

## Adoption of Artificial Intelligence and Entrepreneurial Emergence: A Comparative Analysis of Pioneering Countries

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### Abstract:

This article compares the adoption of artificial intelligence in five leading countries (United States, China, United Kingdom, Germany, and Canada) between 2014 and 2024. It examines how AI fosters innovation and supports the growth of startups and innovative SMEs. The analysis focuses on three dimensions: technological investment, entrepreneurial dynamics, and institutional environment. The findings show that the most successful countries are those that effectively combine research and development, financing mechanisms, and innovation support structures.

**Keywords:** Artificial Intelligence; Innovation; Comparative strategies.

**Jel Classification Codes:** O31, O32, M13.

### 1. INTRODUCTION

In a global economic context marked by intensifying innovation dynamics, artificial intelligence (AI) is now emerging as a transformative technology capable of reshaping the contours of modern entrepreneurship.

While large companies have historically been the first to leverage AI to optimize their value chains, its growing accessibility has gradually opened new opportunities for emerging companies—startups and innovative SMEs—seeking to strengthen their competitiveness, agility, and growth capacity.

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Global investment in AI has grown significantly in recent years, reaching \$75 billion in 2020, a 40% increase over the previous year (OECD, 2023).

Internationally, AI's contribution to entrepreneurial innovation is evident in massive investments in research and development, strong momentum in the creation of AI startups, and growing adoption of these technologies in the healthcare, finance, manufacturing, and service sectors.

According to (Stanford Institute for Human-Centered Artificial Intelligence (HAI), 2024), private investment in AI exceeded \$91 billion globally in 2023, with nearly 68% concentrated in the United States and China. This geographic concentration reflects not only technological leadership, but also an institutional capacity to create ecosystems conducive to innovation.

Furthermore, (Government AI Readiness Index 2023, 2023), reveals that the countries ranked highest in terms of institutional readiness for AI are also those with the strongest growth rates in terms of innovative business creation.

Tech startups that integrate AI from their earliest stages of development benefit from substantial gains in productivity, strategic differentiation, and speed of adaptation to the market (Capgemini , 2022). Incubators and accelerators specializing in AI technologies play a crucial role in supporting these start-ups in structuring their offerings, accessing financing, and networking with market players.

The objective of the study is to analyze, over the period 2014–2024, how AI has been mobilized in these countries to support the emergence, development, and sustainability of innovative start-ups, while identifying key institutional and technological factors that foster AI-based entrepreneurship.

the central research question guiding this study is the following:

**How do AI investments and innovation policies influence the growth and competitiveness of start-ups in advanced economies?**

To further clarify this issue, the following secondary questions are formulated in direct alignment with the main research question:

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- To what extent do technological and R&D capabilities influence the creation, survival, and performance of start-ups?
- How do AI-related investments and financing mechanisms contribute to the growth and competitiveness of start-ups?
- To what extent do institutional and organizational support mechanisms facilitate AI adoption and enhance the performance of innovative start-ups and SMEs?

Based on the existing theoretical and empirical literature, this study advances two hypotheses that are exploratory rather than strictly causal, given the comparative and descriptive nature of the analysis.

First, countries that demonstrate higher and more sustained levels of investment in artificial intelligence tend to exhibit stronger entrepreneurial dynamics, reflected in higher rates of start-up creation, survival, and innovation performance **(H1)**.

Second, supportive public policies and institutional mechanisms aimed at facilitating AI adoption among SMEs are associated with greater resilience and competitiveness of young innovative firms **(H2)**.

Methodologically, the study adopts a qualitative–quantitative comparative approach based on a theoretical framework highlighting the economic, technological, and organizational implications of artificial intelligence in the development of emerging companies. Rather than testing strict causal relationships, the analysis seeks to identify structural patterns and relative positioning across countries.

Five countries considered to be leaders in the field of AI—the United States, China, the United Kingdom, Germany, and Canada—were selected for the diversity of their public policies, innovation strategies, and institutional environments. The analysis relies on a structured set of indicators grouped into three broad dimensions: economic, technological, and organizational.

For each dimension, specific indicators are explicitly associated with the variable they are intended to measure. Each indicator is carefully chosen to correspond directly to the variable it measures, ensuring that it captures the

intended aspect of AI investment, technological capability, or organizational support, rather than reflecting its outcomes or impacts.

To ensure coherence between variables, indicators, hypotheses, and secondary research questions, each indicator is explicitly linked to the variable it measures and to the relevant hypothesis. The dependent variable, entrepreneurial dynamics, is measured using three indicators: start-up creation rate, start-up survival rate, and innovation performance (**H1**, secondary question 1).

The first independent variable, AI-related investment, is measured by public and private expenditure, R&D intensity, and patent activity (**H1**, secondary question 2). The second independent variable, institutional and organizational support, is measured by AI adoption among SMEs, the presence of incubators and accelerators, and participation in digital innovation programs (**H2**, secondary question 3).

Economic indicators capture AI-related investment efforts, including public and private expenditure dedicated to AI development. Technological indicators focus on innovation capacity, such as AI-related R&D expenditure and patent activity. Organizational indicators reflect the diffusion and institutional support of AI, including adoption rates among firms—particularly SMEs—and the presence of public support mechanisms such as incubators, accelerators, and digital innovation programs.

All data were collected from internationally recognized sources, including the OECD, the Stanford AI Index, WIPO, Statista, the World Bank, and McKinsey & Company, as well as recent scientific publications.

To ensure comparability across countries and over time, values were normalized on a scale from 0 to 100. Average scores over the 2014–2024 period were computed for each indicator, allowing for a balanced and comprehensive assessment. The results are presented using combined graphs and analytical radar charts to facilitate interpretation.

This methodological framework aims to highlight the structural conditions that enable certain countries to better integrate AI into their entrepreneurial strategies while providing useful benchmarks for policymakers and researchers interested in fostering AI-driven innovation.

## **2. Literature review**

Artificial intelligence (AI) has attracted growing attention in economic and management research due to its transformative effects on business models, organizational performance, and entrepreneurship. Conceptually, AI is defined as a set of computational techniques enabling machines to perform tasks traditionally requiring human intelligence (Russell, S; Norvig, P, 2020). However, the mere adoption of AI technologies does not automatically generate value; its impact depends on how firms and institutions leverage these tools within broader organizational and institutional frameworks.

Technological and R&D capabilities are often highlighted as key drivers of AI-based innovation. (Davenport & Ronanki, 2018) identify automation, predictive analytics, and decision support as primary applications of AI in business, yielding efficiency gains. Yet, these gains require complementary investments in workforce skills, organizational capacities, and supportive infrastructures.

(McKinsey & Company, 2021) and (Capgemini, 2022) Similarly emphasize that AI adoption alone is insufficient; productivity and strategic benefits materialize only when technological investment is aligned with organizational and financial capabilities. These insights directly inform our study's operationalization of entrepreneurial dynamics and technological variables, highlighting the need to measure not only AI adoption but also the capacities enabling its effective use.

From the perspective of start-ups, AI provides a mechanism to overcome resource constraints and develop scalable, data-driven business models (Brynjolfsson & McAfee, 2017). However, productivity gains are neither automatic nor immediate, requiring sustained organizational adaptation and workforce reskilling (Autor, 2020) and (Bessen, 2019).

(Frey & Osborne, 2017) further show that AI reshapes labor markets, replacing routine tasks while creating high-value positions. Taken together, these findings suggest that the performance of innovative start-ups depends on the interaction between technological capabilities and organizational

readiness, reinforcing the rationale for including indicators of start-up creation, survival, and innovation output in the study.

At the macroeconomic and institutional level, countries investing heavily in AI tend to exhibit higher growth in innovative sectors (OECD, 2023) and (IMF, 2024).

Yet, aggregate outcomes alone do not explain how institutional frameworks, public policies, and ecosystem support translate investment into measurable entrepreneurial performance. Recent studies emphasize the importance of structured support mechanisms, ethical governance, and access to finance in shaping AI-driven innovation (Jorzik, Smith, & Patel, 2024).

This aligns with the study's focus on organizational and institutional indicators, highlighting the complementary role of public policies and ecosystem support in enhancing start-up competitiveness and resilience.

In sum, the literature underscores three interrelated dimensions essential for understanding AI-driven entrepreneurship:

1. Technological and R&D capabilities: enabling innovation and scalability.
2. Entrepreneurial and organizational dynamics: determining start-up survival, growth, and performance.
3. Institutional and ecosystem support: facilitating AI adoption and amplifying the impact of technological investment.

By integrating these dimensions, this study addresses the gap in comparative research linking AI investment, entrepreneurial activity, and institutional support, providing a structured framework to analyze start-up performance across different national contexts.

### **3. Global trends in AI adoption by emerging companies**

Over the past decade, artificial intelligence has established itself as a major driver of innovation, not only for large companies but also for startups and SMEs.

According to the (Stanford Institute for Human-Centered Artificial Intelligence (HAI), 2024), the number of AI startups worldwide increased sixfold between 2014 and 2023, with a marked concentration in the digital

health, finance, and cybersecurity sectors.

At the same time, global venture capital investment in AI technologies reached more than \$70 billion in 2023, up from less than \$10 billion in 2014 (CB Insights, 2024).

This rise can be explained by the fact that AI allows young companies to compensate for their lack of resources with agile technologies: automation of repetitive tasks, large-scale personalization, and predictive analysis applied to markets.

Platforms such as OpenAI, Hugging Face, and others now provide accessible tools, accelerating the democratization of AI in entrepreneurship. However, this momentum is unevenly distributed.

According to the (OECD, 2023), only 20% of SMEs in non-G20 countries have effectively integrated AI into their operations, compared to more than 60% in the most advanced member countries. This asymmetry reflects profound differences in technological capabilities, digital infrastructure, entrepreneurial culture, and access to financing.

In addition, public policy plays a decisive role. Countries such as Canada, Germany, and China have implemented ambitious national AI strategies, including funds dedicated to the creation of startups, specialized incubators, and massive training programs.

These initiatives aim to create an environment conducive to the emergence of companies capable of fully exploiting the potential of AI (OECD, 2021). In this context, it is essential to analyze the performance of the most advanced countries to identify the key factors that explain their success in adopting AI for entrepreneurial innovation.

#### **4. Global AI Ranking**

The global ranking of countries in terms of artificial intelligence reflects a combination of indicators covering three complementary dimensions: technological innovation (public and private investment in AI R&D, patent filings), entrepreneurial dynamics (number of AI startups created, venture capital, revenue growth), and the support ecosystem (support structures, adoption rate by SMEs, and level of institutional

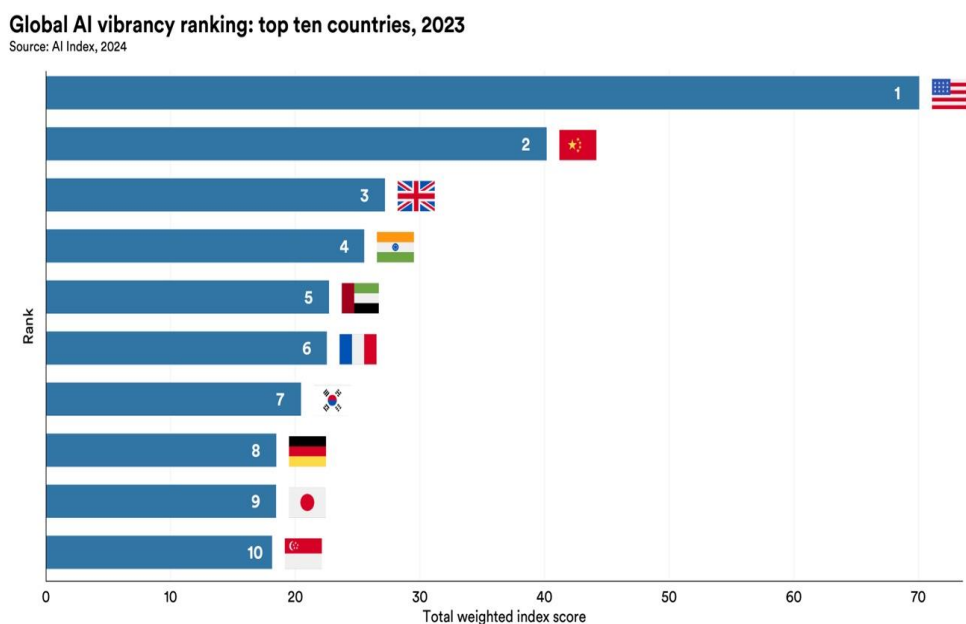
readiness for AI).

According to the latest data from the (OECD, 2024) and the (Stanford Institute for Human-Centered Artificial Intelligence (HAI), 2024), the United States and China remain at the top of the global rankings, driven by high investment intensity, sustained scientific output, and a highly dynamic entrepreneurial fabric.

The United Kingdom and Germany, for their part, are taking a more sectoral and institutional approach, relying on structured public programs and strong academic roots to develop their AI capabilities.

This ranking, based on standardized indicators for the period 2014–2024, thus makes it possible to identify the leading countries not only in terms of innovation power, but also in terms of their ability to transform this innovation into sustainable entrepreneurial growth, particularly through the creation and support of emerging companies.

**Fig.1.** Global AI Ranking (2024)



Source: AI Index, 2024.

The analysis highlights the diversity of the paths taken by the five

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leading countries in artificial intelligence. The United States maintains a significant lead, supported by a dynamic technological environment, sustained investment in R&D, and strong entrepreneurial activity.

China is performing strongly, particularly in terms of industrial deployment, despite certain limitations in governance and training.

The United Kingdom and Germany are adopting a more targeted strategy, focusing on the quality of support mechanisms and a well-structured sectoral approach.

Finally, Canada stands out for its commitments to ethics and training but lags in terms of commercial adoption of AI.

These findings show that overall performance in AI depends on the interaction of three fundamental dimensions: technological innovation, entrepreneurial dynamism, and the robustness of the support ecosystem.

However, beyond this ranking, it is essential to examine in more detail the empirical data and the specific impacts of AI on businesses and the economy in these countries. To this end, we will conduct an in-depth comparative analysis to better understand the dynamics between AI investment, technology adoption, and their effects on productivity, employment, and innovation.

## **5. Comparative analysis of AI indicators at the international level**

To complement this overview of global positions on AI, a detailed comparison between several countries provides a better understanding of the interactions between AI investment, sectoral adoption, job creation, and the impact on productivity.

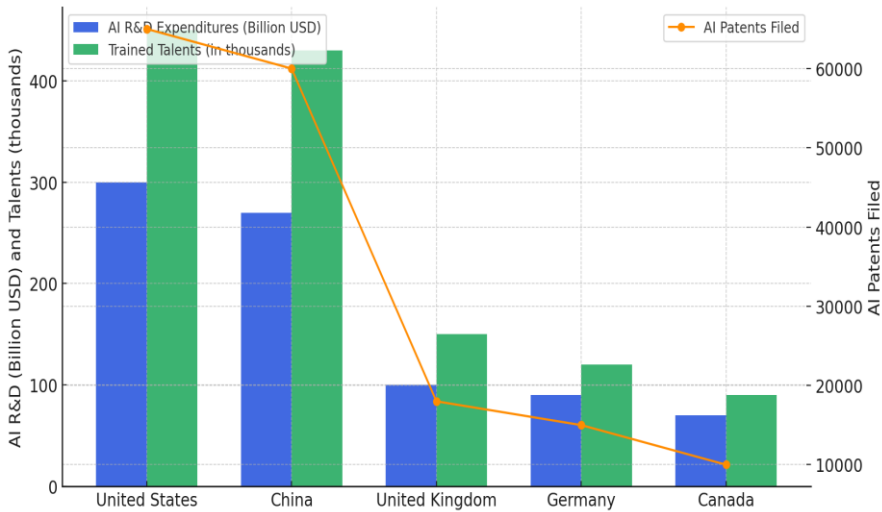
The data presented here allows for a comparison of indicators relating to the impact of AI on businesses, private and public investment, and innovation. These elements are essential for understanding the key factors for success in the field of AI around the world.

The study is structured around three interdependent areas of analysis that provide a framework for comparative analysis:

## 5.1 Technological innovation

measured through patents, R&D spending, and targeted investments in AI:

**Fig.2.** AI innovation indicators (2014-2024)



**Source:** Compiled by the author based on (OECD, Statista, WIPO, McKinsey).

The combined graph highlights the differing dynamics of innovation in artificial intelligence in five pioneering countries: the United States, China, the United Kingdom, Germany, and Canada, over a ten-year period (2014–2024). Three key indicators were selected: cumulative AI R&D spending, the number of AI patents filed, and the volume of AI talent trained.

The United States is well ahead of the pack, with R&D investments exceeding \$300 billion, accompanied by a massive output of patents (65,000) and the training of 500,000 talents over the period. This triple performance confirms the United States' strong capacity for technological innovation, supported by a robust academic and private ecosystem (Brynjolfsson & McAfee, 2017) and (McKinsey & Company, 2021).

China, while performing slightly less well, maintains a strategic position thanks to investments of close to \$270 billion and a comparable volume of patents (58,400). China is also focusing on talent development, with more than 450,000 trained professionals, supporting its ambition for global leadership as part of its “AI 2030” strategy (OECD, 2024).

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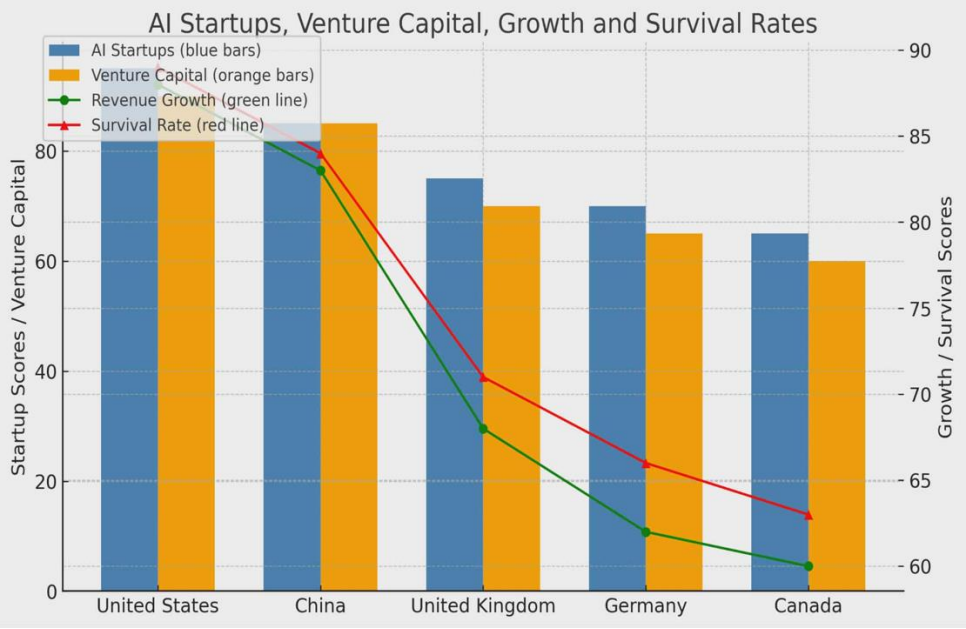
The United Kingdom and Germany are taking a more targeted approach. The United Kingdom, with USD 110 billion in R&D spending and 17,500 patents, is focusing on cybersecurity and finance, while Germany (USD 95 billion, 14,200 patents) specializes in Industry 4.0. These countries train fewer talents (150,000 and 120,000 respectively), which limits their ability to rapidly disseminate AI within SMEs (Buxmann & Schmidt, 2022).

Canada, although lagging in terms of patents (9,000) and investment (USD 65 billion), shows a notable commitment to training (90,000 AI talents) and responsible AI principles. This makes it a committed player, but one with limited capacity to transform innovation into direct economic competitiveness.

**5.2 Entrepreneurial dynamics**

This second area explores the impact of artificial intelligence on entrepreneurial dynamics by analyzing the vitality and growth of emerging companies.

**Fig.3.** AI entrepreneurial dynamics indicators (2014-2024)



**Source:** Compiled by the author based on (OECD, CB insights, McKinsey & Company Startup Genome).

The graphical analysis, focused on entrepreneurial dynamics in the field of artificial intelligence, highlights significant contrasts between the five leading countries analyzed over the period 2014–2024.

The combined graph illustrates four key indicators: the number of AI startups created, venture capital investments, average revenue growth, and the survival rate of young companies.

The United States stands out with high performance across all indicators, reflecting a mature entrepreneurial ecosystem supported by a high density of venture capital (score of 90), growth momentum (score of 85), and a high survival rate (88). These results corroborate the analyses of (Brynjolfsson & McAfee, 2017), which highlight the importance of AI in the strategic repositioning of companies and the structuring of new, high-performance economic models.

China, for its part, is on an upward trajectory, combining a high volume of startup creation with massive private funding, although its survival rate remains slightly lower (82), confirming the findings of the (IMF, 2024) on differences in entrepreneurial robustness.

In Europe, the dynamics are more mixed. The United Kingdom and Germany show moderate performance, with average venture capital scores (70 and 65 respectively), which limits their ability to rapidly grow their tech startups. This trend is consistent with the work of (Buxmann & Schmidt, 2022) on the barriers to industrial transition in German technology entrepreneurship.

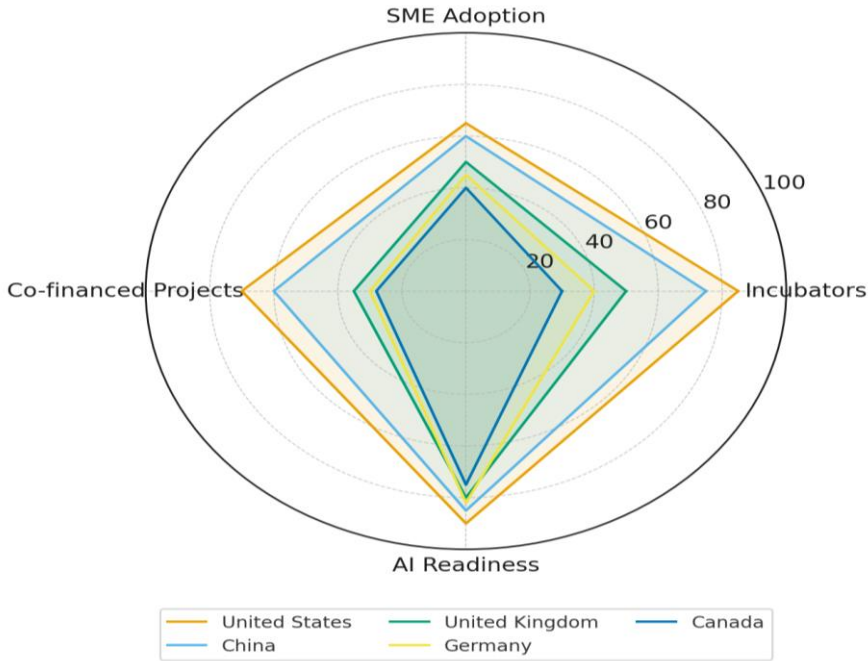
Canada, despite its potential in responsible AI, has the lowest scores across all indicators, highlighting a persistent difficulty in transforming scientific innovations into sustainable economic value.

### **5.3 Support ecosystem**

The third focus area examines the environment supporting AI, looking at institutional structures and support mechanisms for emerging companies.

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**Fig.4.** Support ecosystem indicators (score)



**Source:** compiled by author.

The radar chart above compares five pioneering countries (United States, China, United Kingdom, Germany, Canada) across four key indicators of entrepreneurial dynamics in the field of artificial intelligence: a dense network of specialized incubators/accelerators, AI adoption rates by public co-financing mechanisms (promoting access to innovation), and an AI Readiness Index.

These data have been normalized on a scale of 0 to 100, and the values have been calculated based on reference thresholds from international reports, allowing for a comparative assessment of the maturity of AI support ecosystems.

The United States scores highly across all dimensions, with a score of 85/100 for incubators, 68 for SME adoption, 73 for co-financed projects, and 95 for the AI Readiness Index, reflecting a highly structured entrepreneurial ecosystem supported by consistent public policies and a very active private sector.

China follows closely behind with 75 for incubators, 60 for SME adoption, 65 for co-financed projects, and 90 for AI Readiness, reflecting an ambitious national strategy centered around five-year plans and pilot zones for technological innovation (OECD, 2024) and (Stanford Institute for Human-Centered Artificial Intelligence (HAI), 2024).

The United Kingdom and Germany are in an intermediate position. The United Kingdom scores 50 for incubators, 52 for adoption, 42 for co-financing, and 85 for AI Readiness, while Germany scores 40, 48, 38, and 82 respectively. These two countries are focusing more on sectoral specialization.

Canada, with scores of 30 for incubators, 45 for SME adoption, 35 for co-financed projects, and 88 for AI Readiness, presents a contrasting profile.

## **6. Results and discussion**

Cross-analysis of the three areas studied (technological innovation, entrepreneurial dynamics, and support ecosystem) highlights a winning model observed mainly in the United States and China. These two countries have the highest composite scores (77.3/100 for the United States and 70.8/100 for China), reflecting a strong correlation between R&D investment, startup creation, technology adoption by SMEs, and the effectiveness of public support mechanisms (Stanford Institute for Human-Centered Artificial Intelligence (HAI), 2024) and (OECD, 2023).

This positioning can be explained by long-term national strategies that closely link public and private funding, the structuring of innovation hubs, and the implementation of ambitious industrial policies in favor of AI.

The United States stands out for its fluid entrepreneurial environment, supported by abundant venture capital, technology-intensive research universities, and a strong culture of commercializing innovations (Brynjolfsson & McAfee, 2017).

China, for its part, combines state planning with massive capital mobilization, enabling it to rapidly transform research into applied industrial solutions, despite certain ethical limitations (Tsinghua University, 2023).

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In comparison, the United Kingdom and Germany are adopting a more targeted strategy, focused on sectoral quality. The United Kingdom is investing primarily in digital services, cybersecurity, and finance, with more than \$110 billion in R&D spending and 17,500 patents filed (Buxmann & Schmidt, 2022).

Germany favors Industry 4.0, with a strong technological foundation but slower diffusion of AI to SMEs, mainly due to a talent shortage. These countries are struggling to create integrated ecosystems, which limits the rapid transformation of innovations into economic value.

Canada, for its part, has a mixed profile: recognized for its leadership in ethical AI and academic research, it lags in terms of project co-financing and AI adoption by small businesses.

Despite a high AI Readiness Index, the lack of large-scale support structures is slowing down the industrialization of innovation (Startup Genome, 2023).

Ultimately, the lessons learned from this analysis reveal that the development of AI for entrepreneurial innovation depends on a combination of interdependent factors.

The best-performing countries are those that manage to simultaneously align three dimensions: a robust technological base, sustained entrepreneurial momentum, and a structured support ecosystem.

Conversely, nations that focus their efforts on a single dimension, without integrating the other levers, encounter difficulties in developing sustainable and competitive AI industries (Capgemini, 2022) and (Singh, Zhang, & Dubois, 2024).

This systemic approach, based on the complementarity of public policies, infrastructure, and skills, is the real driver of innovative entrepreneurship in the age of artificial intelligence.

## **7. CONCLUSION**

In an international context marked by the acceleration of digital transformation, this study examined the conditions that enable artificial intelligence (AI) to effectively support innovation and the development of

emerging companies.

It did so through a comparative analysis of five leading countries (the United States, China, the United Kingdom, Germany, and Canada) over the period 2014–2024. The central question of this research was to understand how AI investments and innovation policies influence the growth and competitiveness of young companies in advanced economies.

The results largely confirm the two hypotheses formulated. On the one hand (H1), countries that invest significantly in AI R&D and technological infrastructure (notably the United States and China) have established ecosystems conducive to the emergence of competitive startups.

These countries not only have a high volume of patents and investments, but also a strong capacity to convert these resources into concrete innovations.

On the other hand (H2), public innovation policies that strategically integrate AI, as is the case in the United Kingdom and China, have made it possible to structure effective support mechanisms, promoting access to financing, entrepreneurial support, and technology diffusion.

Analysis of the three axes has highlighted different dynamics. The first axis, focused on technological innovation, underscores the importance of continuous investment in R&D, patent production, and private sector involvement.

The United States stands out for its global technological leadership, while China is making rapid progress in industrializing its innovations. The second axis, focusing on entrepreneurial dynamics, reveals a strong correlation between the intensity of startup creation, the availability of venture capital, and the growth of young companies.

Here again, the United States benefits from a particularly favorable environment, but China is taking advantage of targeted policies that stimulate technological entrepreneurship.

Finally, the third axis, dedicated to the support ecosystem, highlights the structuring role of specialized incubators, public co-financing programs, and a high AI Readiness Index. While Canada stands out for its ethics and talent, it lags in commercial deployment.

Certain limitations should be noted. First, the standardization of indicators on a common scale sometimes masks the specific contextual characteristics of each country (culture of innovation, market structure, legal framework).

Second, the analysis remains focused on five highly developed countries, which reduces the generalizability of the conclusions for emerging or developing economies.

In addition, some statistical data remain partial or heterogeneous depending on the available sources.

Based on these findings, several recommendations can be made. Countries wishing to promote innovation through AI should invest in a balanced manner in three key areas: technology, entrepreneurship, and support.

It is essential to build bridges between public research, industrial needs, and innovative start-ups through appropriate funding mechanisms and public-private partnerships.

In addition, particular attention must be paid to continuing education, the ethical governance of AI, and the territorialization of innovation policies to avoid an excessive concentration of technological benefits in certain geographical areas.

Ultimately, this study confirms that successful AI integration depends on a coherent, systemic national strategy that is sustained over time. This integrated model, as seen in the United States and China, is a source of inspiration for countries in transition that wish to make AI a sustainable lever for growth, innovation, and economic sovereignty.

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