

Entrepreneurial Ecosystems in the Czech Republic and Slovakia: A Topic Modelling Analysis of Startup Activity

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Abstract: This study examines entrepreneurial ecosystems in the Czech Republic and Slovakia during the period 2017–2025 using venture-level data extracted from Crunchbase. The research applies Latent Dirichlet Allocation (LDA) topic modelling to startup business descriptions in order to identify dominant entrepreneurial domains and ecosystem specialization patterns across major cities. The results reveal a strong geographical concentration of entrepreneurial activity, with Prague emerging as the dominant regional startup and venture capital hub. Topic modelling identified 13 major entrepreneurial domains, with Digital Consulting & Software Solutions representing the largest category, accounting for 46.5% of all ventures. Additional prominent areas include SaaS and smart finance platforms, e-commerce, digital marketing, industrial automation, fintech, blockchain technologies, and HealthTech-related activities. The findings further demonstrate that larger metropolitan ecosystems exhibit greater thematic diversification, while smaller ecosystems tend to specialize in narrower technological niches. Venture capital funding was found to be even more geographically concentrated than entrepreneurial activity itself, particularly within Prague-based digital and software ventures. Overall, the study highlights the increasing importance of digital transformation, software-based innovation, and platform-oriented business models within Central European entrepreneurial ecosystems.

1. Introduction

Entrepreneurial ecosystems have become an increasingly important driver of regional innovation, technological development, and economic growth (Audretsch & Belitski, 2017; Stam, 2015). These ecosystems consist of interconnected actors and institutions, including startups, investors, universities, research organizations, governments, and support infrastructures, that collectively shape entrepreneurial activity within specific geographical areas (Isenberg, 2010; Spigel, 2017). In recent years, the growing digitalization of economies and the emergence of new technology-driven business models have further strengthened the importance of entrepreneurial ecosystems as centers of innovation and competitiveness.

Previous research has demonstrated that entrepreneurial activity tends to concentrate geographically in urban areas where access to skilled labor, financing, knowledge spillovers, and innovation infrastructure is strongest (Feldman & Kogler, 2010; Marra et al., 2017). Cities with developed entrepreneurial ecosystems benefit from dense networks of startups, venture capital firms, incubators, accelerators, and research institutions that facilitate the creation and scaling of innovative ventures (Florida & Mellander, 2016). At the same time, entrepreneurial ecosystems increasingly differ in their technological specialization, reflecting local industrial structures, institutional environments, and investment patterns.

The Czech Republic and Slovakia represent particularly interesting contexts for examining entrepreneurial ecosystems in Central and Eastern Europe. Both countries have undergone substantial economic and technological transformation since the transition to market economies and have become increasingly integrated into European and global innovation systems. Cities such as Prague, Bratislava, and Brno have emerged as important regional startup hubs attracting entrepreneurial talent, venture capital, and technology-oriented firms. Despite this growing importance, relatively limited research has systematically examined the thematic structure and specialization patterns of entrepreneurial ecosystems within these countries using large-scale startup data and computational text analysis methods.

Recent advances in natural language processing (NLP) and machine learning provide new opportunities for analyzing entrepreneurial ecosystems through venture-level textual data. Topic modelling techniques enable the identification of latent thematic structures within startup business descriptions, offering insights into dominant technological domains, emerging innovation trends, and ecosystem specialization patterns (Blei et al., 2003; DiMaggio et al.,

2013). Among these methods, Latent Dirichlet Allocation (LDA) has become one of the most widely used approaches for uncovering hidden topics in large textual corpora and identifying patterns of technological and entrepreneurial activity.

Against this background, the present study examines entrepreneurial ecosystems in the Czech Republic and Slovakia during the period 2017–2025 using venture-level data extracted from CrunchBase. The study applies LDA topic modelling to startup business descriptions in order to identify major entrepreneurial domains and ecosystem specialization patterns across leading urban ecosystems. In addition, the analysis investigates the geographical concentration of venture activity and venture capital funding across cities and technological topics.

The remainder of the paper is structured as follows. The next section describes the data and methodology, including the preprocessing pipeline and LDA topic modelling approach. The subsequent section presents the empirical results on entrepreneurial specialization and venture capital distribution across ecosystems. The final section discusses the implications of the findings and concludes the study.

2. Literature Review

2.1 Entrepreneurial Ecosystems and Regional Innovation

The concept of entrepreneurial ecosystems has gained increasing attention in entrepreneurship and regional development research over the last decade. Entrepreneurial ecosystems refer to interconnected sets of actors, institutions, organizations, and processes that collectively support entrepreneurial activity within a specific geographical area (Isenberg, 2010; Stam, 2015). These ecosystems typically include startups, universities, investors, research institutions, incubators, accelerators, governmental agencies, and supporting infrastructure that together shape the conditions for innovation and business creation.

Existing research emphasizes that entrepreneurial ecosystems are inherently spatial and tend to concentrate in urban regions characterized by strong knowledge bases, access to financing, and dense professional networks (Feldman & Kogler, 2010; Spigel, 2017). Cities play a particularly important role because they facilitate knowledge spillovers, labor market pooling, and collaboration between firms, universities, and investors (Florida & Mellander, 2016). Metropolitan ecosystems often provide better access to venture capital, entrepreneurial talent,

and innovation infrastructure, enabling startups to scale more rapidly and operate in highly knowledge-intensive sectors.

Previous studies have also demonstrated that entrepreneurial ecosystems differ substantially in their technological specialization and industrial orientation. Some ecosystems develop strong capabilities in software development, fintech, biotechnology, artificial intelligence, or advanced manufacturing, depending on local institutional conditions and historical industrial structures (Audretsch & Belitski, 2017). These specialization patterns influence regional competitiveness, innovation performance, and venture capital attraction.

In the context of Central and Eastern Europe, entrepreneurial ecosystem research remains relatively limited compared to Western Europe or North America. Existing studies suggest that post-socialist economies have experienced rapid entrepreneurial transformation driven by digitalization, foreign investment, and integration into global innovation networks. Cities such as Prague, Bratislava, and Brno have emerged as important technology and startup hubs within the region, particularly in software engineering, cybersecurity, fintech, and digital services. However, systematic analyses of ecosystem specialization and technological diversification in the Czech Republic and Slovakia remain scarce.

2.2 Digital Entrepreneurship and Technology-Oriented Startups

The rapid development of digital technologies has significantly transformed entrepreneurial activity worldwide. Digital entrepreneurship refers to the creation of new ventures based on digital technologies, software solutions, online platforms, and data-driven business models (Nambisan, 2017). The expansion of cloud computing, artificial intelligence, blockchain technologies, e-commerce platforms, and mobile applications has reduced entry barriers for startups while simultaneously enabling faster innovation and internationalization.

Recent research highlights that digital startups increasingly dominate entrepreneurial ecosystems due to their scalability, lower operational costs, and strong growth potential (Autio et al., 2018). Platform-based business models, software-as-a-service (SaaS) solutions, fintech applications, and digital consulting services have become major drivers of entrepreneurial growth across urban innovation ecosystems. At the same time, digitalization has accelerated technological convergence across sectors such as healthcare, finance, logistics, industrial automation, and media production.

Artificial intelligence, blockchain technologies, and fintech have attracted particular attention in recent entrepreneurship research. AI-based startups increasingly focus on data analytics, machine learning, automation, and decision-support systems, while blockchain ventures develop decentralized financial services, crypto-payment systems, and digital asset management solutions (Treiblmaier, 2019). Similarly, Industry 4.0 technologies and IoT applications have created new entrepreneurial opportunities in manufacturing, logistics, and smart infrastructure.

The increasing dominance of digital entrepreneurship has also intensified geographical concentration within leading urban ecosystems. Venture capital firms tend to allocate funding toward regions with strong technological capabilities, entrepreneurial networks, and highly skilled labor forces. Consequently, major metropolitan ecosystems often attract disproportionate shares of startup investment and innovation activity, reinforcing regional inequalities in entrepreneurial development.

2.3 Topic Modelling and Computational Entrepreneurship Research

The growing availability of large-scale startup databases has encouraged the use of computational methods in entrepreneurship research. In particular, natural language processing (NLP) techniques enable researchers to analyze startup descriptions, patents, business models, and technological narratives at scale. Among these methods, topic modelling has emerged as an important tool for identifying latent thematic structures within large textual corpora.

Latent Dirichlet Allocation (LDA), introduced by Blei et al. (2003), is one of the most widely used topic modelling techniques. LDA assumes that documents consist of mixtures of latent topics, where each topic represents a probability distribution over words. The method enables the identification of dominant themes, technological domains, and emerging innovation trends without requiring predefined classifications.

Topic modelling has been increasingly applied in innovation and entrepreneurship studies. Previous research has used LDA to analyze startup ecosystems, technological trajectories, patent portfolios, venture capital investments, and emerging industries (DiMaggio et al., 2013). The method is particularly valuable for identifying specialization patterns across entrepreneurial ecosystems because it captures latent semantic relationships between ventures and technologies.

Despite the growing use of computational methods in entrepreneurship research, relatively few studies have applied topic modelling to analyze startup ecosystems in Central and Eastern Europe. Existing studies often focus on single industries or rely on traditional industrial classifications that may not fully capture rapidly evolving digital business models. By combining startup database analytics with NLP and topic modelling techniques, the present study contributes to the literature by providing a data-driven understanding of entrepreneurial specialization, technological diversification, and venture capital concentration within Czech and Slovak entrepreneurial ecosystems.

3. Data and Methodology

In the empirical part of this paper, we analyze ventures extracted from CrunchBase, an online platform providing detailed information on high-technology startups, including industry classifications, locations, founding years, employment, and financing data. Crunchbase collects information through collaborations with incubators, venture capital funds, and direct contributions from entrepreneurs, while artificial intelligence, machine learning, and web crawling technologies are used to validate and continuously update company profiles. Founded in 2007, Crunchbase is widely recognized as one of the most comprehensive databases for entrepreneurship research (Bzhalava et al., 2022; Dalle et al., 2017).

Table 1. Number of ventures in the period 2017-2025

Time period	Number of ventures
2017	459
2018	410
2019	336
2020	317
2021	252
2022	127
2023	99
2024	64
2025	54

Source: CrunchBase.

For this study, we limit our dataset to ventures from Slovakia and Czech Republic that began operations in the period 2017-2025. We also exclude missing values in the business description

field, resulting in a final sample of 2118 ventures. Table 1 presents the distribution of ventures across various time periods.

Table 2. Number of ventures in the top selected entrepreneurial ecosystems in Slovakia and Czech Republic (in 2017–2025)

City	Number of ventures
Prague	1079
Bratislava	280
Brno	174
Ostrava	51
Košice	26
Galanta	22

Source: CrunchBase.

This research examines entrepreneurial ecosystems at the city level. Cities are widely recognized as important hubs for high-technology entrepreneurship because they concentrate human capital, research institutions, industrial activity, and financial resources (Marra et al., 2017). Access to venture capital, government support programs, and entrepreneurial networks is typically stronger in urban areas, enhancing opportunities for startup creation and growth. Furthermore, innovation is supported through co-working spaces, conferences, and professional networking activities that encourage collaboration and knowledge spillovers. Table 2 reports the number of ventures in top selected entrepreneurial ecosystems.

To prepare the textual data for topic modeling, venture descriptions were preprocessed and cleaned using Python’s NLTK framework. The preprocessing pipeline consisted of lowercase conversion, removal of punctuation, numbers, special characters, and stop words, and lemmatization of terms. Only nouns and adjectives were retained to focus the analysis on the most relevant technological and business-related concepts.

To identify the main areas of entrepreneurial activity, this study applies Latent Dirichlet Allocation (LDA) topic modelling to venture business descriptions. LDA is an unsupervised machine-learning method that groups frequently co-occurring words into latent thematic topics (Blei et al., 2003). Each venture is subsequently assigned to its dominant topic based on the highest topic probability, enabling the analysis of ecosystem specialization and diversification patterns.

Table 3. Topic model evaluation results

K	Coherence	Perplexity	Topic Diversity
2	0.371	-5.911	0.950
3	0.433	-5.967	1.000
4	0.414	-5.987	1.000
5	0.475	-6.017	0.980
6	0.457	-6.013	0.983
7	0.494	-6.027	0.971
8	0.498	-6.045	0.975
9	0.550	-6.059	0.989
10	0.532	-6.058	1.000
11	0.527	-6.051	0.982
12	0.527	-6.075	0.975
13	0.551	-6.059	0.969
14	0.537	-6.202	0.986
15	0.554	-6.725	0.980
16	0.557	-7.286	0.969
17	0.557	-7.517	0.976
18	0.546	-7.625	0.922
19	0.573	-7.696	0.947
20	0.559	-7.792	0.965
21	0.577	-7.911	0.938
22	0.560	-7.995	0.955
23	0.568	-8.075	0.952
24	0.549	-8.162	0.946
25	0.553	-8.264	0.916
26	0.569	-8.328	0.977
27	0.552	-8.396	0.981
28	0.564	-8.520	0.950
29	0.579	-8.637	0.924
30	0.586	-8.703	0.947
31	0.605	-8.853	0.942
32	0.586	-8.944	0.900
33	0.606	-8.977	0.930
34	0.602	-9.124	0.918

To determine the optimal number of topics, LDA models were estimated for K values ranging from 2 to 35 using constant hyperparameters. Model performance was evaluated using coherence, perplexity, and topic diversity metrics (see Table 3). Coherence generally improved as the number of topics increased, reaching its highest value at K = 33. However, higher-topic models also reduced interpretability and topic distinctiveness. Within the lower and more stable range of models, coherence increased notably up to K = 13 while topic diversity remained high. Therefore, K = 13 was selected as the optimal specification, providing a balanced trade-off between semantic interpretability, model complexity, and topic diversity.

4 Results and discussion

Table 2 shows a strong geographical concentration of entrepreneurial activity in a small number of urban ecosystems in the Czech Republic and Slovakia during 2017–2025. Prague clearly dominates the regional startup landscape with 1,079 ventures, followed by Bratislava (280) and Brno (174). Considerably lower numbers were identified in Ostrava, Košice, and Galanta, indicating that entrepreneurial activity is concentrated primarily in larger metropolitan and innovation-oriented cities. These findings highlight the importance of urban ecosystems, where access to talent, investors, universities, and business infrastructure creates favorable conditions for startup development and growth.

Table 4 presents the results of the LDA topic modelling analysis and reveals a highly diversified entrepreneurial landscape dominated by digital and technology-oriented business activities. The most prevalent topic, *Digital Consulting & Software Solutions* (46.5%), significantly exceeds all other categories and reflects the central role of software development, digital transformation, and technology consulting within the analyzed entrepreneurial ecosystems. The dominant keywords associated with this topic—such as consulting, digital, software, application, and development—indicate that many ventures operate through service-based and platform-oriented business models focused on digital innovation and business process optimization.

Several additional topics further emphasize the importance of digitalization and platform economies. *SaaS, Energy & Smart Finance Platforms* (9.6%) combines software-as-a-service models with energy, finance, insurance, and smart marketplace solutions, suggesting growing entrepreneurial interest in digital financial technologies and sustainability-oriented service platforms. Similarly, *E-Commerce & Consumer Product Retail* (9.5%) highlights the expansion of online commerce, digital retail, and consumer-oriented technology solutions. The prevalence of these topics demonstrates the strong integration of digital business models into entrepreneurial activity in both countries.

The analysis also identifies a number of specialized technology domains. *AI Research & Fintech Analytics* (2.4%) reflects ventures focused on artificial intelligence, data analytics, and financial technologies, while *Asset Management & Crypto Payment Platforms* (4.9%) and *Virtual Technology & Blockchain Services* (1.1%) point to the emergence of blockchain-based applications, crypto-payment systems, and virtual technologies. Although these topics

represent smaller shares of the dataset, they indicate the presence of advanced and innovation-intensive entrepreneurial niches within the regional ecosystem.

Table 4. Topic-based classification and trend identification (2017-2025)

Topic label	Top ten words	Topic prevalence
T1: Real Estate & Property Design Services	Real, estate, investment, project, financial, printing, designing, service, property, 3d	6.1%
T2: Digital Consulting & Software Solutions	Consulting, digital, technology, product, service, solution, management, development, software, application	46.5%
T3: AI Research & Fintech Analytics	Research, provider, intelligence, market, analysis, artificial, data, fintech, performance, loan	2.4%
T4: Asset Management & Crypto Payment Platforms	Asset, platform, manufacturer, crypto, cost, planning, efficient, risk, real, payment	4.9%
T5: SaaS, Energy & Smart Finance Platforms	Platform, energy, saas, traditional, saving, smart, marketplace, finance, insurance, community	9.6%
T6: Industrial Automation & Corporate Tools	Datum, tool, network, automation, machine, manufacture, modern, corporate, exchange, accounting	3.4%
T7: Virtual Technology & Blockchain Services	Virtual, training, tech, equipment, integration, book, reality, blockchain, publishing, supplement	1.1%
T8: E-Commerce & Consumer Product Retail	Product, online, commerce, accessory, store, advanced, testing, gift, home, range	9.5%
T9: Healthcare, Events & Educational Programs	Event, program, food, support, experience, professional, healthcare, quality, public, education	3.8%
T10: Digital Marketing & Creative Branding	Marketing, design, agency, advertising, creative, social, brand, content, strategy, seo	5.9%
T11: HealthTech, IoT & Technical Maintenance	Electric, repair, analytic, medical, health, device, iot, maintenance, travel, clinic	1.8%
T12: Mobile Apps, Logistics & Advisory Services	App, mobile, logistic, advisory, developer, personal, family, science, life, talent	1.7%
T13: Media Production & Industrial Systems	System, production, video, detection, space, communication, studio, office, delivery, automotive	2.7%

Industrial and operational technologies also constitute an important segment of entrepreneurial activity. *Industrial Automation & Corporate Tools* (3.4%) includes ventures focused on automation, manufacturing systems, machine technologies, and accounting or corporate management tools. Likewise, *HealthTech, IoT & Technical Maintenance* (1.8%) combines

healthcare technologies with IoT devices, analytics, and technical maintenance services, reflecting the increasing convergence of digital and industrial innovation.

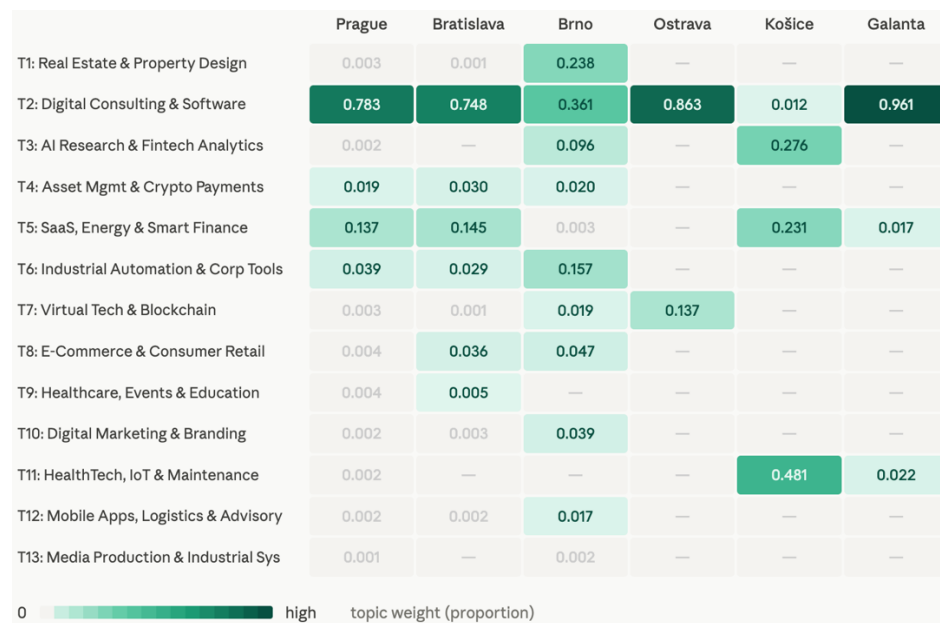
Additional topics reveal diversification into creative and service-oriented sectors. *Digital Marketing & Creative Branding* (5.9%) captures entrepreneurial activities related to advertising, branding, SEO, and social media management, while *Media Production & Industrial Systems* (2.7%) includes ventures operating in video production, communication technologies, and industrial systems. Furthermore, *Healthcare, Events & Educational Programs* (3.8%) and *Mobile Apps, Logistics & Advisory Services* (1.7%) illustrate the broad application of digital technologies across healthcare, education, logistics, and advisory activities.

Overall, the topic modelling results demonstrate that entrepreneurial ecosystems in the Czech Republic and Slovakia are strongly shaped by digital transformation, software-based innovation, and platform-oriented business models. At the same time, the presence of topics related to AI, fintech, blockchain, industrial automation, and smart technologies suggests increasing technological diversification and the emergence of specialized innovation niches within the regional startup landscape.

Figure 1. Venture activity across topics and entrepreneurial ecosystems



Figure 2. Venture capital funding across topics and entrepreneurial ecosystems



Figures 1 and 2 illustrate the distribution of venture activity and venture capital funding across topics and entrepreneurial ecosystems in the Czech Republic and Slovakia. The results reveal substantial differences between cities in both entrepreneurial specialization and funding concentration.

Figure 1 shows that *Digital Consulting & Software Solutions* (T2) is the dominant entrepreneurial activity across all ecosystems, particularly in Prague (46.5%), Brno (51.1%), Ostrava (49.0%), and Košice (50.0%). This finding confirms the central role of software development, digital services, and consulting activities within regional entrepreneurial ecosystems. Prague additionally demonstrates strong diversification across multiple topics, including *SaaS, Energy & Smart Finance Platforms* (T5), *E-Commerce & Consumer Product Retail* (T8), *Real Estate & Property Design Services* (T1), and *Digital Marketing & Creative Branding* (T10). In contrast, smaller ecosystems exhibit higher specialization patterns. For example, Galanta shows relatively strong concentrations in *SaaS, Energy & Smart Finance Platforms* and *E-Commerce & Consumer Product Retail*, while Košice demonstrates above-average activity in *AI Research & Fintech Analytics* and *E-Commerce & Consumer Product Retail*. These findings suggest that larger metropolitan ecosystems are more diversified, whereas smaller cities tend to specialize in narrower technological or business domains.

Figure 2 demonstrates that venture capital funding is even more concentrated than entrepreneurial activity itself. Prague overwhelmingly dominates total funding across nearly all topics, especially within *Digital Consulting & Software Solutions* (78.3%) and *SaaS, Energy & Smart Finance Platforms* (13.7%). This indicates that Prague functions not only as the largest entrepreneurial ecosystem but also as the primary regional center for venture capital allocation. Bratislava and Brno receive comparatively lower but still meaningful funding shares, particularly in software solutions, industrial automation, and real estate-related ventures. Several ecosystems display highly concentrated funding specialization despite relatively smaller numbers of ventures. For instance, Ostrava records exceptionally high funding concentration in *Digital Consulting & Software Solutions* (86.3%), while Košice attracts substantial investment in *HealthTech, IoT & Technical Maintenance* (48.1%) and *AI Research & Fintech Analytics* (27.6%). Galanta demonstrates strong funding concentration in *Digital Consulting & Software Solutions* (96.1%), although based on a relatively small venture base.

Overall, the figures indicate that entrepreneurial ecosystems in the Czech Republic and Slovakia are strongly shaped by digital and software-oriented activities, while venture capital investment remains highly geographically concentrated in Prague. At the same time, several smaller ecosystems display emerging specialization patterns in AI, fintech, industrial automation, healthcare technologies, and platform-based business models, highlighting increasing diversification within the regional innovation landscape.

5 Policy Recommendations

The findings of this study have different policy implications for the Czech Republic and Slovakia because the observed entrepreneurial ecosystems operate within two distinct national innovation systems. Although Prague and Bratislava both function as dominant metropolitan startup hubs within their respective countries, the results also reveal important differences in the scale, geographical distribution, and specialization of entrepreneurial activity. Consequently, policy should combine country-specific measures with initiatives designed to strengthen cross-border connections between the two ecosystems.

For the **Czech Republic**, the results indicate a particularly strong concentration of entrepreneurial activity and venture capital in Prague, while Brno and Ostrava represent important secondary ecosystems with more specialized entrepreneurial profiles. Czech

innovation policy could therefore focus on strengthening connections between Prague and secondary cities. In particular, regional co-investment instruments, university–industry partnerships, technology-transfer programmes, and specialized innovation infrastructure could be used to strengthen existing capabilities in Brno and Ostrava. Support should be targeted toward areas identified in the analysis, including software development, AI and fintech, industrial automation, HealthTech, and digital platforms. Such measures could increase the capacity of secondary Czech ecosystems to generate and scale technology-oriented firms while maintaining Prague's role as an international investment and entrepreneurial hub.

For **Slovakia**, the policy challenge is somewhat different. Bratislava accounts for the largest share of entrepreneurial activity and investment, while Košice smaller ecosystems display narrower but potentially distinctive areas of specialization. Slovak policy could therefore place greater emphasis on improving access to financing, research infrastructure, skilled labour, and entrepreneurial support outside Bratislava. In particular, Košice's observed concentration in HealthTech, IoT, AI, and fintech-related activities suggests opportunities for targeted regional ecosystem development based on existing technological capabilities. Rather than applying identical support measures across Slovakia, regional programmes could be designed around the specific technological and industrial strengths of individual ecosystems.

A second priority for both countries should be **improving access to growth-stage financing outside the dominant capital-city ecosystems**. The results show that venture capital is even more geographically concentrated than entrepreneurial activity. Public-private co-investment funds, regional investment vehicles, and investment-readiness programmes could help connect promising ventures in secondary cities with domestic and international investors. These instruments should be designed to complement private capital and should include transparent eligibility criteria and performance monitoring.

Third, both countries could strengthen **university–industry and research–entrepreneurship linkages**. The presence of AI, HealthTech, industrial automation, fintech, and other knowledge-intensive topics suggests that entrepreneurial policy should connect startups more systematically with universities, research institutions, and established companies. Entrepreneurship education, technology-transfer mechanisms, applied research partnerships, and research commercialization programmes could support the development of higher-value ventures in both national ecosystems.

Fourth, the Czech Republic and Slovakia could benefit from **greater cross-border ecosystem integration**. Prague, Brno, Bratislava, and Košice should not be viewed exclusively as competing national hubs. Their complementary capabilities could support joint accelerator programmes, investor networks, university partnerships, technology-transfer initiatives, and startup internationalization programmes. Cross-border cooperation could provide startups in smaller ecosystems with access to a larger pool of investors, talent, research capabilities, and potential customers.

Finally, both governments should develop **data-driven mechanisms for monitoring entrepreneurial ecosystems**. The topic-modelling approach employed in this study demonstrates how startup-level data can identify technological specialization and emerging areas of entrepreneurial activity. National and regional innovation agencies could combine startup, investment, business-register, research, and patent data to monitor changes in ecosystem specialization and identify regional financing or infrastructure gaps. Such monitoring would allow policy instruments to evolve alongside technological and entrepreneurial developments.

Overall, the findings suggest that the Czech Republic and Slovakia should pursue **related but differentiated entrepreneurial ecosystem strategies**. In the Czech Republic, policy can focus on strengthening the links between Prague and established secondary ecosystems such as Brno and Ostrava. In Slovakia, greater attention can be directed toward reducing the resource and financing gap between Bratislava and emerging ecosystems such as Košice. At the same time, cross-border cooperation can connect these ecosystems and facilitate the circulation of capital, knowledge, talent, and entrepreneurial opportunities across the Czech–Slovak innovation space.

6 Conclusion

This study analyzed entrepreneurial ecosystems in the Czech Republic and Slovakia using Crunchbase venture data and LDA topic modelling techniques. The results demonstrate a strong geographical concentration of entrepreneurial activity within a limited number of entrepreneurial ecosystems, with Prague clearly dominating both venture activity and venture capital funding. Bratislava and Brno also emerged as important entrepreneurial centers, while

smaller cities such as Ostrava, Košice, and Galanta exhibited more specialized entrepreneurial structures. These findings confirm the importance of metropolitan ecosystems in attracting talent, investment, and innovation-related infrastructure that support startup formation and growth.

The topic modelling analysis reveals that entrepreneurial activity in both countries is strongly shaped by digital transformation and software-oriented business models. The dominant topic, *Digital Consulting & Software Solutions*, accounted for nearly half of all ventures, highlighting the central role of digital services, software development, and platform-based business activities in regional entrepreneurial ecosystems. Other important domains included SaaS and smart finance platforms, e-commerce, digital marketing, industrial automation, AI-driven analytics, fintech, blockchain technologies, and healthcare-related innovation.

The entrepreneurial ecosystem-level analysis further showed that larger metropolitan ecosystems tend to exhibit greater thematic diversification, whereas smaller ecosystems are characterized by narrower specialization patterns. Prague demonstrated the broadest distribution of entrepreneurial activities across multiple technological domains, while smaller cities concentrated more strongly on selected niches such as AI, HealthTech, blockchain services, or digital platforms. Venture capital allocation was found to be even more geographically concentrated than entrepreneurial activity itself, with Prague functioning as the dominant regional investment hub.

Overall, the findings suggest that entrepreneurial ecosystems in the Czech Republic and Slovakia are evolving toward increasingly knowledge-intensive, software-driven, and platform-oriented economic activities. At the same time, the emergence of specialized niches in AI, fintech, blockchain, industrial automation, and HealthTech indicates growing technological sophistication within the regional startup landscape. From a policy perspective, the results highlight the importance of strengthening regional innovation infrastructure, access to venture financing, and university–industry collaboration outside capital-city ecosystems in order to support more balanced entrepreneurial development across regions.

Despite its contributions, this study has several limitations. The analysis relies on Crunchbase data, which may underrepresent smaller or less visible ventures that are not included in the platform. In addition, topic modelling captures latent thematic structures based on textual descriptions and therefore depends on the quality and completeness of company-provided

information. Future research could extend the analysis by incorporating longitudinal dynamics, inter-city collaboration networks, startup performance indicators, or comparative analyses with other Central and Eastern European entrepreneurial ecosystems.

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