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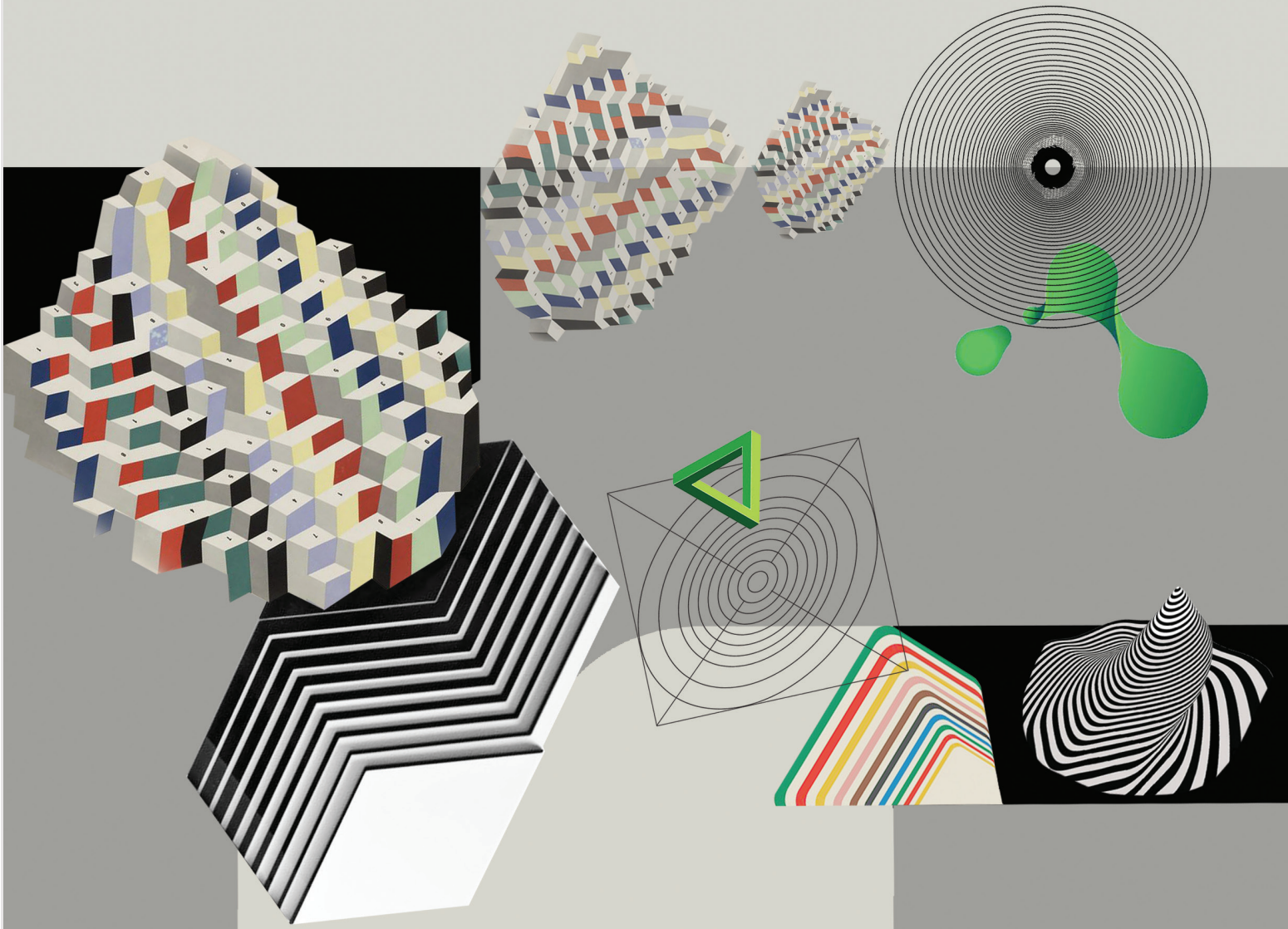
SPECIAL ISSUE

ENTREPRENEURSHIP: NEW CHALLENGES AND STRATEGIES



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Foresight and STI Governance is an international interdisciplinary peer-reviewed open-access journal. It publishes original research articles, offering new theoretical insights and practice-oriented knowledge in important areas of strategic planning and the creation of science, technology, and innovation (STI) policy, and it examines possible and alternative futures in all human endeavors in order to make such insights available to the right person at the right time to ensure the right decision.

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SPECIAL ISSUE

"ENTREPRENEURSHIP: NEW CHALLENGES AND STRATEGIES"

EDITORIAL

STRATEGIES

PANDEMIC: LESSONS AND TRENDS

Crisis as a Challenge and Enabler for Entrepreneurship: Lessons from the Pandemic

Introductory article by the editor of the special issue

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The present issue of the journal discusses the new challenges that occurred partly due to the COVID-9 pandemic, but also due to the massive changes that took place over the past decade in entrepreneurial environments in many economies and the respective strategies of entrepreneurs and entrepreneurial communities.

These entrepreneurial communities consist of many different actors including state and non-state support institutions, universities, venture industry, and business angels. These entrepreneurial ecosystems are by definition "glocal", i.e., they support local enterprises and start-ups in order to promote their growing performance and internationalization. Thus, while they are based on the same general structural principles, the concrete features of them might vary. The first paper by Marta Gancarczyk and Slavomir Konopa, opening the rubric "Strategies", explores the specifics of different regional entrepreneurial ecosystems in Poland. Their dynamics were investigated over the relatively long period of 2011-2018. The evidence is important, because it shows that there are several systems of governance of regional entrepreneurship ecosystems which were established in diverse Polish regions in order to promote so-called high-growth potential and the authors show that at least two relatively different systems of governance perform well. This evidence is so important because it contradicts the well-known 'one size fits all' approach. Not only might regional entrepreneurship ecosystems differ, but also the models of governance should be adjusted for regional/local conditions. Thus, the paper not only contributes to an understanding of the interplay between high-growth potential and the authorities and other actors of the regional entrepreneurship ecosystem, but also specifies respective models of good governance.

Universities belong, at least in developed knowledge-based market economies, to the core of the regional entrepreneurship ecosystem. Their role is especially important in providing different forms of entrepreneurial education. However, under the present conditions, there are plenty of open extra-university initiatives which contribute to entrepreneurship education, primarily online. Should universities compete or cooperate with such initiatives, widening their supply and attracting students and other prospective participants? Pavel Sorokin, Alexander Povalko, and Julia Vyatskaya have found and analyzed 45 such informal educational initiatives in Russia and they stress the prospective role of universities as assessing institutions which could develop and implement a quality control system of learning outcomes as well as conduct the monitoring of the effectiveness of such out-of-university-initiatives. Sure, some doubts can be raised about whether entrepreneurial universities, being by themselves engaged in entrepreneurship education, would become independent and impartial assessors. However, from a strategic point of view, starting a debate on the prospective forms of cooperation between universities and non-university institutions, especially in a context lacking several aspects of entrepreneurial ecosystems, like Russia, seems to be very important.

The COVID-19 pandemic became a 'black swan' for many firms and even whole industries, however, after more than a year, not only difficulties and problems have emerged, but also solutions and trends can be analyzed. The papers in the second part of this special issue are about the changes and consequences of them for entrepreneurship in the world. In the reflexive paper by Olga Belousova, Aard Groen, and Steven T. Walsh, there are some key questions under debate. Will the disruptive changes initiated by the pandemic be-

come sustainable, even after the pandemic ends? Can the COVID-19 crisis create an environment that fosters or suppresses entrepreneurial opportunities? The authors explore the main changes in business practices initiated by the pandemic. The most important contribution of this paper seems to be the discussion on the differences and the intertwining of opportunities caused by COVID-19 and the entrepreneurial opportunities created by the main drivers of economic development during the emergence of a long Schumpeterian wave of the so-called Industry 4.0. They point out that, contrary to traditional industry drivers, which usually start to develop in a single industry or in a group of related industries, the COVID-19 crisis has a pan-industrial character. As the pandemic coincided with the emergence of Industry 4.0, it accelerated the adoption of its most important forerunners. Thus, one might consider this a 'big enabler' according to Per Davidsson [Davidsson et al., 2021], widening the field of entrepreneurial opportunities.

Is this really so? The paper by Michael Fritsch, Maria Greve, and Michael Wyrwich provides an up-to-date overview of COVID-19's influence upon the early entrepreneurial landscape in Germany. They show that it affected not only the already existing entrepreneurial firms, but also the start-ups. Analyzing the available statistics of business registrations and business closures, they conclude that while the number of business entries slightly decreased during the first year of the pandemic, the effect was quite different in specific industries. Moreover, the segment of innovative manufacturing and technology-oriented service start-ups experienced even an increase, thus supporting the thesis of the previous paper. The negative effect not so much of the pandemic itself, but rather of state subsidies and the temporary suspension of some criteria enabling insolvency could weaken the German economy, because there were fewer exits in 2020 and a number of 'zombie' firms could survive. In general, according to this paper, the effect of the pandemic was twofold: it supported some ongoing structural changes, but in some sense it also distorted the normal functioning of the economy, but now it is unclear whether this effect will be only temporary.

The paper by Ondřej Dvouletý explores the pandemic's effect upon entrepreneurial activity in the Czech Republic in the short term, one year after its beginning. This article is based on data, which were obtained from the Czech Statistical Office. The results of the related panel regression models and tests comparing the forecasted values of new businesses entries and exits with the actual values obtained after the end of 2020 do not show any significant drop in Czech entrepreneurial activity. Contrary to pessimistic assumptions, Czech entrepreneurial activity even grew compared with the previous year. Sure, the evidence should be interpreted with caution, because some previous trends as well as the generous support of entrepreneurs by the Czech government during the pandemic could distort the picture. Thus, the author stresses that there is a need to check the long-term effects of the pandemic on the business demography and the structure of the sector especially in such important branches as tourism, hospitality, culture, and sport.

Nevertheless, both papers support the assumption that the impact of COVID-19 on entrepreneurship was manifold, in economies with well-functioning entrepreneurial ecosystems and rapid and sound state responses to the pandemic, entrepreneurship not only experienced shocks but also looked for some new opportunities. This was especially true for innovative new ventures.

However, in some larger economies with imperfect entrepreneurship ecosystems and huge cross-regional disparities in regional gross product, the wellbeing of the population, and the density of entrepreneurial firms, this might differ. Thus, in the paper by Stepan Zemtsov, Alexander Chepurenko, and Alexander Mikhailov, the situation of start-ups in Russian regions is observed. The article reveals the trends and factors of the creation of high-tech companies in the regions of Russia in 2013-2020. Contrary to both Germany and the Czech Republic, in 2020 the number of start-ups made up 40% less of the economy than in 2015 (which was a year of acute economic crisis). Most of them are concentrated in Moscow, Moscow region, and St. Petersburg. According to an econometric analysis, start-up activity in Russia depends upon the concentration of human capital, the availability of markets, and a favorable business climate, i.e., the same factors as in established market economies. During the pandemic, start-up activity declined minimally in regions with large agglomerations and a high level of education. It shows the importance of a certain density of human capital and the sustainability of educational and research infrastructure even in countries with lower performing institutions. Although the authors call for some regionalization of policies to support the start-ups and a number of concrete steps to manifest regional clusters with sustainable innovation incubation, the feasibility of such recommendations seems to be low under the pro-centrist structure of power and state funding in Russia.

Meanwhile, the biggest part of entrepreneurial activity in every economy is combined not with start-ups but with the so-called everyday entrepreneurship, i.e., with the businesses established by people who do not aim to achieve ambitious goals, but who nevertheless change the socioeconomic realms in their countries. In some of them, as in Italy, a certain part of entrepreneurial firms are represented by several third sector actors, among them, cooperatives. They were also forced to adapt their strategies to the dramatic changes that took place during the pandemic. The paper by Ermanno Tortia and Roberta Troisi is one of the first attempts in the literature to investigate the adaptive capacities of cooperatives in Italy and is based on a fresh pilot third sector survey in the Marche region (Spring 2021). The empirical results of the survey confirm the rather high

level of resilience of cooperatives, at least compared with other non-profit enterprises, during the pandemic. The authors relate it to the higher involvement of the staff in decision making and the adaptability of the work process to new circumstances. Therefore, in entrepreneurial ecosystems with a significant share of cooperatives, such organizations can play a buffering and anti-cyclical role during sudden crises while filling the supply gaps and even absorbing labor power.

There are some open questions, which the reader may raise after having read the papers presented in this special issue. The first question concerns whether the data obtained by statistical observations do indeed reflect the whole picture of entrepreneurial activity during the pandemic, including hybrid entrepreneurs and other forms of informal entrepreneurial activity. There are some signs that especially informal entrepreneurial activity has spread during the pandemic, but the nature of it and the expected socioeconomic outcomes have not yet been investigated. Second, the time constraints: we are now still collecting the evidence of the first year of the pandemic, but its prolonged effects upon entrepreneurship are not yet apparent. Third, these effects can be different by country and industry, and depend upon the activity of governments, regional authorities, business associations, other actors, and institutions. Thus, this topic will require another round of exploration in the future.

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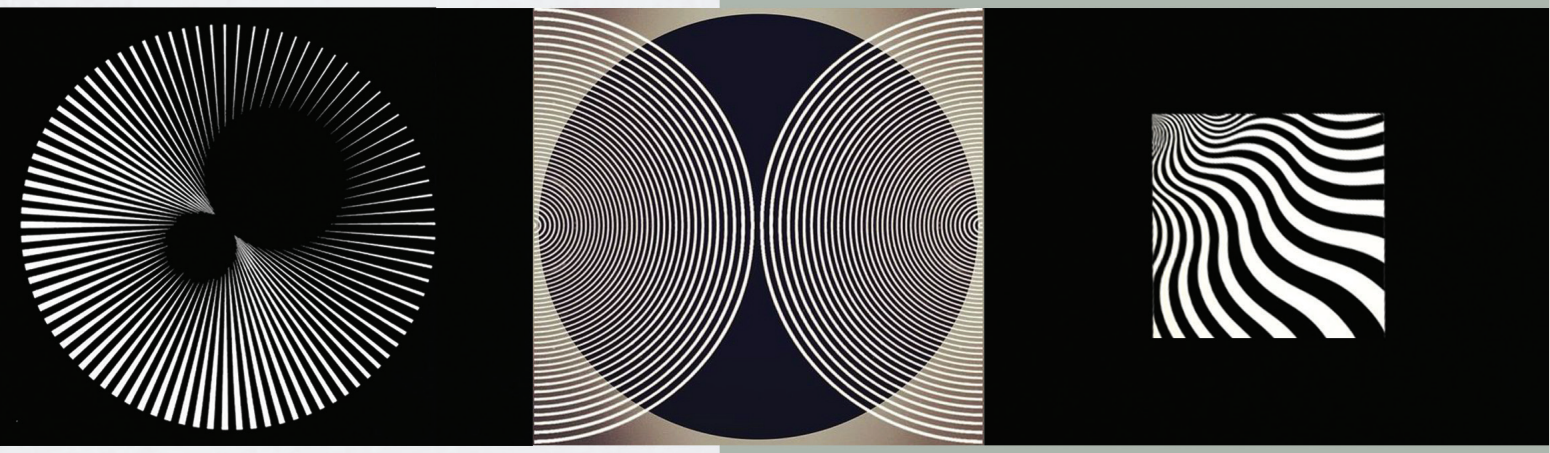
STRATEGIES



Exploring the Governance of Entrepreneurial Ecosystems for Productive High Growth

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Abstract

This paper aims to empirically identify the characteristics and governance types of regional entrepreneurial ecosystems (EEs) associated with productive high-growth entrepreneurship (PHGE). We developed a unique database comprised of public statistics on high-growth enterprises and regional EEs in Poland over the course of 2011–2018. The Hierarchical Clustering on Principal Components and a taxonomic analysis were used to identify how different types of EE governance relate to varying levels of high-growth enterprises' performance. We have identified and described the relationships between PHGE and diverse clusters of EE governance and evolution stages toward developed structures. Two clusters proved similarly effective in generating PHGE and they represent alternative EE governance solutions as well as the most advanced evolutionary phases. The proposed conceptualizations of productive high-growth entrepreneurship and EE governance types advance the understanding and measurement of these phenomena. The profiling and configurational approach adopted in this research reflects the heterogeneity of EE governance types and outcomes and can be further replicated in other research settings.

Key words: entrepreneurial ecosystems; high-growth enterprises; governance; productive entrepreneurship

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Entrepreneurial ecosystems (EEs) are broadly considered the relationships and interactions among industrial, social, and institutional conditions in specific territorial units to generate productive entrepreneurship [*Stam*, 2015; *Mason*, *Brown*, 2014; *Isenberg*, 2021]. The growing research on EEs is mostly concerned with the identification of combinations of agency and other systemic components in a particular territory vis-à-vis differentiated outcomes [*Wurth et al.*, 2021]. Still, the EE concept features important research gaps in terms of conceptualizations and measurements that might impede further academic advancements and effective territorial development policy.

First, the idea of EEs is under-developed regarding the nature of this phenomenon as a governance structure rather than just a configuration of actors and factors [*Colombo et al*., 2019; *Colombelli et al.,* 2019; *Cho et al.,* 2021]. Governance represents a regulatory, institutional structure that affects the performance and dynamics of territorial units [*Markusen*, 1996; *Williamson*, 2005]. Therefore, recognizing types of governance and their outcomes is critical for theory and policy. Second, a research gap exists regarding the conceptualization and measurement of productive entrepreneurship [*Wurth et al.*, 2021; *Torres*, *Godinho*, 2021]. Productive entrepreneurship is predominantly defined as high-growth enterprises (HGEs). This approach focuses on the role of company size dynamics in macroeconomic indicators [*Birch et al.,* 1995; *Coad*, 2009; *Acs et al.,* 2008; OECD, 2007, 2021; *Gancarczyk*, 2019]. However, the microeconomic efficiency of HGEs and the expansion-performance relationship for sustainable enterprise development are underscored [*Coad et al.,* 2020; *Mogos et al.,* 2015; *Steffens et al.,* 2009]. Consequently, the third, aggregate research gap refers to how productive high-growth entrepreneurship is affected by the EE governance [*Colombo et al*., 2019; *Brown et al.,* 2017; *Capozza et al.,* 2018].

Against the above underexplored areas, *the aim of this paper is to empirically identify the characteristics and governance types of regional entrepreneurial ecosystems associated with productive high-growth entrepreneurship.* We adopt multidimensional exploratory techniques of the Hierarchical Clustering on Principal Components and taxonomic analysis to identify how various types of EE governance are associated with differing levels of enterprise performance. As research material, a unique database was compiled from public statistics during the period 2011-2018 on Polish regional EEs and high-growth enterprises.

The study provides theoretical and policy-relevant contributions. It advances the literature on EEs by conceptualizing productive high-growth entrepreneurship in relation to EEs as outcome-oriented governance structures. Moreover, it contributes both to EE research and policy by empirically identifying how various types of EE governance contribute to productive high growth of enterprises. Correspondingly, the paper adds to the studies and policy on entrepreneurial growth by revealing how the growth performance nexus is conditioned by the regional context. This research is also valuable for profiling and as a configurational approach to the understanding of different EE governance types. The applied approach captures the heterogeneity of regional environments in generating economic outcomes.

Conceptualizing Productive High-Growth Entrepreneurship

From their inception, EE research and policy have been oriented toward productive entrepreneurship that contributes to economic output or capacity to increase this output [*Baumol*, 1996; OECD, 2010; *Dominiak et al.,* 2016]. So defined, productive entrepreneurship is predominantly captured as HGEs and unicorns that profoundly contribute to employment, value added, and innovation [*Birch*, 1995; *Acs et al.*, 2008; OECD, 2007, 2021]. Currently, one of the critical challenges in boosting EE studies is to clarify and specify the expected impacts from EEs and related measures [*Wurth et al.*, 2021, *Torres*, *Godinho*, 2021].

The present understanding of HGEs as productive entrepreneurship is often reduced to considerable and rapid size increases that ensure the referred macroeconomic outputs [OECD, 2007, 2021]. This approach ignores the importance of sustainability through microeconomic efficiency (e.g., profitability), which allows for the survival and continuing growth of enterprises [*Mogos et al.*, 2015; *Garnsey et al.*, 2006; *Steffens et al.*, 2009; *Coad*, 2009; *Zbierowski*, 2012; *Bolek*, 2018]. HGEs' intense investment in innovation and new markets induces low liquidity and solvency and thus raises concerns regarding performance and survival [OECD, 2021; *Oliveira*, *Fortunato*, 2006]. The focus on the efficiency of growth is also justified from a policy point of view since profitable growth alleviates the threat of failed public support. Correspondingly, theoretical approaches to firm expansion point to the difference between growth as size increases (measured by revenue, employment, asset value or value-added dynamics) and efficiency (measured by profitability dynamics) [*Achtenhagen et al.*, 2010; *Marris*, 1964).

Despite the above arguments, both the prevalent stream of research on HGEs and the current EE literature either miss the difference between size and performance measures or focus on size increases only, leaving performance issues underexplored [*Coad et al.*, 2020; *Achtenhagen et al.*, 2010; *Davidsson et al.*, 2009; *Steffens et al.* 2009; *Wurth et al.*, 2021]. Therefore, we clarify the concept of output from EEs as *productive high-growth entrepreneurship* that combines considerable size increases with efficiency, to ensure sustainability, i.e., survival and continuous expansion. Consequently, this paper also proposes a more fined-grained approach to the measures of productive entrepreneurship toward sustainability outcomes. The proposed approach reflects efficient expansion through growth performance measures, integrating size increase variables (e.g., sales, employment) and efficiency variables (e.g., profitability, liquidity).

Regional EEs as Outcome-Oriented Governance Structures

Entrepreneurial ecosystems emerged as a concept and policy drawing upon the importance of the territorial context for enterprise development. EEs represent sets of outcome-oriented and interrelated actors and factors from the business, social, and public spheres in the multi-scalar context of regional, country, and international conditions [*Stam*, 2017; *Stam*, *Spigel*, 2016; *Brown*, *Mason*, 2017; *Bruns et al.*, 2017]. Territorial units demonstrate unique combinations of the above characteristics, therefore, "one size fits all" solutions do not apply for the purpose of research and policy [*Mason*, *Brown*, 2014; *Brown*, *Mawson*, 2019; *Capozza et al.*, 2018]. Moreover, differing EEs might raise divergent outcomes in terms of productive entrepreneurship [*Brown*, *Mason*, 2017; *Wurth et al.*, 2021].

Territorial heterogeneity and complexity favor qualitative case studies as a research method, but this limits the opportunity to generalize the results. To overcome difficulties in generalizing, the governance concept can be adopted as a higher-order construct. This enables a theoretical synthesis to reveal the common rules that pertain to the types of regional EEs representing distinct governance structures and related outputs [*Colombo et al.*, 2019; *Colombelli et al.*, 2019].

Governance is considered institutional modes (structures) or sets of rules that regulate the functioning of a particular economic system and thus affect its efficiency and change [*Williamson*, 2005; *Markusen*, 1996; *Colombo et al.*, 2019; *Colombelli et al.*, 2019]. However, EE-specific governance remains a nascent theme with few conceptual papers and a lack of empirical evidence, in particular, a quantitative one. We advance this research by synthesizing differentiated EE governance based on the literature in innovation systems and clusters [*Markusen*, 1996; *Guerrieri*, *Pietrobelli*, 2004; *Brown*, *Mason*, 2017; *Stam*, 2015]. This literature suggests that different types of governance might determine investment and economic stability, upgrading, innovation, and the evolution of EEs to generate PHGE. Below, these outputs are systemized depending upon the type of governance and according to sets of governance discriminating criteria.

EE Governance according to Central Tenants

EEs are governance structures centered around key or central tenants that set out the rules for investment decisions and economic stability [*Colombelli et al.*, 2019]. These tenants differ in size and ownership and can comprise SMEs, large enterprises (LEs), foreign direct investors (FDIs), and public investors [*Mason*, *Brown*, 2014; *Isenberg*, 2021]. An *SME-dominated EE* benefits from predominantly local ownership of businesses. Rather than by external investors, investment decisions are controlled internally, which stabilizes the regional economy [*Markusen*, 1996; *Malizia, Motoyama,* 2019]. Most high-growers are young SMEs, however, growth and profitability of small firms are irregular and discontinuous [*Brown*, *Mason*, 2017; *Coad*, 2009]. Moreover, SMEs have limited potential to access international markets and technologies [*Felzenstein et al.*, 2015; *Brown*, *Mawson*, 2015]. The discontinuity of SME expansion and their limited capacity to compete internationally might negatively affect the prospects for resilience and sustainable profitability [*Felzenstein et al.*, 2015].

Ecosystems centered around large enterprises with local ownership enable major investment decisions to be determined within the region. LEs demonstrate more predictable and persistent growth than small firms thus ensuring a more stable expansion of SME subcontractors [*Brown*, *Mason*, 2017; *Coad*, 2009]. Large firms are sources of knowledge spillovers, venture funds, and spin-offs that turn into high growers [*Klepper*, 2007; *Colombo et al.*, 2019]. They also act as gate openers to international markets [*Munari et al.,* 2012].

An alternative to SMEs or LEs as regional focal firms are foreign direct investments (*FDI-based EEs*). In this case, major investment decisions, collaborative links, as well as sources of finance and technology, are located outside the region [*Markusen*, 2017; *Guerrieri*, *Pietrobelli*, 2004; *Pisoni et al.*, 2013]. A regional economy reliant upon FDIs is less stable due to the volatility of external investments [*Pathak et al.,* 2015]. In general, subsidiaries offer minor prospects for financing or knowledge transfer compared to locally owned SME- or LE-based ecosystems [*Pisoni et al.,* 2013]. However, knowledge and R&D-intensive FDIs, as well as subsidiaries embedded in the region, were found to be conducive for the expansion and enhanced performance of local firms [*Gorynia et al.*, 2007; *Bhawe*, *Zahra*, 2019; *Herrmann*, 2019].

Public investor-led EEs might be unstable due to political decisions and public budget constraints [*Humphrey et al.*, 2021]. However, well-targeted public funds enhance structural change and progressive regional transformation [*Foray*, 2014; *Lema et al.,* 2018]. Public sources of financing and knowledge transfer often trigger startups and scale-ups [*Arauzo-Carod et al.*, 2018; *Corrente et al.*, 2019].

EE Governance according to Socio-Business Collaboration and Human Resource Competence

Based on territorial collaboration and human resource competence, hierarchical and relational governance modes can be distinguished, which determine opportunities for learning and upgrading. Upgrading is moving up the value chain toward more knowledge-intensive activities and higher added value (such as the transition from manufacturing to engineering and design) [*Humphrey et al.*, 2021; *Gereffi et al.*, 2005]. The intensity of collaboration among various social and business actors determines mutual learning. Benefits from socio-business collaboration are enabled by human resource competence [*Bhawe*, *Zahra*, 2019; *Lehm-*

ann et al., 2019]. Lower-skilled labor is less capable of absorbing knowledge spillovers and benefiting from collaboration [*Tingvall*, *Videnord*, 2018]. *Hierarchical EE governance* features lower human resource competence and limited regional collaboration [*Colombelli et al.*, 2019; *Gereffi et al.*, 2005]. This governance enables only minor opportunities for upgrading local enterprises [*Pisoni et al.*, 2013]. Alternatively, *relational EEs* demonstrate intense collaboration and high human competences, allowing for knowledge spillovers and upgrading [*Colombelli et al.*, 2019; *Gereffi et al.*, 2005].

EE Governance according to Knowledge Sources

Based on the criteria of knowledge sources, such as formal, science-based knowledge or tacit, experienced-based knowledge, the main governance modes are identified [*Jensen et al.*, 2007; *Alhusen*, *Bennat*, 2021]. These in turn affect the intensity and type of innovation which is widely reported as conducive to the growth of firms [*Audretsch et al.,* 2014; *Arauzo-Carod et al.*, 2018]. To overcome the liabilities of smallness in the area of investment in innovation, SMEs need external R&D and knowledge transfer [*Stam*, 2015; *Mason*, *Brown*, 2014]. SMEs in R&D and knowledge-intensive industries often grow dynamically [*Coad*, *Grassano*, 2019; *Przybylska*, 2018]. In the *science-technology-innovation (STI) model*, focal enterprises use science-based knowledge from their own R&D departments, universities, and specialized technology firms to generate breakthrough product innovations [*Jensen et al.*, 2007; *Alhusen*, *Bennat*, 2021].

These focal companies establish less intensive business collaborations with non-R&D suppliers, such as SMEs, who benefit from process innovations. In the *doing-using-innovation (DUI) model*, focal firms form intense business collaboration with SME suppliers. This governance generates incremental product and process innovations, based on the exchange of practices and routines rather than science-based knowledge [*Jensen et al.*, 2007; *Alhusen*, *Bennat*, 2021]. In the most advanced *combined and complex innovation (CCI) model*, focal firms adopt both an R&D-intensive model of STI, as well as a practice-based model of DUI, with related product and process innovations [*Isaksen*, *Karlsen*, 2012].

EE Governance according to Evolutionary Phases

Ultimately, territorial governance changes with EE evolution or life cycles that explain how EEs start and advance into fully developed structures [*Cho et al.*, 2021; *Mack*, *Mayer*, 2016].

A conceptual development proposed by [*Colombelli et al.,* 2019] looks at EE evolution through the lens of intensity and density of internal collaboration. Based on their approach, the birth phase features weak internal collaboration, the transition phase represents intermediate collaboration, while the consolidation (developed) phase accomplishes strong collaboration. Brown and Mason [*Brown, Mason,* 2017] identify embryonic (early stage) and scale-up (developed) EEs according to characteristics such as intensity of entrepreneurial activity and HGEs, collaboration and international linkages, and public financing. Considering that many EEs are in a transition or in an intermediate stage, a three-stage framework is appropriate for taking take into account EE progress and related governance. This framework covers *the EE phases of birth, transition, and consolidation* – from low to increasing intensity of entrepreneurial activity, international linkages, and socio-business collaboration, and from high to decreasing public involvement.

Individual EEs might concurrently represent various governance types that differently contribute to productive high-growth entrepreneurship. As mentioned, this area is empirically under-researched and requires explorative investigations. Therefore, we formulate the following research questions:

RQ 1. How does the performance of high growers differ in different EE governance types?

RQ 2. What are the characteristics and types of EE governance that generate productive high-growth entrepreneurship?

Method

The construct of EEs and their governance represent complex categories that need to be described by several observable variables. This poses a challenge for operationalizing and measuring the EE phenomenon and its outcomes in a comprehensive way. The extant evidence of EE influence is predominantly based on the case studies of successful regions, while quantitative approaches are less common [*Wurth et al.*, 2021]. The aim of this study and the above research questions justify the adoption of an exploratory analytical approach. Consequently, we used the Hierarchical Clustering on Principal Components and a taxonomic technique to identify how different types of EEs associate with varying levels of performance of high growth enterprises [*Jolliffe*, 2002; *Sanguansat*, 2012]. This approach is also suitable when the studied phenomenon features many variables against a limited number of observations. Since EEs are delimited within the boundaries of particular territorial units, this research captures EEs as regions, based on Polish voivodeships.

We developed a unique database that combines public statistics on the expansion and performance of high growth enterprises in the Polish regions (voivodeships) and data on the structural characteristics of these regions in 2011-2018. This period has been determined by the accessibility of the data on high growers and other critical dimensions describing regional EEs. The year 2011 is the earliest available starting point for the data on high growers in the OECD, Eurostat, and Polish statistics, following the first definitions and measurement methodologies [OECD, 2007, 2021]. The source of data on high growers is a survey conducted by Statistics Poland, in which high growers are enter-

prises employing at least 10 people, with at least 20% annual increase in revenues over three consecutive years. An aggregate size increase is expressed by total revenue growth rate of 72.8% or more [OECD, 2021; see also Statistics Poland[1], 2018]. The number of the surveyed HGEs amounted to 3,746 in 2011, 5,300 in 2012, 4,012 in 2013, 3,351 in 2014, 3,768 in 2015, 3,985 in 2016, 3,940 in 2017, and 4,533 in 2018 [Statistics Poland, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020]. The data on the characteristics of EEs were extracted from the Local Data Bank of Statistics Poland that follows the methodology of Eurostat's Structural Business Statistics, Business Demography Statistics, and the European Innovation Survey in the regional context.

A theory-driven set of governance criteria versus productive high growth entrepreneurship and corresponding variables are presented in Table 1.

The structure of central tenants is expressed as the number of micro (MICRE), small (SE), medium (ME), large (LE), and FDI enterprises per 1,000 inhabitants in the region (European Commission, 2020; Markusen, 1996). The engagement of the public investor (PUBL) is captured as the amount of the EU Structural Funds per capita. Socio-business collaboration (ORG) comprised non-profit organizations that integrate social and business targets [*Malizia*, *Motoyama*, 2019; *Litzel*, 2017]. Human resource competences have been captured as a percentage of the population with a tertiary education (EDU). SMEs pursuing formal collaboration within clusters or other agreements are an approximation of business collaboration (CLUST). International collaboration has been captured as the export activity of high growers (EXP) and as the density of FDI-backed enterprises (FDI), with the latter variable being also informative for the structure of central tenants [*Munari et al.*, 2012]. Internal (I_RD) and external (E_RD) expenditures in regional GDP have been separately acknowledged in order to identify the sources of science-based knowledge - within EEs or from external entities [OECD, 2015; OECD-Eurostat, 2018]. Innovative activity comprised the shares of enterprises innovating in the area of product (INPROD) or process (INPROC) [OECD, 2015]. Finally, productive high growth entrepreneurship (PHGE) has been aggregated as a latent variable comprising HGEs' size and efficiency dynamics, i.e., the dynamics of revenue and three efficiency measures. Recently, Acs et al. [*Acs et al.*, 2008] have also adopted an aggregate variable when measuring growth input to job creation in order to avoid a bias from one size measure only.

Based on the above theoretical background, Table 2 explains the configurations of criteria and variables indicating types of EE governance.

Results

The PCA analysis produced two dimensions of variables included in Table 3. The variables of export (EXP) and internal R&D expenditures (I_RD) did not prove a significant correlation with the first and second principal components, and they were excluded from further analysis.

The correlation between the variables and dimensions (principal components) is significant at the level of 0.01.

Dimensions 1 and 2 explain 54.73% and 20,16% of variance, respectively, which accounts for 74.89% of the overall data variance [*Sanguansat*, 2012]. These two dimensions were selected for their highest explanatory power regarding the variance in data, and the variance above 70% enables a reliable analysis (Figure 1) [*Jolliffe*, 2002].

Dimension 1 reveals a positive correlation among productive high growth entrepreneurship (PHGE) and such characteristics of regional EEs as the density of socio-business links (ORG), the number of micro, small, medium, and large enterprises (MICRE, SE, ME, LE) as well as FDI-backed enterprises (FDI), human resource competences (EDU), and external R&D expenditures on investment (E_RD). The variable of public support (PUBL) has proven to be a de-stimulant, negatively correlated with Dimension 1 (Table 3, Figure 1).

Dimension 2 differentiates the regions, however, it does not correlate with the variables forming Dimension 1, including productive high growth entrepreneurship (PHGE). Based on earlier research, we adopted a theory-based assumption that business collaboration (CLUST) and innovation (INPROD, INPROC) are inputs and conditions for growth and efficiency, which reveal their impact in the longer term [*Audretsch et al.*, 2014; *Arauzo-Carod et al.*, 2018] Consequently, further hierarchical cluster analysis comprised both dimensions and produced six clusters of regional EEs (Figure 2).

The descriptive statistics of EE clusters (Table 4) include an aggregate relative indicator (average) for a given dimension, defined as the average of the variables' normalized values.

The mean relative differentiation of variables in each cluster is acceptable to treat the identified clusters as internally coherent types of ecosystems (Table 4). The high shares of deviations in the mean for Cluster 1 in Dimension 1 and for Cluster 5 in Dimension 2 are acknowldged in further interpretations. Cluster 6 in Dimension 1 takes the highest values of the variables and represents the point of reference, therefore, here the relative differentiation equals zero percent.

To understand the characteristics of clusters and synthesize their governance profiles related to productive entrepreneurship, we performed a taxonomic analysis (Table 5). The variables were defined as stimulants and normalized to values ranging from 0-1.

The six clusters of EEs represent differing levels of high growth enterprises' performance and the context components correlated with this performance in Dimen-

[1] https://stat.gov.pl/en/topics/economic-activities-finances/activity-of-enterprises-activity-of-companies/,accessed 01.07.2021.

Table 1. **Variables Describing Ecosystem Governance and Productive High-Growth Entrepreneurship**

Governance criterion	Variable	Description
Central tenants	MICRE	Number of enterprises with 0-9 employees per 1,000 inhabitants*
	SE	Number of enterprises with 10-49 employees per 1,000 inhabitants*
	ME	Number of enterprises with 50-249 employees per 1,000 inhabitants*
	LE	Number of enterprises with >250 employees per 1,000 inhabitants*
	PUBL	Public support from the Structural Funds in million PLN per capita, nominal prices*
	FDI	Number of enterprises with foreign capital per 10,000 inhabitants*
Socio-business collaboration	ORG	% of non-profit organizations promoting labor market and labor activity*
Human resource competence	EDU	% of population with tertiary education*
Business collaboration	CLUST	% of enterprises with 10-249 employees cooperating in clusters or other formal initiatives*
International collaboration	FDI	Number of enterprises with foreign capital per 10,000 inhabitants*
	EXP	High-growers' net revenue from export sale in million PLN per enterprise*
Science-based sources of knowledge	I_RD	Internal R&D expenditures as % of regional GDP*
	E_RD	External R&D expenditures as % of regional GDP*
Innovation	INPROD	% of enterprises with at least one product innovation*
	INPROC	% of enterprises with at least one process innovation*
Productive high-growth entrepre-neurship	PHGE	Latent variable* as the mean of four normalized indicators: % increase of revenue, % increase of gross financial result, gross turnover profitability indicator, % increase of 1st degree financial liquidity

* Mean 2011-2018 except for E_RD and INPROC accessible only for 2011-2017.
Source: own elaboration based on Statistics Poland, Local Data Bank.

sion 1 (Table 5). They also vary in scores for Dimension 2, denoting theory-based inputs for sustainable growth. The highest performer in terms of the growth efficiency nexus (PHGE) and related EE characteristics in Dimension 1 is Cluster 6. However, it comprises only one EE, namely, the Mazowieckie region with the major city of the capital of Poland. This case needs to be treated as an outlier, since the statistics of the capital city dominate this region, and most indicators represent the city as a unique administrative unit rather than the entire region. That bias could not have been alleviated, since the data on HGEs refer to Mazowieckie, without discriminating between the Warsaw metropole and the surrounding region. Consequently, we remove Cluster 6 from the analysis of the findings and focus on the five other clusters.

Clusters 4 and 5 demonstrate the highest and relatively similar scores regarding productive high growth entrepreneurship. At the same time, the characteristics of their values in Dimensions 1 and 2 (Tables 4 and 5) and governance profiles (Table 6) considerably differ.

Cluster 5 (Pomorskie, Wielkopolskie) rates the highest in Dimension 1 including the conditions directly associated with PHGE, but it is the second lowest in Dimension 2, which contributes to longer-term efficiency. This cluster features low public involvement, but relatively high density of LEs, SMEs, and FDIs that jointly form a balanced structure of central tenants. Dense socio-business links support the relational governance structure, however, only medium-level human resource competences weigh toward a combination of relational and hierarchical governance. External R&D scores are medium and, at the same time, the cluster reveals weak innovative activity, acknowledging the difference in favor of Pomorskie (Figure 2). The reason for the weak innovation might be that the moderate STI model based on external R&D is not supported by the practice-based DUI governance, due to low business collaboration. Regarding the evolutionary phase, dense entrepreneurial activity, socio-business collaboration, international linkages, and low public involvement point toward a developed EE system. However, considering the low business collaboration, Cluster 5 represents the late transition-consolidation phase.

Cluster 4 (Dolnoslaskie, Malopolskie, Slaskie) rates the second highest in Dimensions 1 and 2. Moderate public involvement, high density of LEs and FDIs, and only medium density of SMEs point to large firms and foreign investors as central tenants. Intense internal collaboration and highly educated human resources enable relational governance. High external R&D investment provides evidence of strong science-based (STI) governance. At the same time, the cluster's high innovative output is not directly correlated with R&D in Dimension 1, but rather with business collaboration (Dimension 1), and the cluster features a medium level of business collaboration. This suggests that the innovative performance is also driven by tacit knowledge

Table 2. **The Configurations of Variables Adopted to Determine EE Governance Types**

Criteria and variables	Type of EE governance
Central tenants: micro-enterprises (MICRE), small enterprises (SE), medium enterprises (ME), large enterprises (LE), foreign direct investment (FDI), public support (PUBL)	SME-based, LE-based, FDI-based, Public investor-based
Socio-business collaboration (ORG), human resource competence (EDU)	Hierarchical governance, relational governance
Science-based sources of knowledge (I_RD, E_RD), innovation (INPROC, INPROD), business collaboration (CLUST)	STI, DUI, CCI governance
Entrepreneurial activity (MICRE, SE, ME), international linkages (FDI), socio-business collaboration (ORG), business collaboration (CLUST), public support (PUBL)	Birth, transition, and consolidation governance as EE evolves

Source: own elaboration.

and the experience-based model of DUI. Strong international linkages (FDI investment) and socio-business links prove the developed EE system. However, considering a weaker entrepreneurial activity as the proportion of SMEs vs LEs, a medium level of business collaboration, and medium public involvement, the referred EEs represent the transition-consolidation phase of evolution.

Cluster 3 (Lubuskie, Lodzkie, Kujawsko-Pomorskie, Zachodniopomorskie) demonstrates only moderate values in PHGE and the correlated criteria of EE governance. FDIs, the public investor, and SMEs hold the position of central tenants. Public support takes higher values and FDIs hold a relatively stronger position vis-à-vis LEs than in the leading clusters 4 and 5. The low level of human competence and medium level of socio-business links point to hierarchical governance. External R&D is low, taking profoundly weaker values than in the best performing clusters. As a result, low-to-medium innovation activity in Cluster 3 is accomplished through a mixture of weak STI and moderate DUI governance (medium business collaboration). The international linkages of Cluster 3 are strong, however, due to the medium levels of public involvement, entrepreneurial activity, as well as business and socio-business links, Cluster 3 meets the requirements for the transition stage.

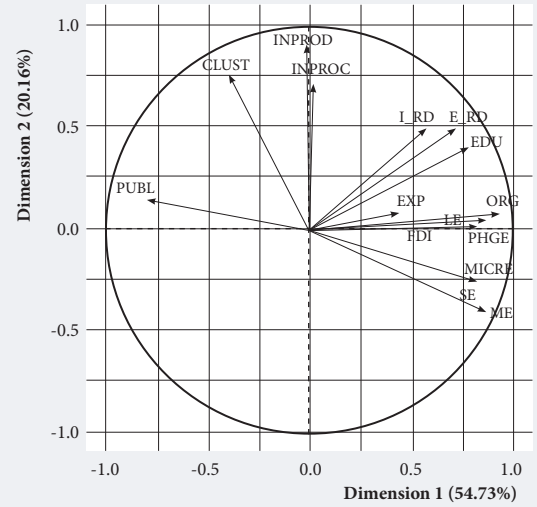
Cluster 2 (Lubelskie, Opolskie, Podkarpackie, Podlaskie) rates the second lowest in PHGE and correlated variables of Dimension 1, while in Dimension 2, it is the highest performer among the five EE groupings. Public investor and FDIs act as central tenants. This is due to the considerably higher public funds and weaker entrepreneurial activity. Similar to Cluster 3, FDIs have a relatively stronger position compared to LEs than in the best performing clusters. Low human competence and low socio-business collaboration indicate hierarchical governance. STI governance is weak due to low external R&D. The strongest innovative output can be attributed to the most intense business collaboration among all the clusters, proving a strong DUI governance. Intense business collaboration combined

Table 3. **Two Dimensions of Variables Produced by the PCA Analysis**

Variable	Correlation	P-value
Dimension 1		
PHGE	0.9658343	1.331213e-09
ORG	0.9405466	6.011350e-08
LE	0.9327047	1.401061e-07
FDI	0.9128340	8.121140e-07
ME	0.8833916	5.745165e-06
SE	0.8714761	1.098492e-05
MICRE	0.8395073	4.757921e-05
EDU	0.7896126	2.747577e-04
E_RD	0.7262494	1.443392e-03
PUBL	–0.7898403	2.728606e-04
Dimension 2		
INPROD	0.9338522	1.245992e-07
CLUST	0.7615736	6.084131e-04
INPROC	0.7025502	2.406230e-03

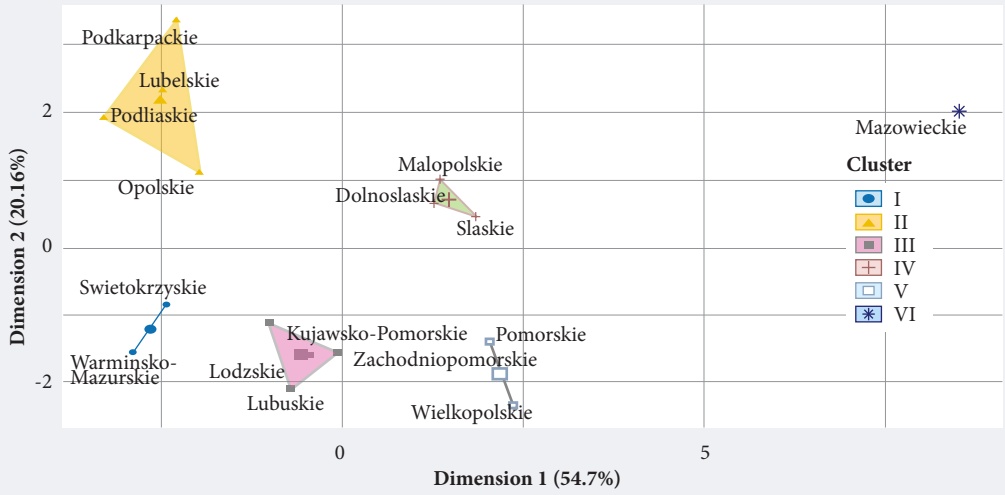
Source: own elaboration.

Figure 1. **The Strength and Direction of Correlation between Variables and Dimensions 1 and 2**



Source: own elaboration.

Figure 2. **Clusters of Regional EEs Based on Two-Dimensional PCA**



Source: own elaboration.

with medium international linkages can lead to the future advancement of PHGE. Still, weak socio-business collaboration, low entrepreneurial activity, and high public involvement point to the birth-early transition phase of EE evolution.

Cluster 1 (Swietokrzyskie, Warminsko-Mazurskie) scores the lowest in terms of PHGE and governance criteria in Dimensions 1 and 2. Backed by public investors and SMEs as central tenants, it almost lacks FDI. Hierarchical governance is determined by very low human competences and low socio-business collaboration. Low external R&D (weak STI governance) and moderate performance in product and process innovations meet medium business collaboration. The latter acts as the driver for moderate DUI governance in terms of knowledge sources. The interpretation of the overall values for Dimension 1 should acknowledge a large differentiation between two EEs included in Cluster 1 (Table 3). Namely Swietokrzyskie shows better performance in this regard than Warminsko-Mazurskie (Figure 2). Weak performance in entrepreneurial activity, international linkages, and socio-business collaboration as well as medium business collaboration and high public engagement reveal the birth phase of Cluster 1.

Discussion and Contributions

Discussion of Results

Our research has addressed the aim to empirically identify the characteristics and governance types of regional entrepreneurial ecosystems associated with productive high growth entrepreneurship. This aim was guided by two research questions, regarding the differences in high growers' performance in the various types of EE governance (*RQ1*) and regarding the characteristics and governance types of EEs that generate PHGE (*RQ2*).

The identified types of EE governance enable the identification of relationships and causalities among actors and factors [*Colombo et al.*, 2019]. Instead of one solution only, two clusters ensure the similarly high performance of HGEs and they represent alternative EE governance profiles regarding expected output. These governance profiles are close to the developed EE phase of consolidation. Nevertheless, they are not fully developed and reveal both strengths and weaknesses.

Cluster 4 builds its strengths on the lead position of large enterprises and foreign subsidiaries as central tenants. The relational governance ensures absorptive capacity and knowledge spillovers to upgrade in global value chains, while LEs and FDIs provide access to international markets and resources outside the region [*Colombo et al.*, 2019; *Munari et al.*, 2012; *Lehmann et al.*, 2019]. The external orientation is also reflected in strong science-based (STI) governance that relies on the acquisition of external knowledge. Strong STI governance combined with a moderate DUI model produce high innovative performance [*Audretsch et al.*, 2014; *Coad*, *Grassano*, 2019]. This performance and business collaboration provide prospects for the future expansion and profitability of HGEs [*Audretsch et al.*, 2014]. What can raise concerns about the sustainability of this system is only the middling level of entrepreneurial activity. The latter combined with the predominance of external sources of knowledge signals weaker internal potential for innovation and entrepreneurship [*Markusen*, 1996] and thus threatens the prospects for the transition to the consolidation phase [*Colombelli et al.*, 2019]. The overly dominant position of LEs or FDIs vs local SMEs might prevent mutuality and balancing

Table 4. **Descriptive Statistics of the EE Clusters**

Statistics	Cluster					
	I	II	III	IV	V	VI
Dimension 1						
Standard deviation	0.10	0.06	0.15	0.09	0.22	0
Average	**0.12**	**0.15**	**0.31**	**0.44**	**0.51**	**1**
Coefficient of variation (%)	80.1	39.27	48.87	20.20	43.30	0
Dimension 2						
Standard deviation	0.04	0.14	0.07	0.21	0.07	0.31
Average*	**0.23**	**0.65**	**0.20**	**0.52**	**0.13**	**0.61**
Coefficient of variation (%)	19.66	22.13	33.9	39.91	50.65	51.26

* — the computation of Average in Dimension 2 recognizes PUBL as a de-stimulant, negatively correlated with PHGE.

Source: own elaboration.

costs and benefits among the EE tenants [*Brown*, *Mason*, 2017; *Munari et al.*, 2012].

Cluster 5 builds its PGHE based on the balanced enterprise structure with large firms, FDIs, and strong local SMEs as central tenants [*Markusen*, 2017; *Stam*, 2015]. The combination of relational and hierarchical governance can ensure the absorption of knowledge spillovers and support upgrading toward higher value-adding activities. However, a moderately developed STI model with weak DUI application and business collaboration lower the prospects for innovation – at present, the lowest among the researched clusters [*Litzel*, 2017; *Grillitsch*, *Nilsson*, 2019]. The transition to a developed EE will depend upon increasing innovation and business collaboration, and on the further advancement of human competence to reap the benefits from collaboration with LEs and FDIs [*Audretsch et al.*, 2014; *Brown*, *Mason*, 2017].

Regarding the EEs that are less favorable environments for PHGE and occupy lower evolutionary stages, they suffer from the scarcity of large firms and host public investors, FDIs, and SMEs as central tenants. Predominantly hierarchical governance might prevent the upgrading of enterprises in value chains. Governance types employed for innovation activities are chiefly experienced-based, while science-driven models are weak. Nevertheless, Cluster 2 proves that strong experience-based models of innovation supported by public investors and FDIs can produce the highest innovative output of all EE groupings. To advance to more developed EE stages that produce PHGE, the relevant clusters need to improve the conditions directly contributing to sustainable entrepreneurship. These are primarily human competences and the strength of internal collaboration toward relational governance and upgrading.

Contributions

The paper conceptually and empirically advances the research on EE governance and related output. The relationship between firm growth efficiency and the characteristics of the external environment represents the core of the concepts of EEs and enterprise growth, however, it remains underexplored [*Brown*, *Mason*, 2017; *Brown*, *Mawson*, 2019; *Stam*, 2015]. To the best of our knowledge and based on the most recent reviews [*Wurth, et al.*, 2021], this study is unique in tack-

Table 5. **Taxonomic Analysis of Six Clusters of EEs according to Two Dimensions**

Variable	Cluster					
	I	II	III	IV	V	VI
Dimension 1						
PHGE	**0.02 (Very low)**	**0.12 (Low)**	**0.25 (Medium)**	**0.42 (High)**	**0.44 (High)**	**1**
ORG	0.08 (Low)[1]	0.08 (Low)	0.20 (Medium)	0.5 (High)	0.53 (High)	1
LE	0.15 (Low)	0.15 (Low)	0.21 (Medium)	0.35 (High)	0.34 (High)	1
FDI	0.02 (Low)	0.14 (Medium)	0.23 (High)	0.27 (High)	0.28 (High)	1
ME	0.30 (Low)	0.18 (Low)	0.41 (Medium)	0.46 (Medium)	0.77 (High)	1
SE	0.27 (Low)	0.26 (Low)	0.53 (Medium)	0.6 (Medium)	0.79 (High)	1
MICRE	0.14 (Low)	0.23 (Low)	0.45 (Medium)	0.51 (Medium)	0.65 (High)	1
EDU	0.02 (Very low)	0.08 (Low)	0.14 (Low)	0.43 (High)	0.32 (Medium)	1
E_RD	0.11 (Low)	0.14 (Low)	0.14 (Low)	0.43 (High)	0.22 (Medium)	1
PUBL[2]	0.14 (High)	0.16 (High)	0.5 (Medium)	0.45 (Medium)	0.76 (Low)	1
Dimension 2						
INPROD	0.18 (Medium)	0.75 (High)	0.12 (Low)	0.67 (High)	0.08 (Low)	0.83
INPROC	0.26 (Medium)	0.72 (High)	0.22 (Medium)	0.6 (High)	0.11 (Low)	0.74
CLUST	0.25 (Medium)	0.49 (High)	0.25 (Medium)	0.28 (Medium)	0.20 (Low)	0.25

[1] Nominal scales were determined according to the least differences among the values within scale intervals.

[2] The values for PUBL acknowledge the nature of this variable as a de-stimulant.

Consequently, the lower the values for PUBL in Table 5, the higher the amounts of public support.

Source: own elaboration.

Table 6. **PHGE and Governance Profiles of the EE Clusters**

Governance criteria	Clusters				
	I	II	III	IV	V
PHGE maturity	Low	Low	Medium	High	High
Central tenants	Public investor and SMEs	Public investor and FDIs	FDIs, SMEs, public investor	LEs and FDIs	LEs, FDIs and SMEs; a balanced enterprise structure
Socio-business collaboration, human resource competence	Hierarchical	Hierarchical / nascent relational	Hierarchical	Relational	Relational / hierarchical
Sources of knowledge (application of governance models)	Weak STI, moderate DUI	Weak STI, strong DUI	Weak STI, moderate DUI	Strong STI and moderate DUI	Moderate STI, weak DUI
Evolutionary phase	Birth	Birth / early transition	Transition	Transition / consolidation	Late transition / consolidation

Source: own elaboration.

ling these issues on theoretical and empirical grounds. Our findings raise three contributions, namely, i) to the literature on entrepreneurial ecosystems, ii) to the research on entrepreneurial growth, and iii) to related policy areas.

First, regarding the research on EEs, this research proposes a theoretical advancement, by broadening the concept of EE and by conceptualizing the output of EEs as productive, i.e., efficient and thus sustainable, high growth entrepreneurship. The concept of territorial governance enabled an advanced theorizing and generalization of EE governance types and related outcomes. Resonating with the most recent research agenda in EEs, our study fulfills the calls for functional and outcome-oriented approaches [*Wurth et al.,* 2021, *Mason*, *Brown*, 2014; *Brown*, *Mason*, 2017]. By emphasizing governance rather than isolated components and individual variables, it addresses the complexity of EEs [*Stam*, 2015; *Grillitsch*, *Nilsson*, 2019].

To identify alternative governance arrangements associated with enterprise growth and performance, a configurational and taxonomical approach has been adopted. This approach reflects a variety of territorial EEs, instead of promoting one universal model for all locations [*Herrmann*, 2019; *Hassink et al.*, 2019]. It also enhances knowledge building through profiling these complex phenomena [*Brown*, *Mawson*, 2019]. Namely, the research can accumulate the knowledge of several alternative governance solutions and move toward a more comprehensive understanding of EEs [*Wurth, et al.*, 2021]. Nascent studies in EE governance focused on qualitative cases of life cycles captured as particular organizations and territories [*Colombelli et al.*, 2019]. This study is unique in the quantitative generalizations of EE governance, since extant quantitative studies were focused on individual EE components.

Second, this research contributes to the studies on firm growth by expanding the knowledge on external and territorial conditions for profitable and thus sustainable expansion. The extant studies are dominated by internal characteristics of high growers, while external factors are under-researched [*Shepherd*, *Wiklund*, 2009; *Welter et al.* 2019]. Moreover, the existing research does not pay enough attention to growth performance relationships [*Davidsson et al.*, 2009, *Coad et al.*, 2020]. This paper explores how the external environment formed by EE governance associates with the performance of HGEs and it identifies the most effective governance arrangements in this regard. Like other studies, it confirms the importance of environmental resource munificence [*Chandler, McKelvie, Davidsson*, 2009; *Corrente et al.*, 2019]. It differs in going beyond environmental components toward advanced theorizing through the lens of governance.

Third, our findings provide a policy-relevant contribution. The identified alternative EE profiles might serve as canvas for setting up entrepreneurship policy and regional policy directed toward the upgrade of EEs [*Brown*, *Mawson*, 2019]. Policymakers might consider the best performing EEs as benchmarks for developing tailored public measures for weaker ecosystems [*Brown*, *Mawson*, 2019; *Colombelli et al.,* 2019]. The latter can be strengthened in the areas that proved less developed than in the leading environments.

The policies for entrepreneurship and regional development should also consider the role of the EU Structural Funds identified as negatively correlated with the performance of HGEs. This relationship might be typical of less developed regions, where EU funds are predominantly directed at cohesion [*Wojnicka-Sycz*, 2020]. In the period considered, Polish regions were low-to-moderate performers in terms of competitive and innovative positions among their European counterparts (RIS data, 2012, 2016[2]; and ERCI data[3], 2010, 2013, 2016). Nevertheless, since productive entrepreneurship is recognized as a key driver of re-

[2] https://ec.europa.eu/growth/industry/policy/innovation/regional_en/, accessed 01.07.2021.

[3] https://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness/, accessed 01.07.2021.

gional development [*Audretsch et al.*, 2014; *Grillitsch*, *Nilsson*, 2019], policy should also target regional upgrading and innovation capacity development for enterprise growth and performance. As was revealed for the EEs with the greatest public support (Clusters 1 and 2), the EU funding can yield different results in terms of catching up. One of the explanations rests on the different quality of governance regulating these ecosystems.

Limitations and Implications

Ultimately, we need to acknowledge the limitations of this study and ways of addressing them. One country-specific setting can be seen as a limitation of this study. However, considering the heterogeneous nature of regional EEs, a more fine-tuned approach can be accomplished when a consistent institutional system is investigated [*Asheim*, 2019; *Hassink et al.*, 2019]. This enhances proper interpretations of causal mechanisms and alertness to potential biases [*Asheim et al.*, 2019]. Further research might consider expanding the setting to other countries. Moreover, EEs can be researched at different evolutionary stages separately (young, growing, mature EEs) and with regard to the type of output when evolving (not only HGEs' performance, but also population wealth, knowledge spillovers, etc.).

Another limitation might stem from the short, eight-year period of the investigation that does not capture regional dynamics. However, the longevity and evolutionary nature of regional development point to the persistence of the identified EE profiles. This persistence is also supported by the rankings in regional innovation and competitiveness (RIS 2017, 2019; ERCI, 2019). By adopting mean variables from eight years, we avoid the bias if only one point in time had been measured. As statistics expand in this area, future research should comprise long-term panel data to directly investigate the dynamics of EEs, such as their converging or diverging paths.

The set of EE governance criteria we investigated may be treated as non-exhaustive. Nevertheless, EE theorists propose a functional approach that tracks EE governance vis-à-vis a particular outcome [*Stam*, 2015; *Brown*, *Mawson*, 2019]. The selective EE characteristics are justified by the focus on the performance of HGEs and its drivers derived from the extant regional studies. By following a theory-driven set of variables, we add to the profiling of ecosystems. This approach is more feasible than the attempts to accommodate all the possible characteristics *[Wurth et al.*, 2021; *Brown*, *Mason*, 2017]. The profiles of EEs identified in further studies can be ultimately synthesized in narrative and systematic reviews.

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Informal Entrepreneurship Education: Overview of the Russian Field

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Abstract

This article analyzes the informal sector of entrepreneurial education — free "open" educational projects at the federal level in the context of broader trends in the development of education and society, including education's 'unbundling'. The search for information was carried out using the Internet, as a result, 45 initiatives were discovered. The results show that the sector of entrepreneurship education is broad, but there are a large number of areas for improvement, in which universities can play an important role. In particular, this concerns elaborating and implementing a system for evaluating educational results, organizing monitoring of the effectiveness of such initiatives, including the analysis of success stories. In addition, a separate task is to expand the set of targeted programs for specific audiences (for example, unemployed), as well as to improve the content of such initiatives more deeply according to the specifics of the relevant target groups (for example, young mothers or older people).

Keywords: entrepreneurship; entrepreneurship education; non-formal education; open initiatives; 'unbundling' education; ecosystem of entrepreneurship education

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Introduction

The higher education sphere is in the process of a major "unbundling" [*McCowan*, 2017]. Along with the traditional "long" educational products (bachelor's, master's, and other programs) new learning formats such as massive open online courses (MOOCs) or full-time intensive courses are gaining importance [*Ivancheva et al.,* 2020]. Such initiatives form the previously nonexistent "micro-degree" system, which became a key factor in labor market development [*Kulik,* 2018]. The unbundling of education is a part of the overall science and technology development trend, which among other things includes the emergence of Industry 4.0 and the accelerated digitization of the economy and other key areas of life. This transformation is associated with the emergence of educational ecosystems. No generally accepted definition of the latter has yet been suggested, but experts agree they should be seen as formal and additional education and training systems based on cutting-edge technologies, which take into account the geographical and infrastructural context. A wide range of stakeholders affect the educational process, representing the state, business, and non-profit sector among others, with different requirements for the quality of education and different criteria they apply to evaluate its results [*Bandyopadhyay et al.,* 2021]. The emergence of ecosystems reflects a significant increase in the complexity of this area in recent years, including the university segment traditionally regarded as its core element [*Brush,* 2014]. Faced with the growing competitive pressure from the informal sector, universities are conducting major institutional restructuring, advancing, and differentiating the structure of their educational products.

Despite their positive potential, the above trends are unfolding against the background of a growing "productivity paradox" [*Acemoglu et al.,* 2014; *Ortagus et al.,* 2018; *Polak,* 2017; *Krohn,* 2019]: despite rapid technological development and increased coverage of education in recent decades, global economic growth rates have been declining (all the way down to negative values caused by the COVID-19 pandemic). The importance of education as a driver of technology and business process modernization at the global and national levels is increasing, especially that of entrepreneurship education (since entrepreneurship implies the creation of new companies, structures, and institutions). It is no coincidence that education's contribution to the development of entrepreneurship (including innovative entrepreneurship) is seen as a priority policy objective in Russia and other countries [*Kuzminov et al.,* 2019; *Acs et al.,* 2014, 2016; *Bhat, Khan,* 2014].

However, despite its rapid growth, the entrepreneurship education segment remains insufficiently researched in Russia and abroad alike [*Nabi et al.,* 2017; *Sorokin et al.,* 2020]. The existing reputable monitoring studies tend to have formal coverage, with no in-depth content analysis and performance evaluation of initiatives designed to build entrepreneurial competencies [*Sieger et al.,* 2018; *Bosma et al.,* 2020]. Meanwhile World Economic Forum (WEF) experts [*Wilson et al.,* 2009] note the importance of such informal learning offered by non-profit organizations (NPOs) in the framework of corporate programs and other continuing education formats. A variety of stakeholders show interest in innovation training, ranging from student families and businesses to the public sector. Russian education policies frequently include projects to help a wide range of people develop relevant skills to support entrepreneurship and stress the role of the informal sector in this process.[1] New business formats may emerge and develop over the course of such training, potentially changing the educational ecosystem landscape, primarily in higher education. Meanwhile the steps taken to promote entrepreneurship education in the public and private sectors remain haphazard. This also applies to informal (open access) initiatives designed not only for students or employees of particular organizations but for wider audiences as well. A number of such programs have been launched in recent years under the auspices of the Russian Venture Company (RVC), the Internet Initiatives Development Fund (IIDF), and the Chamber of Commerce and Industry (CCI) for the widest possible audience, but they are just part of a rapidly emerging landscape. Even institutionally affiliated university programs remain, to a varying degree, open to everyone.

This paper attempts to compensate for the lack of knowledge and understanding of the national entrepreneurial education ecosystem. Particular attention is paid to the component least covered in the literature but a strategically important element, namely free open access informal educational initiatives aimed at a wide range of participants.

Literature Review

Analyzing the international experience of implementing open access projects in the area under consideration would help develop relevant domestic systems. In our case, it also provided the basis for developing the study methodology, including the choice of criteria applied to select and analyze observation units.

In 2009 WEF and OECD experts conducted one of the most comprehensive studies of open access entrepreneurship education programs in the world [*Wilson et al.,* 2009]. Their coverage, initiators, and direct and indirect performance indicators were studied. The samples were built on the basis of the internet and other open source searches, with a focus on leading universi-

[1] https://admtyumen.ru/files/upload/OIV/D_ipipp/5_Популяризация.pdf, accessed on 19.11.2020 (in Russian).

ties, research organizations, and large companies. The key initiators included government agencies, businesses, NGOs, and universities engaged in entrepreneurship education, mainly for young people and with a focus on technology. This solves the social integration problem, which indirectly confirms the effectiveness of social entrepreneurship training.

In India and the US informal initiatives to develop entrepreneurial competences are often supported by NGOs. Priority is given to women, young people, and the unemployed, while coverage rates serve as performance criteria [*Manimala, Thomas,* 2017]. In Kazakhstan the state is the key initiator of open access entrepreneurship education projects [*Bisengalieva, Smagulova,* 2019].

Russian approaches to open business education and training are described in a limited number of studies focused on young people interested in such competencies. The special role of development institutions, relevant ministries, R&D organizations, universities, and big business is noted. The Strategic Initiatives Agency (SIA), business associations, and leading companies provide the most tangible support for entrepreneurship in the country [*Freinkman, Yakovlev,* 2014].

An analysis of educational projects launched with public support and reflected in the government department and university documentation revealed a lack of initiatives to promote technological entrepreneurship [*Golovina et al.,* 2017]. Other researchers come to similar conclusions regarding government programs designed for a wide audience [*Rudenko,* 2019; *Stromov et al.,* 2019; *Sokolov,* 2017]. A regional case study of the Tatarstan business education market revealed the low effectiveness of free government-sponsored projects and their inconsistency with other support measures [*Akhmetshin, Palyakin,* 2020]. The main reason is the unsatisfactory quality of business trainers' training and that of the course content.

Domestic research in the area under consideration has a pronounced focus on universities: initiatives aimed at students are analyzed and a significant lack of uniformity between them is noted [*Rubin,* 2016; *Chepurenko,* 2017]. Due to the infrastructural and institutional constraints, Russian universities' potential in promoting the development of entrepreneurship is not being fully implemented, despite the significantly increased demand [*Chepurenko et al.,* 2019; *Zobnina et al.,* 2019].

Russian researchers note the low level of program participation in the additional professional education sector, despite the proven positive correlation between training and economic growth in the regions [*Dukhon et al.,* 2018]. The MOOC market is highly diversified (Coursera, Lectorium, and other platforms), but the courses' effectiveness remains low [*Orlova,* 2017]. However, the sample of the above study included only paid programs designed for a limited audience. We could not find publications describing the educational landscape after the launch of national projects in 2018, which might have significantly changed the situation.

This review confirms the novelty of the undertaken study of the national educational ecosystem which was analyzed through the prism of informal free educational initiatives, using Russia as an example. As noted above, this sphere rarely becomes the subject of empirical research not just in Russia but also elsewhere, despite the high demand for relevant services in the current context. The predominantly descriptive nature of the study is due to its goal: to present the main characteristics of the informal sector of the Russian entrepreneurship education market by analyzing the available open data sources. An in-depth study of specific initiatives, the evaluation of their quality and performance, identification of cause-and-effect relationships between individual factors, and the latter's effects require a separate analysis.

Methodology of the Study

The search for open access training programs was carried out between December 2020 and February 2021. The focus was on official strategic documents and websites of the leading relevant market players, first of all development institutions such as the Russian Ministry of Economic Development's Investment Policy Department, SIA, RVC, the autonomous non-profit organizations "Russia – the Country of Opportunity", "SME Corporation" JSC, "Business Environment" JSC, and "Sberbank of Russia" PJSC. An additional keyword internet search allowed the author to take into account international research results [*Yan, Guan,* 2019].[2] The main project selection criterion was open access to them. The following categories were excluded from the analysis: formal higher education programs (integrated into bachelor's and master's degree curricula); topics included in secondary school curricula; and paid business education and corporate training courses. One-off short-term initiatives (such as, e.g., webinars on entrepreneurship) were also disregarded, but not those aimed at specific socio-demographic or professional groups (women, self-employed, older people, etc.). The educational initiatives selected for analysis were considered open access ones if they were free-of-charge and had no requirements for applicants' affiliation with any particular organization.

Another sample building criterion was the educational component, namely that the initiative was described as an educational one by its organizers, and its description included content (in the form of methodological

[2] The following keywords and their combinations were applied during the search: entrepreneurship education, entrepreneurship courses, entrepreneurship education courses, entrepreneurship support, entrepreneurship programs, entrepreneurship training, government entrepreneurship support program, private entrepreneurship support, social entrepreneurship, youth entrepreneurship, innovative and technology entrepreneurship, women's entrepreneurship.

Table 1. **Evaluation criteria for inclusion of training programmes in the sample (N = 45)**

Criterion	Description	Literature
Format	Distinguishing between face-to-face and online formats	[*Hua, Ren*, 2020]
Access to training, and performance evaluation system	Presence or absence of "entry control" and "exit performance evaluation" systems.	[*Nabi et al.*, 2017]
Target audience	Beginner and active entrepreneurs, various socio-demographic groups, etc.	[*Wilson et al*., 2009]
Initiators	Public and private sectors, universities, etc.	[*Manimala, Thomas*, 2017]
Content focus of training	Social, routine, innovation, technology entrepreneurship. The latter commands the highest attention in international literature, since it's expected to yield the highest returns. Social entrepreneurship is increasingly receiving special support.	[*Sun, Li,* 2020; *Golovina et al*., 2017; *Fomina, Chahine*, 2019]
Relative success	Notional ranking of educational initiatives by their results.	Developed by the authors

Source: authors.

manuals, or special training events such as lectures or seminars). Only relatively long educational programs were taken into account. In total, 45 programs and courses were included in the sample. The evaluation criteria are presented in Table 1.

Evaluating educational programs' performance directly on the basis of publicly available data is a very difficult task. It is only possible if one understands exactly how participating in education transforms into actual business projects. One should focus on training initiatives' success indicators based on such data as coverage, best practices, various proxy indicators, and build an initial ranking using such parameters. For example, performance can be assessed as satisfactory if the coverage was sufficiently high, taking into account target audiences' characteristics and success stories.

The main limitation of our methodology is that it only allows one to use open-source data. Such sources include educational projects' descriptions and information on the courses' and programs' scope and content publicly available for preliminary review. The objectives of this study did not include an in-depth analysis of specific cases, since describing the basic parameters of the Russian landscape of informal entrepreneurship education initiatives was seen as important in itself.

Empirical Analysis of Informal Entrepreneurship Education

Formats

Twenty-eight Russian organizations offering free educational services designed to acquire entrepreneurial skills were identified. Most of the programs are offered online (40), with only a few available face-to-face (3) or in a mixed format (2). The prevalence of distance learning is in line with the global trend [*Kumar et al.,* 2019]. In particular, there were five online university courses offered on Coursera and two each on Open Education, Universarium, and the university's own (HSE) platforms.

A small group of four programs offer a wider range of teaching methods than traditional online courses, for example, mentoring support, the interactive selection of the course structure, and remote communication with a mentor.

Interactive learning with high-technology supported interaction between teacher and students, teamwork opportunities, and so on increases the effectiveness of entrepreneurship education [*Sansone,* 2019]. In the Russian context, this format is rare and remains insufficiently developed in terms of methodology, at least from the point of view of information availability.

Availability of Programs and the Evaluation of Results

The identified initiatives were analyzed in terms of the presence or absence of "entry" and "exit" control systems. Access to most of them is completely open. We mean not only the absence of any charges for a wide range of applicants (all educational initiatives in the sample met this criterion), but also no assessment or testing of the entrants' knowledge or skills. Typically, just registering by stating ones' full name, e-mail address, and mobile number was sufficient. Only five out of the 45 programs had a more complex registration procedure.

Interim and final progress evaluation systems were analyzed. These are applied either in the form of examination or by asking students to defend a business project or business plan (Table 2). International educational standards require that large online platforms such as Coursera provide free access to descriptions of basic evaluation mechanisms, including an examination or more complex knowledge and competencies assessment formats. Being able to learn about such systems in advance positively affects students' accomplishments [*Jimaa,* 2011].

Most of such "schools" do not provide information about the principles of the systems they use to evalu-

Table 2. **Specifications of Evaluation System**

Type of students' progress evaluation system*	Number of initiatives
No data on specifications of evaluation system	27
Examination	14
Business project defence	4

* According to the initiatives' official websites.
Source: authors.

ate the results of students' learning. An exception is the "Innovation Economy and Technological Entrepreneurship" course: it holds interim exams during the training and upon completion students must defend business projects. A previous assessment of the course's effectiveness has shown that combining formal testing with project defence improves students' performance, with both these methods being equally important [*Sorokin et al.,* 2020].

As the MOOCs example shows, simplified exit requirements (e.g., an easy test) reduce the dropout rate during training because it increases students' motivation to complete the course [*Semenova, Rudakova,* 2015]. However, too low requirements for the level of knowledge students must acquire during the course can lead to a situation when those who have formally completed their studies do not actually possess the relevant competencies. University projects in most cases (11 out of 12) use an examination system, which positively distinguishes them from other market players but possibly limits their coverage.

Thus, most of the initiatives do not make sufficient effort to ensure their evaluation systems are open, which can be seen as a serious limitation and a failure to meet basic standards for providing educational services.

Target Audience

In the current literature, training courses' focus on beginners or experienced businessmen frequently is chosen as the first parameter for analyzing their audience. It is based on the Global Entrepreneurship Monitor study [*Bosma et al.,* 2020] which distinguishes nascent entrepreneurship and new business ownership, which require different program content. A similar classification is also applied in the Russian context: educational products designed for beginners offer basic entrepreneurial skills (from generating ideas to registering as an individual entrepreneur), while courses for experienced businessmen cover more complex issues such as moving business online, expanding market niches, etc.

As can be seen in Table 3, most of the training initiatives are designed for people making the first steps in business, which seems logical given that the objective is to attract new players into entrepreneurship. Each program was assessed in terms of targeting specific audiences, including those identified as priority ones in government entrepreneurship support policies. Training programs for existing businessmen, schoolchildren, people under 30 (including students), women, discharged military personnel, people over 45, unemployed, disabled, and orphanage residents were planned to be launched in the framework of the federal project "Promoting Entrepreneurship".[3]

Course organizers typically do not indicate their target socio-demographic groups (this was the case for 28 initiatives, or 62.2% of the total sample). Only a few projects declared a clear focus on young people (12, or 26.7%), women (4, 8.9%), and people of pre-retirement age (1). Supporting the youth is very common (12 initiatives, half of which are aimed at involving trainees in the innovation sector, such as ID Lab Skolkovo, etc.). This segment is supported by the results of student surveys: a third of the respondents consider entrepreneurship to be a promising career path [*Kosharnaya, Korzh,* 2020]. Three out of four courses designed to support women's entrepreneurship stress their focus on mothers on maternity leave or raising minor children (e.g., the "Entrepreneur Mom"[4]), which also confirms this career path's importance for more vulnerable social groups.

Only one federal initiative designed for people of pre-retirement age was identified: "Entrepreneurship and Practical Business Skills". However, this course does not appear to offer in-depth, specific content for the target audience. Meanwhile, as studies show, its members can become active and successful players due to their rich professional experience [*Singh, de Noble,* 2003]. However, this statement may not be entirely applicable to the generation who lived under the socialist system and did not gain any entrepreneurial experience over the course of the next 30 years.

No targeted offers were found for the self-employed, despite the growth in their number and the special attention paid to them in the National Project "Small and Medium-Sized Entrepreneurship, and Support for Individual Entrepreneurial Initiatives".[5] Becoming self-employed may indicate a higher willingness to establish a business, although such people's career paths differ from entrepreneurship in its traditional understanding, such as creating a start-up [*Golenkova et al.,* 2020]. The issue of supporting the self-employed (and similar groups such as., e.g., freelancers) is relevant, but poorly studied not only in the Russian, but also in the global

[3] https://admtyumen.ru/files/upload/OIV/D_ipipp/5_Популяризация.pdf, accessed on 19.11.2020 (in Russian).

[4] https://mama-predprinimatel.ru/, accessed on 19.11.2020 (in Russian).

[5] https://corpmsp.ru/about/deyatelnost/natsionalnyy_proekt_maloe_i_srednee_predprinimatelstvo_i_podderzhka_individualnoy_predprinimatelskoy/, accessed on 19.11.2020 (in Russian).

Table 3. **Programs Ratio Designed for Nascent and Experienced Entrepreneurs (N=45)**

Audience	Number of initiatives	Share in total number (%)
Nascent	37	82.2
Experienced	4	8.9
Nascent + Experienced	4	8.9
Source: authors.		

context[6] [*Ozimek,* 2019]. The educational programs' content is of course adapted to match the declared target audience, but inevitably only to a limited extent. For example, the Entrepreneur Mom and Women's Digital Academy projects only offer an analysis of entrepreneurial opportunities which require minimal time. No targeted open access educational initiatives were found for the former military, unemployed, and self-employed, though all these groups were classified in official documents as requiring special support.

Initiators

The initiatives of companies owned mainly by private individuals (e.g., Pepeliaev Group LLC) were naturally classified as private sector ones; if the organizers were more than 50% affiliated with the state, the project was classified as a public-private one (e.g., the initiatives offered by of Sberbank PJSC). The public sector initiatives comprised educational projects funded exclusively with public money (except those offered by universities). Initiatives implemented under the auspices of universities (which are mostly state-owned in Russia) were classified as a separate category. Russian NPOs remain at the periphery of the landscape under consideration, while in other countries they are almost the key players [*Manimala, Thomas,* 2017].

As shown in Table 4, most of such projects are initiated by the government, either on its own (9) or in partnership with business (14). In the first case, the SME Corporation (National SME Project) and the Russian Ministry of Economic Development are the key operators. Only 10 of the identified initiatives are classified as private, with companies leading the way in social entrepreneurship training (4 out of 8 such initiatives in the sample).

Table 4. **Distribution of Entrepreneurship Education Programs by Organizer (N=45)**

Initiator	Number of programmes	Share in total number (%)
Universities	12	27
Private sector	10	22
Private-public partnership + NPOs	14	31
Public sector	9	20
Source: authors.		

A separate group comprises 12 university projects, mainly with regional status, focused on traditional "long" education (excluded from the analysis). All of them indicate the high potential for expanding the audience of universities' educational products. Thus, most of the open access initiatives are implemented either by the state or by affiliated structures in the framework of public-private partnerships, or by publicly funded universities.

Focus of Training

Authors of entrepreneurship studies often focus on the social [*Dacin et al.,* 2011] and the innovation technology [*Szabo, Herman,* 2012] dimensions. We have analyzed the landscape of the identified players in terms of the social, innovation technology, and routine entrepreneurial training segments. Demand for social entrepreneurship comes from key public institutions and from potential entrepreneurs themselves [*Moskovskaya et al.,* 2017]. The innovation technology area deserves a separate study due to its high potential for accelerating economic growth, which is important in the context of the "productivity paradox" mentioned earlier [*Acs et al.,* 2016]. All projects that do not fall in the first two groups are focused on training in routine entrepreneurship. The initiatives were classified on the basis of available information, including statements by the project organizers themselves.

In terms of prevalence, participation in routine entrepreneurship training is twice as high as in other categories (Table 5). This can be explained by the fact that in Russia players often do not focus on increasing their profits but act out of necessity, which encourages routine rather than innovative behavior [*Chepurenko et al.,* 2017].

Support for technological entrepreneurship is provided not only through education, but also in other formats (acceleration, infrastructure, etc.). For example, the HSE Business Incubator plays a notable role, which is at the top of the UBI Global University Accelerators ranking. Along with acceleration, the free, open access educational program "Launching a Start-up in a Month" is being implemented (included in this study's sample).

Training in social entrepreneurship is offered relatively rarely and remains the prerogative of private players. At the same time, it can be in demand as a potential revenue source. E.g., the project "Social Entrepreneurship: from Idea to Profit" declares its goal as teaching

[6] https://www.upwork.com/i/freelancing-in-america/, accessed on 18.06.2021.

Table 5. **Distribution of training programmes by content (N=45)**

Entrepreneurship type	Number of initiatives	Share in total number (%)
Social	8	17.8
Innovation technology	7	15.5
Routine	30	66.7

Source: authors.

people "how to monetize a socially important business".[7] Thus all content vectors are represented in the Russian open access entrepreneurial education initiatives landscape, albeit on different scales.

Informal Education Initiatives' Results: A Ranking Attempt

The relative performance of the training programs under consideration was evaluated (taking into account the current debate) on the basis of a wide range of available sources including data about their coverage, success stories, number of companies created by graduates, amount of capital raised, and so on. In almost all cases when coverage data was made available (25 training initiatives), the projects could be considered effective. However, initiatives with less than 30 participants and present on the market for no more than a year were ranked as "laggards". All projects were broken down into three groups based on their relative success. The group of leaders comprised programs that reported not only relatively high coverage, but also shared success stories or any other indirect indicators of their effectiveness (9 projects). The average performers group included initiatives which, according to open access data, either had a relatively high coverage, or reported other indirect success indicators (17). Laggards published no information about their coverage (or reported low coverage), no success stories, or any other indirect evidence of their effectiveness (19). Let us take a closer look at each group's main characteristics.

"Leaders". This group comprises initiatives such as SME Corporation, Entrepreneur's Alphabet, and Entrepreneurship School. The latter two projects' coverage amounted to 64,544 and 70,801 people, respectively. The Entrepreneur Mom program, despite a more modest audience (3,938 people), shared success stories of its participants. Members of this group have a number of common features:

- *Partnership with the state*. All nine initiatives directly or indirectly collaborate with public authorities, and only one (Innovation Economy and Technological Entrepreneurship) is implemented by a university.
- *Affiliated primarily with foreign partners*. Five of the nine initiatives (11% of the total) participate in the BusinessClass project[8] and name Google's Russian office as a partner. It was not possible to establish to what extent Google was involved in the design and implementation of the courses. The description of the course "Innovation Economy and Technological Entrepreneurship" (organized and implemented exclusively by Russian companies) also mentions collaboration with foreign experts.
- *Mainly online provision*. Six of the nine initiatives are implemented only online. The only exceptions are the SME Corporation projects with a vast geographic coverage (all 85 Russian regions).
- *Focus on routine entrepreneurship*. Eight of the nine initiatives are focused exclusively on routine entrepreneurship.
- *General audience*. No program in this category (except two) is designed for a specific target group.

"Average Performers". The group covers initiatives that reported either their coverage or other project success indicators, but not both. It comprises 17 programs. Of these, the federal level coverage is reported for 14, the number of covered regions for two, and data on investments attracted by students' start-ups (1.3 billion roubles) for one. Members in this group share several common characteristics:

- *Partnership with the state*. As in the case of "leaders", they are mainly affiliated with public authorities. Two of the 17 initiatives are implemented by government agencies, five by public-private partnerships, nine by universities, and a single one by a private provider.
- *High share of university initiatives*. Nine projects of the 17 are implemented by universities (exclusively online).
- *General profile*. These initiatives are designed for teaching not only routine (9 out of 17), but also social (2) and technological entrepreneurship (6).
- *Specific audience*. More than half of the 17 initiatives (9) explicitly define their target audience: two are designed for women and seven for young people. Unlike the "leaders", this group is more likely to segment their audience.

"Laggards". Projects in this group do not publish information on any of their performance indicators, be it coverage or other parameters, or the available data clearly indicates their poor performance and low de-

[7] https://бизнесюгры.рф/support/informatsiya-dlya-subektov-kreativnykh-industriy/obrazovatelnye-onlayn-meropriyatiya/, accessed on 18.06.2021 (in Russian).

[8] https://business-class.pro/, accessed on 18.06.2021.

mand for them (three initiatives covering less than 30 people each). Their main characteristics are as follows:

- *Low affiliation with the state*. Seven of the 19 programs are owned by private companies (only 10 such initiatives in the whole sample). The lack of government support may explain the problems with promoting these projects.
- *Low involvement of educational organizations*. Only two of these initiatives were launched by universities (note that in the whole sample there are 12 such projects). Outsider projects are often initiated by organizations whose main activities are unrelated to education. The lack of relevant experience and competencies adversely affects the programs' or courses' content.
- *Insufficiently transparent progress evaluation system*. Sixteen of the 19 programs do not describe the mechanisms they use to evaluate students' progress.
- *Priority of social entrepreneurship*. Six of the 19 initiatives are focused on training in social entrepreneurship (8 in the whole sample of 45 programs).

Conclusion

This paper attempted to make an initial assessment of the current landscape of open access entrepreneurship education initiatives in Russia by using the "unbundling" concept and taking into account the contemporary science and technology development trends.

The informal sector represents an important, but insufficiently researched area of the rapidly growing national entrepreneurship education ecosystem, which is taking over an increasing share of the traditional formal education segment. This study identified 12 cases of universities offering alternative entrepreneurship education products with a flexible structure, designed for a wide audience. However, universities do not dominate the market in question. Initiatives offered by new players, including the private sector, non-profit organizations, and state development institutions act not as supplements, but rather as alternatives to traditional "long" professional education programs. This erosion of universities' monopoly will allow people to more effectively accomplish the objectives associated with the accelerated modernization of educational technologies and business processes.

Entrepreneurship training makes a special contribution to the country's socioeconomic development. However, the formal education system is not keeping pace with its growth. First of all, this applies to universities, with their cumbersome system of lengthy bureaucratic approval procedures. The proposals of new educational service providers, including large companies (Sberbank) and development institutions (RVC, IIDF) emerged in response to this sluggishness of traditional higher education organizations.

Universities' cooperation with public and private partners in the informal sector of entrepreneurship education must be stepped up. Universities can act as operators in launching and implementing such projects, in particular as competence centers to design course content and progress evaluation systems. Possible recommendations to improve open access entrepreneurship education initiatives in Russia include the following:

1. Introducing a system for evaluating students' progress during and after the training, which is adequately supported by the necessary resources, equipment, and sufficiently qualified personnel to implement advanced teaching practices.
2. Monitoring education productivity, including success stories, e.g., in the form of tracking graduates' career paths.
3. Extending targeted programs designed for specific audiences, including in the scope of the National SME Project (e.g., for the unemployed) and more precisely adapting them to match specific characteristics and requirements of relevant groups (e.g., young mothers or older people).
4. Increasing the range of open access initiatives in training technology and innovation entrepreneurs, which have the highest potential to contribute to economic growth but remain underrepresented in the Russian context.

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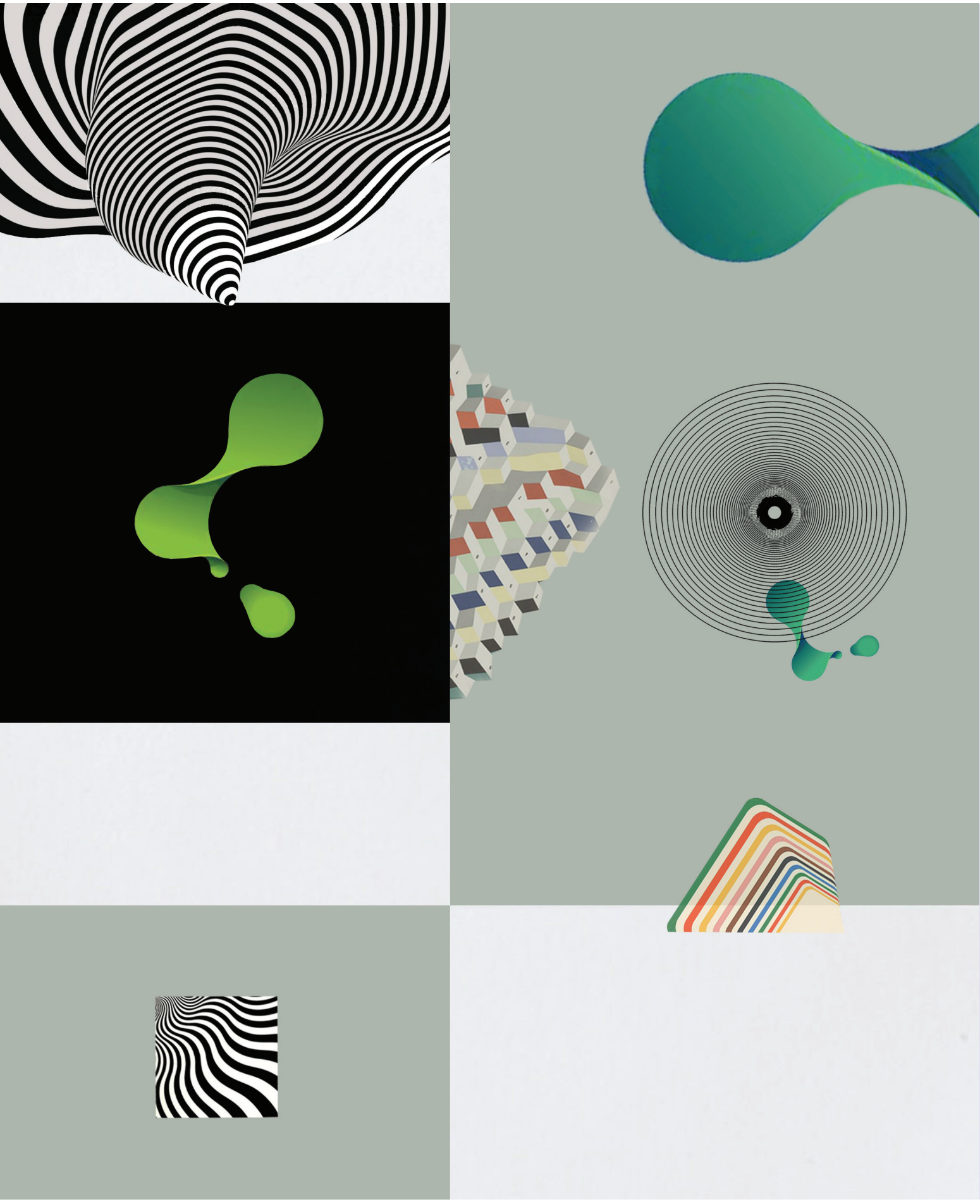

COVID-19 as Industry Forcing Function: Challenges for Entrepreneurship in the Post-Pandemic Future

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Abstract

The COVID-19 crisis has changed how firms and industries do business – at least for now. What is uncertain, is the duration of that change. Will the industry change induced by the COVID-19 crisis persist and, if so, for how long? Can a crisis, and particularly the COVID-19 crisis, act as a more permanent change agent and create an environment that mimics the entrepreneurial opportunity that industry forcing functions create? If yes, then there is cause to consider the entrepreneurial opportunity that the COVID-19 crisis provides.

In this paper, we review the changes that the pandemic has brought to business practices. Furthermore, we discuss the differences between crisis-based opportunity and entrepreneurial opportunity created by industry forcing functions in order to illuminate the ability of a COVID-19 crisis–induced Low Touch Economy to sustainably create entrepreneurial opportunities. We show examples and list the attributes of industry forcing functions that have already provided sustainable entrepreneurial opportunity. Then, we match these attributes with the factors related to the COVID-19-related Low Touch Economy.

We find that the COVID-19 crisis has similarities and differences to traditional industry forcing functions started by disruptive technologies. However, unlike traditional industry forcing functions, the COVID-19 crisis acts in a pan-industrial manner, making the impact of the pandemic more profound. Furthermore, the timing of the pandemic is important: the COVID-19 crisis struck during the emergence of a Schumpeterian wave of Industry 4.0 and accelerated the adoption of its most important harbingers. We provide researchers and practitioners a lens through which to review not only the COVID-19 crisis's possibility of lasting effects, but also how it will affect entrepreneurs.

Keywords: COVID-19; pandemic; crisis; entrepreneurship; industry forcing function; low touch economy

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Introduction

Even in 2021, COVID-19 still continues to affect the everyday lives of people, organizations, and countries. This crisis stressed our society and revealed health, economic, and political vulnerabilities. Worldwide lockdowns limited global and domestic flow of travel and trade [*Ho, Maddrell,* 2021]. FFurther significant changes have been observed in how business is conducted creating the Low Touch Economy that practitioners and academics alike are debating about to determine whether it will sustainably shape future consumer behavior [*Santos Vieira de Jesus et al.,* 2020; *Sheth,* 2020].

As socioeconomic, cultural, and political relations are being reconfigured due to the pandemic, we witness disruptions in business practices, leading to major uncertainty about the future. Currently, businesses of all sizes are rapidly adopting novel digital technologies [*Liguori, Pittz,* 2020; *Sharma et al.,* 2020] and leveraging their local and virtual communities [*Floetgen et al.,* 2021] in order to remain resilient and agile during the crisis. The pandemic appears to have changed the basic assumptions we held about business and social life [*Anker,* 2021]. However, it still remains to be seen whether these changes will stay once everything is back to normal [*Sheth,* 2020].

While crises are usually major and negative events, they can create opportunities for starting or changing a business [*Doern et al.,* 2019]. Will the COVID-19–induced Low Touch Economy lead to the sustained generation of entrepreneurial opportunities [*Stanciu et al.,* 2020]? There is a group of socioeconomic change agents that have created sustainable entrepreneurial opportunity and academics refer to this group as industry forcing functions.[1] Industry forcing functions can be regulatory, technological, or policy-driven. For example, the US Clean Air Act of 1970 changed how the automobile industry did business and eventually initiated the development of a new industry [*Gerard, Lave,* 2005] through sustained entrepreneurial opportunity. These types of regulation initiate an innovation express for those with entrepreneurial capacity. Technology-based forcing functions often create supplementary industries — such as, in this case, the development of the "cleanroom industry" [*Chavez et al.,* 2017] — by stimulating entrepreneurial action in new and existing firms. An example of a policy-based forcing function is the Marshall Plan [*Agnew, Entrikin,* 2004] that also created long-lasting entrepreneurial opportunities. But what about the COVID-19 pandemic and the policies, regulations, and technologies surrounding it? To assess the potential of the COVID-19 crisis to create lasting entrepreneurial opportunities, we discuss the factors unique to the COVID-19 pandemic and how these factors compare to industry forcing functions.

We show how the COVID-19 crisis induced the Low Touch Economy, which is a great match to industry forcing functions. However, one major difference is that industry forcing functions usually start out in a single industry and then expand to others. The COVID-induced Low Touch Economy is unique due to its pan-industrial nature. This aspect of the pandemic has an exceptionally large impact upon entrepreneurial opportunity. We establish that the pandemic's pan-industrial nature alone can serve as a forcing function to induce the generation of new ideas, inventions, and innovations. Yet, the pandemic has also accelerated the disruptive Schumpeterian wave of Industry 4.0. Implications for research and practice are discussed.

COVID-19 Crisis and Shifts in the Economy

Most definitions describe a crisis as an "*extreme, unexpected, or unpredictable event that requires an urgent response from organizations*" [*Doern et al.,* 2019, p. 401]. Although there are different types of crises, all of them have three elements in common: surprise, threat, and a short response time [*Durst, Henschel,* 2021]. The COVID-19 crisis is no exception. Furthermore, it is also transboundary. On the one hand it easily cuts across geographical and policy boundaries [*Boin, Lodge,* 2016]. On the other hand, it also crosses industrial boundaries and affects a wide range of industries and sectors simultaneously [*Ivanov, Dolgui,* 2020].

In fact, the coronavirus pandemic clearly has an impact on virtually all manufacturers, retailers, and wholesalers globally. According to [*Ivanov,* 2020] 94% of the Fortune 1000 companies experienced coronavirus-driven supply chain disruptions and that at least 5 million companies globally rely on at least one tier-one or tier-two supplier in the Wuhan region of China, COVID-19's origin. Beyond the disruption of the direct supply chain activities, the coronavirus measures led to the creation of the Low Touch Economy [*Santos Vieira de Jesus et al.,* 2020] and caused simultaneous disturbances in both supply and demand, initiating a ripple effect and performance degradation in terms of revenue, service level, and productivity [*Ivanov, Dolgui,* 2020].

The Low Touch Economy refers to a new state of the economy, a result of the COVID-19 pandemic control and mitigation health measures that led to behavior shifts and economic disruption [*Santos Vieira de Jesus et al.,* 2020]. Companies in the context of the Low Touch Economy have to adapt their business models, create high impact innovations, and flexibly navigate the pandemic's aftershocks in the global economy, and do so with respect to the new hygiene measures and constraints on business-as-usual. These measures

[1] http://news.unm.edu/news/anderson-school-s-innovation-group-to-help-new-mexicos-businesses-respond-to-covid-19-management-challenges, accessed 09.09.2021.

include the substitution of offline events for virtual ones, the reduction of physical interactions between employees and consumers, the use of online tools and apps to interact and work, travel bans, limitations on large gatherings, and the isolation of vulnerable groups [*Santos Vieira de Jesus et al.,* 2020].

The low touch aspect is very important for understanding the impact and entrepreneurial opportunity that the COVID-19 crisis presents, and it has a profound impact on both the content and the process of the business practices as we know it. Analyzing previous crises, such as the 2008–2009 global financial crisis, research suggests that the service side of businesses was much less disrupted and even the manufacturing sector could rely on the maintenance and after-sales services in order to compensate for the production disruption [*Rapaccini et al.,* 2020]. In the current situation, however, services have become highly complicated (if not put on hold) due to the national lockdowns and international travel bans. The current trends that emerge as a result of these disruptions include: uncertainty of demand, an increase in the role of technology in search for agility, and increased focus on collaboration, social, and environmental innovation [*Sharma et al.,* 2020]. We further expand upon these trends.

Uncertainty in Demand

In the past year, certain sectors, such as automobiles, crude oil, and transportation, have experienced a tremendous decline in demand due to COVID-19 restrictions. Yet, the business areas necessary to facilitate remote working, online education, and the supply of essential goods and services have witnessed explosive growth [*Anker,* 2021]. Certain businesses, like firms operating in the healthcare sector, were forced to match demand-supply equations on a daily basis [*Sharma et al.,* 2020]. What is common in these changes across the sectors is the inherent unpredictability of the change.

The COVID-19 crisis is an example of such change originating not from human agency, but rather brought upon by natural forces beyond human control. This crisis truly challenged the main assumption of the current business practice: predictability that promoted efficiency as the dominant criteria of success [*Anker,* 2021]. Almost overnight, lean, efficient, and planned-to-the-second operations that used to be a core capability became a core rigidity, to rephrase Leonard-Barton [*Leonard-Barton,* 1992]. The uncertainty that the pandemic brought, required firms to transition from the "planning soloist" mindset to the "hedging networker" approach to business [*Harms et al.,* 2021]. Both business and governments engaged in developing multiple parallel diversification initiatives, developing policies and collaborations to overcome the disruptions caused by COVID-19, and transition until things return to normal.

Under the assumption of uncertainty, a diversification strategy with three or more distinct and independent supply chains for the same process allows businesses to become less reliant on one large market, region, or nation [*Anker,* 2021]. Making use of a similar idea of reducing reliance on the predictability of global operations, more and more companies turn to their local ecosystems. Previously, such decisions have been described in the contexts of sanctions and forced isolation of countries, such as Iran [*Aliasghar et al.,* 2020]. Nowadays, however, examples come from a variety of industries spanning from emergency response and 3D printing of lung ventilators [*Belhouideg,* 2020] to hospitality businesses hustling within their local ecosystem to create new partnerships and compensate for the closure of the hotels and restaurants, and cancellation of events [*Harms et al.,* 2021]. Technology harbingers of Industry 4.0 definitely provide new means to support local supply chains [*Walsh,* 2001]. The move from mass production to mass customization brought on by one of the technologies underpinning Industry 4.0—3D printing— made supply lines shorter [*Elders et al.,* 2001].

This use of Industry 4.0 technologies increases diversification, which, in turn, increases resilience. The entrepreneurial action comes, however, from recognizing change and rapidly taking advantage of it. Agility and flexibility are important aspects of the entrepreneurial mindset [*Shepherd et al.,* 2010; *Hattenberg et al.,* 2020] and are often based on major technological improvements—in our case those technologies underpinning Industry 4.0.

Increased Role of Technology

Technology has emerged as an important factor that determines the success or failure of a firm during COVID-19 [*Sharma et al.,* 2020]. Currently, firms simultaneously adopt numerous technologies that can give them visibility across the value chain. Furthermore, firms also adopt technologies that help in improving efficiency and agility in the context of the Low Touch Economy [*Sharma et al.,* 2020]. These technologies include digital platforms [*Ruutu et al.,* 2017; *Floetgen et al.,* 2021], innovative logistics solutions [*Rapaccini et al.,* 2020], predictive analytics, and systems based on Internet of Things [*Paiola, Gebauer,* 2020; *Rapaccini et al.,* 2020]. At the service of multinational retailers such as Amazon, they were critically important to enable the governmental lockdowns: without the multinational retailers' vast supply chain ecosystem and logistic solutions, and their willingness to quickly adapt operations to support governments' emergency policies, lockdowns would have been impossible [*Anker,* 2021].

Furthermore, digitalization has also democratized the marketplace, opening up novel opportunities for connecting with customers. Virtual business channels challenge business models of traditional entrepreneur-

ship [*Nambisan,* 2017], but provide a unique opportunity to reinvigorate the search for product-market fit and the hunt for new business models capable of surviving and thriving in a COVID-19-impacted world [*Liguori, Pittz,* 2020]. In fact, among all of the digitalization projects, technologies that are closely linked to the development of advanced service and digital offerings (e.g., connected products and data valorization, diagnostic and preventive maintenance, customer relationship management, and ticketing and troubleshooting to provide remote assistance) are currently accelerating at the highest speed [*Rapaccini et al.,* 2020].

However, digitalization brings not only opportunities, but also challenges. The highly iterative nature of digital products and services requires entrepreneurs and small businesses to quickly acquire the corresponding competencies and resources for effective deployment [*Liguori et al.,* 2020]. This means that the strong capabilities developed in one sphere of the business may become core rigidities [*Leonard-Barton,* 1992] unless the business is capable of transforming them at an ever-increasing speed, transitioning from ordinary to dynamic capabilities [*Teece,* 2014]. This transition will, however, put additional strain on resources and capabilities, which are not always readily available, especially in younger and smaller firms [*Sapienza et al.,* 2006] or minority-owned businesses [*Walsh, Linton,* 2011; *Neumeyer et al.,* 2020] that traditionally lack resources and competencies for experimentation and development.

Social Innovation for Resilience

In the search for resilience, researchers also note, along with the technology, there was an upheaval of the consideration for humans and human capital. The COVID-19 pandemic has profound socio-psychological, physical, and technical implications for entrepreneurs and employees [*Carnevale, Hatak,* 2020]. It is described as a "*growing interest in personal well-being that minimizes person-to-person contact due to the experience of the pandemic*" [*Lee, Lee,* 2021, p. 5]. Since the COVID-19 pandemic required businesses and people to reconfigure their forms of sociality [*Santos Vieira de Jesus et al.,* 2020], digital servitization came as a solution for business to reach out to customers in the Low Touch Economy reality [*Rapaccini et al.,* 2020]. Kirk and Rifkin [2020] even suggest that the pandemic has changed who we are as humans: the exponential increase in digital technology that replicates social interaction pushes the boundaries between human and machine, leading to digitally mediated sociality.

Yet, despite the digitalization and the Low Touch Economy, the shared goal of controlling the spread of COVID-19 renewed the importance of a sense of community [*Lee, Lee,* 2021], transforming the ultimate form of recognition from the individual achievement into the acknowledgement of care for others. For example, in the first months of the COVID-19 lockdown, the ride-sharing provider, BlaBlaCar, has successfully introduced a new platform—"BlaBlaHelp"—through which communities can support one another with grocery shopping and delivery of essential items, including medicines. Within 72 hours, more than 20,000 people registered on the platform. This occurrence has further increased not only awareness about the platform but also the trust in BlaBlaCar's values and services, which additionally resulted in a significant increase in summer holiday bookings via its platform [*Floetgen et al.,* 2021].

The Low Touch Economy induced by COVID-19 has, therefore, changed how firms operate (shifting the managerial focus from eliminating slacks in search of efficiency toward building resilience to counteract uncertainty), how they compete (changing the praised hero from an achiever to someone who supports the community and cares for others), where they compete (moving transactions to the digital marketplace basically overnight), and the tools they use to do so (as we can witness in the ever-increasing technology adoption rates). However, disruption oftentimes brings about the most significant innovations and improvements [*Christensen,* 1997]. Numerous voices suggest that the pandemic will result in major societal shifts and that it will bring long-lasting positive outcomes [*Kirk, Rifkin,* 2020].

COVID-19 Crisis as a Source of Opportunity

While crises are usually major and negative events, they can lead to new opportunities for starting or changing a business [*Doern et al.,* 2019] and fuel business expansion [*Eggers,* 2020]. A crisis can act as "an external enabler" [*Davidsson,* 2015], triggering new products, services, and venture ideas, enhancing outcomes of new and ongoing ventures, and reshaping existing products and ventures [*Davidsson et al.,* 2021; *Doern et al.,* 2019]. Yet, previous research has shown that crises can also stretch institutions to the limit, rendering standard operating procedures inapplicable and severely testing professional norms [*Boin, Lodge,* 2016]. This is due to the departure from the pre-existing systems, procedures, and capabilities that novel ventures can be highly effective at alleviating suffering [*Shepherd, Williams,* 2014]. Hence, the uncertainty of the COVID-19 crisis may be the source of life-changing disruptions as well as a possibility for future development [Springer, 2020].

In the context of the COVID-19-induced Low Touch Economy and uncertainty, we note an accelerated adoption of novel technologies that allow for higher agility and resilience of both businesses and communities [*Rapaccini et al.,* 2020]. Where television, social media, and other transformational technologies often took years to achieve widespread adoption, many of the digital and technological offerings currently introduced face few or no barriers in the process of active experimentation and adaptation to the Low Touch Economy induced by COVID-19 [*Kirk, Rifkin,* 2020].

In healthcare, digital health has been accelerated [*Lee, Lee,* 2021] and telemedicine is said to have reclaimed center stage [*Marin,* 2020]. For manufacturing firms, the post-COVID-19 era could finally experience the massive adoption of industrial internet, condition monitoring, predictive maintenance, digital rooms, augmented and virtual reality, and digital twins in services and solutions [*Rapaccini et al.,* 2020].

As digital technologies have profound effects on entrepreneurial processes [*von Briel et al.,* 2017], these changes offer novel challenges and opportunities for the entrepreneurs of tomorrow. Entrepreneurial companies are those innovative, proactive, and risk-taking actors that pioneer new markets, discovering new opportunities and actively experimenting to address them [*Miller,* 1983; *Shane, Venkataraman,* 2000]. The value entrepreneurs place on autonomy, their tolerance of uncertainty, and their ability to approach new situations openly and proactively often help them thrive in highly uncertain and demanding environments, such as the COVID-19 crisis [*Carnevale, Hatak,* 2020]. It is the combination of the proactive entrepreneurial and market orientations that allows companies to overcome or even benefit from challenges imposed by the crisis [*Eggers,* 2020]. When incumbents actively hedge their options based on what is within their control, monitoring their actions appears to bring limited benefits as compared to capitalizing upon the upcoming technologies, market trends, and opportunities [*Beliaeva et al.,* 2020; *Walsh, Kirchhoff,* 2003]. The digitalization brought by the COVID-19-induced Low Touch Economy opened up novel channels for entrepreneurs to connect with their stakeholders [*Liguori, Pittz,* 2020]. Those small and agile players have the advantage of building their ventures *ex nihilo* based on novel approaches and technologies. Furthermore, abundant in the digital world, specific sources of social support—such as positive feedback from customers—may ultimately enhance the entrepreneurs' well-being in the context of the Low Touch Economy of reduced physical and social interaction in daily business conduct [*Carnevale, Hatak,* 2020]. This proactive orientation and flexibility to follow the market is why young firms have a greater likelihood of surviving during crisis periods than they do during growth periods [*Simón-Moya et al.,* 2016].

In contrast, the extent to which the new technology advances remain an integral part of the economy depends largely on whether the recent legislative and regulatory changes become permanent [*Marin,* 2020]. As COVID-19 spread across the globe, governments responded with denial; over-provisioning or panic-buying; obsessive cleanliness; various forms of protectionism; exertion of control over others; and more positive supportiveresponses, such as business support, enhancing capacity of healthcare andmutual aid [*Maddrell,* 2020; *Springer*, 2020]. With lockdowns and other low touch economy creating measures, governments forced to work outside established routines and practices, each country tends to respond in its own manner, mostly influenced by the standards adopted by national experts advising their governments on pandemic responses [*Baekkeskov,* 2016]. Under uncertainty and urgency, the potential for evidence-based policy is indeed limited, but to sustain the momentum created by COVID-19, it is necessary that legislation evolves together with science and technology.

As we are now in the middle of a lasting disruption, it is difficult to say what the post-COVID world will look like and whether it will continue creating sustained entrepreneurial opportunities. The pandemic experience is unprecedented in modern history, making it difficult to find a relevant reference point for comparison and informed foresight. Several authors have compared the COVID-19 crisis to earlier pandemics [*Stanciu et al.,* 2020], natural disasters (for example, in political elections) [*James, Alihodzic,* 2020], and to the financial crisis of 2008 [*Chen, Yeh,* 2021]. In this article, we choose to take a different angle. Since the Low Touch Economy has a profound impact upon the technology adoption curve and requires institutions to adapt quickly, we seek inspiration in two examples of industry forcing function — the technological forcing function of Willis Whitfield's cleanroom [*Chavez et al.,* 2017] and the regulatory-based forcing function of the US Clean Air Act [*Gerard, Lave,* 2005].

Industry Forcing Functions

Willis Whitfield invented the modern-day cleanroom. This is how Cleanroomtechnology (2012) describes it: "*The laminar-flow cleanroom created a work environment that was more than 1,000 times cleaner than the cleanrooms in use at the time. Within a few short years, $50 billion worth of laminar-flow cleanrooms were being built worldwide and the invention is used in hospitals, laboratories, and manufacturing plants today*."[2] This has revolutionized manufacturing in electronics, changed the safety standards for hospital operating rooms, and stimulated further space exploration.

Passed in 1970, the Clean Air Act is the other example we want to mention here. It became one of modern America's most consequential laws. Translated into real-world rules by the newly established Environmental Protection Agency, the act has since reduced air pollution in the United States by 70 percent—even as the population, the economy, and the number of cars on roads have grown [*Gardiner,* 2020]. Since lawmakers wrote the act to evolve along with scientific and technological advances, it has stood the test of time [*Gardiner,* 2020] and has not only impacted the citizens' duration of life but also saved trillions of dollars [*Gerard, Lave,* 2005].

Although of a different nature, both disruptive innovations—the cleanroom and the Clean Air Act— can be

[2] https://cleanroomtechnology.com/news/article_page/A_revolutionary_invention/82304, accessed 15.05.2021.

considered industry forcing functions. They have created lasting change by rendering the existing order of things obsolete and undesirable [*Linton, Walsh,* 2004] and drove the market toward the envisioned future standard [*Davidsson,* 2004]. Will the COVID-19 crisis, which disrupted our daily lives so profoundly and made us reassess the basic assumptions about business practice, sociality, and community, have a similar lasting effect in the future?

COVID-19 as a Forcing Function

Although regulation and policies can be industry forcing functions, most global economies have thus far enacted legislation and policies designed to have firms transition the pandemic. That is, the legislation and policies aim to support companies until the COVID-19 pandemic can be overcome and firms return to the pre-COVID dynamics of doing business [*Fakhruddin et al.,* 2020]. These transition support policies and regulations do little to provide an entrepreneurial opportunity. Furthermore, individual countries react to COVID-19 in diverse manners [*Baekkeskov,* 2016], complicating a sustained response from businesses. These efforts alone would not have created a lasting change.

However, regulations that promote social distancing—and foster the Low Touch Economy—have already created entrepreneurial opportunities, among them those linked to digitalization [*Scheidgen et al.,* 2021; *Liguori, Pittz,* 2020]. Since the COVID-19 pandemic is still upon us and we observe that despite the vaccination efforts, new variants emerge and countries exit and enter lockdowns in an a-synchronized manner, we conclude that the world will carry on with a certain form of social distancing, making the move back to the old normal unlikely. We argue that this aspect of the COVID-19 pandemic creates entrepreneurial opportunity and acts like an industry forcing function.

However, while most industry forcing functions are based on technology or regulatory change, the COVID-19 crisis is based on disease transference and affects all and any industries independent of the technologies they use. The COVID-19 crisis is, thus, pan-industrial and creates these opportunities in many industry sectors. In fact, COVID-19 changes how we work and live [*Ratten,* 2020]. It has affected how we socialize, interact, and reward each other both as individuals and as a community [*Anker,* 2021; *Lee, Lee,* 2021]. Moreover, COVID-19 changes the discussions in supply chain management and shifts the focus from a simple financial consideration to a resilience and sustainability strategy [*Sharma et al.,* 2020]. Once this strategy is implemented, this does not appear likely to change. However, a projection of the duration of these changes remains unexplored.

One manner in which to understand the duration of the impact that the current pandemic crisis brings, is to ask whether the COVID-19 pandemic has affected the Schumpeterian wave of Industry 4.0. The COVID-19 crisis occurred during the emergence of Industry 4.0 and, to a certain extent, the two are now intertwined. The Low Touch Economy induced by the crisis has affected both the supply side and the demand side of businesses and created a market-pull demand for disruptive technology [*Walsh, Kirchhoff,* 2003; *Walsh et al.,* 2002]. Since the adoption of technologies grew faster in order to combat the pandemic's consequences, the technologies underpinning Industry 4.0, such as block chain, Internet of Things, and additive manufacturing have been put to a much broader use [*Paiola, Gebauer,* 2020; *Rapaccini et al.,* 2020]. Furthermore, as the change occurs in a pan-industrial manner, it gained broader acceptance and legitimacy, leading to more entrepreneurial opportunities and less resistance from the societal and regulatory sides [*Kirk, Rifkin,* 2020]. There is, therefore, evidence that the COVID-19 pandemic has accelerated the use of Industry 4.0's underpinning technologies and therefore affected and accelerated the Schumpeterian wave [*Cros et al.,* 2021].

Discussion and Conclusion

Although crises and industry forcing functions have similar characteristics, they do, however, differ in duration. Industry forcing functions like policy, regulation, and technology development cause the creative destruction of industry standard products [*Linton, Walsh,* 2004]. Yet, they also create opportunities to redefine specific marketplaces and create new ones. A crisis most often affects many industries at the same time and is pan-industrial. Numerous policies are initially considered to transit the bad times. If the policies are successful and a crisis is transited, these types of crisis tend to be regionally limited like the crisis of the German pension system [*Sinn,* 1999]. Other crises are not transited as well. These other crises take on aspects of an industry forcing function and do so in a pan-industrial manner.

The Great Depression is one of those crises that did not transit well. The generation that lived through the Great Depression [*Aitkin et al.,* 1970] had long-lasting, ingrained thoughts toward banks and labor unions, and they translated their experience into politics, policy, and regulations, which many regard as the roots of World War II, as the psychology of the people changed and populations as a whole felt they had a lot less to lose [*Rogler,* 2002]. However, the Great Depression also created a generation that wished to create stable world economies and social justice [*Brokaw,* 2000].

Where does the COVID-19 pandemic and its resultant policies fit as a crisis? There is tremendous ambiguity and uncertainty involved in the COVID-19 pandemic [*Durodié,* 2020]. Two years into the crisis, a new variant of the virus, the Omikron variant, now re-intensifies the global pandemic. Not enough is known about our current vaccine's efficacy toward the new variant. Is the worst of the pandemic, therefore, behind us or is the worst yet to come? Certain lasting effects of the pan-

demic are, however, already noted [*Kirk, Rifkin,* 2020]. Adapting to the new normal, companies have to innovate and increase their resilience and agility, but they need to do it in the context of new hygiene and health measures [*Santos Vieira de Jesus et al.,* 2020]. The Low Touch Economy induced by COVID-19 has changed how firms compete, where they compete, and the tools they use to do so. Many predict that industry and firm supply chains will change dramatically and permanently due to COVID-19 [*Anker,* 2021; *Sharma et al.,* 2020]. More importantly, the remote-working population is on the rise and many employers and workers regard this as beneficial and long lasting [*Brynjolfsson et al.,* 2020; *Carnevale, Hatak,* 2020]. The pandemic has further accelerated the adoption of novel technologies that allow higher agility and resilience of both businesses and communities [*Rapaccini et al.,* 2020; *Kirk, Rifkin,* 2020]. Future studies need to ascertain the effect that the COVID-19 pandemic has had in accelerating the embrace of Industry 4.0's technological harbingers. Initial studies on block chain [*Marbouh et al.,* 2020], additive manufacturing [*Larrañeta et al.,* 2020], artificial intelligence [*Ahuja et al.,* 2020], and Internet of Things [*Alam et al.,* 2021] show that COVID-19 has indeed accelerated the disruptive, Schumpeterian wave of Industry 4.0 [*Cros et al.,* 2021]. However, future research will have to follow closely how lasting these initial changes are. Furthermore, it is not clear whether these changes can fully replace business practice as we know it, or whether they will augment the portfolio of tools and strategies that businesses use instead. As such, we cannot yet predict whether, in the longer run, the global supply chains' efficiency will become less important than the flexibility and resilience achieved through local collaborations and partnerships, especially in higher costs areas such as the EU and the US. We also do not know whether these initial changes will be an effective strategy against possible new outbreaks of viruses like COVID-19. Furthermore, the numerous developments that the COVID-19 crisis has induced reside on different levels (from an individual to industry and to society as a whole) and are not necessarily in equilibrium. The pandemic's multi-level effects will also offer numerous future research avenues.

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The COVID-19 Pandemic and Entrepreneurship in Germany

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Abstract

The COVID-19 pandemic severely affected not only incumbent firms, but also the emergence of start-ups. This paper investigates and analyzes the pandemic's effect on new business formation, as well as business exits and insolvencies, in Germany. We find that the overall level of business registrations slightly decreased during the first year of the pandemic, but that the effect is specific to certain industries. Innovative manufacturing industries and technology-oriented services experienced an increase in the numbers of start-ups. High subsidies and a temporary suspension of important criteria obliging firms to declare insolvency weakened market selection resulting in fewer exits in 2020. The relaxation of insolvency regulations may lead to considerable numbers of 'zombie' firms. Generally, the pandemic re-enforced ongoing structural change, but also exerted specific effects that may be temporary in nature.

Keywords: COVID-19; entrepreneurship; new business formation; hi-tech sectors; Germany

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Introduction

The COVID-19 pandemic began early in 2020. A year and a half later, with the implementation of the vaccination program, the pandemic appears to be slowly resolving itself. That being said, the economic consequences of the pandemic are much more severe than those of the Great Financial Crisis that occurred in 2008-2009 [OECD 2021]. The effects and consequences of the pandemic are, however, highly dependent upon national and regional economic conditions, particularly on the national policy response [*Bailey et al.,* 2020]. Hence, international comparisons may lead to important insights.

Since entrepreneurs represent one of the most vulnerable groups of the labor force heavily affected by the COVID-19 crisis, there has been pronounced scholarly attention toward small businesses and entrepreneurship since the beginning of the pandemic. The emerging literature encompasses studies on the impact of government support for firms and particularly SMEs as a response to the outbreak of the pandemic [*Gourinchas et al.,* 2021; *Core, De Marco,* 2021; *Belghitar et al.,* 2021; *Demary,* 2021; *Holtemöller et al.,* 2020; *Dörr et al.,* 2021a], changing innovation patterns [*Birkholz et al.,* 2021], as well as the impact of the crisis on the mental health and well-being of entrepreneurs [*Torrès et al.,* 2021].

This paper adds to the existing literature by documenting the evolution of new business formation and reporting on available evidence for exits and insolvencies in Germany over the course of the COVID-19 pandemic. We draw on data from various publicly available sources such as Business Registration Statistics and Bureau van Dijk.[1] The empirical evidence suggests a general amplification of ongoing structural change, and some distinct effects that may be temporary in nature. Although it is still unknown whether the pandemic will cause a global recession, it is obvious that the massive increase in public expenditures as a response to its outbreak constitutes a heavy burden that will continue to shape public policy. It is also likely that the pandemic will impact a variety of economic activities in the coming years.

Germany's Policy Reactions to the Pandemic

After the outbreak of the SARS-CoV-2 virus in China in late 2019, the disease spread rapidly around the globe, reaching Europe by late January 2020. The German government responded with a series of country-wide containment measures based on infection rates. Germany's first policy intervention banned mass events, effective on March 8, 2020. This intervention was followed by the closing of schools and child-care facilities, effective on March 16. The first national lockdown began on March 22, and continued until May 3. While this initial lockdown was phased out early in the summer of 2020, two subsequent waves of surging infection led to another period of lockdowns of varying intensity beginning in November 2020 (Figure 1).

The curve in Figure 1 depicts daily new confirmed cases of COVID-19 in Germany between January 27, 2020, when the first case in Germany was officially registered, and May 13, 2021, the latest available date at the time of writing this article. The curve shows the moving seven-day average and thus represents smoothed statistics. Three shaded time periods reflect lockdown or lockdown-like measures of varying intensity. The first lockdown was effective between March 22, 2020, and May 3, 2020. The so-called "light lockdown" was officially enacted on November 2 at the federal level and was prolonged several times. On December 13, 2020, January 5, and 19, 2021, the lockdown measures were tightened and remained effective until April 18, 2021. The end of the second shaded period marks the end of the shutdown of retail shops. As of April 23, 2021, a so-called "Federal Emergence Break" policy became effective and encompasses a variety of lockdown-like policy measures that are supposed to be applied locally at a county level depending upon the recent trends in COVID-19 cases.

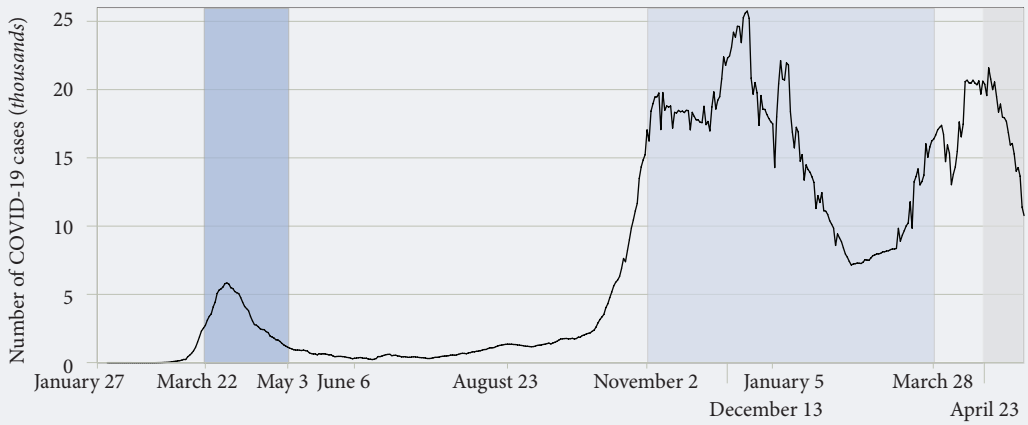
In the early stages of the pandemic, German firms reported reduced expectations and high levels of uncertainty [*Buchheim et al.,* 2020]. The hospitality, transportation, and entertainment industries were negatively affected by public containment measures. A growing number of employees began to work primarily from home. It is estimated that the German GDP declined by about 5% in 2020, but forecasts expect growth rates above 3% in 2021 and 2022 [*Wollmershäuser et al.,* 2021].

In an attempt to minimize the negative economic impact of lockdowns and avoid a recession, the German government introduced multiple measures to support incumbent firms. Massive public subsidies and a temporary[2] relaxation of the rules dealing with the obligation to file for insolvency (*COVID-19 Insolvenzaussetzungsgesetz;* COVID-19 Insolvency Suspension Act) enacted at the end of March 2020, were all designed to help businesses survive. These policy measures contributed to forestalling a surge of insolvencies, as well as maintaining unemployment figures at an acceptable level. One of these measures was an emergency aid package called *Soforthilfe* (instant aid). Around 50 billion euros were allocated to solo self-employed individuals, as well as micro businesses with no more than 10 employees. The aid could cover operating costs up to 15,000 euros and

[1] All reported empirical evidence is subject to data availability at the time of writing this paper at the end of May and early June 2021.

[2] The obligation to file for insolvency was generally suspended until end of September 2020. For certain businesses, e.g., firms that applied for state aid that was not delivered, this regulation was extended until end of April 2021.

Figure 1. **The Course of the COVID-19 Pandemic and Lockdown Periods in Germany**



Source: John Hopkins University CSSE COVID-19 Data. https://ourworldindata.org/coronavirus, accessed17.05.2021.

applications for the emergency aid packages were accepted between the end of March and the end of May 2020. Another measure was *Kurzarbeit* (short-time work scheme). This program supplemented employees' earnings that were temporarily reduced by shortened work schedules. This measure was intended to support businesses by allowing them to retain their employees during the crisis.

What Should One Expect?

Governmental responses to a pandemic such as the COVID-19 can have a variety of effects. There are obvious impacts caused by publicly ordered lockdowns, or people behaving more cautiously. For example, more adults began working at home and students were forced to learn in virtual classrooms, both of these trends increased the amount of time people spent online. As a consequence, some businesses were no longer viable, while other business experienced a boom. These pronounced sectoral and regional differences[3] will also impact start-up trends and the exit of incumbent firms.

Given the changing framework conditions, an increase of market exits in industries that could hardly operate during a lockdown could be expected,[4] the impact upon new business formation, however, is unclear. The emergence of new business opportunities in fields such as digital services, and/or the prospect of becoming unemployed may fuel entries, but increased uncertainty could also have a dampening effect. Start-ups induced by unemployment might result in small-scale and replicative businesses, but new entries in technology and innovative manufacturing industries could be more ambitious [*Konon et al.,* 2018; *Ebersberger, Kuckertz,* 2021].

For an overview of the early research and potential effects of the COVID-19 pandemic on entrepreneurship see [*Kuckertz, Brändle,* 2021]. *Dinlersoz et al.,* [2021] find pronounced differences between the emergence of new businesses during the COVID-19 pandemic and the Great Financial Crisis of 2008-2009. Their analysis suggests that the Great Financial Crisis should not be viewed as an analogous event.[5] Based on administrative data for applications of Employer Identification Numbers in the US, the authors identify a sharp decline of new business formation activity in the first few weeks of the pandemic followed by a pronounced rebound. According to their data, business applications reached a 'normal' level about 18 weeks after the onset of the pandemic and began to increase in the subsequent weeks. Many of the new businesses will be small, often being only the owner with no additional employees (solo self-employment) [*Dinlersoz et al.,* 2021].

The report by [*Djankov, Zhang,* 2021] demonstrated pronounced differences in the level of new business formation during the first three quarters of 2020 across countries. While there were significant increases in the number of start-ups in the US, Turkey, Chile, and the UK, other countries experienced a decline in new business formation.[6] The authors provide some empirical evidence supporting their conjecture that differences in the legal requirements for starting a firm is the primary factor that explains these cross-country variations. Apparently, the lower the require-

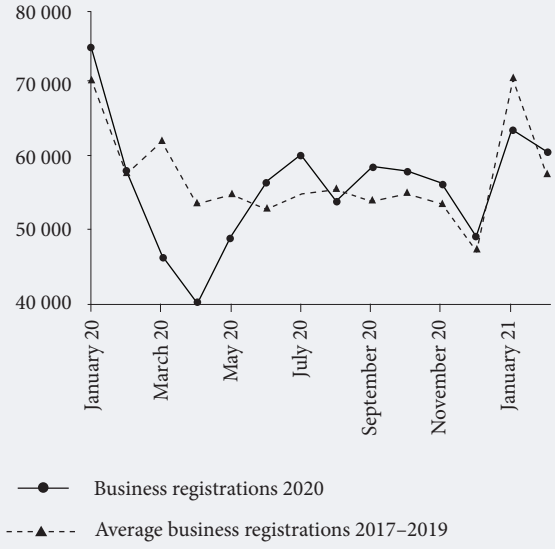
[3] For expected regional impacts of the pandemic see [*Bailey et al.,* 2020].

[4] E.g., retail shops, hospitality, tourism, transportation, personal services, as well as activities related to live events such as performing artists and the organization of exhibitions.

[5] See [*Klapper, Love,* 2011] for the US, and [*Hundt, Sternberg,* 2014] for Germany.

[6] For Germany, there is estimate of a 4% reduction of new business applications during the first three quarters of 2020 [*Djankov, Zhang,* 2021].

Figure 2. **Number of Business Registrations in Germany during the First Year of the Pandemic Compared to the 2017-2019 Average**



Source: German Statistical Office.

ments, the higher the number of start-ups during the pandemic.

Another effect of the COVID-19 pandemic could be the impact of public spending to support firms and employees. Overall, the immediate fiscal impulse in Germany amounted to nearly 40% of 2019 GDP, representing a particularly strong fiscal response in comparison to other countries.[7] The increased public debt may force governments to reduce subsidies in the coming years. Uncertainty about such future consequences can shape behavior today and may result in a reduction in the level of new business formation in the future.

New Business Formation during the Pandemic

The most recent data on start-ups in Germany come from the Business Registration Statistics (*Gewerbeanzeigenstatistik*). This database counts the notifications of new businesses recorded in the Business Register in a timely manner, with monthly updates and the inclusion of solo entrepreneurs.[8] Individuals starting a for-profit business are required to register with the municipal trade office.

Figure 2 shows the number of business registrations per month in Germany during the first year of the pandemic, from January 2020 to January 2021 as well as the average number of monthly business registrations in the years 2017-2019 as a comparison. The graph clearly shows a sharp decline in the number of business registrations that coincides with the outbreak of the pandemic in Germany and the first lockdown that began mid-March 2020. Figure 2 also shows a dramatic recovery of start-up activity after the initial decrease.[9]

There are a number of possible reasons behind the increase in new business formation. For example, individuals who lost their jobs may have opted for self-employment, either out of necessity, or because of a perceived opportunity in response to the changing environment. The 10.2% increase in the number of sideline start-ups in 2020 compared to the previous year.[10] (Statistical Office 2021) indicates that some individuals who received *Kurzarbeit* (short-time work scheme) compensation began experimenting with moonlighting schemes. These speculations require more research to determine the true causes behind the fluctuations of new business formation in Germany during the first year of the pandemic.

Unfortunately, the business registration data do not distinguish between industries. To detect sector-specific patterns of start-up activities during the first year of the pandemic, we use the Orbis database provided by the Bureau van Dijk. We use the reported date of incorporation and allocate firms into sectors using NACE Rev. 2 4-digit system. Although the Orbis database tends to underrepresent small firms due to survivorship bias, the fact that our analysis relies on 2020 data obviates this issue. It can also be assumed that the Orbis data represent the real firm population sufficiently well for identifying structural changes in new business formation (see [*Kalemli-Ozcan et al.*, 2015], for a detailed review).

Figure 3 shows new businesses in innovative (high-tech and technologically advanced) manufacturing and technology-oriented services from January to December 2020. Again, we use the average number of start-ups in the respective sectors in the years 2017-2019 as a benchmark. The figure clearly indicates increasing numbers of start-ups in innovative manufacturing industries and in technology-orient-

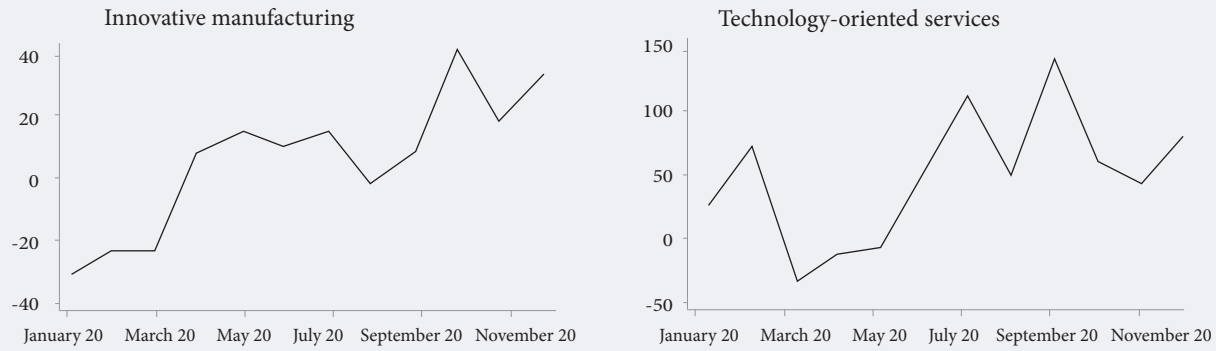
[7] For a detailed overview of the discretionary fiscal measures see https://www.bruegel.org/publications/datasets/covid-national-dataset, accessed on 16.06.2021.

[8] Disadvantages of the database are a lack of information on business characteristics, the fact that notifications are often made but no business is founded and start-ups in the liberal professions are not required to register.

[9] Other fluctuations of the numbers of business registrations in 2020 that can be observed roughly correspond to the regular seasonal dynamics of past years.

[10] https://www.destatis.de/DE/Presse/Pressemitteilungen/2021/02/PD21_062_52311.html, accessed 16.06.2021.

Figure 3. **Number of Start-Ups in Innovative Manufacturing and Technology-Oriented Services in Germany in 2020, Compared to the 2017-2019 Average**



Note: For a list of 4-digit NACE Rev.2 industries comprising high-tech manufacturing and high-tech services, see Table 1.
Source: Bureau van Dijk, own calculations.

ed services.[11] Quite remarkably, but in line with the general increase in the service sector's share of the German economy, the surplus of start-ups in technology-oriented service industries (e.g., software and games) is substantially larger than in innovative manufacturing. Another interesting pattern emerges if we consider the new venture dynamics based on the initial situation prior to the pandemic. In the beginning of 2020, the number of innovative manufacturing start-ups was below the benchmark level, yet the pandemic seems to have triggered a boost in this type of start-up. This corresponds to an analysis by [*Konon et al.,* 2018] who find a high number of start-ups in German innovative manufacturing industries and in technology-oriented services during times of relatively high unemployment and low GDP growth.

Not surprisingly, a decrease in the number of start-ups is observed in other service sectors, such as: accommodation and food services, arts and entertainment, and recreation (see Figure 4). Other sectors (construction, wholesale and retail, repair shops, real estate services, and education) that initially experienced a significant drop in new business formation through early May 2020 (the end date of the first lockdown), experienced a sustained recovery throughout the rest of the year. This trend is probably due to an increase of online activities, such as tele-conferencing and internet shopping, caused by pandemic-related mobility restrictions.

Overall, new business formation during the first pandemic year in Germany resembles the patterns found for a number of other countries and clearly indicates ongoing structural change toward digitization [*Djankov, Zhang,* 2021]. This upward trend of new business formation in innovative and technology-oriented industries during the early stage of the pandemic indicates a pronounced structural change of the economy.

Business Deregistrations

One important indicator of the extent of an economic crisis is the number of business deregistrations. Market exits are usually associated with job losses and might carry a 'risk of contagion' along the affected value chain and have negative spillover effects in other industries, particularly the financial sector [*Müller,* 2021; *Gropp et al.,* 2020].[12] This is especially true for deregistrations caused by insolvency.

Figure 5 shows the number of business deregistration cases in Germany per month during the first year of the pandemic as compared to the 2017-2019 average. While the number of deregistrations over the 2017-2019 period decreased by about 2% each year, the number dropped by 14% in 2020 as compared to the average level of the previous years. Despite typical monthly fluctuations in the deregistration numbers, it is worth noting that the largest deviations from the averages of previous years occurred in the months of the lockdown periods (March/April 2020; November 2020 – January 2021).

There are several factors that may contribute to explaining the sharp drop in the number of business deregistrations in the first year of the pandemic.

[11] Bersch and Gottschalk [2021] confirm this trend based on the Enterprise Panel of the Centre for European Economic Research (ZEW) and Dahlke et al. [2021] identify fields of rapid-response COVID-19 innovations.

[12] It should be noted that the majority of market exits are not caused by insolvency. Most exits occur if the firm owner decides that the business is not sufficiently successful (profitable).

Table 1. **List of Industries Included in High-Tech Manufacturing and Technology-Oriented Services (NACE Rev. 2 Codes)**

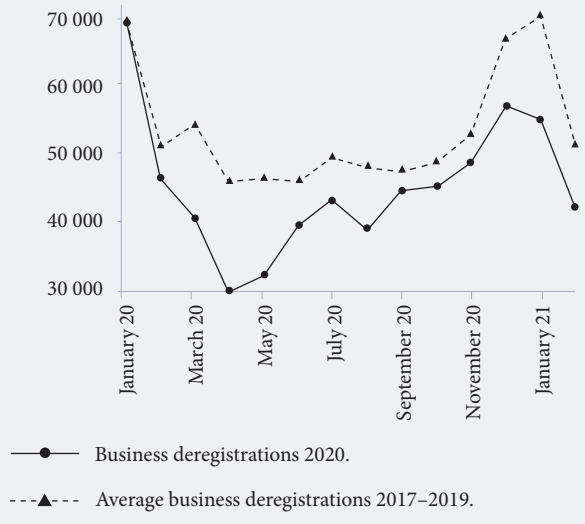
Code	Description
	Innovative Manufacturing
20.13	Manufacture of other inorganic basic chemicals
20.14	Manufacture of other organic basic chemicals
20.20	Manufacture of pesticides and other agrochemical products
20.52	Manufacture of glues
20.53	Manufacture of essential oils
20.59	Manufacture of other chemical products n.e.c.
21.10	Manufacture of basic pharmaceutical products
21.20	Manufacture of pharmaceutical preparations
22.11	Manufacture of rubber tires and tubes; retreading and rebuilding of rubber tire
22.19	Manufacture of other rubber products
23.19	Manufacture and processing of other glass, including technical glassware
25.4	Manufacture of weapons and ammunition
26.11	Manufacture of electronic components
26.12	Manufacture of loaded electronic boards
26.20	Manufacture of computers and peripheral equipment
26.30	Manufacture of communication equipment
26.40	Manufacture of consumer electronics
26.51	Manufacture of instruments and appliances for measuring, testing and navigation
26.60	Manufacture of irradiation, electromedical and electrotherapeutic equipment
26.70	Manufacture of optical instruments and photographic equipment
27.11	Manufacture of electric motors, generators and transformers
27.20	Manufacture of batteries and accumulators
27.40	Manufacture of electric lighting equipment
27.51	Manufacture of electric domestic appliances
27.90	Manufacture of other electrical equipment
28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
28.12	Manufacture of fluid power equipment
28.13	Manufacture of other pumps and compressors
28.15	Manufacture of bearings, gears, gearing and driving elements
28.23	Manufacture of office machinery and equipment (except computers and peripheral equipment)
28.24	Manufacture of power-driven hand tools
28.29	Manufacture of other general-purpose machinery n.e.c.
28.30	Manufacture of agricultural and forestry machinery
28.41	Manufacture of metal forming machinery
28.49	Manufacture of other machine tools
28.93	Manufacture of machinery for food, beverage and tobacco processing
28.94	Manufacture of machinery for textile, apparel and leather production
28.95	Manufacture of machinery for paper and paperboard production
28.99	Manufacture of other special-purpose machinery n.e.c.
29.10	Manufacture of motor vehicles
29.31	Manufacture of electrical and electronic equipment for motor vehicles
29.32	Manufacture of other parts and accessories for motor vehicles
30.20	Manufacture of railway locomotives and rolling stock
30.30	Manufacture of air and spacecraft and related machinery
30.40	Manufacture of military fighting vehicles
32.50	Manufacture of medical and dental instruments and supplies
	Technology-Oriented Services
61.1	Wired telecommunications activities
61.2	Wireless telecommunications activities
61.3	Satellite telecommunications activities
62	Computer programming, consultancy and related activities
63.1	Data processing, hosting and related activities; web portals
71.1	Architectural and engineering activities and related technical consultancy
71.2	Technical testing and analysis
72.1	Research and experimental development on natural sciences and engineering

Source: Leibniz Centre for European Economic Research (ZEW).

Figure 4. **Number of Start-Ups in Germany across Industries Compared to the 2017-2019 Average**

Source: authors based on Bureau van Dijk data.

Figure 5. **Amount of Business Deregistration Cases in Germany during the First Year of the Pandemic as Compared to the 2017-19 Average**



Source: Statistics Germany.

The most likely explanation for the drop in business deregistrations is the suspension of the obligation to file for insolvency beginning in March 2020. The number of market exits caused by insolvencies (e.g., [*DeTienne et al.,* 2015]) shows a slight increase after the relaxation of the obligation to file for insolvency was rescinded in September 2020. It should be noted that in some cases, the relaxation of the rules was extended until April 2021. Other possible explanations include measures taken by the German government to support businesses and employees, and the wait-and-see attitude adopted by certain firms [*Holtemöller, Muradoglu,* 2020; *Müller,* 2021]. Positive expectations of a post-crisis rebound were supported by the fact that household savings in Germany significantly increased in 2020 [*Gropp, McShane,* 2021].

If government subsidies and temporarily relaxed insolvency regulation resulted in fewer business deregistrations in 2020, one would expect a sharp increase in deregistrations in 2021 as the subsidies and relaxations fade away. A number of economists issued warnings that the relaxed regulations may create a breeding ground for a 'zombification' of the economy [*Demary,* 2021; *Holtemöller et al.,* 2020]. Others expressed concern over the number of retained exits and insolvencies, describing the backlog as a 'time bomb' capable of destroying smaller businesses when it finally explodes [*Gourinchas et al.,* 2021]. Initial estimates of the existing insolvency gap in Germany, however, suggest that most 'zombie' firms are small enterprises that are unlikely to generate significant negative spillovers [*Dörr et al.,* 2021a, b].[13] Due to their small size, these firms are also unlikely to hamper the desirable process of 'creative destruction' by absorbing resources that are urgently needed elsewhere.

Lessons Learned

The COVID-19 pandemic continues to take a toll on every aspect of human life. Recurring lockdowns and social distancing have constrained private businesses, caused economic damage, and changed social interactions. Limiting the costs of this toll requires creativity and flexibility by policymakers and entrepreneurial responses by economic actors. Robust entrepreneurial responses offered by incumbent firms and new businesses experimenting with innovative concepts and ideas may induce new growth paths that are pivotal for economic recovery and future prosperity.

One of the pandemic's push effects is accelerated digitization, not only in the business sector, but also in the educational sector, health services, and public administration. Both public and private organizations are now experimenting with new forms of organization and new business models that may send economic development in new directions. Although some of these pandemic-induced changes may be temporary, it is likely that some will endure.

Our results indicate that the average level of new business formation in Germany has not been substantially affected by the COVID-19 pandemic. Obviously, the pandemic induced pronounced changes in the sectoral structure of newly emerging firms. In particular, we find a rising share of start-ups in innovative manufacturing and technology-oriented services. This pattern is in line with previous evidence showing that economic crises can spur innovative entrepreneurship [*Konon et al.,* 2018]. Our finding of fewer business closures compared to pre-pandemic years was probably caused by a temporary relaxation of the obligation to file for insolvency and public subsidies that helped keep firms alive.

Open Questions

Our assessment of the consequences of the COVID-19 pandemic on start-up activity and business closures in Germany provides a number of insights. Since the pandemic is still ongoing, our analysis and results are preliminary. Future studies may arrive at more nuanced conclusions about the effect of the pandemic on business dynamics and about how innovative entrepreneurship impacts structural change and economic development in times of crisis.

Because the intensity of the pandemic and the political strategies to cope with its consequences vary

[13] An insolvency gap in early 2021was estimated at about 25,000 predominantly small firms [*Dörr et al.,* 2021a].

across countries and regions, an international and regional comparison may provide additional insights. It is well known from previous research that regions with an entrepreneurial culture and tradition are more resilient to major structural crises and reveal higher growth during recovery phases [*Fritsch, Wyrwich,* 2020]. Hence, one may expect that regions with an entrepreneurial culture and tradition may also be more successful in coping with the COVID-19 pandemic [*Korsgaard et al.,* 2020].

Future research could focus on the consequences of increased digitalization and internet trade for geographic settlement structures and the development of regions. This process may also affect the geography of (innovative) start-ups. Although evidence shows that there is an increasing concentration of innovative start-ups in large cities in Germany [*Fritsch, Wyrwich,* 2021], the digitalization push may lead to a reversal of this pattern in the future. In this respect, the pandemic may also trigger development in more peripheral regions.

In the coming years, there is a need to investigate the long-term effects of the pandemic and the public policy measures on firms, entrepreneurship, and social interactions. For example, in Germany, the crisis led to a significant increase of public debt that was to a large extent due to the massive government spending on rescue measures to protect business and workplaces. In the coming years, these higher levels of public debt may translate into an increased tax burden for the private sector or in a reduction of government spending. The way governments deal with this challenge of higher debt is of critical importance. If they react with reduced spending on education and R&D, this would adversely affect the opportunities for innovative entrepreneurship to commercialize knowledge generated at universities and research centers. There can hardly be any doubt that education and R&D are of key importance for future growth that will generate higher public revenues. New ideas and better solutions will also help to deal with other challenges such as global warming or a future pandemic.

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A First Year's Impact of the Pandemic on the Czech Entrepreneurial Activity

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Abstract

Every crisis affects entrepreneurial activity; for some entrepreneurs, it is an opportunity for a new start; others are forced to shut down their businesses. This study aimed to analyze the effect of the global coronavirus (so-called COVID-19) pandemic on Czech entrepreneurial activity. The article exploits the administrative data covering business demographics of seventy-seven Local Administrative Units (LAU1) regions over the years 2008-2020. Data were obtained from the Czech Statistical Office. The study provides insights into the short term effects of the pandemic, i.e. one year after. The results from the panel regression models and placebo tests comparing forecasted values of new businesses registrations and closures with actual values obtained after the end of 2020 do not show that there would be a significant drop in the Czech entrepreneurial activity. On the opposite, the data indicate that the Czech entrepreneurial activity grew and even increased compared with 2019. However, the obtained results need to be interpreted with caution, as many factors influenced Czech businesses' development. Specifically, we mention the past economic growth, the introduction of public entrepreneurship and SME policy instruments and financial back-ups of the business owners. There are several implications of the conducted research. For instance, there is a need to observe the long-term effects of the pandemic on business demography and its structure. We propose to study changes in bankruptcy rates in the most harmed sectors such as tourism, hospitality, culture or sport and compare them with sectors that could easier transfer their business activities online.

Keywords: entrepreneurial activity; business demographics; global pandemic; crisis; COVID-19; forecasting; econometric analysis

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Introduction

The population of economically active businesses and self-employed persons, i.e., entrepreneurial activity, is continuously influenced by many identified determinants both on the supply and demand sides [*Freytag, Thurik,* 2007; *Urbano et al.,* 2019]. Crises, economic shocks, and natural disasters belong to external factors that have the potential and power to affect the levels and structure of entrepreneurial activity [*Santos et al.,* 2017; *Doern et al.,* 2019].

At the end of 2019, such an event occurred. The coronavirus (so-called COVID-19) started spreading from Wuhan, China to other parts of the world so quickly that World Health Organization (2020) declared the COVID-19 pandemic on March 11, 2020[1]. As a result, governments responded with numerous restrictive actions, which also affected entrepreneurs, who had to move their businesses online, adapt to governmental restrictions, or close their businesses temporarily or entirely. Some individuals took the pandemic as an opportunity to establish a new venture or innovate the existing business despite the adverse conditions, others as a signal to completely shut down [*Kuckertz et al.,* 2020; *Ratten,* 2020; *Croteau et al.,* 2021; *Dvouletý et al.,* 2021a].

However, has the pandemic influenced the overall levels of entrepreneurial activity? Did it result in decreased levels of the population engaged in entrepreneurship and self-employment? Although the pandemic is not yet over, we may already quantify its initial and short-term effects. This is the main aim of the paper. This study analyzes how was the overall population of the Czech enterprises was influenced by the pandemic in the short term, i.e., one year after the beginning of the crisis. The Czech Republic serves as an example of a small open Central European economy with above-average entrepreneurship levels [*Dvouletý,* 2019; *Hamplová et al.,* 2021]. However, the introduced empirical approach may be used by scholars from other countries who are interested in quantifying the effects of the global pandemic upon entrepreneurial development. The research results have value also for policymakers, who invested considerable efforts and financial resources toward supporting entrepreneurship in times of crisis over the past year [*Żak, Garncarz,* 2020; *Brown et al.,* 2020; *Pedauga et al.,* 2021]. The empirical approach used in this paper is based on the application of econometric, statistical, and forecasting techniques (specifically panel regression analysis and paired t-tests) on the level of regional Local Administrative Units (LAU1) and official business demographics data obtained from the Czech Statistical Office.

Data and Methods

The most significant restrictions imposed upon the Czech economy started in late March 2020 after the declaration of a global pandemic [*Hedvičáková, Kozubíková,* 2021], which was characteristic of other countries [*Rashid, Ratten,* 2021; *Storr et al.,* 2021; *Apostolopoulos et al.,* 2021]. The restrictions included mainly the closure of shops and businesses, schools, accommodation facilities, the restriction of free movement, and the obligation to wear a mask covering both the mouth and nose [*Dvorak et al.,* 2021].

This study is based on organizational statistics administrative data obtained from the Czech Statistical Office (2021). The available data include information on the overall number of economically active entities, the number of newly registered businesses, and business closures. We managed to collect data for the period of years 2008-2020. This allows us to observe changes in Czech entrepreneurial activity after the first year of the global pandemic.

Initially, we may see the year-to-year changes in the overall levels of activity. In 2019, the Czech Statistical Office's (2021) data[2] show that there were 1,530,749 enterprises with reported economic activity. This number even increased to 1,576,331 at the end of 2020, so we do not see any significant drop in the overall activity level, but rather the opposite.

It is worth noting that the overall levels of entrepreneurial activity cannot provide us with a more complex picture of what is happening, so we need to dive deeper into its inflows and outflows. The registrations of new businesses represent the inflows and outflows include closures of existing enterprises [*Iversen et al.,* 2007; *Congregado,* 2007]. Therefore, we observe both inflows and outflows of Czech entrepreneurial activity at the Local Administrative Unit – LAU1[3] levels to obtain a more detailed picture. The Czech Republic consists of seventy-seven LAU1 districts (Figure 1 shows the districts on the map) that are not frequently used for analysis due to the lack of data [*Baštová et al.,* 2011; *Dvouletý,* 2017]. Table 1 shows summary statistics for both respective variables, i.e., the number of newly registered enterprises and the number of officially closed businesses in the year at the LAU1 level.

[1] https://www.who.int/news-room/detail/27-04-2020-who-timeline---covid-19, accessed 04.06.2021.

[2] https://www.czso.cz/csu/czso/organizational-statistics, accessed 04.06.2021.

[3] https://ec.europa.eu/eurostat/web/nuts/local-administrative-units, accessed 04.06.2021.

Figure 1. **Map of the Czech Republic showing LAU1 regions**

Source: Wikimedia Commons (2021), available under the Creative Commons License CC0. https://cs.wikipedia.org/wiki/Okresy_v_%C4%8Cesku#/media/Soubor:Okresy_%C4%8CR_2007.PNG, accessed 04.06.2021.

The empirical approach is based on applying econometric, statistical, and forecasting techniques *to analyze the impact of the pandemic upon the inflows into and outflows from entrepreneurship after the end of the first year.* The approach includes the following steps:

1. First, we estimate LAU1 panel regression models on both flow-capturing variables over the years 2008-2020 to see if 2020 values deviate from the long-term trend.
2. We proceed by estimating both models on a reduced sample of the years 2008-2019 and forecast the values of new registrations and business closures in 2020.
3. Once evaluating the quality of the forecasted values in 2020, we employ the paired t-tests (placebo test) to see whether the predicted values differ from the actual values.

Results

We estimate regression models based on a balanced longitudinal sample of seventy-seven districts over the years 2008-2020. We use the least-squares dummy variables (LSDV) estimator, which is suitable for a relatively stable panel [*Verbeek,* 2008]. Thus, the estimated models include district and year dummies. All reported models were estimated with robust standard errors. As a robustness check, there are, for each of the two dependent variables, two estimated models presented in Table 2. The robustness check included the logarithmic transformation of dependent variables to make the variance more stable. The obtained results are stable and do not significantly differ between Models 1 and 2 and Models 3 and 4, respectively. Therefore, the main findings can be found in Model 1 for new business registrations and Model 3 for business closures.

Furthermore, the results confirm that the inflows and outflows depend on time and location, as many scholars emphasized in their publications [*Audretsch et al.,* 2012; *Muñoz, Kimmitt,* 2019]. Notably, we see that there were slightly lower registrations of new businesses and more business closures in 2020 when compared with the reference year;

Table 1. **Summary statistics of LAU 1 data for years 2008-2020**

Variable/indicator	Mean	Median	Minimum	Maximum	Number of Observations
New Businesses Registrations	1358.7	840.0	248.0	29 801.1	1001
Business Closures	956.2	625.0	148.0	32 440	1001
Source: Own elaboration based on the Czech Statistical Office (2020) data.					

Table 2. **Panel regression analysis**

Model number	(1)	(2)	(3)	(4)
Independent variables/ Dependent variables	New Businesses Registrations	Log(New Businesses Registrations)	Business Closures	Log(Business Closures)
		LAU1 Regions		
Benesov	–26128.9*** (430.3)	–3.575*** (0.0429)	–13141.4*** (1762.2)	–3.121*** (0.108)
Beroun	–26132.0*** (430.8)	–3.575*** (0.0441)	–13271.4*** (1761.3)	–3.240*** (0.0891)
Blansko	–26139.2*** (431.3)	–3.583*** (0.0491)	–13232.4*** (1762.0)	–3.145*** (0.0887)
Brno-mesto	–21360.9*** (446.6)	–1.584*** (0.0535)	–10621.5*** (1763.8)	–1.415*** (0.0961)
Brno-venkov	–25086.3*** (430.8)	–2.708*** (0.0436)	–12589.4*** (1761.8)	–2.401*** (0.0930)
Bruntal	–26202.2*** (430.4)	–3.674*** (0.0425)	–13201.1*** (1763.2)	–3.091*** (0.109)
Breclav	–25948.7*** (430.7)	–3.359*** (0.0432)	–12926.2*** (1771.8)	–2.827*** (0.117)
Cheb	–26119.8*** (432.4)	–3.594*** (0.0624)	–12887.7*** (1773.5)	–2.874*** (0.145)
Chomutov	–25943.9*** (431.0)	–3.366*** (0.0502)	–12895.6*** (1761.3)	–2.694*** (0.0917)
Chrudim	–26024.7*** (430.8)	–3.445*** (0.0454)	–13144.4*** (1761.9)	–3.013*** (0.0902)
Domazlice	–26471.3*** (430.5)	–4.184*** (0.0451)	–13477.3*** (1762.0)	–3.724*** (0.0985)
Decin	–25989.2*** (430.5)	–3.417*** (0.0476)	–12951.0*** (1761.7)	–2.786*** (0.0965)
Frydek-Mistek	–25204.8*** (431.1)	–2.772*** (0.0495)	–12703.5*** (1763.2)	–2.488*** (0.105)
Havlickuv Brod	–26147.5*** (430.6)	–3.599*** (0.0424)	–13316.5*** (1761.8)	–3.323*** (0.0922)
Hodonin	–25694.2*** (430.3)	–3.118*** (0.0420)	–12839.3*** (1762.8)	–2.667*** (0.0972)
Hradec Kralove	–25344.1*** (431.8)	–2.866*** (0.0445)	–12673.3*** (1762.4)	–2.481*** (0.0887)
Jablonec nad Nisou	–26148.6*** (430.7)	–3.607*** (0.0442)	–13172.9*** (1761.7)	–3.065*** (0.0882)
Jesenik	–26543.8*** (431.0)	–4.366*** (0.0421)	–13564.5*** (1762.9)	–4.032*** (0.105)
Jihlava	–25966.9*** (430.7)	–3.381*** (0.0438)	–13254.2*** (1762.6)	–3.178*** (0.0987)
Jindrichuv Hradec	–26169.8*** (430.4)	–3.633*** (0.0436)	–13260.2*** (1763.4)	–3.187*** (0.0912)
Jicin	–26233.2*** (431.1)	–3.725*** (0.0473)	–13322.6*** (1762.2)	–3.348*** (0.0903)
Karlovy Vary	–25721.2*** (441.8)	–3.178*** (0.0642)	–12801.5*** (1763.3)	–2.628*** (0.103)
Karvina	–25210.3*** (430.9)	–2.779*** (0.0422)	–12446.8*** (1763.3)	–2.257*** (0.106)
Kladno	–25565.4*** (431.0)	–3.018*** (0.0427)	–12726.9*** (1761.0)	–2.522*** (0.0887)
Klatovy	–26260.2*** (430.5)	–3.775*** (0.0460)	–13286.8*** (1761.8)	–3.263*** (0.0920)
Kolin	–26111.2*** (430.7)	–3.548*** (0.0438)	–13200.8*** (1762.4)	–3.097*** (0.0895)
Kromeriz	–26108.3*** (430.2)	–3.555*** (0.0449)	–13063.2*** (1763.2)	–2.904*** (0.0938)
Kutna Hora	–26330.5***	–3.881***	–13224.4***	–3.189***
Liberec	–25302.5*** (431.9)	–2.840*** (0.0414)	–12473.8*** (1778.7)	–2.450*** (0.125)
Litomerice	–26001.9*** (430.5)	–3.422*** (0.0441)	–12893.5*** (1763.4)	–2.784*** (0.104)
Louny	–26259.5*** (431.2)	–3.767*** (0.0531)	–13196.3*** (1760.7)	–3.158*** (0.0980)
Mlada Boleslav	–25886.9*** (434.6)	–3.326*** (0.0596)	–13070.9*** (1762.6)	–2.969*** (0.109)
Most	–26007.2*** (431.9)	–3.429*** (0.0570)	–13171.6*** (1762.6)	–3.054*** (0.0993)
Melnik	–26017.8*** (430.3)	–3.436*** (0.0410)	–13065.7*** (1761.0)	–2.921*** (0.0924)
Novy Jicin	–25861.2*** (430.4)	–3.271*** (0.0414)	–12997.5*** (1763.1)	–2.790*** (0.102)
Nymburk	–26122.8*** (430.8)	–3.564*** (0.0429)	–13232.8*** (1760.8)	–3.161*** (0.0892)
Nachod	–26070.2*** (430.3)	–3.497*** (0.0416)	–13169.8*** (1761.6)	–3.096*** (0.0971)
Olomouc	–24918.2*** (431.4)	–2.617*** (0.0427)	–12575.5*** (1764.6)	–2.383*** (0.102)
Opava	–25627.8*** (430.4)	–3.065*** (0.0412)	–12780.4*** (1765.0)	–2.568*** (0.126)
Ostrava-mesto	–23658.2*** (434.0)	–2.122*** (0.0445)	–11467.5*** (1768.6)	–1.720*** (0.115)
Pardubice	–25344.4*** (431.3)	–2.864*** (0.0421)	–12664.5*** (1761.3)	–2.455*** (0.0895)
Pelhrimov	–26304.5*** (430.4)	–3.841*** (0.0452)	–13403.5*** (1763.3)	–3.517*** (0.0991)
Plzen-jih	–26460.5*** (430.7)	–4.149*** (0.0433)	–13470.5*** (1761.4)	–3.751*** (0.0979)
Plzen-mesto	–24768.2*** (466.3)	–2.581*** (0.0644)	–12235.0*** (1769.2)	–2.180*** (0.109)
Plzen-sever	–26329.1*** (430.3)	–3.883*** (0.0470)	–13416.4*** (1762.1)	–3.595*** (0.0987)
Prachatice	–26484.5*** (430.9)	–4.210*** (0.0463)	–13440.2*** (1764.2)	–3.600*** (0.0967)
Praha-vychod	–25076.3*** (431.0)	–2.700*** (0.0460)	–12852.8*** (1761.1)	–2.656*** (0.0916)
Praha-zapad	–25333.7*** (431.3)	–2.853*** (0.0493)	–12741.1*** (1765.1)	–2.634*** (0.121)
Prostejov	–26134.2*** (430.4)	–3.583*** (0.0414)	–13174.9*** (1765.8)	–3.070*** (0.107)
Pisek	–26321.5*** (430.5)	–3.867*** (0.0423)	–13304.3*** (1762.6)	–3.283*** (0.0937)
Prerov	–26018.0*** (430.4)	–3.439*** (0.0419)	–13063.5*** (1764.8)	–2.896*** (0.107)

Table 2 continued

Model number	(1)	(2)	(3)	(4)
Independent variables/ Dependent variables	**New Businesses Registrations**	**Log(New Businesses Registrations)**	**Business Closures**	**Log(Business Closures)**
Pribram	−25944.2*** (430.0)	−3.357*** (0.0414)	−13093.0*** (1760.7)	−2.971*** (0.0936)
Rakovnik	−26458.0*** (430.5)	−4.157*** (0.0502)	−13421.8*** (1762.7)	−3.570*** (0.0926)
Rokycany	−26544.6*** (430.4)	−4.383*** (0.0491)	−13523.2*** (1762.2)	−3.900*** (0.0985)
Rychnov nad Kneznou	−26346.2*** (430.4)	−3.917*** (0.0437)	−13378.6*** (1762.8)	−3.534*** (0.113)
Semily	−26310.0*** (430.3)	−3.845*** (0.0426)	−13358.2*** (1760.8)	−3.441*** (0.0939)
Sokolov	−26314.6*** (430.4)	−3.868*** (0.0493)	−13195.5*** (1761.2)	−3.092*** (0.0960)
Strakonice	−26338.3*** (430.5)	−3.903*** (0.0444)	−13342.3*** (1761.7)	−3.373*** (0.1000)
Svitavy	−26153.4*** (430.6)	−3.605*** (0.0460)	−13292.7*** (1761.8)	−3.311*** (0.101)
Tachov	−26456.4*** (431.2)	−4.180*** (0.0686)	−13437.5*** (1762.5)	−3.639*** (0.0964)
Teplice	−25852.3*** (434.0)	−3.274*** (0.0560)	−12770.2*** (1762.3)	−2.586*** (0.102)
Trutnov	−25909.6*** (430.6)	−3.327*** (0.0428)	−13045.2*** (1761.0)	−2.869*** (0.0877)
Tabor	−26021.9*** (430.6)	−3.447*** (0.0455)	−13035.5*** (1761.9)	−2.945*** (0.104)
Trebic	−26031.1*** (430.3)	−3.452*** (0.0418)	−13163.7*** (1763.9)	−3.052*** (0.103)
Uherske Hradiste	−25759.6*** (430.4)	−3.177*** (0.0418)	−12931.7*** (1762.6)	−2.737*** (0.0941)
Vsetin	−25816.0*** (430.9)	−3.227*** (0.0480)	−12958.5*** (1763.2)	−2.769*** (0.0897)
Vyskov	−26166.8*** (430.3)	−3.628*** (0.0411)	−13311.8*** (1761.1)	−3.298*** (0.0903)
Zlin	−25296.6*** (430.7)	−2.831*** (0.0434)	−12638.1*** (1763.9)	−2.453*** (0.0941)
Znojmo	−25997.8*** (430.8)	−3.414*** (0.0412)	−13096.5*** (1762.7)	−2.932*** (0.0919)
Usti nad Labem	−25908.8*** (430.8)	−3.326*** (0.0459)	−13004.8*** (1761.2)	−2.810*** (0.0900)
Usti nad Orlici	−25909.2*** (430.5)	−3.319*** (0.0407)	−13043.8*** (1761.3)	−2.916*** (0.0939)
Ceska Lipa	−26169.8*** (430.4)	−3.635*** (0.0433)	−13174.9*** (1761.5)	−3.053*** (0.0930)
Ceske Budejovice	−25039.1*** (431.7)	−2.684*** (0.0412)	−12553.9*** (1761.9)	−2.351*** (0.0957)
Cesky Krumlov	−26343.1*** (430.6)	−3.915*** (0.0454)	−13372.2*** (1762.9)	−3.417*** (0.0949)
Sumperk	−26045.1*** (430.8)	−3.466*** (0.0429)	−13120.2*** (1761.8)	−2.968*** (0.0932)
Zdar and Sazavou	−25993.8*** (430.7)	−3.407*** (0.0452)	−13243.2*** (1762.9)	−3.179*** (0.101)
Years				
2009		−0.000598 (0.0234)	658.9*** (107.3)	0.795*** (0.0400)
2010	53.35 (40.01)	0.0103 (0.0202)	114.4 (90.45)	0.147*** (0.0277)
2011	16.81 (52.93)	−0.0478* (0.0202)	30.94 (102.2)	0.0476+ (0.0249)
2012	−148.2*** (37.54)	−0.165*** (0.0199)	99.57 (87.43)	0.114*** (0.0223)
2013	−221.8*** (39.02)	−0.232*** (0.0204)	1296.1*** (260.8)	1.003*** (0.0476)
2014	−317.9*** (43.41)	−0.336*** (0.0202)	141.6+ (86.03)	0.174*** (0.0231)
2015	−259.4*** (42.14)	−0.271*** (0.0203)	164.3+ (85.33)	0.180*** (0.0243)
2016	−240.4*** (37.61)	−0.273*** (0.0200)	163.4* (80.88)	0.189*** (0.0219)
2017	−189.1*** (44.30)	−0.252*** (0.0203)	228.5** (77.58)	0.242*** (0.0214)
2018	−205.2*** (44.06)	−0.269*** (0.0207)	217.7** (80.56)	0.193*** (0.0232)
2019	−201.3*** (45.22)	−0.264*** (0.0203)	706.8*** (119.8)	0.696*** (0.0210)
2020	−281.8*** (37.95)	−0.318*** (0.0206)	149.3+ (84.41)	0.0721** (0.0257)
Other components				
Constant	27040.4*** (435.7)	10.38*** (0.0442)	13502.2*** (1754.0)	9.158*** (0.0850)
Observations	1,001	1,001	1,001	1,001
Prob > chi2	0.000	0.000	0.000	0.000
R^2	0.995	0.983	0.819	0.925
Akaike information criterion	13710.6	−1940.8	16249.1	−385.1
Bayesian information criterion	14147.5	−1504.0	16686.0	51.79

Notes: Robust standard errors in parentheses, stat. significance is reported as follows: + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. Reference groups for dummy variables: LAU1 Region – Praha (Capital), Year – 2008.

Source: Own elaboration based on the Czech Statistical Office (2020) data and STATA 14 software..

Table 3. **Forecast quality diagnostics (forecasted observations – 77 per variable)**

Variable/indicator	Root Mean Squared Error	Mean Absolute Error	Mean Absolute Percent Error	Theil Inequality Coefficient
New Businesses Registrations	180.33	154.52	19.20	0.027
Business Closures	356.74	140.82	21.65	0.097

Source: Own processing based on the EViews 9 software.

however, we cannot say whether these changes resulted from the pandemic or not. The statistical significance of the included variables and the model R-Squared indicators (R^2) promises the sufficient usage of Models 1 and 3 for forecasting purposes.

Thus, in the next step, we re-estimated Models 1 and 3 based on a reduced sample of the years 2008-2019 (please note we do not report the models for parsimonious reasons again, but they are available upon request) and used the estimates to forecast the values of new registrations and business closures in 2020. The evaluation of the quality of the forecasted values was based on the traditional quality measures like Root Mean Squared Error (RMSE) or Theil Inequality Coefficient [Li et al., 2019]. The forecast quality checks also included comparisons of models with different specifications of trend functions. Still, in the end, we found the specification of models as reported in Table 2 as the most accurate. Table 3 shows forecast accuracy measures for the predicted values.

Finally, we may use these predicted values, simulating a no pandemic situation (or placebo test) and statistically compare them with the actual values of new business registrations and business closures at the end of the year 2020. The results of the paired t-tests are available in Table 4. Unfortunately, they do not find any statistical support for differences between both pairs of variables. Therefore, *we cannot say that the first year of the pandemic significantly influenced the inflows into and outflows from Czech entrepreneurial activity.*

Concluding Remarks

This article aimed to provide empirical evidence concerning the effect of the global pandemic upon the overall population of Czech enterprises after the first year. The conducted analysis is based on administrative data covering business demographics of seventy-seven LAU1 regions over the years 2008-2020. The results from the panel regression models and placebo tests comparing forecasted values of new business registrations and closures with actual values obtained after the end of 2020 do not show that there would be a significant drop in the Czech entrepreneurial activity. Quite the opposite, the data indicate that activity grew and even increased to levels above those observed in 2019.

However, these findings need to be interpreted with caution and do not mean that the pandemic did not influence Czech entrepreneurs. First, entrepreneurs and self-employed persons might have formed expectations that this will only be a short-term event, so they mobilized all available financial reserves to keep the businesses operating with the hope of a better tomorrow. Nevertheless, their capabilities to secure liquidity over a more extended period while experiencing a continuous drop in sales is very limited and might eventually result in bankruptcy [*Brown et al.,* 2020]. Second, the observed increase in the levels of entrepreneurship could be related to the past economic growth of the country, measured in terms of employment, nominal wages, and gross domestic product growth. However, the delay in macroeconomic de-

Table 4. **Results of the paired t-tests comparing actual 2020 values with the forecasted values**

New Businesses Registrations	**mean**	**standard error**	**observations (N)**	**t-statistics**
New Businesses Registrations	1,229.47	340.95	77	0.313
New Businesses Registrations (Forecasted)	1,381.55	345.90	77	**p-value (H_1: Difference≠0)**
				0.755
Business Closures	**mean**	**standard error**	**observations (N)**	**t-statistics**
Business Closures	800.01	208.97	77	0.247
Business Closures (Forecasted)	732.84	173.60	77	**p-value (H_1: Difference≠0):**
				0.805

Source: Own processing based on the EViews 9 software.

velopment is expected to shift this positive trend as the pandemic is ongoing and restrictions are still active [*Jašová et al.,* 2017; *Petkovski et al.,* 2018; *Hedvičáková, Kozubíková,* 2021]. Third, along with government restrictions, several public policy actions aimed at mitigating the adverse effects of the pandemic upon Czech businesses were introduced. The main programs were focused on maintaining employment and jobs through subsidies, investment, innovation research, and development projects funded through grants, tax relief schemes, and the coverage of selected operational costs such as rental costs. Besides, entrepreneurship and SME policy expanded the offer of credit guarantees and soft loans provided by the Czech-Moravian Guarantee and Development Bank. In addition, several specific programs were aimed at supporting the most endangered sectors such as tourism, hospitality, culture or sport. These policy efforts might delay business bankruptcies and help entrepreneurs and self-employed persons to survive these difficult times [*Betzler et al.,* 2021; *Hedvičáková, Kozubíková,* 2021; *Novotný, Pellešová,* 2021]. However, it is challenging to say whether these policies will get to those most in need as the effects of Czech entrepreneurship and SME policies were not always found to be positive, as documented in evaluation studies by [*Assudani et al.,* 2017; Čadil *et al.,* 2017; *Pelucha et al.,* 2019; *Ratinger et al.,* 2020; *Dvouletý et al.,* 2021a] indicating that the programs are often used by "professional aid applicants" and those who need public support do not even apply. It will be thus critical to assess these programs carefully, see the structure of the applicants and analyze their effects by using rigorous counterfactual impact evaluation research designs. Fourth, business demography statistics capture only formal registrations and formal closures. The real picture may differ due to the fact that some do not quit officially while already exhibiting no entrepreneurial activity; on the contrary, many start-ups make their first steps while not yet officially registered [*Stenholm et al.,* 2013; *Dvouletý,* 2018]. Therefore, the official statistics cannot capture individuals who intended to start a business, but due to the pandemic never proceeded with official registration or with the later stages of the business preparations [*Nakara et al.,* 2020; *Loan et al.,* 2021; *Dvouletý et al.,* 2021a]. It is expected that especially this group of individuals will be negatively influenced by the pandemic, which mitigated mobility, social activities, and gathering, which are often considered supportive for the development of the business to more advanced stages [*Kibler et al.,* 2014]. Still, the lack of data on entrepreneurial intentions needs to be understood as a limitation of the presented empirical results. Another limitation of the conducted study is the lack of the data on factors influencing the development of the entrepreneurial activity at the LAU1 level, which could be used as predictors making the forecasted values more precise. These could include regional determinants of entrepreneurship identified by the previous literature such as the level of regional gross domestic product (GDP), unemployment, educational structure of the population, supportive institutions (incubators, accelerators, research centers, or science parks), transportation infrastructure, or labor structure of inhabitants [*Fritsch, Falck,* 2007; *Dvouletý,* 2017; *Neumann,* 2020; *Demirdag, Eraydin,* 2021].

Many future research challenges are arising based on this study. For example, what will the long-term effects of this pandemic be and how will it reshape entrepreneurial activity? What changes will there be in entrepreneurial activity concerning sectoral classification? Will industries more harmed by restrictions report higher bankruptcy rates when compared with the sectors that could more easily move their businesses online? How has the pandemic affected the entrepreneur's personality, family relations, and his/her overall well-being? Unfortunately, to answer all these intriguing questions, we need to wait for more data and for a time when the pandemic is truly over. Nevertheless, researchers may already start collecting data for answering these questions in the future.

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Pandemic Challenges for the Technological Startups in the Russian Regions

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Abstract

Technological startups help to adapt economies to the global risks and allow one to track future trends. This paper identifies the main trends and birth factors of new high-tech companies in the Russian regions during 2013-2020. In 2020, fewer than 10,000 startups were created, this number has been steadily declining (by 40% since 2015), especially during the pandemic (-21%). Most of the startups are concentrated in Moscow, the Moscow region, St Petersburg, and the largest metropolitan areas. The share of the Leningrad, Belgorod, Kaliningrad, Lipetsk, Ulyanovsk, and Kaluga regions is growing due to the proactive policies of local authorities. Most startups are associated with knowledge-intensive services for business (B2B) and digital technologies. In 2020, their number increased in pharmaceuticals (about 100%) and in the production of medical devices (by about 30%).

Based on the results of econometric analysis, start-up activity in Russia, analogous to countries with an established market economy, depends upon human capital concentration, market access, and a favorable business climate. Universities, through attracting students, especially those in STEM specialties, stimulate startup creation; although the share of university startups does not exceed one third of a percent. Budgetary and university expenditures on R&D are ineffective in terms of creating new companies. The influence of development institutions on start-up activity was not found, while clusters and technology parks have a weak effect. The growth of startups is lower in regions with a predominance of large organizations, as well as in resource centers. The latter may be one of the manifestations of the "resource curse". Startup activity is stable over time and depends on the situation in neighboring regions, which limits the chances to change the situation by means of entrepreneurship support policy. During the pandemic, start-up activity decreased minimally in regions with large metropolitan areas and a high level of education. Recommendations include tools for establishing a more balanced cross-regional situation by implementing the model of an entrepreneurial university, an expansion of start-ups' access to capital and markets, and the regionalization of entrepreneurship policies.

Keywords: high-tech sector; entrepreneurship; regional entrepreneurial ecosystem; Russia; entrepreneurial universities; development institutions; STEM; clusters; pandemic; COVID-19

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Introduction

Technological entrepreneurship is one of the key factors of socio-economic development [*Audretsch, Keilbach,* 2008; *Ries,* 2011]. Young firms account for about 20% of employment [OECD, 2020] and almost half of new jobs, while in the United States they provide up to 50% of productivity growth. The acceleration of the technological revolution, among other things due to the effect of the COVID-19 pandemic, increases the risks of structural unemployment and inequality [*Zemtsov,* 2020], which can be effectively countered by supporting and simplifying conditions for the creation of new firms, especially in promising high-tech industries [*Fossen, Sorgner,* 2021].

The 2020 corona-crisis was a stress test for entrepreneurs around the world. According to the TEA (Total Early-Stage Entrepreneurial Activity) index, in 21 out of 35 surveyed countries the share of people starting or maintaining a new business decreased (Figure 2). In Russia, this share decreased from 9.3% to 8.5% due to reduced household incomes, the closure of foreign markets, and epidemiological lockdowns [*Kudrin et al.,* 2021; *Mau et al.,* 2020]. Even before the pandemic, Russia lagged behind many other post-Soviet countries in this regard [*Zbirovsky,* 2017], despite the improvement in formal conditions for doing business [*Zemtsov,* 2020] and the expansion of the toolset applied to support entrepreneurship [*Semenova et al.,* 2019a]. The new venture birth rate remains below the level of the business closures [*Obraztsova, Chepurenko,* 2020], while the number of new high-tech companies has been decreasing since 2016 [*Barinova et al.,* 2020]. The pandemic shock only exacerbated this trend.

In 2020, 72% of the world's young high-tech companies experienced a decrease in revenue; the number of new ventures' market entries fell compared to the 2019 level[1] and their total amount was below the 2018 level.[2] At the same time, reduced software prices combined with the businesses' forced transition to the internet gave rise to a new wave of start-ups specializing in digital and financial technologies, telemedicine services, and online education [*Kuckertz et al.,* 2020; *Dahlke et al.,* 2021; *Fossen, Soergner,* 2021]. This demonstrates that the pandemic is transforming the venture industry structure and that of the future economy.

Start-ups transform ideas into new technologies and products [*Audretsch, Lehman,* 2005]. In the Russian regions where the density of small businesses is 1% higher, GRP per capita is 0.22%-0.67% higher than in others [*Zemtsov,* 2020] and the innovation system is more efficient as well. At the same time, even with a high share of research and development (R&D) personnel and a rich scientific heritage, high-tech solutions are rarely commercialized [*Auzan et al.,* 2019], a situation called the "Russian innovation paradox" [*Gokhberg, Kuznetsova,* 2012]. One explanation is the generally low entrepreneurial activity despite the fact that conditions for creating and fostering start-ups in different regions vary.

Identifying barriers to and incentives for the development of start-ups in Russian regions could contribute to a better understanding of territorial and industry-specific challenges and trends, and help in developing measures to support new ventures in the post-pandemic period. The main objective of the paper is to identify the trends and factors in the creation of new high-tech companies in Russian regions in 2013-2020. Such an empirically based study is new in Russia.

Review of High-Technology Start-Up Studies

Despite its wide usage, there is still no generally accepted definition of the term "start-up". Typically, it refers to a recently (less than one year ago) established firm largely controlled by its founders, which presents new products or services to the market and owns intellectual property rights to them[3] [*Robehmed,* 2013]. About 70% of such companies are closed within 10 years of their establishment due to the lack of customers, funding, team members, or competitor actions.

The founders' personal traits and specialized skills [*Stuetzer et al.,* 2013] or the availability of entrepreneurial capital [*Erikson,* 2002] are the internal factors in start-up growth. External ones are associated with the overall socioeconomic context or the entrepreneurial ecosystem [*Isenberg,* 2011; *Mason, Brown,* 2014; *Audretsch, Belitski,* 2017; *Chepurenko,* 2019; *Zemtsov et al.,* 2020]. It largely determines demand and supply for new businesses [*Verheul et al.,* 2002]. If the former depends on people's and businesses' incomes and interest in new products and services (new markets), the latter is determined by the characteristics of human capital as well as structural and institutional conditions (Figure 1).

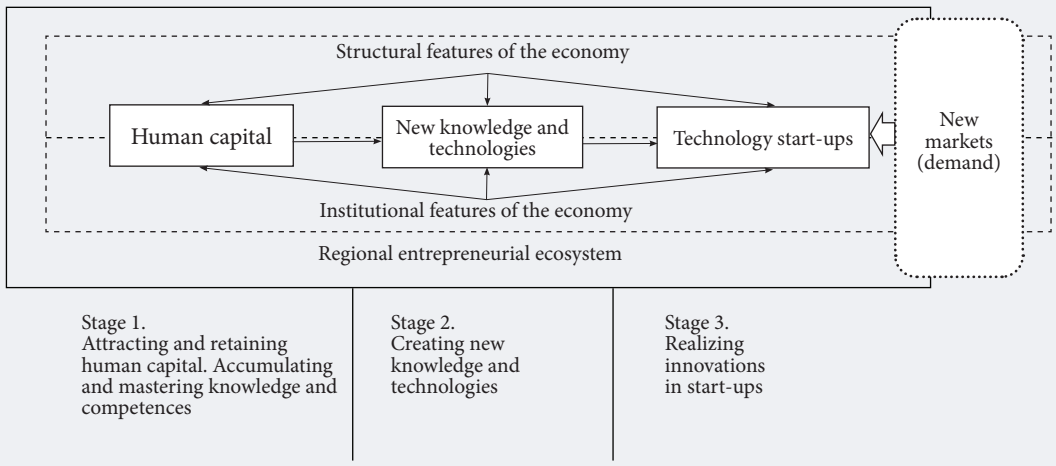
As for the regional context (Table 1), many researchers support the idea that the concentration of human capital and research potential play a fundamental role in start-up creation [*Lasch et al.,* 2010; *Qian et al.,* 2012]. More than 95% of start-up founders had higher education and recruited appropriately qualified teams [*Wright et al.,* 2007]. It is no coincidence that universities, research centers, and R&D divisions of large companies that employ and train highly qualified professionals often turn into start-up "generators" [*Guerrero et al.,* 2016; *Fritsch, Wyrwich,* 2019]. About 44% of the world's start-ups (Figure 2) are concentrated in California and Massachusetts, the leading entrepreneurial ecosystems which originally emerged around MIT and Stanford University [*Saxenian,* 1996]. By 2017, the

[1] https://startupgenome.com/article/state-of-the-global-startup-economy, accessed 19.08.2021.

[2] https://www.crunchbase.com/, accessed 19.08.2021.

[3] https://www.forbes.com/advisor/investing/what-is-a-startup, accessed 19.08.2021.

Figure 1. **Regional Technological Entrepreneurship Model**



Source: authors, based on [*Verheul et al.,* 2002; *Isenberg,* 2011; *Qian et al.,* 2012].

latter's alumni had launched more than 50 unicorn[4] companies (out of approximately 270 in the world, or ≈19%).

The innovation cycle concept allows one to build a technological entrepreneurship model (Figure 1) comprising three stages, each consistent with specific university functions (or missions) [*Zemtsov et al.,* 2015]. At the first stage, universities attract the best minds, creative people, professionals, and future entrepreneurs in the region, accumulate knowledge and competencies, and educate workers. At the second stage, new knowledge is created in the form of academic publications and patents, as a potential resource for establishing new companies. At the last stage, leading universities support start-ups and provide appropriate infrastructure.

A significant amount of time is required for technological entrepreneurship to become embedded in the university and the regional community, accumulate skills and knowledge for building cooperation networks, and foster a favorable socio-cultural environment and business climate [*Shirokova et al.,* 2018]. Such embeddedness increases the persistence of entrepreneurial ecosystems so that leading and outsider regions in terms of start-up activity remain unchanged for decades and even hundreds of years [*Fritsch, Wyrwich,* 2018; *Zemtsov,* 2020]. That is why the rate of new technology companies' creation in the region directly depends upon the presence of old, established universities there [*Fritsch, Wyrwich,* 2018].

The institutional context largely determines both the decision to become an entrepreneur [*Lee et al.,* 2003; *Aparicio et al.,* 2016; *Eriksson, Rataj,* 2019] and the perception of risks and opportunities associated with this decision. From a formal point of view, new ventures are interested in the firm registration requirements, the availability of external funding, the regulatory environment, and the intellectual property regime. As to the informal aspects, the most important ones include corruption, mistrust between people, paternalism, and differences in values which adversely affect technological projects involving a large number of parties [*Auzan et al.,* 2019; *Zemtsov,* 2020].

The structure of the economy affects both the supply of and demand for start-ups. For example, extracting industries demonstrate relatively weak demand for new technologies and, accordingly, for start-ups. The number of the latter, as shown in [*Fritsch, Wyrwich,* 2018] on the basis of German data, is historically lower in the localities close to coal mining regions, due to the "resource curse" [*Guriev, Sonin,* 2008; *Lyubimov,* 2016] which pushes the local capital and labor into the more profitable resource sector. Dependence upon resource rents leads to the disruption of local institutions and corruption, eliminating incentives to launch new ventures for technology entrepreneurs. Unlike large natural resource producers (who are typically not keen to see new competition), start-up activity tends to be higher in major, diversified metropolitan areas due to the high concentration of players, strong competition between them, the scale and diversity of markets, etc. [*Beaudry, Schiffauerova,* 2009; *Audretsch, Fritsch,* 1994]. Clusters emerging in regions specializing in high-tech industries [*Delgado et al.,* 2010; *Belitski, Desai,* 2015] provide access for entrepreneurs to appropriate infrastructure, and knowledge spillovers from large companies and universities into start-ups emerges.

A high density of start-ups in one region increases their density in the neighboring ones due to the interregion-

[4] Private companies whose capitalisation has rapidly reached 1 billion USD. For more see: https://www.weforum.org/agenda/2017/03/the-universities-that-produce-the-most-unicorn-founders-stanford-harvard-uc-and-the-indian-institutes-of-technology, accessed 19.08.2021.

Table 1. **Summary of Previously Identified Start-Up Activity Factors at Regional Level**

Literature	Human capital / student training	Innovation activity, R&D expenditures	Institutional environment / enterprise density	Agglomeration effects	Demand / new markets	Unemployment rate	Infrastructure	Average company size in the region
[*Audretsch, Fritsch,* 1994]	+			+	+	◇		◇
[*Lee et al.,* 2003]	+	+	+	+	+	–		–
[*Audretsch, Lehman,* 2005]	+	+						
[*Fritsch, Mueller,* 2007]		+	+	◇	+	–		
[*Audretsch, Keilbach,* 2008]		+		+	+	–		
[*Plummer,* 2010]		+		+	+			–
[*Lasch et al.,* 2011]	+	+	+	+		◇		
[*Qian et al.,* 2012]	+	-	-	◇				
[*Fritsch, Aamoucke,* 2013]	+	+	+			◇		
[*Audretsch, Belitski,* 2017]			+		◇		+	
[*Belitski, Desai,* 2015]	+	+	+				◇	
[*Goel, Saunoris,* 2017]	◇	+	+	+	+			
[*Sun et al.,* 2017]		+	+	◇	◇			
[*Fritsch, Wyrwich,* 2018]	+			+				
[*Fritsch, Wyrwich,* 2019]	+			+				
[*Eriksson, Rataj,* 2019]	+		+	-		–		

+ — positive effect; – — adverse effect; ◇ — ambiguous.
Source: authors.

al knowledge spillovers and skilled labor, the emergence of value chains, and other positive results [*Plummer,* 2010; *Zemtsov,* 2020]. Entrepreneurship support policy tools play an important role in these processes [*Smallbone, Welter,* 2020; *Zemtsov et al.,* 2020] since they help the authorities to reduce transaction costs by improving the business environment, removing barriers, and upgrading the infrastructure. Direct financial support can be more effective in combination with private capital [*Cumming et al.,* 2017].

Start-Ups in the Russian Regions during the Pandemic Period

The pandemic has affected small businesses in the Russian regions in different ways. A representative survey of small businesses conducted by the Public Opinion Foundation in March 2021 revealed the following picture in the country's federal districts (Figures 2-5).

One can see significant differences between the disadvantaged situation of small and medium-sized enterprises (SMEs) in the Volga region, the South, and Central Russia on the one hand, and the relatively better situation in Siberia and the North Caucasus Federal District, on the other. The latter have a relatively small number of SMEs per 10,000 residents with the predominance of low profit margin micro-businesses and the population's high self-sufficiency in basic products and services. In contrast with the federal districts with more developed small entrepreneurship, the low initial base seems to be affecting the comparisons in this case.

Rising costs are often the reason for a decline in profits. SMEs' situation in the Volga region was, as expected, worse than the average for the whole sample, while in the North Caucasus it was more favorable. The difficult situation in Siberia requires a specific explanation.

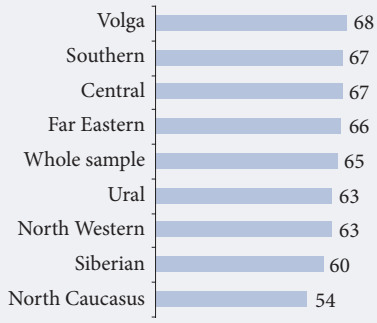
The impact of direct restrictions turned out to be much less adverse in the federal districts with a lower population density (Siberia, the Far East), where, in contrast to the more densely populated areas, the restrictive measures were introduced selectively.

Finally, personnel shortages have most severely affected SMEs in the North Caucasus and turned out to be less of a problem in the Southern Federal District and Siberia. Due to the geographical and economic characteristics of the latter regions, it is easier to attract cheap labor there, while small businesses in construction, retail, and other industries where profit margins depend on the availability of labor are less developed.

Russia lags behind the world's leading economies (Figure 6) in terms of entrepreneurial activity expressed as the TEA index and the concentration of technology companies, ranking only 22nd by their total number and 35th by their per capita number. In Moscow and St. Petersburg, the latter indicator scores are higher than the national average (six and two times, respectively), but still much lower than in the leading global cities. For example, Boston's value (which rounds up the top ten) is 4.5 times higher than Moscow's. Moscow's global ranking by the amount of venture deals and the number of business angels is even lower [*Boos et al.,* 2020]. Russia's low involvement in entrepreneurship reduces the potential number of start-ups.

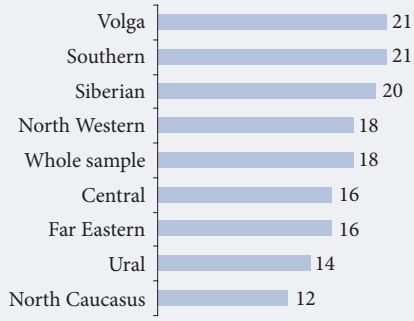
The overall business dynamics in Russia can hardly be described as favorable. Since 2016, the company birth rate (the number of newly created firms per 1,000 existing ones) remains below the death rate. In general, in 2020 the number of new companies in Russia decreased by 23.4%, but the number of registered private high-tech enterprises only fell by 16.8%, i.e., start-ups (private firms with the OKVED codes for medium- and high-technology industries or knowledge-intensive services (Table 2) [*Barinova et al.,* 2020]) turned out to be more resistant to the pandemic's impact than business as a whole. After some growth in 2019,

Figure 2. **Decrease in Business Profitability by Federal District (*share of mentions,* %)**



Source: authors, based on data collected in the scope of the project "Small business in (post)pandemic reality" (TR-145) of the HSE Basic Research Centre, 2021.

Figure 3. **Increased Expenditures and Problems with Current Payments by Federal District (*share of mentions,* %)**

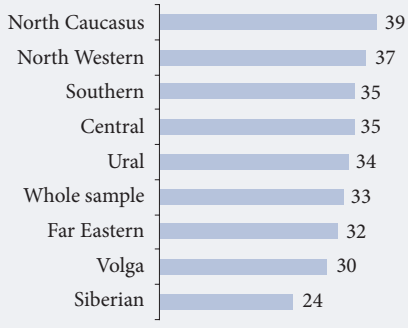


Source: authors, based on data collected in the scope of the project "Small business in (post)pandemic reality" (TR-145) of the HSE Basic Research Centre, 2021.

the number of start-ups producing finished products (i.e., those with revenues) decreased by 21.5% in 2020. About a third of start-ups have non-zero revenues, 73% of them made a profit, and only 133 (0.44%) owned intangible assets including intellectual activity results. Only half of start-ups established in 2015 and a third of those created in 2010 continued operations in 2021 (Figure 7). Among start-ups with non-zero revenues, the relevant figure was much higher at 65%.

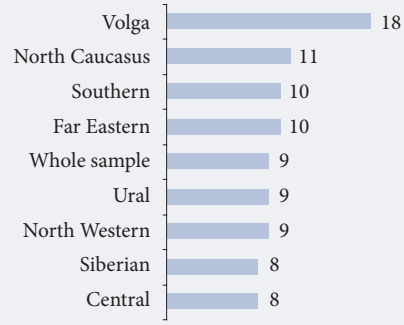
As for start-ups' sectoral structure (Table 2, Figure 4), in 2020 about 46% of them provided knowledge-intensive business services (KIBS), such as legal, accounting, recruiting, management, and others. A fifth of the newly created firms (and about 15% of the revenue of new ventures) belonged in the information and communication technology (ICT) sector. Together, KIBS and ICT, along with chemistry and pharmaceuticals, grew faster than other sectors in 2020. In pharmaceuticals, the number of start-ups has doubled, in the production of medical instruments, it grew 1.3 times, while the production of vehicles, veterinary sciences, and aerospace transportation have significantly strengthened their positions. New ventures operating in these industries and in R&D have significantly increased revenues. Services related to restructuring business processes, digitization and automation, research, and medicine were in high demand during the pandemic. The success of transportation start-ups can be explained by the demand for unmanned vehicles, but it was more likely caused by the fragmentation of companies and the change of the OKVED codes to receive public support. The entire manufacturing sector accounts for less than 19% of technology start-ups, though their share in the high-tech sector's revenues exceeds 45% [*Barinova et al.,* 2020].

Figure 4. **Direct Restrictions on Economic Activities by Federal District (*share of mentions, %*)**



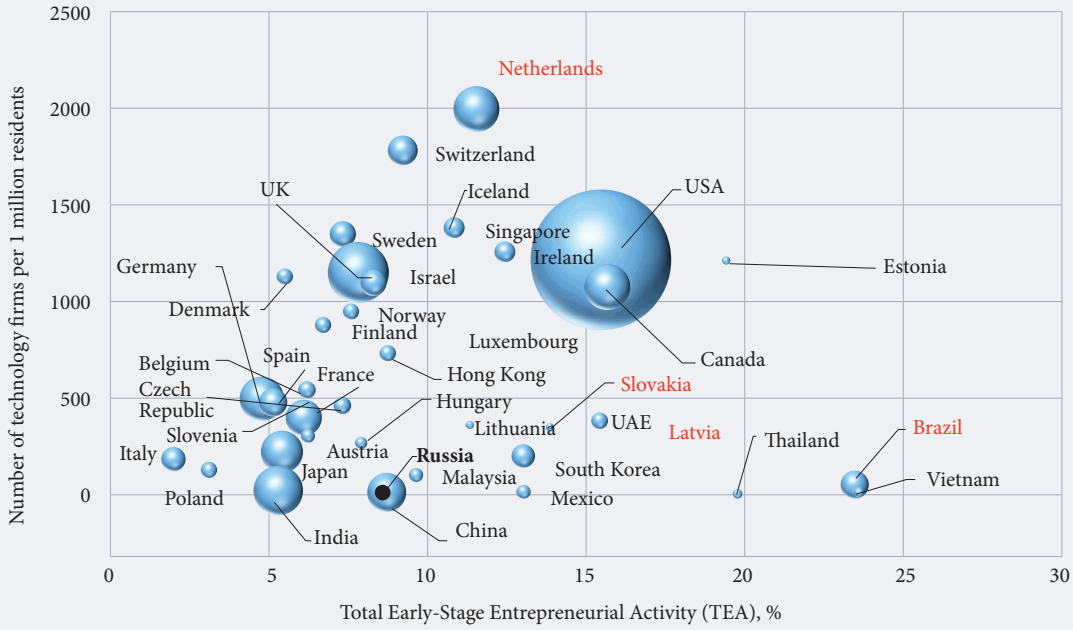
Source: authors, based on data collected in the scope of the project "Small business in (post)pandemic reality" (TR-145) of the HSE Basic Research Centre, 2021.

Figure 5. **Personnel Shortages by Federal District (*share of mentions, %*)**



Source: authors, based on data collected in the scope of the project "Small business in (post)pandemic reality" (TR-145) of the HSE Basic Research Centre, 2021.

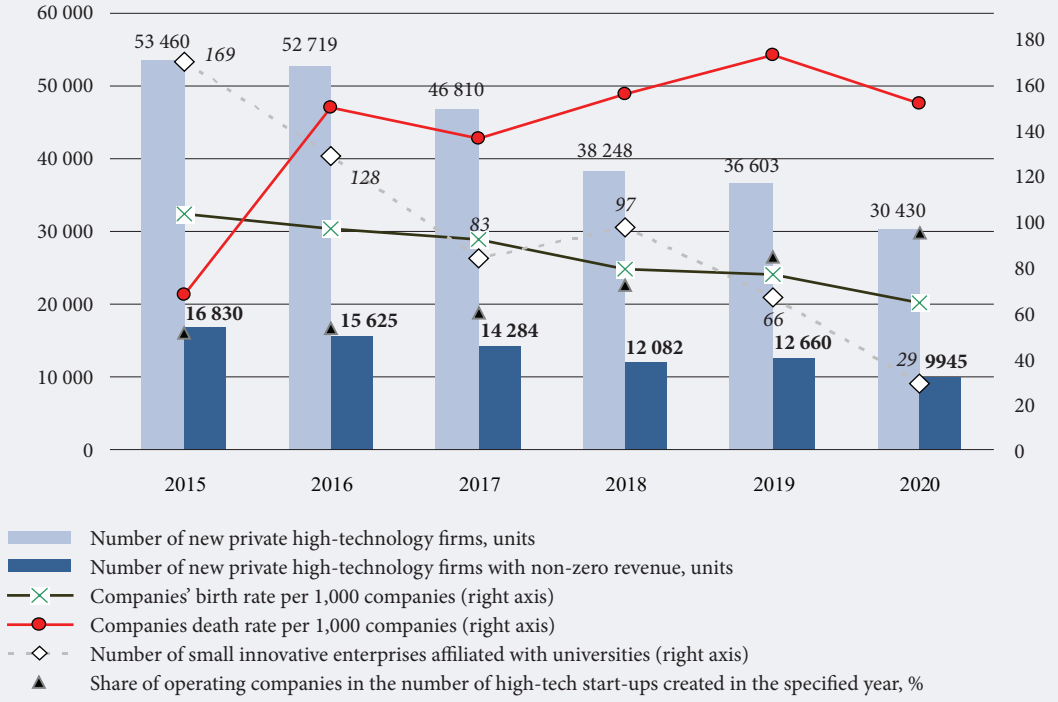
Figure 6. **Start-up Activity by Country**



Note: countries whose TEA values increased in 2020 are underlined.

Sources: start-up data (as of March 2021): Crunchbase (https://www.crunchbase.com/discover/organisation.companies/a4f7810fb97b1b0d98f9b645146bf455, accessed on 18.06.2021); population data: World Bank, 2021 (https://data.worldbank.org/, accessed on 18.06.2021); TEA data: Global Entrepreneurship Monitor (GEM), 2021. (https://www.gemconsortium.org/, accessed on 18.06.2021).

Figure 7. **Number of Existing and New High-tech Firms in 2015–2020 in Russia (as of September 2021)**



Sources: data on creation and liquidation of companies: Rosstat (https://rosstat.gov.ru/folder/14036/, accessed on 18.06.2021); of high-tech of companies: SPARK (https://www.spark-interfax.ru/, accessed on 18.06.2021); RUSLANA (https://ruslana.bvdep.com, accessed on 18.06.2021); of business societies: Accounting and monitoring of SIEs (https://mip.extech.ru/index.php, accessed on 18.06.2021).

To some extent, start-ups' industry distribution may reflect forthcoming changes in the structure of the economy, though the share of the high-tech sector in GDP currently does not exceed 24.3% (21.8% in 2019). Significant changes have occurred here over the past 20 years: in 2000, KIBS accounted for only 35% of start-ups (in 2020 46%), ICT for 14.7% (21%), and the manufacturing sector for 25.7% (19%).

On average, about 1.3 start-ups are created for every 10,000 able-bodied Russian residents; in 2000 this figure was 0.9 and in 2013 it was 2.3. The technology-driven start-ups in Russia are highly heterogeneous geographically. Approximately every fourth such company is created in Moscow, which together with St. Petersburg already account for about 40% of these firms. The top ten regions (including Tatarstan, the Sverdlovsk, Novosibirsk, Samara, Nizhniy Novgorod, and Krasnodar regions, and Bashkortostan) account for approximately 62% of start-ups (about 54% in 2013) and 42% of the workforce. The rate of start-up creation (Figure 9) is higher in large metropolitan areas where major educational and research centers, industries with high added value, and a service economy are concentrated [*Barinova et al.,* 2020], and in coastal haven zones where a variety of services to support foreign economic activity are provided (the Kaliningrad, Leningrad, Primorsky, and Krasnodar regions). The start-up density is lower in the North Caucasus (due to the specifics of the local institutional environment) and in the northern mining areas which do not have the necessary infrastructure, large universities, or a technological specialization. The distribution of start-up activity by region is quite stable: the correlation coefficient between the 2020 and 2000 values is 0.78, which exceeds the average for all small businesses (0.65). In 2020, the number of start-ups grew in only 14 regions (16%), which can be most often explained by the previous year's low base effect (less than 50 companies). The Leningrad and Kaliningrad regions, in contrast to the general background with much higher scores, pursue consistent policies to support technology start-ups in the immediate vicinity of large markets (the EU and St. Petersburg).

Some of the successful regional start-ups sooner or later migrate to major high-tech centers with the appropriate infrastructure and access to funding and development institutions' support. This outflow weakens the already low potential of most regions. Subsequently some start-ups, having grown and transitioned into large company status, move their head offices to other countries, among other reasons due to sanctions-related restrictions. For example, the global game developer Playrix was founded in the Vologda region, but now operates in Dublin.

The above trends are confirmed by a survey of 630 Russian technology entrepreneurs[5]: 41% of them reside in Moscow and 72% of the start-ups they own are focused on providing services to businesses. Just over half (51%) assessed the pandemic's impact as positive, especially for educational and financial projects in high demand. As to the barriers and challenges of 2020, the respondents mentioned reduced household incomes, the weakening of the ruble, and the closure of borders, i.e., the shrinking of available markets. At the same time, 70% of start-ups did not fire their employees or cut salaries, 51% even plan to hire new workers, and 74% have actually created new jobs. Thus, a high concentration of high-tech players in the region not only indicates the presence of favorable conditions for the development of a smart economy but can also partially alleviate the negative effects of the pandemic.

The majority of domestic universities are not focused on research- or entrepreneurship-related objectives [*Zemtsov et al.,* 2015], so relevant ecosystems do not emerge around them. Special legislative steps were taken to facilitate the creation of small innovative enterprises (SIEs) in the form of university-owned business societies.[6] However, legal restrictions on contracts and funding still remain in place, along with the risks of legal prosecution of entrepreneurs for the improper use of public funds. Many SIEs were established for reporting purposes rather than for actual business ones. The creation of SIEs peaked in 2011 at 376 and then gradually decreased to a low of 29 in 2020. Among start-ups with non-zero revenues, their share decreased from 1% to 0.29%. Though more than half of Russian students would like to set up a business within five years of graduation (the average for the world is 38%) [*Shirokova et al.,* 2016], most of them are not offered any entrepreneurship courses [*Dukhon et al.,* 2018].

The Russian venture capital market almost doubled in 2020 thanks to foreign investors, but its share in GDP does not exceed 0.008% (the average for the OECD countries is 0.08%[7]). Numerous development institutions responsible for funding venture projects are expected to give it an impetus [*Semenova et al.,* 2019a], but the bulk of the funds allocated by the Skolkovo Foundation and the Russian Venture Company (RVC) goes toward Moscow-based companies, while these institutions' activities in Russian regions remain very low. About 21% of the surveyed entrepreneurs[8] have any external investors, but only in 2% of these cases are these venture funds, while more than half of the respondents had no access to public support during the pandemic since their industry was not included on the list of adversely affected ones. More than 85% of the surveyed start-ups (Figure 7) have persistent debts.

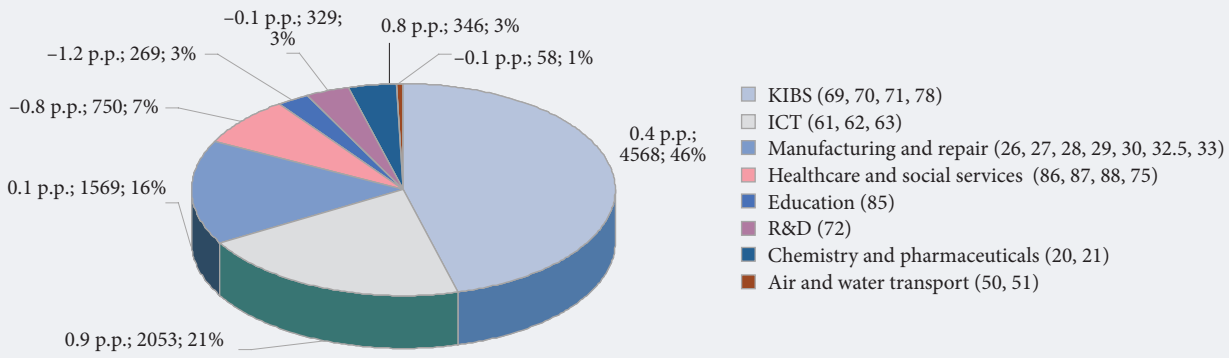
[5] https://drive.google.com/file/d/1ecdEQJz4s0aAEORAl4v87HBo0e7tMb1_/view, accessed 19.08.2021.

[6] RF Federal Law of 2 August 2009 No. 217-ФЗ. https://rg.ru/2009/08/04/int-dok.html, accessed 19.08.2021.

[7] https://stats.oecd.org/Index.aspx?DataSetCode=VC_INVEST#, accessed 19.08.2021.

[8] https://drive.google.com/file/d/1ecdEQJz4s0aAEORAl4v87HBo0e7tMb1_/view, accessed 19.08.2021.

Figure 8. **Structure of Non-Zero Revenue Start-Ups by Branch, 2020**



Note: OKVED codes are indicated in brackets; the first number in the captions indicates the growth of sector's share compared with 2019 (in percentage points), the second – the number of start-ups, and the third – the sector's start-ups' share in their total number.

Source: SPARK (https://www.spark-interfax.ru/, accessed on 18.06.2021).

The government made some steps to improve the conditions for start-ups in Russia during the pandemic. These measures, however, seem to lack a regional focus. In the absence of evident results, the feasibility of many of them requires evaluation.

Methodology of the Study

The key studies in the area under consideration (Table 1) were carried out on the basis of data for developed market economies. Therefore, without additional verification, they cannot be extrapolated to the Russian economy with its specific features such as the excessive share of state-owned enterprises, the low level of small entrepreneurship and private venture capital in most regions, the disproportionately high role of the extractive industries, and so on. In turn, sample surveys do not always adequately reflect overall processes, while the reproducibility of the previously obtained results and conclusions also requires verification.

The literature review and the trend analysis allow one to suggest the following hypotheses for empirical testing:

1. The accumulation of human capital, and especially of students, in the region [*Wright et al.,* 2007] and R&D expenditures [*Qian et al.,* 2012] create conditions for the emergence of high-technology businesses. In developed economies, a larger emergence of start-ups is provided by universities with a higher share of STEM majors [*Fritsch, Wyrvich,* 2019; *Perignat, Katz-Buonincontro,* 2019]. With the growth of creative industries in recent years, art is increasingly considered a relevant training area as well (STEAM). These trends are of little relevance in Russia due to the specifics of the national educational system, the modest role of universities in R&D and in the creation of start-ups, and the low efficiency of the public R&D sector.

2. A favorable business environment (investment climate, availability of capital) increases the likelihood of the emergence of technology start-ups [*Audretsch, Belitski,* 2017; *Eriksson, Rataj,* 2019]. The business climate in Russia is steadily improving [*Zemtsov,* 2020] due to, among other things, the Agency for Strategic Initiatives' (ASI)[9] efforts; however, in the case of technology start-ups, which require support from specific institutions, the effectiveness of these efforts remains questionable. The easier availability of bank capital may not have played a significant role because companies prefer to rely on their own resources. The government policy of replacing private venture funds with development institutions [*Semenova et al.,* 2018] and its results need a separate evaluation.

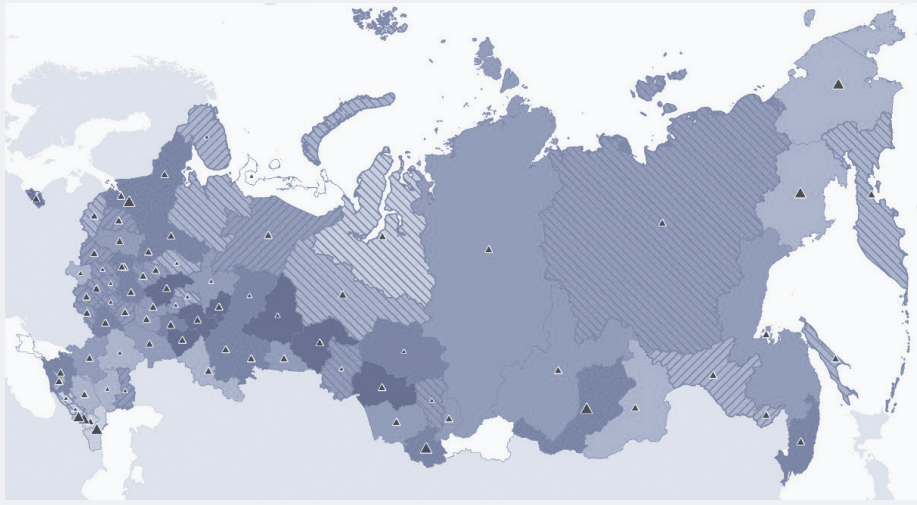
3. To promote start-up development, regions need to build high-quality ICT and innovation infrastructure including access to digital resources and online markets [*Audretsch, Belitski,* 2017; *Chepurenko et al.,* 2017]. Modern digital platforms provide access to global consumers, technologies, and labor markets. At the same time, across the entire venture industry, the impact of ICT may turn out to be less significant, along with the role of clusters and technology parks which have been actively developing in Russia in recent years [*Barinova et al.,* 2020].

4. Regions with large markets, metropolitan areas, and high-income (and therefore high purchasing power) neighboring territories have higher demand for new products and services, which opens up market niches for start-ups [*Audretsch, Fritsch,* 1994; *Lee et al.,* 2003; *Fritsch, Mueller,* 2007]. However, this demand may be significant for servicing small businesses and not make an appreciable impact specifically on IT start-ups.

5. The raw materials production-skewed structure of the economy hinders the development of the venture industry due to the low demand for new technologies

[9] https://asi.ru/government_officials/rating/, accessed 19.08.2021.

Figure 9. **Regional Distribution of Start-ups in Russia in 2015–2020**



Number of new private high-technology firms with non-zero revenues per 10 thousand workforce in 2020

No data | <0.3 | 0.3–0.7 | 0.7–1.1 | 1.1–1.5 | >1.5

Number of new private high-technology firms with non-zero revenues in 2020 as share of 2015 value, %

<50 | 50–100 | >100

Number of firms under consideration grew in 2020

Number of firms under consideration decreased in 2020 by more than a third

Sources: SPARK (https://www.spark-interfax.ru/, accessed on 18.06.2021), Rosstat (https://rosstat.gov.ru/, accessed on 18.06.2021).

and other aspects of the "resource curse". An in-depth analysis of this relationship has not yet been carried out in the literature.

6. The smaller the average effective market size of a respective organization in the region, the higher the entry barriers into the local market (Table 1) and the lower the density of start-ups there [*Lee et al.,* 2003; *Plummer,* 2010]. In Russia, the average organization size is largely determined by the number and role of public institutions, while the correlation with the number of start-ups needs to be checked.

7. The embeddedness of entrepreneurial and innovation activities in the region play a key role in the development of technological start-ups, i.e., the earlier a university was established there, the higher the likelihood of its innovation-related functions (and thus increasing the density of start-ups) [*Fritsch, Wyrwich,* 2018]. Most of the universities established during the Soviet period performed only educational functions, so their impact upon the processes under consideration needs to be confirmed.

8. High start-up activity in some territories promotes the emergence of new ventures in the neighboring ones [*Plummer,* 2010]. The validity of this statement for Russia, with its long distances and institutional barriers between different parts of the country, remains in question.

An econometric model was developed to test the above hypotheses in which the number and growth rate of non-zero revenue start-ups were used as dependent variables; the independent ones are described in Table 3. Each of the selected factors corresponding to the hypotheses included several variables.

To test the hypotheses, several types of models were built using the ordinary least squares method (OLS) with adjusting indicators' heteroscedasticity, random (RE) and fixed effects (FE). If the first two types allow one to identify a general pattern, the latter takes into account individual characteristics of regions.

Econometric Assessment

The models' empirical results are presented in Table 4 (only significant dependencies). In general, the suggested hypotheses can be considered confirmed.

Start-up activity is higher in regions with a larger share of people potentially possessing advanced competencies: the Tyumen and Yaroslavl regions, Bashkortostan, St. Petersburg, etc. For example, a 1% increase in the average duration of employees' education (in years) leads to a 0.26-0.55% increase in start-up density, and to a 0.35% growth rate increase in start-up density (Models 1-4). This is one of two key factors in maintaining start-up activity during the pandemic

(Model 8). Despite the interregional imbalance and the decline in the quality of education in the 2000s, its role in technological development remains important (Model 3).

Despite the small number of innovative companies established in and by universities (Figure 3), the importance of student numbers for creating start-ups has been confirmed. An increase in their number in a region by 1% leads to a 0.5% increase in the number of start-ups there (Model 1), and to a 0.13% higher growth rate (Model 4). Though young entrepreneurs are rarely found among the founders of successful technology companies [*Azoulay et al.,* 2020], proximity to high-ranking universities provides access to cutting-edge technology and highly skilled professionals, among other things due to the knowledge spillover effect. In regions with an appreciable share of university and college graduates specializing in STEM (such as the Tomsk, Rostov, and Samara regions, St. Petersburg, Tatarstan, etc.), start-up density is also higher, which confirms the effectiveness of relevant support measures and the relevance of restructuring the education system. The pandemic hindered inter-university mobility (which was already rather low in Russia) and reduced the opportunities for live communication necessary for the formation of business teams, so the variables in Model 8 have insignificant values.

R&D expenditures (which traditionally remain under 1% of GDP) do not directly affect start-up activity, since about 64.4% of them are made in the public sector which is very inefficient in creating new companies. However, if the share of the entrepreneurial sector in the regional R&D expenditures increases by 1%, the density and growth rate of the number of start-ups increase by 0.1-0.13% and 0.07%, respectively. In private laboratories focused on obtaining end results, knowledge spillover effects lead to the emergence of new companies through intrapreneurship, the expanded network of branches, launching spin-offs, etc. A classic example is one of the world's best business ecosystems in Boulder, Colorado (US), with the major IBM research center [*Mason, Brown,* 2013]. In Russia, a similar example is the AvtoVAZ Science and Technology Centre (in Togliatti), which has nurtured numerous engineering start-up founders. The high share of universities in R&D expenditures (such as in Mari El, the Kostroma region, Chechnya, Altai, etc.) on the contrary reduces the likelihood of the emergence of and increase in the number of start-ups, since university R&D in most of the regions remain poorly developed and only achieve progress in cooperation with businesses, and then only linked with strong research centers. The recent major federal programs to promote the excellence ("5-100", federal and flagship universities) have little changed this situation.

Start-up density in the regions is higher the more developed the banking sector there is (Models 4–6), i.e., there is the more available funding (Moscow, St. Petersburg, the Kaliningrad, Voronezh, and Novosibirsk regions), since most new ventures with non-zero revenues borrow funds to develop and launch new products or services on the market. In Model 5, the increase in the number of start-ups was positively correlated with the investment climate in the region (the SIA rating), including local authorities' policies. This confirms the relevance of government efforts to improve the business climate, but does not prove the sustainability of the achieved effect.

The correlation between the intensity of the new ventures' emergence in the regions and indicators of entrepreneurship support provided by the development institutions turned out to be insignificant in all models, i.e., it has not been confirmed. Most of the new companies outside the capitals did not have access to such support, either because of low awareness or doubts or fears regarding dealing with the public authorities [*Zemtsov,* 2020]. Also, the bulk of financial resources were managed by RUSNANO and the Industry Development Fund, which were not focused on supporting start-ups. This is partly why, at the beginning of 2021, the Russian government initiated a reform of the development institutions.

A 1% increase in household income leads to an increase in the number of start-ups by 0.16% (Model 3), mainly those serving large local businesses and private households. Start-ups are more likely to emerge in or near large and rapidly growing cities (Model 7) where new market niches appear and opportunities for cooperation and knowledge spillovers open up [*Lee et al.,* 2003; *Audretsch, Keilbach,* 2008; *Plummer,* 2010; *Goel, Saunoris,* 2017]. In major metropolitan areas the availability of internet access and the demand for online services are higher, so city size remained the second most important factor in maintaining start-up activity in 2020 (Model 8). Digitization has become one of the survival conditions for businesses during the pandemic [*Kudrin et al.,* 2021], giving an impetus to the development of the internet sector [*Fossen, Soergner,* 2021]. It also played a key role in the emergence of start-ups previously (Model 2).

Only one of the models confirmed the (rather modest) contribution of clusters and technology parks to start-up industry development (Model 6). Technology parks' effect is limited to regions adjacent to large markets and those with extensive bank networks, such as, e.g., the Kaluga and Leningrad regions. However, most often technology parks remain empty or perform office functions.

The average organization size has the strongest adverse effect upon start-up activity among regional economies' structural features (Models 1–7), which can be an indirect sign of high market entry barriers due to the predominance of large players. Such organizations, including public sector ones (and "natural monopolies"), are common in regions with a high value of this indicator (Chechnya, Kabardino-Balkaria, Dagestan, Yamalo-Nenets Autonomous Region, the Zabaikalsky, Astrakhan, and Kemerovo regions). During the pan-

Table 2. **Non-Zero Revenue Start-Ups' Characteristics in 2020/2019**

Code	Activity (industry)	Number in 2020	Share, %	Revenue in 2020, mln. rub.	Share, %	Growth in number in 2020/2019, %	Growth in revenues in 2020/2019, %
	High-technology activities						
21	Production of drugs and medical materials	49	0.5	1847.7	1.4	222.7	1677.4
26	Production of computers, electronic and optical products	105	1.1	3043.1	2.2	70.5	64.7
30.3	Production of aircrafts, and spacecrafts, and equipment	1	0.0	6.6	0.0	33.3	47.5
	Medium-technology activities						
20	Production of chemicals and chemical products	297	3.0	5098.5	3.7	94.6	180.9
27	Production of electrical equipment	205	2.1	2951.9	2.2	76.8	46.5
28	Production of machinery and equipment not included in other categories	417	4.2	5055.2	3.7	86.5	66.2
29	Production of motor vehicles, trailers and semi-trailers	56	0.6	735.3	0.5	60.9	39.7
30	Production of other vehicles and equipment, excluding 30.3	60	0.6	2942.9	2.2	125.0	438.1
32.5	Production of medical instruments and equipment	45	0.5	777.2	0.6	128.6	693.3
33	Repair and installation of machinery and equipment	680	6.8	7747.9	5.7	74.9	60.6
	Knowledge-intensive activities						
50	Water transport activities	33	0.3	2267.8	1.7	52.4	100.5
51	Air and space transport activities	25	0.3	486.0	0.4	113.6	179.4
61	Activities in the field of telecommunications	134	1.3	1048.7	0.8	78.8	95.0
62	Computer software development and related services	1390	14.0	16919.3	12.4	82.8	63.4
63	Information technology activities	529	5.3	3566.7	2.6	81.0	35.6
69	Activities in the field of law and accounting	1823	18.3	8218.8	6.0	78.1	54.7
70	Head office activities; management consulting	648	6.5	41922.7	30.8	74.1	498.3
71	Activities in the field of architecture and engineering	1868	18.8	20162.3	14.8	82.9	83.5
72	Research and development	329	3.3	5487.9	4.0	76.3	172.5
75	Veterinary activities	58	0.6	133.8	0.1	118.4	95.8
78	Employment and recruiting activities	229	2.3	2306.9	1.7	74.1	11.5
85	Education	269	2.7	1150.0	0.8	53.8	35.0
86	Healthcare activities	568	5.7	2056.4	1.5	69.6	24.6
87	Residential care activities	31	0.3	60.8	0.0	100.0	98.7
88	Non-residential care activities	93	0.9	187	0.1	59.2	78.6
	Total for high-technology sector	9945	100	136181	100	78.5	84.9

Source: SPARK (https://www.spark-interfax.ru/, accessed on 18.06.2021).

demic this factor did not play an appreciable role because the crisis affected all regions.

An increased overall share of the high-tech sector contributes to the emergence of start-ups (Models 1 and 7), while a high share of extraction industries in GRP determines low start-up rates. The reasons may include such negative aspects of a resource-based economy as the lack of fostering ecosystems (most large extraction companies conduct R&D at their head offices, i.e., in the Russian capital) and priority is given to less risky and more profitable investments in resource production.

The importance of temporal and spatial effects of entrepreneurial activity is confirmed, which are rarely given attention in the literature and taken into account when making political decisions. First, as regards the time that the first university was founded in the region: the earlier it happened (St. Petersburg, Moscow, Tatarstan, the Tver and Tomsk regions), the higher the density

Table 3. **Factors and Variables Applied in the Models**

Factor and designation	Variable	Source	Period
Human capital (*humancap*)	Average number of years of workers' education, *units*	Calculations	2010–2019
	Number of students per 1,000 population, *people*	Rosstat	2010–2019
	Share of university and college graduates specialising in STEM, %*	Calculations	2015–2017
S&T potential (*rndt*)	Share of internal R&D expenditures in GRP, %	Rosstat	2010–2019
	Share of the commercial sector in R&D expenditures, %	Calculations	2010–2019
	Share of universities in R&D expenditures, %	Rosstat	2012–2019
Institutional environment, business climate (*inst*)	SIA Investment Climate Index, *points*	SIA	2014–2018
	Aggregate index of banking services' availability in the region, *points*	Bank of Russia	2010–2019
	Amount of public financial support for start-ups provided by development institutions per 10 thousand workforce	[*Semenova et al.*, 2019]	2010–2017
Infrastructure (*infr*)	Share of organisations with internet access with at least 2 Mbps bandwidth in the total number of organisations, %	Rosstat	2010-2020
	Number of cluster members and technology park residents per 1,000 workers, *units*	[*Barionova et al.*, 2020]	2016–2018
Market potential and agglomeration effects (*market*)	Monthly per capita income minus minimum living costs, *roubles*	Rosstat's calculations	2010–2020
	Total monetary income of the entire population minus minimum living costs, *billion roubles*	Rosstat's calculations	2010–2020
	Market potential (GRP of this and other regions, and countries' GDPs divided by the distance to them), *trillion roubles*	Calculations	2010–2020
	Regional capital's population, %	Rosstat	2010–2020
Structure of economy (*economstructure*)	Average organisation size (ratio of the number of employees to the number of organisations), *people*	Rosstat	2010–2019
		Rosstat	2010–2019
		Rosstat's calculations	2010–2020
Confidence	Age of the oldest university, *years*	Calculations	2010–2020
Interregional knowledge spillovers	Average number of start-ups per workforce in neighbouring regions	Calculations	2013–2020

*For more about the methodology see [*Semenova et al.,* 2019b], and https://i-regions.org/reiting/monitoring-razvitiya-steam-ritm-obrazovaniya-v-regionakh-airr/, accessed on 18.06.2021.

Source: authors.

and growth in the number of start-ups (Models 1–2, 4–6) due to embeddedness. Second, a high density of start-ups in neighboring territories increases their density and growth rate in the region under consideration (Models 2–4).

Conclusions and Recommendations

The pandemic not only became a challenge, but opened a window of opportunity for entrepreneurs, especially technology start-ups, offering new, customized products and services [*Doern et al.,* 2019; *Davidsson,* 2020] and those focused on developing and building up their businesses [*Eggers,* 2020]. Enterprises emerging after natural disasters and catastrophes, not burdened by the technological and organizational inertia of the pre-crisis period and therefore showing a better performance after it ends, tend to adapt to new circumstances better than others do [*Williams, Shepherd,* 2016]. The number of start-ups in Russia, however, remains very modest: in three-quarters of the country's regions fewer than 100 of such firms are created annually (Figure 5). For most regions, fostering new high-tech companies seems to be both an important and difficult objective to achieve.

Though most start-ups are consistently concentrated in Moscow, the Moscow region, St. Petersburg, and major metropolitan areas, in recent years the shares of the Leningrad, Belgorod, Kaliningrad, Lipetsk, Ulyanovsk, and Kaluga regions have been growing due to proactive local policies. This allowed the above regions to become leaders in the SIA investment attractiveness ratings which reflect the authorities' efforts to support small businesses: simplifying procedures, promoting industrial parks, and so on. Start-up structure is shifting toward providing knowledge-intensive services (distant learning, telemedicine, fin-tech, etc.) and high-tech manufacturing (robots, unmanned vehicles, medical devices, etc.). The correlation coefficient between regional start-up activity in 2020 and 2000 is about 0.67, and for the number of start-ups in various industries, this figure is 0.85. The identified spatial and sectoral trends seem to be quite stable and are likely to persist after the pandemic ends.

The factors of start-up activity in the Russian regions described above on the whole match the global patterns: the importance of accumulating human capital, developing the commercial R&D sector, proximity to large markets, favorable business climate, and adequate infrastructure. At the same time, no evidence was dis-

Table 4. **Factors affecting technology start-up density and growth of their number in Russian regions in 2013-2020**

	Dependent variable	Number of new privately owned high-technology firms with non-zero revenues per 10 000 able-bodied people			Dependent variable growth, % (year to year)				Ratio of dependent variable values in 2020 to 2019, %
	Evaluation method	RE	RE	FE	RE	RE	RE	FE	OLS
Factor group	Factors	1	2	3	4	5	6	7	8
	Constant	–0.11 (0.65)	0.14 (0.93)	–2.2*** (0.62)	–0.31 (0.42)	–3.8*** (1.36)	1.02*** (0.22)	2.14*** (0.75)	–1.64 (2.48)
Human capital	Average number of years in education	0.26* (0.14)	0.55*** (0.16)	0.35* (0.18)	0.35** (0.15)				1.95** (0.89)
	Number of students per 100 people	0.52*** (0.09)			0.13** (0.05)				
	Share of university and college graduates specialising in STEM, %		0.29** (0.11)						
S&T potential	Share of the commercial sector in R&D expenditures, %	0.1** (0.05)	0.13*** (0.05)		0.07** (0.03)				
	Share of universities in R&D expenditures, %	–0.05* (0.02)	–0.06** (0.03)		–0.03** (0.01)				
Institutional conditions (including political)	Banking Services Availability index				0.43*** (0.08)	0.43*** (0.15)	0.25*** (0.06)		
	SIA Investment Climate Index					0.8*** (0.22)			
Infrastructure	Share of organisations with broadband internet access, %		0.19* (0.09)						
	Per capita number of cluster members and technology park residents						0.02* (0.01)		
Market niches and metropolitan area effect	Total monetary income minus minimum living costs			0.16* (0.8)					
	Number of residents in the regional capital city, people								0.09*** (0.03)
	Growth of the number of residents in the regional capital city, %							6.3** (2.82)	
	Growth of regional market potential, %				0.3*** (0.05)	0.42*** (0.06)	0.22*** (0.05)	0.23*** (0.07)	
Structural specifics of the economy	Average organisation size	–1.02*** (0.18)	–1.17*** (0.15)	-0.42** (0.17)	–0.47*** (0.09)	–0.46*** (0.09)	–0.41*** (0.07)	–0.7*** (0.25)	
	Share of the high-technology sector in GRP, %	0.22** (0.1)							
	Increase in the share of high-technology sector in GRP, %							0.29** (0.12)	
	Share of extractive industries in GRP, %							–0.04* (0.02)	
Entrepreneurship roots	Age of the oldest university, years	0.22*** (0.1)	0.26*** (0.09)		0.09** (0.03)	0.19*** (0.05)	0.07* (0.04)		
Interregional knowledge flow	Average ratio of start-ups to workforce in neighbouring regions		0.12*** (0.04)	1.13*** (0.11)	0.08*** (0.03)				
Basic level	Ratio of start-ups to economically active population a year earlier				–0.59*** (0.09)	–0.58*** (0.08)	–0.41*** (0.06)	–1*** (0.1)	–0.29** (0.11)
Adjusted R^2									0.16
LSVD R^2				0.9				0.61	

Note: *p-value<0,1; **p-value<0,05; ***p-value<0,01. All variables are logarithmic. Included 83 regions, data for 2013-2020. Robust standard errors.

Source: authors.

covered in Russia of the positive role played by university R&D, publicly funded research, and development institutions, while the effect of clusters and technology parks is weak. However, the extractive sector suppresses start-up activity and the spatial and temporal effects limit the potential of entrepreneurship policies. The negative development trend of start-up activity factors does not allow for expecting appreciable progress in this area. Households' incomes and accessible markets are shrinking, the share of R&D conducted by the commercial sector shows practically no growth, investments in universities do not pay back because the number of university start-ups stagnates – and all this despite the improvement in the formal conditions for doing business in many regions and the post-crisis acceleration in digitization. Therefore, let us try to outline a range of measures that could help overcome the above trends.

Implementing the "Entrepreneurial University" Concept

To adapt to new risks and opportunities, many Russian regions first of all need to retain their human capital, i.e., reduce the outflow of potential entrepreneurs to Moscow and abroad, and support their initiatives. This requires the following solutions:

- providing grant financing for regional entrepreneurial universities in the framework of the Strategic Academic Leadership Programme[10] to teach students relevant skills [*Chepurenko,* 2017; *Dukhon et al.,* 2018] and build start-up infrastructure. The pandemic experience suggests that projects to develop platforms and applications (to serve as a basis for start-ups offering solutions for the commercialization of relevant approaches) primarily need such support, along with services such as remote diagnostics, care for the sick and the elderly, artificial intelligence (AI), and so on in regional universities and academic institutions with strong medical and technological competences. "Adequate infrastructure facilities" mean production laboratories (fablabs) to make pilot products;
- increasing the share of graduates specializing in STEAM professions, which involves introducing innovative courses at the junction of engineering and creative disciplines using advanced ICT, establishing higher engineering schools, holding all kinds of technological competitions, developing new educational programs in regional universities that have adequate human and intellectual resources;
- promoting partnerships between technology companies and universities by introducing tax incentives and other preferential terms (e.g., selling them unused production facilities and other infrastructure at symbolic prices) when establishing basic university departments and engineering and prototyping centers at regional universities. Development institutions can also provide financial support for projects;
- supporting the collaboration of leading Russian universities with regional research centers: setting up "mirror laboratories" of leading Moscow universities (MIPT, MISIS, HSE, etc.) in local higher education institutions, organizing internships for their young scientists at leading entrepreneurial universities in Moscow and St. Petersburg.

The federal program Priority 2030[11] and the projects "Technological Entrepreneurship Platform" and "Higher Engineering Schools" which involve the application of the above tools deserve special mention.

Promoting Demand for Regional Start-ups' Products and Increasing Their Access to Potential Markets through the Application of Digital Technologies

New challenges require expanding digital infrastructure and involving individuals and businesses in the digital economy. A specific program to support digitization and robotization of state-owned companies operating in many Russian regions could contribute to the emergence of new local markets for start-ups. Building and upgrading ICT infrastructure should be the priority in developing the digital environment in Russian regions, including broadband internet and 5G networks to promote the emergence of new industries in the framework of gignomics: 3D printing, augmented and virtual reality technologies, telemedicine, etc. Public-private partnerships and long-term debt instruments based on private investment are efficient formats for funding such projects in the regions [*Cumming et al.,* 2017].

Policies Promoting Regional Entrepreneurship Ecosystems and Bridging Interregional Gaps in the Start-up Activity

The pandemic created the need to regionalize policies [*Obraztsova, Chepurenko,* 2020]. It is no coincidence that many responsibilities in the sanitation and epidemiology sphere and for providing support for the affected were delegated from the federal to regional authorities. However, the issue of introducing appropriate tax incentives remains unresolved.

Education, science and technology, entrepreneurial, and regional policies need to be coordinated on the basis of an ecosystem approach: inclusivity principles ("rules for all"), interconnectedness, consistency ("think small first"), openness, locality, and priority

[10] https://www.minobrnauki.gov.ru/press-center/news/?ELEMENT_ID=21471, accessed 19.08.2021.

[11] https://priority2030.ru/, accessed 19.08.2021.

[*Zemtsov et al.,* 2020]. Bridging interregional gaps in the levels of start-up activity and R&D also requires further effort.

The weaknesses of most of the regional entrepreneurial ecosystems can be partially overcome by moving project offices with broad federal- and regional-level powers to personnel- and resource-deficient regions (similar to the INO Tomsk project). Industrial parks specializing in fine-tuning and promoting innovative solutions in the field of logistics (in the Far East), new materials (Ural), selection and organic foods (South), new transport technologies (North), AI (central Russia), and others can be established in federal districts with the participation of federal development institutions, leading universities, interregional business associations, representatives of the private venture capital industry, and NGOs. Currently many development institutions do not even have regional offices and focus exclusively on Moscow and Saint Petersburg [*Semenova et al.,* 2019a], while R&D conducted by Russian universities, despite their wide disciplinary coverage, typically do not take into consideration the specifics of the local economy and its strong sides.

Replicating best regional practices in attracting young entrepreneurs can be another area for making promotional efforts. For example, the Republic of Tatarstan is implementing a special rate mortgage and housing rental program for start-up founders willing to move in from other Russian regions[12] or neighboring countries. Unlike social policy, initiatives to support technology start-ups cannot be equalizing and uniform ("one size fits all"). Co-financing start-ups in mining and agricultural regions will be less effective than in centers of research and education activities.

Applying the above new entrepreneurial policies to start-ups will increase the productivity of the innovation sector and that of the Russian economy as a whole.

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The Resilience and Adaptative Strategies of Italian Cooperatives during the COVID-19 Pandemic

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Abstract

Third sector organizations, like the rest of the economic system, have been heavily affected by the pandemic. The aim of this work is to study resilience and adaptability to crisis in terms of economic results and innovative outcomes of the cooperative business model in the Italian third sector during the COVID pandemic. This study uses new evidence from a recent survey on this sector and consists of two main parts. In the first, the institutionalist literature on contractual failures is assumed as an interpretative key in the comparison between the business models, governance, and routines in social cooperatives versus other non-profit organizations (NPOs) interpreted as third sector entities. In the second, we use the new data from a third sector survey in the Marche region, collected in the late spring of 2021 toward the end of lockdown measures. Empirical assumptions concern organizational resilience and adaptation to unexpected negative shocks in cooperatives and other NPOs. The results show that, in the management of the crisis, cooperatives are better able to preserve their human capital and resort to layoffs less often than other NPOs. Shared decision-making, employee involvement, and the adaptability of the work process emerge as dominant organizational characteristics that support resilience and service innovation in cooperatives. The main policy implication concerns the ability of cooperatives to play a stabilizing and a-cyclical role during a crisis and to fill the supply gaps left open by other organizational forms (private, non-profit and the public sector). The originality of this paper lies in the new approach to cooperative organizations and in the analysis of the reaction of cooperatives during the pandemic crisis

Keywords: cooperative enterprises; third sector; COVID-19 pandemic; resilience; contractual failures; governance; economic performance; service innovation

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Introduction

The specialized literature reports that cooperatives behave differently from other organizational forms in relation to at least two fundamental organizational dimensions [*Perotin,* 2013; *Borzaga et al.,* 2021]. The first refers to the adaptability of the business model, i.e., the economic strategies and market responses, in the face of a crisis [*Jensen,* 2013; *Burdín,* 2014]. The second refers to the adaptability of organizational characteristics in responding to unforeseen events. As regards the first notion, cooperatives show a stable development pattern that tends to not be very reactive to the economic cycle, that is, they grow less than average during expansionary periods and contract less during recessions and crisis. The economic literature has shown that this stable pattern corresponds to a more rigid supply curve than other economic organizations, since cooperatives tend to plan their growth in the medium to long term to meet their members' needs [*Borzaga et al.,* 2021]. Several empirical tests have confirmed this theoretical implication [*Bartlett et al.,* 1992], for example, in the case of Italy [*Pencavel et al.,* 2006]. Wide literature reviews can be found in [*Bonin et al.,* 1993; *Pérotin,* 2013].

In this vein, several contributions have analysed the behaviour of cooperatives during the financial crisis of 2008–2011 and the sovereign debt solvency crisis of 2012–2014. A case study on a group of worker cooperatives in Mondragon, in the Basque region of Spain, showed how this business model can accomplish a virtuous synergy between financial, industrial, and commercial activities within the same group to overcoming the crisis by suffering only marginal employment losses, a record in stark contrast to the rest of the Spanish economy in the same period [*Ellis et al.,* 2018].

The survey in the second part of the paper concerns social cooperatives, which are defined by the law as a socially oriented, multi-stakeholder cooperative type [*Borzaga, Galera,* 2016; *Sacchetti, Borzaga,* 2020]. Depending on the definitions, legislation, cultural background, and institutional evolution, cooperatives are included among third sector organizations and non-profit enterprises in some, but not all countries. In Italy, all types of cooperative enterprises (consumer, producer, worker, user, credit, housing, and social cooperatives) are defined by law as non-profit enterprises, as they are all required to reinvest at least 30% of their positive net residuals in indivisible reserves of capital, which cannot be shared between members either during the life of the organization or at the end of it [*Tortia,* 2021]. Social cooperatives in Italy mainly provide social services, a sector that offers a unique opportunity for comparison between different organizational forms (public, non-profit, and private),in particular, social cooperatives and other non-profit organizations (NPOs).

The adaptability of the business model is a guiding criterion in understanding resilience, since the governance rules and routines of cooperative enterprises are based on involvement and participation in decision-making of various non-investor stakeholders, a feature most often absent in other models [*Cheney et al.,* 2014]. Scholars have focused on the specific organizational design and strong organizational identity of cooperatives, based on a broad set of values and principles [*Nelson et al.,* 2016]. Their specific organizational capabilities can help adaptation to environmental change and support relationships with stakeholders that contribute to better resilience and innovation in an emergency such as a pandemic. This is particularly true because cooperatives are locally embedded and can leverage local social capital, relationships, and resources [*Billiet et al.,* 2021]. Cooperative governance, together with their organizational routines and mutual benefit goals, form the backbone of their business model [*Jensen,* 2013].

The reactions of cooperatives to crisis situations are aimed at satisfying their members' needs and requests, which mainly concern the preservation of employment and production levels in worker and producer cooperatives and the guarantee of a stable flow of goods and services in other cooperative forms (e.g., users, credit unions [*Borzaga et al.,* 2021]). To achieve members' objectives and stabilize employment during the crisis, cooperatives can reduce labor costs and cause wages to fluctuate, but they can also accept losses and reduce capital reserves [*Mihazaki, Neary,* 1983; *Craig, Pencavel,* 1993; *Burdín, Dean,* 2012; *Navarra,* 2016].

The first step of our analysis takes into consideration the institutionalist literature on contractual failures and how these are related to the development of cooperative enterprises. Second, some elements of evolutionary theory are taken into consideration to show how cooperatives autonomously develop their own working rules and organizational routines to respond to stakeholder demands and deal with negative shocks. In the second part of the paper, we use new data from a survey on the Italian third sector in the Marche region, including both social cooperatives and other NPOs. By comparing the determinants of economic performance and service innovation in the two groups, we are able to show the stability and resilience of the cooperative business model during the pandemic.

Theoretical Insights: Contractual Failures, Governance Rules, and Organizational Routines in the Cooperative Business Model

This section aims to reconstruct the micro-analytic elements that can differentiate behavioral outcomes in cooperatives from other organizational forms, both IOFs and other third sector organizations, during the current crisis to deliver testable hypotheses and contribute to building a new framework of empirical analysis. We consider the institutionalist theory of contractual failures and its impact upon the working of cooperative governance as a special kind of systemic organizational solution.

The outstanding literature has shown the ability of cooperatives to face negative economic contingencies by adapting their internal structure and distributive patterns. Workers' cooperatives react to the crisis by lowering wages and making them more flexible in order to limit layoffs as much as possible [*Pencavel et al.,* 2006; *Roelants, Sanchez-Bajo,* 2011; *Perotin,* 2013; *Albanese et al.,* 2015], credit cooperatives by limiting credit crunch to firms in difficulty more than commercial banks would [*Angelini et al.,* 1998], consumer cooperatives by lowering the prices of their products to make them accessible to their members [*Mori,* 2014], and social cooperatives by lowering the service fees and expanding supply rather than contracting it [*Borzaga, Galera,* 2016].

The current pandemic conditions show some similarities, but also substantial differences when compared to previous crises, having been characterized by sudden and simultaneous contractions of both supply and demand [*Barua,* 2020; *Didier et al.,* 2021]. In the context of a health emergency and falling demand, third sector organizations can react by resorting to non-market resources such as volunteering and charitable donations, and by lowering the prices of their services thanks to the flexibility of labor costs and the organizational model. Consistently, some third sector activities, in particular care services, could overcome the crisis better than the rest of the economy, or even expand supply [*Borzaga, Galera,* 2016].

Contractual Failures and Governance

The new institutional literature explains investor ownership as the dominant model of property rights and insists upon the importance of specific investments, contractual failures, and opportunism as its determinants [*Williamson,* 1975]. The specificity of assets is positively correlated with increased contractual costs due to contractual incompleteness and the risk of opportunistic behaviors of non-controlling stakeholders. Investor ownership represents the best institutional tool for protecting specific investments and preventing opportunism in terms of haggling, shirking and hold-up. In the Hansmann [*Hansmann,* 1996] model, investor ownership is still identified as the dominant proprietary form but compared on par with the other forms. Its primacy is not taken for granted but explained in efficiency (cost minimization) terms. Ownership is assigned to the stakeholder group that is able to minimize the sum total of transaction costs attached to the working of the organization, as sub-divided into the costs of the market contracting and the costs of ownership. Nothing, in principle, prevents stakeholder-patrons from becoming owners and, indeed, Hansmann shows that this possibility is especially observed on agricultural markets (agricultural cooperatives) and in some sectors populated by non-profit organizations. Also, non-investor-ownership is widespread in professional activities such as professional partnerships, in which most investments are embodied in human capital and not in physical assets. In this regard, cooperative enterprises can be highly efficient organizations compared to IOFs due to the lower agency costs, but only when their members have homogeneous characteristics and preferences to avoid inflated transaction costs in terms of decision-making [*Iliopoulos, Valentinov,* 2018]. As for non-profit organizations, which constitute the third sector in the US, they are defined by Hansmann as organizations without owners (they are financed by philanthropic donors and governed by trustees), as they are created to pursue their social missions in an exclusive way, while control rights assigned to any stakeholder group would introduce unwanted private interests in their management and distribution patterns.

Starting from these premises, the ability of the organizational structure to absorb negative shocks has to do with the flexibility of its business model, which can allow for regaining sustainability and growth in difficult times. Organizational flexibility is here understood as the ability to change and adapt, especially in unpredicted or even emergency conditions. While important environmental shocks surely represent serious challenges and can endanger firm survival, they do also represent opportunities to do away with outdated organizational models and routines and pursue innovative goals in a pro-active way. Flexibility is partly based on the self-organization of work teams and the creation of positive feedback from experimentation [*Englehardt, Simmons,* 2002]. The ability to pursue alternative future scenarios is linked to the development of dynamic capabilities and flexible routines, which help achieve a proper balance between standardization, flexibility, and innovation in organizational processes. Flexible routines support resilience through the loose coupling between structured and performative organizational patterns, whose interactions favor the emergence and selection of new practices and strategies [*Feldman, Pentland,* 2003; *Grote et al.,* 2009].

Organizational flexibility guided by ad hoc working rules and routines supports the internalization and management of negative external shocks and contractual imperfections, potentially improving efficiency [*Poledrini, Tortia,* 2020]. The new institutional literature in the classical works by [*Commons,* 1950; *Ostrom,* 1990, 2005] has insisted upon the importance of governance as a complex set of dedicated rules that are directed toward managing economic relations and resources by means of involvement, incentives, constraints, and sanctions. When these arguments are applied to cooperative enterprises, it can be stated that the ability to absorb negative shocks can be found at the very origins of the cooperative movement. Organizational resilience is substantiated in the stability of employment and of the supply of goods and services, depending on the fulfilment of members' needs [*Weick, Sutcliffe,* 2007; *Lampel et al.,* 2014; *Borzaga et al.,* 2021]. In consumer cooperatives, client involvement and co-production are essential for achieving better quality of goods, lower prices, and the reduction of posi-

tional power on the market. Worker cooperatives, on the other hand, can overcome the imperfections of the employment relationship, since the risks of bilateral opportunism and abuse of power can be limited by including workers in decision-making, which has been shown to support stronger wage flexibility and employment stability [*Navarra, Tortia,* 2014; *Albanese et al.,* 2015].

On the other hand, the cooperative form of business also faces fundamental challenges that can prevent the achievement of economic and financial sustainability. Especially: (i) financial difficulties in the absence of direct access to markets for equity capital [*Jensen, Meckling,* 1979]; (ii) different typologies of collective action failure, especially opportunism and free rider, as inscribed in the classic tragedy-of-the-commons social dilemmas [*Hardin,* 1968; *Alchian, Demsetz,* 1972]; and (iii) high proprietary and governance costs due to heterogeneous members' preferences and objectives [*Hansmann,* 1996]. Consequently, the study of the governance of collective action in productive organizations, after the seminal work of [*Ostrom,* 1990], requires a dedicated scientific approach focused on self-produced working rules that are able to guarantee involvement and the fulfillment of members' needs while, at the same time, forestalling opportunism and self-seeking distortions [*Ostrom,* 1990; *Hansmann,* 2013; *Tortia,* 2021].

In Italy, the social cooperative, as defined by law 381/1990[1], represents the most recent cooperative form in Italy and is positioned at the crossroads between the traditional cooperative forms and the non-profit form of business. The social cooperative is required by law to have an explicit social goal and multi-stakeholder governance supporting the involvement of different constituencies and achieving goals that are not purely mutualistic but also directed toward producing social value [*Hansmann,* 1980; *Borzaga, Galera,* 2016; *Sacchetti, Borzaga,* 2020; *Poledrini, Tortia,* 2020]. Social cooperatives share important features with both worker and consumer cooperatives, since workers are almost always present in their membership, while, at the same time, their social mission and multi-stakeholder governance favor a high degree of involvement of volunteers, customers, users, and beneficiaries, a feature which clearly tends to expand their objectives towards the production of greater social value [*Tortia,* 2020].

The Reactions of Social Cooperatives and Other Non-Profit Entities to the Pandemic

National labor market statistics in Italy show that conventional firms reacted to sharp falls in demand by reducing supply and increasing layoffs when legal constraints and public subsidies do not intervene. In this respect, starting from the beginning of March 2020, all companies have been prevented from laying off permanent workers, while public subsidies have dealt with the payment of reduced rates to redundant workers. These restrictions have been progressively lifted starting from July 1, 2021. Pre-COVID normality should be restored by the end of October 2021.[2]

Considering the reactions to the pandemic of third sector organizations, including social cooperatives, it is possible to expect significant differences compared to IOFs. As concerns cooperatives, they have been identified as organizations that mostly intervene in times of crisis, as the creation of a new collective venture can help the system to reduce poverty and unemployment, softening the rough edges of the business cycle [*Roelants, Sanchez-Bajo,* 2011]. Their ability to withstand crisis can be explained by their effort to preserve their most valued resources, especially human capital, and redistribute emerging losses inside their own boundaries among their members and intertemporally. They strive to keep their supplies stable during a crisis and even fill the space vacated by private enterprises (as long as this is made possible by lockdown measures during a pandemic [*Borzaga et al.,* 2021]). To this end, sustainability and resilience are supported by flexible working hours, smart working, lower and fluctuating wages, lower product prices, and price discrimination. Intertemporally, deferred payments and de-accumulation of reserves can shift temporary increases in costs and the reduction of revenues in the future.[3] In turn, a smaller reduction in economic activity implies a smaller quantitative reduction in the amount of transactions that they are willing to carry out and smaller increases in unemployment. By improving their own resilience, they also counter systemic failure.

As for non-profit organizations, they are legally defined in Italy in a similar way to most other countries, in particular as associations, foundations, and religious entities that reinvest any positive residuals in indivisible reserves[4] and use all their assets to pursue their social missions (through an asset lock). They play a leading role and complement public supply in delivering social services. On the other hand, a less pronounced entrepreneurial attitude, a looser institutional structure (the Italian civil code does not regulate non-profit organizations as enterprises, but as simple non-profit entities), and a stronger reliance on non-market resources, such as voluntary work and charitable donations, may imply that non-profit organizations find it difficult to reach economic and financial sustainability during a crisis with negative consequences for employment and production [*Hoogendoorn,* 2011]. Furthermore, since

[1] http://base.d-p-h.info/fr/fiches/premierdph/fiche-premierdph-441.html

[2] As of 26 December 2021, a new extension for the redundancy block until 31 December 2021 was introduced for all workers in the service sector, crafts, small businesses and three industrial sectors: textiles, clothing and leather goods.

[3] https://www.nytimes.com/2020/12/29/business/cooperatives-basque-spain-economy.html [Accessed 30 June 2021].

[4] Pursuant to Legislative Decree 460/1997, NPOs are subject to the prohibition of distributing, even indirectly, profits and operating surpluses as well as funds, reserves or capital during the life of the entity, and the obligation to devolve the assets of the entity in the event of its dissolution for any reason, to other non-profit organizations of social utility or for purposes of public utility.

most non-profits are not created for running production processes in an entrepreneurial way, they may encounter more difficulties in innovating service provision [*Anheier, Kendall,* 2001; *Sparviero,* 2019].

Given these premises, our hypotheses revolve around how resilience depends upon the adaptability of the business model, for example as regards the amount of capital assets, and whether social cooperatives prefer to increase the negative balance between costs and revenues during a crisis and accept greater losses rather than dismissing redundant workers. They also enquire how resilience depends upon the ability of the organizational model to adapt the supply of services to the needs that emerged during the pandemic and, consequently, upon the degree of organizational change and flexibility and service innovation [*Mobiny, Soster-Ramos,* 2020].

Empirical Analysis

This theoretical approach to cooperative governance allows us to formulate several empirically verifiable implications on how the cooperative business model, as defined by its governance rules, organizational routines, and managerial models, has dealt with the pandemic crisis compared to other third sector NPOs. We elaborate two main empirical hypotheses relating to the economic resilience of the organizational model and to organizational flexibility as a determinant of service innovation. The hypotheses are divided into several sub-hypotheses that refer to some fundamental organizational dimensions.

Our dependent variable in the OLS regressions is expressed in terms of the percentage increase in costs versus revenues during the pandemic in relation to the same results in previous years, separately for cooperatives and other NPOs. As determinants of economic results, we consider some organizational dimensions and their choices in regard to changes in the provision of services and innovation. Hypothesis 1 states:

> **HP1.** We hypothesize that the economic resilience of the cooperative business model compared to other NPOs in terms of its ability to reduce costs in excess of revenues depends upon its adaptability across some salient organizational dimensions. We consider the following organizational drivers of performance:
>
> **HP1. A.** Cooperative enterprises preserve employment levels and human capital during the crisis thanks to their ability to internally manage and partially overcome some contractual imperfections in the employment relationship (especially wage rigidity, excess layoffs, and depletion of human capital) better than other organizational forms. Consequently, we hypothesize that the amount of employment and its variation over time in cooperatives is more loosely correlated or not correlated with economic performance, as cooperatives prefer to reduce wages and make them flexible during a crisis rather than lay off worker-members;
>
> **HP1. B.** Given the non-profit nature of social cooperatives and other NPOs, it is assumed that both organizational types are helped by volunteers in coping with a crisis and that an increase in the number of volunteers helps reduce excess costs during a crisis;
>
> **HP1. C.** External pressures coming from the pandemic crisis and related social demands push both organizational types to introduce new services and to innovate in the provision of existing ones.

In the second step of the analysis, we estimate two logistic regression models to evaluate the impact of the variables describing the degree of organizational flexibility on: (1) providing new services in cooperatives; (2) providing traditional services through new delivery methods in the other NPOs. Hypothesis 2 states

> **HP2.** We hypothesize that the resilience of the business model depends upon its ability to adapt the services provided to the needs that emerged during the pandemic and, consequently, upon its degree of organizational flexibility and adaptability to support organizational change and service innovation. Two sub-hypotheses are stated as follows:
>
> **HP2. A.** Service innovation depends upon the degree of organizational flexibility in terms of the adaptability of decision-making processes when decisions are: fully shared by all stakeholder groups vs proposed by employees and when the timeliness of the decision-making process is guaranteed;
>
> **HP2. B.** Service innovation depends upon the adaptability of the organizational model in terms of adaptability of the members' skills and adaptability of the work organization.

Methodology and Data Sources

The survey was conducted as part of a larger project that involved three Italian regions located respectively in the north, center, and south of Italy and characterized by a homogeneous incidence of third sector non-profit organizations by the number of inhabitants. In this article, we focus on the Marche region of central Italy. A total of 452 responses were collected, with a response rate of 22.6%, in line with other published work using web surveys on non-profit organizations [*Curtis et al.,* 2010]. A distinctive feature of this region, which has captured our interest, lies in the territorial impact of third sector organizations, which are homogeneously located between urban and extra-urban areas. These organizations are widespread throughout the Marche region and have grown over the years, showing a positive balance between mortality and the creation of new entities [ISTAT, 2020]. In particular, in the case of social cooperatives, their number is growing in terms of staff hired and the value of production on total re-

gional GDP. The contribution of the non-profit sector to the regional GDP is about 10% against 8% at the national level (the data refer to the period from 2011 to 2016).[5] In the same period, the trend of new hires is positive (+ 14%).

Two thousand organizations were randomly selected from the latest available regional register of non-profit organizations (BUR n.138 28/12/2017), invited by e-mail and surveyed from April to June 2021. The survey consists of 29 multiple-choice and open-ended questions, which deal with the two main themes of the adaptability of the business model and of the organizational characteristics in responding to unexpected events. As regards the first theme, the questions are based on a similar survey conducted by Istat (Italian National Institute of Statistics) on the response of profit companies to COVID-19 [ISTAT, 2020]. Regarding the second theme, the questions were chosen on the basis of the existing literature that defines the determinants of adaptability as derived from internal decision-making processes, work organization models, and employee skills [*Hatum, Pettigrew,* 2006].

The Variables

The variables used in the OLS regressions are described as follows. The dependent variable of interest is the percentage change in net costs (costs minus revenues) recorded in 2020 with reference to the same measure in the three years prior to COVID-19 (from 2017 to 2019). According to our data, this variation is always negative. The result is not surprising given that we are dealing with a period of crisis. However, it can have different degrees. It can therefore reasonably be argued that a smaller negative change in net revenues indicates a better ability to respond to the crisis.

We consider a host of explanatory variables: (1) the number of employees; (2) the variation in the number of employees recorded in 2020 compared with the average number of employees over the previous three years. The variable is dichotomous and takes on a unitary value if the number of employees has been reduced in some way, in particular by resorting to unemployment benefits; (3) the number of volunteers; (4) the change in the number of volunteers in 2020, measured by the question "Did the number of volunteers increase during the pandemic?" Respondents could answer "Yes", "No", and "Don't know". A dichotomous variable was created that coded Yes=1, No=0. "Don't know" responses were recoded as missing values and excluded from the analysis; (5) the change in service delivery was measured by the question "Did the organization make a change in service delivery during the crisis?" Three options were proposed: "The organization has provided new services", "The organization has provided traditional services through new modes of delivery" and "The organization has not made any change to its service provision options and modes". Two dummy variables (5a and 5b in Table 1) have been operationalized using the "The organization has not made any changes to its services" prompt as the benchmark. As controls, we consider: the amount of net assets, expressed in euros; the age of the organization, expressed in years; the temporary suspension of the activities depending on the following options: "The business was never suspended during the crisis", "The organization has experienced periods of interruption and resumption of business in its operations" and "The business has been suspended for the entire period of the crisis".

The dependent variables of interest in the logistic regressions include a dummy that was chosen after considering the results of the OLS regressions. Options related to changes in service delivery are statistically significant to varying degrees for cooperatives and other NPOs in reducing negative economic results, and thus in improving resilience and the ability to withstand crisis. In particular, the choice of providing new services is the relevant outcome in the case cooperatives (1 if the supply of new services has taken place, 0 otherwise). On the contrary, the choice to provide existing services through new delivery methods is the dependent variable in the case of other NPOs (1 if new delivery methods have been implemented, 0 otherwise). Organizations that did not make any changes to service provision were excluded from the analysis.

We then consider four explanatory dimensions describing the degree of organizational flexibility and include them in both logistic regressions. Two variables capture organizational flexibility in terms of adaptability in decision making. Specifically: (1) the degree of participation in decision-making related to the change in services was measured by three options "It was exclusively decided by the governing bodies of the organization", "It was proposed by the employees and then accepted by the governing bodies", or "It was a fully shared decision among all the organization's members". The variable was operationalized as two dummies (1a and 1b in Table 2) with the "Decision by the governing bodies" serving as benchmark; (2) the timeliness of the decision-making process, measured by the question: "When were the changes in service delivery introduced?". Response options were: "As soon as the lockdown started", "During the summer of 2020", or "Later". An ordinal categorical variable was created taking the value 1 if the changes started at the beginning of the lockdown, 2 if it started in the summer, and 3 if it started later. Organizational adaptability is described by two variables: (3) the adaptability of employees' and volunteers' competencies measured by the proxy "Difficulties in changing the modalities of service delivery", on a Likert scale ranging from 1 (low difficulty) to 3 (high difficulty); (4) the adaptability of the organization of work was described by the question: "What

[5] http://serviziorps.regione.marche.it, accessed 12.07.2021.

Table 1. **OLS Regression Results**

	Model 1 Social Cooperatives	Model 2 Other non-profit entities
	Coeff. (St.Dev.)	Coeff. (St.Dev.)
(Intercept)	49.876*** (2.790)	51.478*** (1.930)
HP1.A. Employment Level and Variation		
1. Number of employees	0.182 (0.111)	1.050*** (0.143)
2. Employees' variation (decrease)	-4.657** (1.777)	-9.328*** (0.990)
HP1.B. Presence and Variation of Volunteers		
3. Number of volunteers	-0.167*** (0.063)	-0.093*** (0.035)
4. Volunteers' variation (increase)	-4.016*** (1.450)	1.244 (0.949)
HP1.C. Service innovation		
5a. New ways of delivering traditional services	-3.312 (2.553)	-3.612** (1.630)
5b. New services	-5.395** (2.613)	-2.395 (1.781)
Controls		
Seamless work activity	-3.926*** (1.412)	-0.904 (0.932)
Organization's age	-0.148** (0.071)	0.086** (0.039)
Amount of net assets	-0.00001** (0.00000)	-0.00001** (0.00000)
R^2	0.422	0.372
f-statistics	8.531***	16.166***
Number of observations	115	256

Significance codes: *** p<0.001, ** p<0.01, * p<0.05

Absence of multicollinearity was verified using the variance inflation factor.

Source: authors.

pattern of work organization better describes your organization during the COVID-19 pandemic?" The response options were: "Work groups with fixed team members and variable tasks"; "Work groups with variable team members and variable tasks"; "Individual work with variable tasks"; and "Individual work with fixed tasks". Increasing levels of work organization flexibility ranging from 1 (individual work with fixed tasks) up to 4 (work groups with fixed team members and variable tasks) are introduced in one ordinal categorical variable (1 to 4). Finally, two dummies control for the field of operation: culture and education, and healthcare and social assistance, taking the other activities as a benchmark.

The binomial logistic regression is formally described by the following relationship in Equation (1):

$$Logit\ (p) = \log\left(\frac{p(y=1)}{1-p(y=1)}\right) = \beta_0 + \\ + \beta_{1i}\ Dec + \beta_{2i}\ Adapt + \beta_{3i}\ X + u_i, \quad (1)$$

in which the dependent binary variable refers to the choice of providing new services in cooperatives (Model 3) and existing services through new delivery methods in other NPOs (Model 4). *Dec* represents the decision-making process variables; *Adapt* the adaptability of the organizational model variables; X – control variables. The coefficients, estimated with maximum likelihood, describe the effect of each independent variable on the log of the odds ratio, while u_i is the residual error.

Results

The results of the OLS regressions and the diagnostic tests are shown in Table 1.

The results of the OLS regressions show that the number of employees is significant and positively related to the variation of the cost-revenue balance in other NPOs (Model 2, 1.050, p<0.001). This means that in the case of other NPOs, a higher number of employees increases the likelihood of a higher costs-revenue balance. Decreasing the number of employees improves economic results during the pandemic, , but this effect is much weaker in cooperatives than other NPOs (-4.657, p<0.01; -9328, p<0.001 respectively). These two results imply that the cooperative business model is more resilient to crisis in terms of labor relations than other NPOs, since the preservation human capital (lower number of layoffs) in cooperatives, irrespective of their dimension, has a negative but smaller impact on economic results. This result can be achieved by making labor costs flexible and reducing them during crisis, which signals better organizational adaptability [*Bonin et al.,* 1993; *Pencavel et al.,* 2006; *Navarra, Tortia,* 2014; *Albanese et al.,* 2015]. Hypothesis HP1. A was verified.

The number of volunteers is negatively related to cost increases in both models (-0.167, p<0.001; -0.093, p<0.001 respectively for Model 1 and Model 2). Thus, a larger number of volunteers reduces the negative effects of the crisis. This effect is significantly stronger in the case of cooperatives. Along the same lines, an

Table 2. **Logistic Regression for Social Cooperatives**

	Model 3 Social cooperatives: introduction of new services	**Model 4 Other NPOs: provision of existing services in new ways**
	Coeff. (St.Dev.)	**Coeff. (St.Dev.)**
(Intercept)	-4.712*** (1.625)	-6.013*** (1.280)
HP2.A. *Decision Making Process*		
1a. Fully shared decision making	2.241** (0.881)	2.398*** (0.604)
1b. Employees' decision making	1.412 (1.072)	2.445*** (0.948)
2. Decision making timeliness	-1.037** (0.491)	1.346*** (0.377)
HP2.B. *Adaptability of the Organizational Model*		
3. Members' competencies adaptability	0.412 (0.439)	-0.620 (0.628)
4. Work organization adaptability	0.821*** (0.254)	2.448** (1.199)
Controls		
Culture and education	-0.473 (0.863)	-0.620 (0.628)
Healthcare and social assistance	1.371** (0.549)	2.448** (1.199)
Pseudo R^2	0.336	0.327
Wald test	27.6***	41.3***
Number of observations	107	240

Significance codes: *** p<0.001, ** p<0.01, * p<0.05

The dependent variable is a dummy, which takes value 1 if during the pandemic: (III) the social cooperative provided new services; (IV) the NPO has introduced new ways of delivering traditional services; 0 if otherwise.

The logit linearity assumption was checked by the Box-Tidwell test; the absence of multicollinearity was verified using the VIF (Variance Inflation Factor).

Source: authors.

increase in the number of volunteers reduces excess costs, albeit only in the case of cooperatives, showing that this organizational typology may be better able to use volunteer work effectively to reduce other categories of costs (-4.016, p< 0.001). Hypothesis HP1. B is completely verified only in the case of cooperatives.

Service innovation in the face of the crisis takes different shapes in the two organizational types. Considering as a benchmark those organizations that did not make any change, new ways of delivering traditional services is negatively related to cost increases in other NPOs (-3.612, p<0.01) while the introduction of new services has a negative impact upon cooperatives (-5.395, p<0.01). This result, again, can testify to the better ability of cooperatives to react to negative shocks by innovating services and not only by adapting existing ones. HP1. C is verified, but in different ways for cooperatives and other NPOs.

As concerns control variables, higher amounts of net assets are negatively related to the increase of costs over revenues (-0.00001, p<0.01 for both models). The age of the organization is negatively correlated with the reduction in net revenues in cooperatives (-0.148, p <0.01), but positively in the other NPOs (0.086, p <0.01). Therefore, older cooperatives respond better to the pandemic crisis, while age is a negative factor in other NPOs. The variable of seamless working activities is negatively related to costs increases, but it is statistically significant only in the case of cooperatives showing that the continuity of the production process is more important in this organizational typology (-3.926, p<0.001).

Table 2 shows the logistic regression results and diagnostic tests, taking the introduction of new services as the relevant outcome in the case of social cooperatives and the provision of existing services in new ways in the case of other NPOs.

With regard to social cooperatives (Model 3), the variables that describe the adaptability of decision making processes are both significant. In particular, participation is positively correlated with the probability of providing new services when decisions are fully shared among stakeholders (2.241, p <0.01) and worker participation also shows a positive sign, but is not significant, signalling a relatively smaller role for direct employee involvement in strategic decisions. Timely decisions, i.e., interventions in the initial phase of the crisis, increase the probability of introducing new services (-1.037, p <0.01). Clearly, the adaptability of decision making has positive impacts upon the probability of providing new services and appears consistent with the main organizational characteristic of cooperatives, namely the participation of members and collective action, especially in terms of

shared decisions. Adaptability and innovation seem to derive from specific working rules and organizational routines incorporated into the organizational model and tested by experience over time. These routines could not be improvized during the pandemic. They had to be fundamentally ready to deal with a sudden crisis and promptly introduce new services [*Hodgson,* 2003]. Hypothesis HP2. A is confirmed in case of cooperatives. Likewise, the adaptability of the organization of work has a positive impact on the ability to provide new services (0.821, p <0.001), confirming that organizational resilience and innovation are closely linked to the flexibility of the work process. Hypothesis HP2. B is confirmed only as concerns work organization adaptability. Finally, service innovation is more likely to occur in health and care services, which have been heavily involved at the forefront of the pandemic crisis (1.371, p <0.01), confirming that creativity is activated and innovation arises out of compression and necessity [*Dewey,* 1934; *Joas,* 1990; *Sacchetti, Tortia,* 2013]. Organizations providing these services have had to adapt to the emergency earlier and in more depth than others.

Concerning other NPOs (Model 4), full member participation and employee involvement increase the likelihood of providing old services in new ways (2,398, p <0.001 and 2,445, p <0.001, respectively). Timely decisions, unlike the case of social cooperatives, show that other NPOs have tended to introduce new delivery modes at later stages of the pandemic, not at its outbreak (1.346, p <0.001). These differences signal that the introduction of new services requires faster and more timely decisions, while other NPOs tend to follow slower and less transformative patterns. Hypothesis HP2. A is confirmed but other NPOs follow a less timely pattern of innovation. Furthermore, the adaptability of the work organization has a positive impact upon the likelihood of innovating the provision of services (1.637, p <0.001), which confirms the importance of renewing dynamic capabilities to respond to external changes and challenges [*Teece, Pisano,* 1994; *Teece et al.,* 1997; *Blandi,* 2018]. Hypothesis HP2. B is confirmed only as concerns work organization adaptability. Finally, as in the case of social cooperatives, health and social assistance are the fields of activity that has witnessed the greatest amounts of innovation in service provision (2,448, p <0.01).

Conclusion

The arguments developed and the empirical results in this article confirm the already existing knowledge that cooperatives behave differently from other organizational forms in the face of negative environmental events, taking the recent pandemic crisis as a notable example. In the first part of the article, we explain why cooperatives are oriented toward protecting employment levels, human capital, and the size of their economic activity better than strategic assets and financial value. The cooperative firm therefore plays a stabilizing and a-cyclical role thanks to its better ability to absorb shocks and redistribute losses within its borders. Contractual imperfections are internalized and managed internally thanks to dedicated governance rules and organizational routines. The preservation or even expansion of production is made possible by lower costs and fewer layoffs, which allows cooperatives to fill the gaps left by conventional companies and the public sector. Together with other non-profit organizations in the third sector, cooperatives integrate public sector supply and are able to innovate the provision of social and welfare services.

In the empirical part of the study, we compared the economic results of cooperatives and other non-profit organizations in the third sector of the Marche region, and their ability to create and innovate service provision. The comparison shows that cooperatives achieve a higher degree of adaptability and resilience than other NPOs, as they resort less often to layoffs and use voluntary work in a more efficient way. This implies that the negative impact of the pandemic is not projected in the long term and cooperatives are able to preserve their human capital pending recovery, although short-term layoffs can cause losses and the depletion of reserves. A lower fluctuation in employment means that, all things being equal, production is also expected to return faster to pre-crisis levels when demand picks up again. On the innovation front, cooperatives show a marked tendency to react to the crisis by introducing new services, rather than innovating existing ones. This, again, is a sign of resilience, as innovation is seen as a strategic tool that can help the organization overcome tough times and restore long-term sustainability in new proactive ways.

Future research will have to systematically compare the behavioral responses of cooperatives with those of other organizational forms, in particular investor-owned firms, during and after the crisis. New and more comprehensive (longitudinal) data will enable post-crisis recovery analysis and may help unveil the underlying causal relationships. For example, it will be important to understand whether hysteresis implies that a share of the newly unemployed will find it difficult obtaining a new job. If so, the ability of cooperatives to stabilize employment and preserve their human capital during the crisis will appear all the more valuable.

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