (public) debt will change (i.e., the number of insolvency proceedings has never been so low in Europe), whether inflation will skyrocket after the pandemic (but rather in the meantime), whether the historically exceptional low-interest-rate environment will end and whether the accumulation of debt mountains will start by triggering serious fiscal consolidations across the board (i.e., it would entail a shift from financialisation-driven growth to a more real-economy-led and often export-oriented growth).<sup>34</sup> In other words, excessive financialisation acted as a Janus-faced phenomenon by prolonging the sustainability of welfare states, on the one hand, while by becoming an important landmine to them, on the other. The result has been a vicious cycle. If the stimulus is abandoned by returning to austerity, it is likely that many companies will go bankrupt, unemployment will soar, the hard-won demand side will succumb, and the already increasingly anti-inclusive economic feature of today would fall into deeper employment challenges (especially because COVID-19 has almost become a driver of automation and robotics in the era of the completion of Industry 4.0), which would result in non-negligible anomalies in public finances.

- (ii) Rising credit flow without spectacular productivity improvements: There was an underlying idea behind liberalising financial markets, namely reaching out infinite capital mobility in space and time; however, the financial system figured out that there is no need for the real economy to realise higher and higher profits in the short term, and it has therefore become a self-propelling mechanism.<sup>35</sup> A relatively new stream of economic literature focuses on the issue of secular stagnation meaning the permanent deterioration observable in the growth trend of productivity and thus that of innovation performance in the advanced world (Teulings and Baldwin 2014). Secular stagnation is associated with increasing uncertainties leading to increasing instability of the socio-economic system. There is a growing body of evidence that increases in uncertainty are mainly associated with protracted negative impetus on economic activity (Baker et al. 2016; Bachmann et al. 2013); thus secular stagnation (a declining growth rate of labour productivity) is associated with increasing uncertainties. For instance, such uncertainties come from the fact that more and more entities started to function as those in the financial sector by circumventing the regulatory framework. Following the collapse of the Bretton Woods system, financial globalization was jumpstarted (e.g., decoupling of banking assets from GDP growth, steadily growing volume of loans, while productivity has barely improved, meaning that credit efficiency has conspicuously declined, etc.). And behind the curtains, non-bank financial institutions showed up in the shadow leading to bubbles and overvalued assets of EU banks (i.e., shadow banking entities delivering banking services are out of the eye of regulators). As many studies pointed out, shadow banking exposure has become very significant (see Abad et al. 2022),<sup>36</sup> as if one is witnessing some sort of expulsion of the real economy from the consciousness of the financial sector by feeding back to secular stagnation. Importantly, one can emphasise that secular stagnation is one of the thorniest challenges advanced world faces today simply because it can be seen as a sort of failure of all economic policy initiatives (e.g., expensive R&D and innovation support measures) as well as financial system activity acting

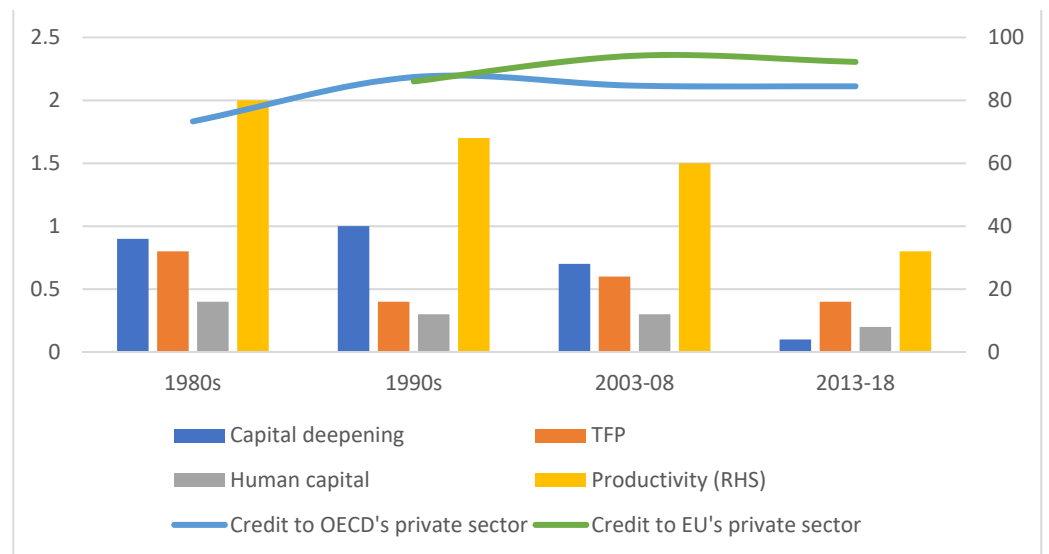
with the aim of dynamising the real economy in the last decades (i.e., by leading to distrust in economic governance and the financial sector in general on the side of the private sector). Paradoxically, one can recognise that we have never devoted as many (financial and other types of) resources to supporting productivity growth as in recent decades, but not only is the boom waiting, productivity growth rate has also been shrinking (see Figure 1). For instance, domestic credit flowing to the private sector provided by banks in OECD countries was 61.32% of GDP in 1981, while it has risen by almost 38% up to 84.48% by 2020 (in EU countries, 86% in 2001 was then followed by a rate of 92.20% in 2020).

- (iii) Increasing socio-economic and political divergences: First, extensive deregulation of the financial markets in promoting financialisation not only meant that financial actors, which had hitherto been subject to strict supervisory rules, would continue to do the same but in greater volumes, but it also opened the door to new solutions by reflecting a completely new approach to lending.<sup>37</sup> For instance, on the one hand, deregulation led to the so-called predatory lending, being pervaded by high-interest-rate credit cards with fees and penalties, payday loans and subprime mortgages, etc.; on the other hand, deregulation of capital markets put the richer in an easier position to avoid paying high taxes by forcing governments to go for public debts in a more voracious way. These all did contribute to increasing inequalities. Second, with the outbreak of the 2008 financial and economic crisis, rising inequality has become the defining challenge of our societies. There is therefore an inherent dynamic between financial development and inequality; up until a certain point, financial development seems to be conducive to growth and moderating inequalities, but after that point, the financial sphere becomes more cautious by turning away from riskier customers by preferring larger and less-risky companies having relatively higher net values (i.e., inequality rises).<sup>38</sup> Wealth inequalities are ten times larger than inequalities in the flow category (Piketty 2017; Atkinson 2015). With the intensifying financialisation (i.e., together with the easier financing), as Favara and Imbs (2015) pointed out, house prices were exposed to rise in a very powerful way by limiting the room for the manoeuvre of younger households to buy a home (i.e., young households are not better off than a similar household was two decades ago)<sup>39</sup> by presumably engendering disappointment in the ruling governments and elites. What is more, in OECD countries, it takes an average of 4.5 generations for a child born to a poor family to reach the middle class (even the corresponding German and French figures are 6); in practice, the growth rate of median household net income has been negligible since the mid-1970s. Komlos (2019) pointed out that the middle class has not only been shrinking but partly disappearing, and its income grew at almost zero rate between 1979 and 2011 (0.1% and 0.7% per year), while the top 1% has been realising an annual income of 3.4–3.9% during the 32 years studied. In addition, the proportion of the population living in households whose per capita consumption and income do not reach the poverty line (USD 3.2 per day), for example, in Germany, which has a significant impact on EU growth, has been stagnating or even declining (from 0.23% in 2000 to 0.24% in 2019).<sup>40</sup> Moreover, the shrinkage of the middle class—most of which tend to slip towards lower-profit jobs—also means that this social stratum is losing its political importance (i.e., it has been empirically proven that people from the middle class are more likely to enter the political system and governance, thus supporting political stability).<sup>41</sup> The thinning of this group is worrying from the development perspective because it is precisely the class that has the critical level of desire to move upwards, which is essential at the system level (for investment in research and development and innovation thanks to intellectual and other resources and savings, self-improvement/self-education), and the desire, in addition to its systemic importance, not to fall behind, and therefore it is the class supporting the healthy system of checks and balances; hence it is the refuge of democratic order (dampening inequality, corruption, etc.). The middle class is predominantly a believer

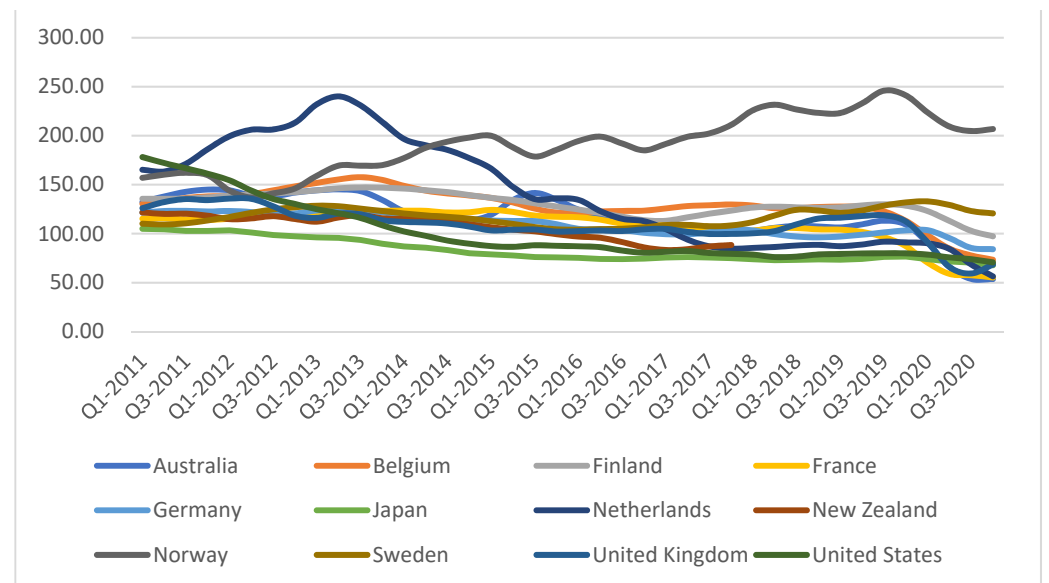


in political stability and good governance (Birdsall 2016), helping to prevent excessive political polarization and fostering trade-offs within government. And if, in spite of all this, slippage and layer shrinkage take place, one can suspect that the configuration of the socio-economic system is in an evolutionary state that is incapable of providing “good jobs” in this form, both in quantity and quality. Illiberalism, populism and nationalism can then gain traction more easily as it happened across the board.<sup>42</sup> Third, with shrinking middle-class and middle-income jobs, corporate giants are dominating by increasing and maintaining a large productivity dispersion across firms.<sup>43</sup> As one of the greatest Hungarian economists, Janos Kornai, once emphasised, if a phenomenon can be detected in many places, it is not a disease. And still, the growing presence of divergences can be treated as a systemic pattern given by systemic tectonic movements such as the exuberance of the financial sector. A predominant part of scholars and economic practitioners have been considering inequality as mainly a national issue; now, it should be clear that it is internationally determined and interdependent.

- (iv) Financial exuberance as a deceptive cushion in time of a black swan (COVID-19):<sup>44</sup> With the runaway of the financial universe meaning the build-up of an ever-more blurring and lengthier bridge between the two sectors with all its repercussions (e.g., resulting in higher concentrations with larger dominating companies), COVID-19-induced economic crisis could not spread quickly to the financial sphere, which is often regarded as a positive development. Yet, there are at least three interlinked underlying phenomena injecting critical instability into the socio-economic system. (1) Big concentrations have become even more pronounced by exerting ever more influence and fuelling inequality across firms. Financial exuberance has led to a financial real economy configuration in which debt and equity financing are easily and widely available, and low-interest rates prevailed across the globe for a relatively unprecedented period when companies equipped with the necessary financial capacity started to intensify their mergers and acquisitions by maintaining their growth (even inorganic).<sup>45</sup> It is true that this process, per se, served as a cushion for business players shaken by the new socio-economic context (excessive digitalisation, lockdown effect of COVID-19, etc.) in a way they could find a relatively easy way out (exit). Although a proxy for capturing this trend is the trajectory of non-performing loans across the European Union which, in spite of COVID-19, has continued to decline even along 2020–2021 together with the fall in bankruptcies as well (Figure 2);<sup>46</sup> with the end of cheap money and governmental support, banks are facing a conspicuous deterioration in their asset quality due to the emergence of household and corporate defaults in a more vigorous way.



**Figure 1.** Contributions to productivity (left axis, %) and domestic credit flow to private sector by banks (right axis, GDP %). Note: contributions to productivity refers to advanced countries, such as OECD countries. Source: data are stemming from World Bank, World Development Indicators 2022.



**Figure 2.** Declining number of bankruptcies (Quarterly, 2007 = 100). Source: OECD.Stats.

This per se will hamper the banking sector to be an efficient contributor to the recovery later on.<sup>47</sup> (2) Forced digitalisation, but no positive signs in plain sight. On the one hand, COVID-19 bolstered the usage and development of alternative smart, cheap and even digitalised payment methods by resulting in a higher risk of cybersecurity.<sup>48</sup> On the other hand, the financial and banking sphere, as a major employer, did make a shift towards a more digitalised employment model with the introduction of remote work in the case of 40–60% of a working week whereby the labour market shock given by COVID-19 was limited to the real economy. It nurtured a misleading feeling of comfort by assuming positive impacts on productivity and business activity. Still, employment in the financial and banking sector has been declining further; plus, there is no clear-cut evidence whether the broad introduction of home office has had a positive impact on productivity, workers’ job satisfaction or innovation activity in general.<sup>49</sup> (3) No healthy contraction, but a gathering inflation storm. There is also a widespread belief

that since the financial and economic crisis of 2008, being uninterrupted by COVID-19, the banking sector, including the European one, has been going through a healthy contraction in the spirit of increasing efficiency and cultivating stability.<sup>50</sup> However, there is underlying inertia for such contraction, namely that more and more workers have been intentionally leaving the financial/banking universe (as well) without even reappearing in the labour market by contributing to the so-called (and inflationary) Great Resignation (i.e., labour shortage is a ubiquitous phenomenon even in the financial system). Labour shortage, by its very nature, fuels scary inflation, especially in the aftermath of COVID-19 (i.e., hiring requirements have been lowered, and there is a pressure on increasing wages and salaries ever-more spectacularly).

- (v) Encoding critical instability and distrust via unresolved cybersecurity: excessive financialisation driven by digitalisation has triggered enormous cyberattacks in the broadened financial sector (financial sphere, banking sphere and the growing share of non-banking payment service providers and apps). Excessive digitalisation has increased the channels along which private and business customers are available and can be manipulated in many ways. It is hardly by chance that misinformation and disinformation were mentioned among one of the most intriguing and withering challenges of today's democracies around the globe. Only during the first half of 2020, the number of cyberattacks targeting exclusively the financial universe rose surpassingly (a 238% increase was registered by VMware, and according to the calculation of IBM, the average cost of a data breach that happened to a financial institution accounted for approx. USD 5.7 million, while attacks geared towards apps also went up vehemently by 22% since 2020). In short, both the number of ways and the extent of potential (financial and confidence-related) damage have jumped significantly (i.e., think of phishing emails, ransomware attacks paralysing even public services and financial/banking actors<sup>51</sup>, SQL injections<sup>52</sup>, DDoS attacks, supply chain attacks<sup>53</sup> or bank drops).
- (vi) Altered economic wisdom: First, according to the traditional monetarist theory, we should expect higher inflation in parallel with the increase in the money supply. Contrary to theory, however, one can recognise that high inflation did not emerge from the volatile but precisely the relatively stable money supply from the 1960s onwards, i.e., it did not emerge as a result of money-supply-increasing periods.<sup>54</sup> What is more, it was not primarily a combination of monetary but other factors. This calls for a refinement in our theory since the old one may be only true if the financial system is an efficient intermediary system for the real economy. Currently, unfortunately, this is not the case. Importantly, mainly because of the distorted harmony between the financial universe and the real economy, stock market indices correlate more with money supply than traditional CPI metrics. Second, according to mainstream economics, a more intensive and deeper financial intermediation cultivates economic growth and development, i.e., credit growth feeds back into increasing economic growth in terms of GDP. Although with the shift from the Great Moderation to the Great Recession, due to the financial and economic crisis of 2008, there have been voices trying to rethink and refine that finance and growth narrative; those works are still remaining in the same paradigm in the sense that they tackle the financial universe as an immense part of the real economy without considering its runaway (as a disguised real sphere, as [Bofinger et al. \(2021\)](#) put it).<sup>55</sup> And even though seemingly there is evidence of the strong positive relationship between credit growth and GDP growth, excessive credit growth is now treated as one of the most pivotal signals of a forthcoming decay. The Great Moderation (approx. 1992–2007) was pervaded by low fluctuations (i.e., moderated level of unemployment, inflation, stable GDP growth) giving a misleading feeling of comfort whereby people tended to go for more and more credit. It encoded a process of excessive indebtedness with an above-the-optimum boom cycle marching toward a below-the-necessary recession with full steam (the Great Recession). As a corollary, easing the external financing constraint for households and firms is neither good, as

the basic literature suggested (Beck et al. 2000; Levine 2005), nor bad but can be both.<sup>56</sup> Third, conventional theory postulates that credit (and leverage) is worthwhile for companies (i.e., net debt benefits the company). But, and by feeding back to growing concentrations, as mentioned earlier, in the configuration of the financial universe and real economy emerging, the business-as-usual way of bank lending started to contain an underlying preference over internal sources of funds in the case of small and medium companies as compared to more powerful giants. Unsurprisingly, there is a declining trend in leverage in the last decades by even approaching zero as well (also known as zero-leverage mystery).<sup>57</sup> And fourth, economics theory on the nexus between technological advancement (technological revolutions leading to new techno-economic paradigms) and the financial sector seems to have been ill-based. The role of the financial sector in the technological-economic paradigm shift cannot be properly grasped by prevailing theories. One ruling economic theory assumes that innovations are the achievements of the real economy and the financial sector is responsible for the diffusion and widespread use of such innovations (Perez 2003, 2009); while the other theory emphasizes the primacy of liquidity-enhancing power in financial sector innovations leading to ones in the real economy (Minsky 1982, 1986, 2008; Wray 2018). The basic underlying assumption of both theories is the existence of a harmony between the two spheres, based on which we should see innovation dynamism one way or another, but this relationship no longer exists today. Insofar as the financial universe has outgrown the real economy (e.g., banks went beyond the sheer operation of lending by becoming qualitatively new players in town by asking to whom to sell the loan)<sup>58</sup>, that is to say, it does not function as an integral part of it, it suggests that the financial sector's traditional liquidity-creating methods via financial innovations have lost their orientation. It also implies that the financial system as of today is not necessarily contributing to the deployment of Industry 4.0 and the real transition to the digital economy. What it has been producing is just side effects and unintended consequences of such liquidity creation (i.e., creating and preserving uncompetitive and stagnating zombie firms).

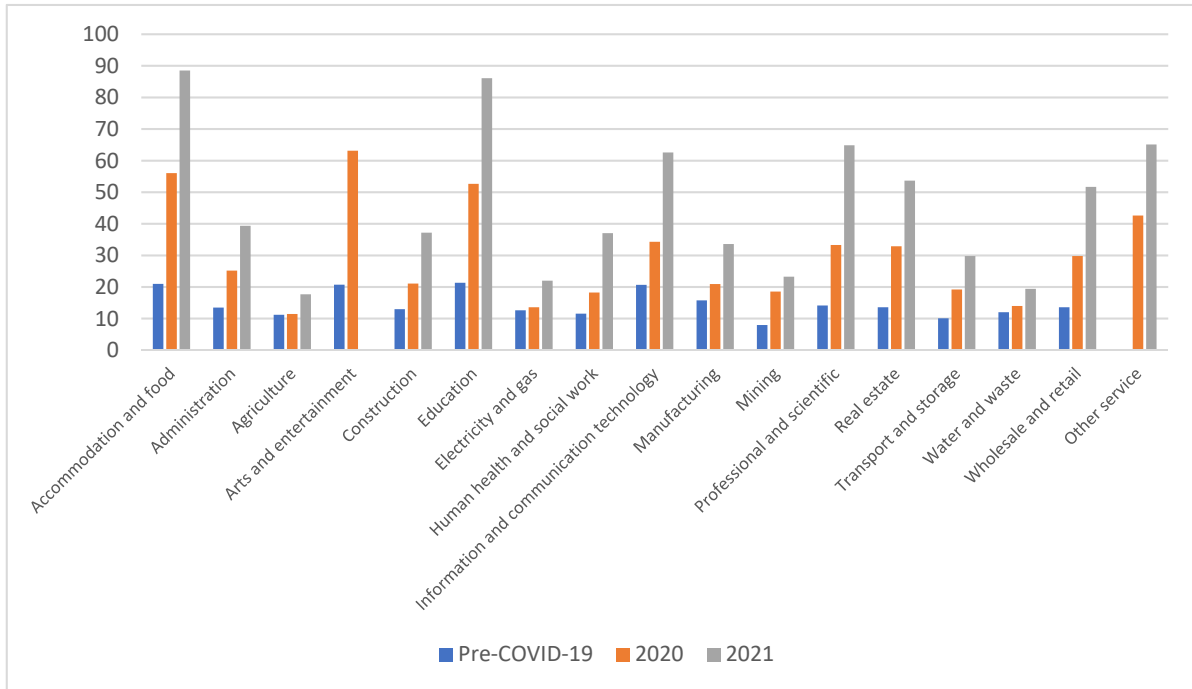
Financialisation has its own landmines. It has led to ever-expanding markets for corporate and sovereign debts by providing ever-growing liquidity via credit abundance contributing not to a shared but an increasingly unequal and unsecured growth path whose complex process and its side effects, such as zombification, are incomprehensible with old economic approaches.

#### 4.2. Zombies—Sunspots for Industry 4.0?

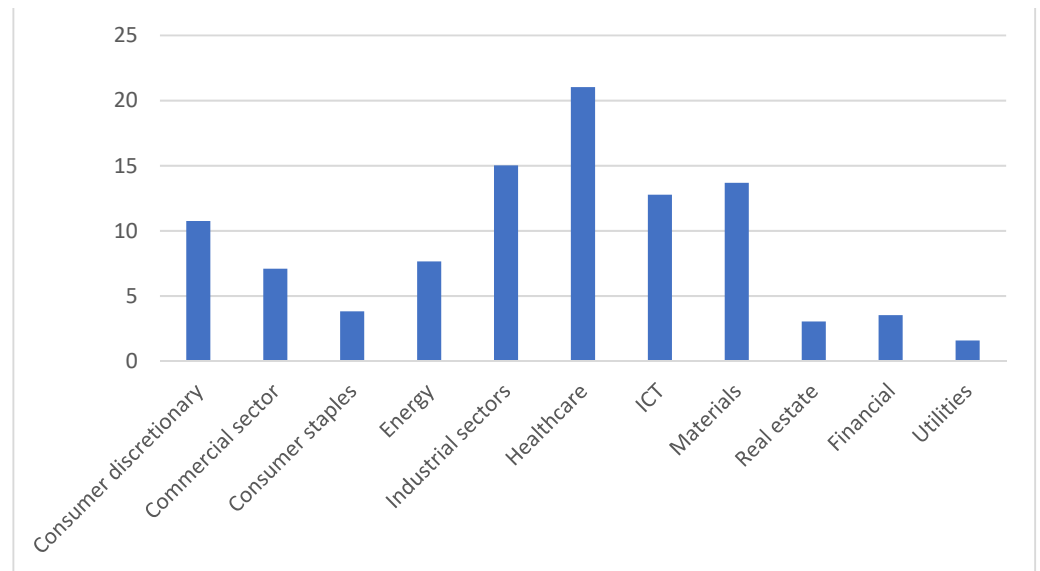
Importantly, zombies are mainly those firms that are still able to remain on the market alive without realising any significant advancement in terms of profits, productivity or employment growth.<sup>59</sup> In other words, firms can be regarded as zombies having negative interest coverage ratios over the last years (i.e., they were unable to meet their debt service through their profits during the past three years). Although the number of studies on zombie firms has been growing, those works have a predilection to believe that, especially in the light of the COVID-19 crisis management, zombies are not posing a particular systemic problem (e.g., in the case of Sweden, see Cella 2020; in the case of the US, see Favara et al. 2021).<sup>60</sup>

We are the dissonant voice in this chorus when arguing that zombies have become a systemic feature making our socio-economic innovation ecosystem noisier<sup>61</sup>, hence stifling down the innovation dynamism, hampering real development. In other words, zombies might be seen as *sunspots* (sunspot economic variables not having a direct and sudden impact on fundamentals); they are important contributors to critical instabilities emerging especially if enough people start worrying about them in the manner of learning by experience (the growing presence of zombies restrains innovation and price increases and also limits the possibility of raising wages, thus deterring new entrants by making them demotivated). In this respect, there is a scope for extensive experience because the

channels of zombification seem to have already formed and the number of zombie firms has been increasing mainly since the 1980s (even in core EU Member States such as Germany), as Figures 3 and 4 depict.<sup>62</sup>



**Figure 3.** Share of company debt with interest coverage ratio less than one worldwide from 2019 to 2021, by sector. *Source:* IMF, Orbis Research 2022.



**Figure 4.** Share of listed companies in Europe with an interest coverage ratio less than 1 per sector (%). *Note:* the total number of companies listed 162,841, while the share of zombie firms within was 3.7% (6039). *Source:* own compilation based on finbox.com database.

Zombification has become an integral part of the system by showing self-sustaining and self-reinforcing features (i.e., zombification stimulates further credit prudence breaking since a higher share of zombies depresses productivity engendering lowering interest rates which is also reinforcing credit consumerism by sustaining and even increasing zombie



activities). Without being exhaustive, at least, the following five pivotal and intertwined channels of zombification can be identified:

- i. *Noisy expectations*: When the volatility of trends becomes very low, people tend to consider moderated trends as a period of calmness which is very likely to continue in the future without significant interruptions.<sup>63</sup> People are therefore filing for credit cards and using them in a good deal of quantity in those times by expecting the best. In other words, higher-risk-taking behaviour, from the side of both banks (i.e., in a form of poor risk management practices) and private/business sectors, is encoded in a time of moderation (e.g., 1992–2007) when abundant liquidity and relative calmness of financial and banking players instil zombification.<sup>64</sup> And that leads to the fact that the boom phase of the business cycle is running even higher, while when the recession hits, the bust phase is falling even deeper (because there has been excessive indebtedness and credit consumerism viewed as systemic risk factors).
- ii. *Noisy lending*: Even the same company's credit rating (i.e., assessments of creditworthiness) may be subject to completely different assessments from different banks.<sup>65</sup> And since banks more and more avoid writing down significant losses that would otherwise worsen the bank's reputation, zombification is just a means to do so (not to mention the fact that banks could allow more and more indebted and non-viable zombie firms to live longer by offering them new loans to repay older debts due to loose monetary policies and increasing liquidity available), while financialisation is a means of pursuing more profits at the same time.<sup>66</sup> All this happened in an environment pervaded by excessive liquidity; thereby, access to credits became ever-more simple and easy by resulting in zombification that entailed worsening average productivity performance.<sup>67</sup>
- iii. *Noisy institutional, regulatory and business incentives*: Weak insolvency regimes contribute to the survival of zombie firms whereby zombie lending may continue;<sup>68</sup> governmental support and loose monetary policy to prop up lending result in a behaviour change in the day-to-day operation of banks since the flood of liquidity increases their risk tolerance (i.e., riskier loans are soaring even towards less productive and probably unviable firms with a greater chance); and there might be a culturally driven zombification channel, i.e., increasing tolerance with respect to allowing less-productive firms to get credits if and when their market existence safeguards a more inclusive society pursued by economic policy (i.e., their employability becomes a priority when assessing their creditworthiness).<sup>69</sup>
- iv. *Noisy asymmetrical information*: Zombie lending and zombification together build up a business environment pervaded not only by asymmetrical but also noisy information flow to be relied on when it comes to important decisions, i.e., it is harder to identify whether the partner company is creditworthy or actually a zombie which could be a malicious landmine in the future. Companies may become misinformed by zombie lending masking the creditworthiness of one or more of their suppliers by resulting in a business network soaked with a good deal of contagion risk that sprinkles the mourning among them (i.e., a large company prefers creditworthy suppliers who, due to the tendency of banks to zombie lending, are not necessarily proven to be zombies in advance). It is similar to what happened in George Akerlof's famous "market for lemon" model: there will be an immanent tendency for companies of deteriorating quality and efficiency to dominate the market, which will feed back on zombification and zombie lending.<sup>70</sup>
- v. *Noisy crisis management*: The financial and real economic crisis of 2008 and its ensuing eurozone crisis have brought a "relatively coordinated" stimulus to life. Through this, nation states could demonstrate their ability to act. The crisis of 2008 reinforced the view that indebtedness does not necessarily lead to automatically escaping inflation, low interest rates and a fiscal crisis. What is more, authori-

tative studies argued that fiscal policy offers the best policy response (Baldwin and di Mauro 2020a, 2020b). Rescuing weaker banks is equivalent to creating and maintaining their competitive advantage (i.e., fending off their exit) by presumably destabilising the entire financial system since such unviable zombie banks may crowd out real competitors too.<sup>71</sup> Importantly, there was a belief that such intervention increases competition by incentivising lending to the real economy (i.e., to be materialised in a form of more real investment entailing positive impetus on growth and innovation).<sup>72</sup> But once the financial sector shows a runaway described in this paper, such effect can be nothing else but a phantasmagory. Then we should not be surprised that the public health emergency caused by the coronavirus epidemic that started in 2019 has led to an increase in debt ratios without any more serious consequences (e.g., Germany has suspended the debt brake rule and reached a deficit of 4.2% in 2020). However, with the help of the ECB (Single Supervisory Mechanism, SSM), the classification rules for non-performing loans were also relaxed during the pandemic. Initially, this was only a recommendation up until more specific guidance/regulation came out from the European Commission and the European Banking Authority. Importantly, bankruptcies have been suspended in many cases, and a moratorium has been also launched together with other direct state support and guarantees. All this opened the way for zombification, especially in countries where interventions were not adequately addressed and/or banks do not have sufficient capital buffers to write off losses.<sup>73</sup>

It would be a wrong inference that zombie firms must be eliminated one by one because of at least two things. On the one hand, some of them may become able to recover from that zombie status if and when proper support measures are initiated.<sup>74</sup> On the other hand, unless excessive financialisation is addressed, a certain level of zombies helps to prevent the so-called *competitive release process*.<sup>75</sup> It is not unfounded to assume that if all zombie companies were to be eliminated, it would be easier for the bigger ones to reach even greater concentrations by further exacerbating the disharmony between the financial and real economy, by heightening income and wealth inequalities, not to mention the weakening of inclusive growth. While there were policy measures to reduce the share of zombie firms across the board since the 2008 financial and economic crisis (e.g., in Germany, Greece, Italy and Spain), large concentrations rose, i.e., the share of large companies in manufacturing could increase even further<sup>76</sup> by potentially fossilizing innovation dynamism and boosting inequalities towards new heights.

## 5. Discussion

This paper aimed to illustrate the existence of general landmines of financialisation entangled with the intertwined and still burgeoning noisy channels of zombification that create a noisy socio-economic configuration for Industry 4.0 development by hampering its healthy unfolding. Consequently, Industry 4.0 does not seem to be able to autochthonously bring back the real economy (non-financial corporate sector) into the consciousness of the financial sector unless systemic landmines (including zombification) are addressed.

Noisy expectations, as we have shown, are out there since many scholars, pundits and policies as well as business practitioners tend to believe that Industry 4.0 will bring innovation dynamism to a new level pervaded by a productivity boom. The disharmony between the financial sector and the real economy, coupled with liquidity-expander lax crisis management, resulted in a configuration in which firms that are open to Industry 4.0 may find themselves misinformed and misguided because the excessive financialisation and zombification come with a set of disguised landmines as indicated (e.g., weak insolvency regimes, zombified suppliers, etc., not to mention the unresolved issue of cybersecurity forcing even more firms to refrain from the voluminous front-load investments, in which debt financing is inevitable, in Industry 4.0 by choosing zero-leverage functioning instead).

The bridge between the financial and real economy spheres is already crumbling and appears to be doing so farther and farther. The message of our paper is that a set of policies is needed that are targeting both ends of that bridge, both the financial universe and the real economy in supporting a sustained Industry 4.0 development.<sup>77</sup> Economic policy (in Europe) is chasing a mirage and does not even notice the landmines lurking in the socio-economic innovation ecosystem when designing funding programmes to support Industry 4.0 developments while not eliminating systemic inertia forces.

Zombies are more than mere sunspots but are the real obstacles to real socio-economic development. The documented micro- and macro-level noises accumulate and make the socio-economic innovation ecosystem noisier. At the micro-level, the existence of zombies makes the decision of other actors noisier (more expensive, riskier), and they may find themselves in a more difficult situation, while at the macro level, zombie lending is being embedded in the system, and it is becoming increasingly difficult for the states to find so-called Goldilocks zones whose actors could be promoted in favouring a more sustainable Industry 4.0 development and transition to the digital economy.

The world economy is now facing particularly great challenges. If there is one thing we can learn from history, it is that during crises, things are born that we could not have imagined before. Thus, we can hope for a new mindset.

A game-changer approach would be a delicate regulation of the financial universe by taking into account its runaway with zombification, an approach which sees the performance of the financial system in terms of how successfully it supports the industrial revolution in the real economy by bringing some sort of directionality into the financial system to be more conducive to the healthy unfolding of Industry 4.0 (to be more in line with a greener economic model) requiring longer-term and larger front-load investment culture (i.e., analysing and identifying zombie activity both in the business sector and in the banking sphere, aligning short- and longer-term goals; offering management knowledge and other kinds of support for SMEs to overcome their zombie status).<sup>78</sup> Finally, the approach chosen shall very much depend on the ruling or desired societal contract in the given country because it seems that fostering Industry 4.0 is not without the costs of disappearing inclusiveness from the socio-economic system. In this sense, systemic zombification might be seen as a side effect of pursuing inclusive growth while inhibiting the development of I4.0 with full steam. Addressing zombified Industry 4.0 therefore has to be on today's policy agenda but not in a helter-skelter fashion. A healthier development of Industry 4.0 can be a great helper for the microsphere (companies) to increase their ability to operate in a circular manner. There is a vital need for a more efficient allocation of resources, including financial resources, to open the door for instance to "an eco-surplus business culture" with a minimised risk of policy failure (Vuong 2018, 2021) featured with technological and non-technological innovations and smart adaptations that reduce the use of materials and increase the product life while the recycling of their components can become a more realistic perspective.

As we emphasised earlier, the present paper is supposed to be a pioneer in the field of studying the complex and disharmonic amalgam of the financial sector and the real economy in affecting the development of Industry 4.0. We are at the very beginning of such new research avenue to be complemented by reasonable econometric or basic regression analyses, for instance, later on (e.g., building partly on CompNet as well as Compustat to carry out correlation analysis, regression analysis, using VAR model or panel database analysis as GMM to see the extent to which policies and initiatives over excessive and zombified financialisation influence the complex process of Industry 4.0 and its unfolding). It is our hope that other researchers will join this undertaking.

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## Notes

- 1 Ranging from the long-lasting and to some extent still unresolved consequences of the 2008 financial and economic crisis including the eurozone crisis such as flaring populism, secessionism and nationalism across the board (today, one in four nations is governed by a populist leader/party) by endangering the sustainability of the European integration process as a whole, the escalating trade war between the United States and China affecting many other countries, the migration and COVID-19 crises, creeping military conflicts, the ever-more deciphered and publicly discussed business scandals (Wirecard, security fraud by Chinese-based companies such as Luckin, Archegos Capital, etc.), etc.
- 2 The systemic pattern of growing inequality has been emphasised in a detailed manner by Atkinson (2015) and Piketty (2017); while Colantone et al. (2022) revisited the evidence on inequality as a driving force behind the backlash of globalisation.
- 3 For instance, Blais et al. (2020) illustrated that fact exquisitely. The rates were as follows: Austria (1962: 93.77%, 1995: 85.98%; 2019: 75.59%); Belgium (1961: 92.34%; 1995: 91.15%; 2019: 88.38%); France (1967: 81.12%; 1997: 67.96%; 2017: 48.70%); Germany (1972: 91.11%; 1994: 78.97%; 2021: 76.57%); Italy (1963: 92.88%; 1996: 82.91%; 2018: 72.93%).
- 4 [ . . . ] sucht den ruhenden Pol in der Erscheinungen Flucht" by Schiller, Der Spaziergang.
- 5 Many papers admitted that available data, which might be of interest pertaining to non-financial firms, have many shortcomings in this respect (since we are dealing with a more secular phenomenon, and the available time series for 10 years at best do not seem to be as conducive as it would be required), and we are at the very beginning of such new research avenue to be complemented by reasonable econometric or basic regression analyses, for instance, later on (e.g., building partly on CompNet as well as Compustat to carry out correlation analysis, regression analysis, using VAR model or panel database analysis as GMM to see the extent to which policies and initiatives over excessive and zombified financialisation influence the complex process of Industry 4.0 and its unfolding).
- 6 The first industrial revolution dates back to the 18th century when power generation started to gain momentum (e.g., facilities with water power and steam engine), the second appeared in the 19th century with the discovery of electricity and assembly line (mass) production (e.g., automotive industry), and the third one entered the world stage with the fast diffusion of information and communication technologies from the 1970s based on smart chipsets (e.g., Internet, robots, automation opportunities).
- 7 Despite the lack of convincing empirical backing (Baldassarre and Ricciardi 2017), improved productivity via Industry-4.0-related technologies (e.g., robotics) and nontechnological solutions in the real economy and the financial sector alike is widely expected in the literature. See: Aichholzer et al. (2015); Vaidya et al. (2018); World Economic Forum (2018); Zambion et al. (2019). For the case of the financial sector, see: Mehdiabadi et al. (2020).
- 8 For more on upskilling, see: de de Pleijt and Weisdorf (2017) or Krzywdzinski et al. (2016).
- 9 A survey conducted by Chapman University in 2016 showed that, after corruption, what Americans fear the most is cyberterrorism. Available: <http://www.usatoday.com/story/news/nation-now/2016/10/12/survey-top-10-things-americans-fear-most/91934874/> (Accessed on 2 April 2022). It is hardly by chance that Piggini (2016) documented that not only the number of reported industrial control incidents but also the number of cyberattacks against manufacturing firms have been conspicuously growing, initiated by ransomware, malware and various types of phishing activities, engendering smaller-scale and also full disruptions (e.g., in public services as well).
- 10 Not surprisingly, IBM stopped two years of experimenting with telecommuting in 2017, before the coronavirus pandemic began, because telework had a negative impact on work efficiency.
- 11 For more on the reallocation channel, see: Martin and Scarpetta (2012). Of course, not only the tangible (salaries/wages, bonuses, etc.) but also the intangible (e.g., autonomy, space for self-realisation, increased responsibility) part of the incentive regime matters (See: Beck-Krala et al. 2017), whose power can be curbed in the case of extensive ICT-based monitoring and control, encoding the culture of anxiety mentioned above. For instance, UPS follows every move of its drivers via ICT devices, or, at Amazon, harrowing work conditions have been revealed as an undercover journalist reported after visiting an Amazon warehouse where workers are using bottles when they have to pee because fulfilment demands are too high at the company.
- 12 Not to mention the welfare growth side of the same coin, where Komlos (2019) found that, between 1979 and 2013, welfare growth was substantially slower than income growth and that the middle-class quintiles fared worse.
- 13 On the labour impact, sensitive analyses were prepared by Cette et al. (2016) or Kurz (2017).
- 14 Source: Statista, Citigroup, World Bank. For more on the negative association between adopting robots and manufacturing employment in the OECD countries, see: Cali and Presidente (2022).
- 15 In a survey carried out by Capgemini Research Institute, 58% of company respondents reported that the positive impetus of automation on productivity was actually invisible. Available: <https://www.capgemini.com/wp-content/uploads/2018/11/Report-%E2%80%93Upskilling-your-people-for-the-age-of-the-machine.pdf> (Accessed on 2 April 2022).



- 16 The growing importance of ageing and its multifaceted consequences have become a deeply researched topic today when life expectancy has reached 70 years in the world (and has even exceeded it in many countries), and for the first time in the history of mankind, the number of individuals aged 60 or older has eclipsed that of the number of children under the age of five. On the increasing European awareness over the issue of inclusion, see: Europe2020 Strategy or the Annual Convention for Inclusive Growth.
- 17 See: OECD Inclusive Growth Initiative. Not to mention the Sustainable Development Goals of the United Nations accentuating the promotion of sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. Recent work, among others, offers work–life balance in a more dedicated and flexible way, which is required more and more by generation Y. See: [Robak \(2017\)](#).
- 18 Let us note that these readiness-related analyses have a predilection to concentrate primarily on the technology side of Industry 4.0 potential in the case of countries/companies. For more on such bias in Industry 4.0 assessment methods, see: [Hizam-Hanafiah et al. \(2020\)](#).
- 19 Since company leaders and employees do often have entirely different incentives, leaders and employees also differ on which skills are most needed and who is responsible for developing them when it comes to Industry 4.0 as [Deloitte \(2020\)](#) documented.
- 20 For more on the ethical and moral aspects, see: [Deloitte \(2019\)](#).
- 21 See: <https://www.interreg-central.eu/Content.Node/4STEPS.html> (Accessed on 2 April 2022).
- 22 To name a few more spectacular efforts, and beyond the level of communication and visionary narratives (For a European Industrial Renaissance of 2014, Task Force on Advanced Manufacturing for Clean Production of 2013, Strategic Policy Forum on Digital Entrepreneurship, Grand Coalition for Digital Jobs, EC’s Digital Single Market Strategy), S3P-Industry initiative, or the more general Horizon 2020, offered more than EUR 80 billion for supporting industrial leadership between 2014 and 2020; more than EUR 100 billion were also available via European Structural and Investment Funds for the Member States to reinvigorate innovation in line with smart specialisation. For more on EU policies towards Industry 4.0, see: [Dosso \(2020\)](#).
- 23 See: [https://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_gii\\_2020/at.pdf](https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020/at.pdf) (Accessed on 2 April 2022).
- 24 Sometimes seriously stepping, sometimes jumping.
- 25 See the consensual view given by many scholars, such as [Orhangazi \(2008\)](#); [Lapavitsas and Powell \(2013\)](#); [Davis \(2018\)](#); or [Soener \(2021\)](#).
- 26 See more on the Gerschenkronian great spurts in [Gerschenkron \(1962\)](#). Of course, diligent readers of how financialisation has developed can observe that the literature on the interaction between growth and financialisation has shifted with the 2008 financial and economic crisis. After the Great Recession, voices about the more negative impact of financialisation on economic growth started to gain traction. For instance, [Stockhammer \(2012\)](#) and [Cecchetti and Kharroubi \(2015\)](#) did also emphasise the crucial importance of excessive global financialisation in the slowing down of economic growth becoming ever more fragile.
- 27 By updating the version of *In God We Trust!* that has prevailed primarily in the US.
- 28 For a more comprehensive account of these issues, see: [Palley \(2013\)](#).
- 29 See: <https://www.multpl.com/shiller-pe> (Accessed on 2 April 2022).
- 30 See: <https://www.currentmarketvaluation.com/models/buffett-indicator.php> Accessed on (Accessed on 2 April 2022).
- 31 See: <https://www.forbes.com/sites/stephenmcbride1/2021/02/08/millennials-will-propel-stocks-higher-for-years/?sh=187a97506e5d> (Accessed on 2 April 2022).
- 32 Although there were approaches in the US and Europe in diametrical opposition to each other, programmes now seem to have been worthwhile. For instance, in the US, where the government allowed workers to lose their jobs, jobless aid was offered for more than 56 million workers between January and August of 2020. The European Union and the Member States did also start their furlough programs with the aim of preserving the workers as much as possible. See: <https://www.bloomberg.com/graphics/2021-furlough-jobs-unemployment-europe-united-states/> (Accessed on 2 April 2022).
- 33 Note that in Europe, the institutionalised fiscal rules and regulations have not been sufficiently followed and, most importantly, noncompliance has been the rule rather than the exception. See: [European Fiscal Board \(2019\)](#); [Gaspar and Amaglobeli \(2019\)](#).
- 34 For an example, see the case of Iceland. See: [Gudmundsson \(2015\)](#) and [Raza et al. \(2016\)](#). Let us note that putting European debt-to-GDP rates altogether on a more sustainable path is of crucial importance since high discrepancies in Member States’ indebtedness does also mean differing fiscal spaces deployable in mitigating shocks and to dynamise structural transformation (i.e., into green, inclusive and more sustainable growth/development).
- 35 The parasitic-like nature of the financial universe unleashed new systemic patterns: (i) the *share of capital* in national income has been rising, while that of the labour share has been declining since the 1970s (see [Milanovic 2019](#), pp. 24–25); (ii) it can be captured by looking at the growing trends in *share buy-backs*; thereby, the players are to boost the stock market artificially. It implies that they are not looking for riskier but productivity-enhancing investments in the real economy (40% of S&P 500 firms bought back shares in 1990; their proportion was 60% in 1997–2003, while 85% today). It is hardly by chance that a global *saving glut* of the rich has become a well-researched field (i.e., over more than 40 years, top earners have been accumulating savings instead of seeking out financing investments in the real economy; see [Mian et al. \(2021\)](#)). It also generates a bias towards larger companies at the expense of the middle ones ([Andrews et al. 2016](#)).



- 36 According to comprehensive research of the European Banking Authority on the exposure of European banks to shadow banking entities, German institutions, serving an economy driving the European growth potential substantially, reported the second largest exposure. See: [European Banking Authority \(2015\)](#), p. 13).
- 37 Affecting also the incentive structure of investment managers by directing them to take more risks. See: [Rajan \(2005\)](#).
- 38 See: [La Porta et al. \(1999\)](#) or [Kang-Kook and Md Abu Bakkar \(2021\)](#). Owing to the fact that cash flows are risky in a competitive industrial environment, banks take competition risks into consideration when making lending decisions ([Gaspar and Massa 2006](#); [Irvine and Pontiff 2009](#)). Thus, banks prefer less risky companies with big net value.
- 39 For a more comprehensive account of this nexus, see: [Paz-Pardo \(2021\)](#).
- 40 See: <http://iresearch.worldbank.org/PovcalNet/povDuplicateWB.aspx> (Accessed on 2 April 2022).
- 41 In this respect, [Putnam and Garrett \(2020\)](#) offered a sensitive account, while the the book by [Tankersley \(2020\)](#) did also join this line of thinking.
- 42 For instance, see the emergence of the Donald J. Trump administration in the United States, the case of the Brexit in the European Union or other populist-leaders-led economic governance show up in a more dedicated way. More on illiberalism, see: [Sajo et al. \(2021\)](#).
- 43 Larger companies are much better able to design vertical restraints and use their patents to reduce the risk of their often very costly R&D and innovation activities (see [Sovinsky et al. \(2016\)](#)). This is also the reason why, after five years, a maximum of 8 out of 100 micro-enterprises entering the market will be able to have more than 10 employees, while 26–56% of them no longer exist. See: [Kovács \(2020a, 2020b\)](#).
- 44 A black swan is an event with a very low probability to happen but having a tremendous impact afterwards.
- 45 For more on the possible outlook of the M&As in the post-pandemic world, see: [Kooli and Lock Son \(2021\)](#).
- 46 As the [OECD \(2022\)](#) mentioned, some core European countries did suspend the obligation to file for bankruptcy for part of 2020 as a reaction to COVID-19 by allowing entrepreneurs and SMEs to defend their market existence despite the pandemic (i.e., insolvency started to decline along 2020 and 2021 as compared to 2019).
- 47 In Q4 2014, the average gross non-performing loans and advances in percentage of total gross loans and advances in the EU was 6.7%, while it was merely 2.3 by Q2 of 2021. See: ECB, CBD2.Q.B0.W0.11.\_Z.\_Z.A.F.I3632.\_Z.\_Z.\_Z.\_Z.\_Z.PC. Still, a growing trend in corporate and household defaults has been out there as [OECD \(2021\)](#) documented.
- 48 See: <https://home.kpmg/xx/en/blogs/home/posts/2020/07/payments-deals-soar-despite-covid-19.html> (Accessed on 2 April 2022).
- 49 See: [European Parliament \(2021\)](#). See more: <https://www.igmchicago.org/> (Accessed on 2 April 2022).
- 50 According to The European Banking Federation, the total number of credit institutions continues to decline: since 2008, the number of credit institutions has fallen by one-third. Compared to 2019, the number of branches decreased by almost 8% as banks intensify the use of digital banking. Nevertheless, the number of branches of non-EU banks has increased by 20%. Meanwhile, employment in the sector is decreasing at a slower pace. The sector employed over 2.2 million people in the European Union by the end of 2020. See: <https://www.ebf.eu/facts-and-figures-2021/> (Accessed on 2 April 2022).
- 51 The banking sector experienced an outstanding increase in ransomware attacks since that number increased by more than 1318% in the first half of 2021 compared to the same period of 2020. See: [TrendMicro \(2021\)](#).
- 52 Cybercriminals started to focus more on application programming interfaces (APIs). See: <https://www.prnewswire.com/news-releases/akamai-security-research-apis-are-now-target-of-choice-for-cybercriminals-attacking-financial-services-organizations-301007128.html> (Accessed on 2 April 2022).
- 53 Meaning that a victim is attacked (breached) in an almost completely unnoticed way via a compromised third-party vendor in their supply chain. [European Union Agency for Cybersecurity \(2021\)](#) reported that more than 66% of compromised suppliers either did not know or failed to recognise in time the fact of the breach.
- 54 [Vague \(2021\)](#) found that, in a sample of 47 countries, since 1960, high inflation did not straightforwardly follow periods pervaded by rapid money supply growth.
- 55 Of course, there are dissonant voices to it; see: [Mian et al. \(2021\)](#).
- 56 What is more, financial development may foster growth via expanding opportunities, as [Levine \(2021\)](#) suggested, but insofar as we are dealing with a world economy filled exclusively with *homo oeconomicus*.
- 57 See: [Haddad and Lotfaliei \(2019\)](#). Leverage, measured as debt-to-equity, has been on a decreasing trend. In the EU27, corporate debt increased from 97.7 per cent of GDP to 99.8% in the period 2009–2019, while EU27 corporate financial leverage fell significantly from 73.6% to 53.3% during the same period.
- 58 See: [Kregel \(2012\)](#). Let us mention that the aspect of *becoming* has not been addressed at all by mainstream economics, either. It refers to irreversible processes emerging as a result of far-from-equilibrium systems, such as the open, adaptive and complex socio-economic innovation ecosystem. See more: [Kovács \(2022b\)](#).
- 59 See: [Caballero et al. \(2008\)](#); [McGowan et al. \(2017\)](#).

- 60 For instance, as Joseph E. Gagnon, senior fellow at The Peterson Institute for International Economics, articulated that “[ . . . ] Some economists are concerned that these “zombie” firms will drain resources from the healthy parts of the US economy, slow the recovery, and inhibit productivity growth. These fears are fundamentally misguided. Zombies are a consequence of a weak economy, not a cause.” Available: <https://www.piie.com/blogs/realtime-economic-issues-watch/whos-afraid-zombie-firms> (Accessed on 2 April 2022). Meanwhile, for instance, Schivardi et al. (2020) argued that the correlation between healthy firm performance and zombies is a mechanical consequence of an increase in the fraction of zombies with no causal meaning.
- 61 Noisier in the sense that zombification makes it more difficult to make a decision without errors (e.g., misinformation leading to wrong decisions when choosing suppliers that are, in turn, zombies, etc.). For a comprehensive account of noise, see: Kahneman et al. (2021).
- 62 On the complex nature of being zombie see Banerjee and Hofmann (2021) showing that a non-negligible share of zombies may be able to exit from the zombie status, in the case of Germany, Bittner et al. (2021) offered an account.
- 63 Because of shared norms and the ruling narrative over how the socio-economic system works, which was presented confidently by respect-experts in a way as Kahneman et al. (2021) suggested, people tended to assume that such moderating period will continue in the near future. For more on how such economics narrative backfired by neglecting underlying phenomena resulting in noise, see Kovács (2022b).
- 64 More nuanced views over zombification can be seen in a generalised manner or in a country-specific way (Duval et al. 2020; Blattner et al. 2019; Storz et al. 2017; Schivardi et al. 2020; Acharya et al. 2019; Peek and Rosengren 2005).
- 65 For instance, large and small banks may judge creditworthiness differently. By the same token, rating agencies are more prone to assign positive ratings to larger banks—especially because those banks often ask them to provide securities rating businesses as well. See: Hau et al. (2012).
- 66 Bank health and insolvency regime play an important role in the process as Andrews and Petroulakis (2019) documented.
- 67 See the inverted U-shaped relationship between credit access and productivity growth by Aghion et al. (2018).
- 68 See: OECD (2017). Many European core countries did change and ease insolvency laws in coping with COVID-19; see: <https://www.squirepattonboggs.com/-/media/files/insights/publications/2020/04/global-impact-of-covid19-on-insolvency-laws/global-impact-of-covid19-on-insolvency-laws.pdf> (accessed on 2 April 2022).
- 69 See: Kovács (2022b). When pursuing inclusive growth entails zombification, see the pivotal case of China by Zhang et al. (2020).
- 70 As Storz et al. (2017) documented, weaker banks, primarily in the Mediterranean region, typically have business relations with more zombie firms, who in turn are more likely to be sub-optimally indebted, making the bank even weaker.
- 71 The intensity of competition within the financial sector should not be overlooked as Claessens (2009) highlighted.
- 72 A more interventionist state is likely to be associated with a higher share of zombie bank presence as it was the result of Calderon and Schaeck (2016).
- 73 Although the ECB (SSM) has increased banks’ loss-absorbing capacity (trying to incentivise banks not to delay their write-offs) by significantly easing their capital requirements, so far, it has not counteracted enough the zombification effects of these steps mentioned.
- 74 A fine insights is advocated by Goto and Wilbur (2019) namely that total elimination of zombie firms can be as problematic as letting them flourishing.
- 75 Competitive release happens in living systems such as the socio-economic innovation ecosystem. For instance, in cancer research, we know that when treatment-sensitive cells die en masse due to intensive chemotherapy, the resistant subpopulations, that were previously controlled begin to explode rapidly, and the end result will be much worse than without treatment. See, for instance, Seton-Rogers (2016).
- 76 As Eurostat data suggest on annual enterprise statistics by size class for special aggregates of activities (NACE Rev. 2), the number of large companies (employing 250 employees or more) has been increasing since 2011 across the EU27. Regulation on insolvency regime was changed in Greece, Italy and Spain in an effort to dampen the number of zombies since 2010, and the data imply that as certain zombies were taken out from the system, medium and even larger companies could dominate in a more conspicuous way. For example, the number of large companies in manufacturing in 2011 was as follows: Greece (120), Italy (1269), Spain (814) and EU27 (14,600); meanwhile, it rose by 2019: Greece (138), Italy (1431), Spain (981) and EU27 (15,800). It is all the more telling that the number of medium-sized enterprises has been dwindling (that number was 102,000 in the EU27 in 2011, while it declined to 100,000 by 2019). See: Eurostat (SBS\_SC\_SCA\_R2).
- 77 As Brig. Gen. Gavin got the answer to his question “What’s the best way to take a bridge?” in the classical movie ‘A Bridge Too Far’, the best way is to take both ends at once.
- 78 Of course, applying Industry-4.0-related technologies is also of the essence in the financial system itself. See: Mehdiabadi et al. (2020).

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