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**INVESTMENT IN DIGITALIZATION AND GROWTH OF STARTUP ECOSYSTEMS FOR COUNTRIES IN THE EUROPEAN UNION**

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Abstract (100 words maximum)

As countries in the European Union want to stay competitive in both digitalization and startup ecosystems, this paper investigates the correlation between the two. The Triple Helix theory (where government, industry, and universities together provide support) was used to assess startup ecosystems. A correlation was found between the digitalization efforts of EU countries and the Triple Helix; it is more significant how each country performs among its peers than what score was given. The university arm correlated the closest to digital investment, which suggests that universities may be a key building block in both digitalization and startup ecosystems.

Keywords (minimum of four)

Digitalization, Startups Ecosystems, Triple Helix, Model, Industry, University, Government, European Union

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## 1.0 Introduction

Digital technology is changing the world and changing it for the better. As businesses become more and more digital, they can increase efficiency via automation of processes and become closer with customers, as they are able to reallocate resources. The European Commission has dedicated 2020 to 2030 as Europe's "digital decade," with overarching goals over 4 key areas: Infrastructure, Government, Skills, and Businesses. Within the digital transformation of businesses, there are 3 KPIs: Tech up-take (with a goal of having 75% of EU companies using Cloud/AI/Big Data), Innovators (grow scale-ups and finance to double EU unicorns), and Late adopters (more than 90% of SMEs reach at least a basic level of digital intensity) (European Commission, 2021-a). This paper will focus on the "Innovators" goal and closely examine the relationship of digitalization to the rankings of startup ecosystems of European Union countries.

Firms everywhere are digitalizing, and those that ignore or put off this pressing topic will be left behind. The European Union was selected to begin building this model as the same data is gathered per country, making it easier to clearly see the effects per country as well as how they perform in comparison to each other.

Not only are existing firms attempting to digitalize, but startups are also highly affected and must respond the change in consumer preferences (driven in no small part by the COVID-19 pandemic). Startups benefit highly from being digital. Firstly, digital platforms provide a way for startups to reach a global audience quickly and easily. Secondly, digital platforms can help startups to build a community of users and supporters who can help to spread the word about the startup and its products or services. Thirdly, startups that use digital processes are more efficient and are able to harness data to provide better services.

This paper is not the first to discuss the relationship between digitalization and startup ecosystems- however, it aims to create a defined framework and first-draft model to understand

the connection more evidently. The purpose is not to prove how important specific metrics are to startup ecosystem development, but rather to understand how different metrics support startup ecosystem growth in the European Union and how the growth is correlated to digitalization efforts of EU countries. This topic is made more relevant by the presence of the European Startup Nations Alliance (ESNA), introduced by the Portuguese government at last year's Web Summit in Lisbon (Portugal Digital, 2022). The ESNA aims to identify and share best practices for European startup growth. The agreement was signed by 26 European Union member states and Iceland (Portugal Digital, 2022).

This paper will investigate the related growth between investment in digitalization and the startup economies of EU countries and suggest further research to analyze and understand which factors can influence the success of a startup ecosystem, as well as the businesses that are a part of it.

## **1.1 Defining a Startup Ecosystem**

A startup ecosystem is a collection where entrepreneurs, mentors, existing startups, funding and investors, and sources of talent meet. Startup ecosystems are drivers of economic growth via implementation of innovative business ideas, support of entrepreneurship, retaining talent, and creation of jobs. By introducing new products, concepts, and ideas, startups encourage competition, challenge larger market incumbents, and retain local talent while simultaneously drawing talent from other regions and countries (Federal Ministry for Economic Affairs and Climate Action, 2022).

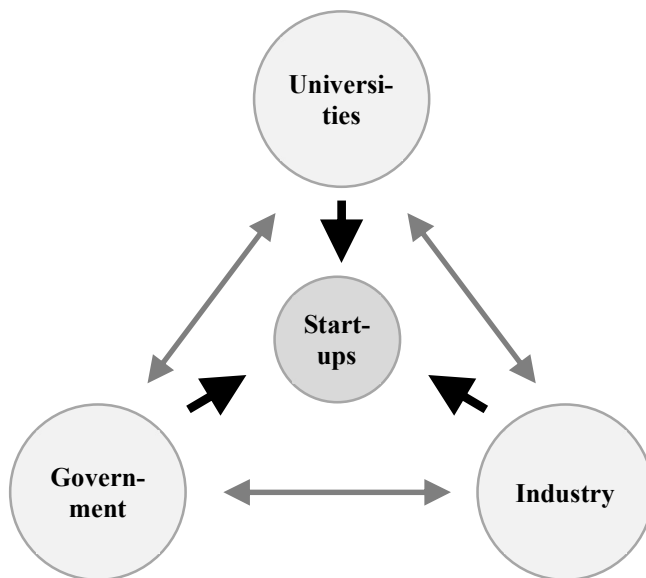
This analysis is based on the academic theory that startup ecosystems are influenced by the so-called "triple helix model of innovation" of interactions within each country between university, industry, and government actions (see Figure 1). This concept was first discussed by Etzkowitz and Leydesdorff in their 1995 paper, "The Triple Helix -- University-Industry-

Government Relations: A Laboratory for Knowledge Based Economic Development” (Etzkowitz, H., & Leydesdorff, L., 1995).

Etzkowitz and Leydesdorff analyze the increasingly deeper overlap of the three arms of the triple helix matrix, discussing that the modern university approach of combining teaching and research helped create many more “experimentally trained academicians” (Etzkowitz, H., & Leydesdorff, L., 1995). They theorized that the triple helix could accurately reflect the interactions between academics, industries, and governments (Etzkowitz, H., & Leydesdorff, L., 1995). Thus, each country has an individual helix, based on existing structures and partnerships (see Figure 1).

**Figure 1**

*The Triple Helix of University, Industry, and Government interactions*



*Note.* Own depiction, based on Etzkowitz & Leydesdorff’s theory (Etzkowitz, H., & Leydesdorff, L., 1995)

Universities, being hubs of research and knowledge and a source of young graduates eager to join the workforce, have a significant impact on the economies and industries that their graduates enter. Governments are another key to the puzzle, especially when it comes to legal

and regulatory structure and financial support. Many governments have their own country-wide funding platforms and various agencies to support, encourage, and promote the growth of entrepreneurship and startups. Lastly, each country's industry influence is critical to review. The existence of successful and matured startups draws entrepreneurs to a country or region where they know that they can find mentors and advisors, who can connect them with resources such as like-minded individuals and funding. Many regions of innovation and startups focus on a few key industries- for example, the mobility industry in Bavaria. This also encourages founders seeking to build a business in this industry to join their peers in that area.

Since its inception in 1995, Etzkowitz and Leydesdorff have expanded upon their initial theory in many additional papers and in collaboration with other authors and students. The theory of the startup ecosystem triple helix now is widely used in academia- for example, some have expanded upon the influence of public funds in stimulating cooperation between the three arms of the helix (de Lima Figueiredo et al., 2022), others have supported the idea that all three arms of the helix together have a positive effect on the startup ecosystem, more so than any one arm by itself (Flechas et al., 2022). The Triple Helix theory was selected for this paper based on its common use in academia.

This analysis aims to support the theory that countries who invest in digital are also countries that have better startup ecosystems, supported by their own "triple helixes" of industries, governments, and universities.

## **2.0 Methodology**

### **2.1 Digital Economy and Society Index (DESI) Scores**

This paper will draw conclusions based on each country's current level of and rate of digitalization, drawn from the Digital Economy and Society Index report (DESI) by the European Commission (European Commission, 2022-a). These scores are directly drawn from each country's progress towards the European Commission's digital goals without having been altered, assumed, or calculated from an algorithm in any way. The DESI report gives a comprehensive overview to compare the progress of each country in the European Union towards their common goal of a digitized economy and society. It consists of 4 facets: Connectivity, Human Capital/Digital Skills, Integration of Digital Technology, and Digital Public Services, making up Europe's *Digital Compass* (European Commission, 2021-a). These scores are summed for a Total Digitalization Score in this model.

### **2.2 StartupBlick's Ecosystem Scores**

Startup ecosystems scores are from StartupBlick's 2022 Report and give scores over 3 areas: Quality, Quantity, and Business (StartupBlick, 2022). All three scores are added up to give a Total Ecosystem Score. The scores are calculated every year in the report published by StartupBlick; however, previous editions are not free and only the change from the previous year is shared. The countries covered in this report are the 27 countries of the European Union: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, and Sweden.

StartupBlick's ecosystem scores are calculated from using StartupBlick's own methodology (an unpublished trade secret). Therefore, this paper uses the given scores as a proxy and attempts to better understand the startup ecosystem evaluation via the three arms of

the startup helix- which for this paper serves as a starting model.

StartupBlick's own system is over three scores of Quantity, Quality, and Business Environment. The quantity score looks at the number of startups, coworking spaces, accelerators, and startup-based meetups (StartupBlick, 2022). This data was collected by StartupBlick from their partners, including Crunchbase, Meetup, Coworker, and more. The quality score considers the presence of strategic branches and R&D centers, number of employees per startup, presence of unicorns and influencers, number of startups backed by Y-combinators, and more (StartupBlick, 2022). The business environment score examines the diversity index, internet speed, internet freedom, number of patents per capita, and more (StartupBlick, 2022). As the methodology and weighting of criteria is not known, only the Total Ecosystem Score and relative Total Ecosystem Ranking are used for the purposes of this report (see Table 2).

### **2.3 Building the Triple Helix Model**

In order to make the analysis as objective as possible, only numerical data are used and interviews were excluded from gathered data. Effort is made to avoid assumptions in creating scores and so comparative rankings are used and thus countries are directly evaluated against each other.

To create the triple helix rankings, each of the three arms is examined and multiple metrics considered. For the government arm, this includes share of GDP spent on education (European Commission, 2022-d), as well as 4 eGovernment metrics from the European Commission- namely, scores for User centricity, Transparency, Key enablers, and Cross border services (European Commission, 2021-b) (see Appendix Table 3). For the university arm, this consists of the number of universities from the top 1000 worldwide per country (Webometrics, 2021, The World Bank Group, 2022-b), the number of private and public university students

per capita (European Commission, 2022-b), and the percentage of inhabitants with a tertiary education (European Commission, 2022-c) (see Appendix Table 4). For the industry arm, this includes responses from the European Investment Bank survey, which asked approximately 12,000 firms across the EU about what they had done in the past year to implement digital processes (European Investment Bank, 2022), VC funding per capita in 2018 (most recent year collected) (Dealroom.co, 2018, p. 15), GDP per capita (The World Bank Group, 2022a), Average Later Stage Venture Investment size in 2021 (Organization for Economic Co-operation and Development, 2021), Average Seed Investment size in 2021 (Organization for Economic Co-operation and Development, 2021), and Average Start Up and Other Early Stage Investment in 2021 (Organization for Economic Co-operation and Development, 2021) (see Appendix Table 5).

The Triple Helix Ranking is calculated as the average across the rankings for the three arms of the helix. These metrics are by nature high level and cannot be complete. There are many more influencing factors- however, those used were determined to be useful proxy influencers. Further research should be performed to gain a more holistic view on drivers of startup ecosystem growth.

All countries are ranked 1 - 27 based on their scores in each metric. The metrics are normalized for the population when appropriate. For the triple helix startup ecosystem outputs, which this paper has built up, only rankings are calculated as it is not known how much weight should be attributed to each metric- and therefore this model weights each equally and recognizes that this is a starting point. The countries are only compared among their European counterparts and not on a world view- this paper's analysis can only be applied to countries of the EU.

To assess the degree in which the scores and rankings for digitalization correlate to the growth of startup ecosystems, the relevant rankings and scores are put through linear regression

and R2 values are calculated. This process is performed on the combinations of: Total Digitalization Scores and Total Ecosystem Scores (from StartupBlock), Digitalization Rankings and Ecosystem Rankings (from StartupBlick), Digitalization Rankings to Triple Helix Rankings (created from this paper), and combinations of each arm of the Triple Helix rankings. Higher R2 values indicate a higher correlation.

Finally, this paper discusses what may have made certain countries more successful in digitalization, in their startup ecosystems, or both (Sweden, Estonia, and Germany are discussed). These evaluations are based on further examination of the metrics in each of the three helix arms. Consideration was given to how the metrics have performed over time, and results are discussed.

### **3.0 Findings**

#### **3.1 Understanding DESI and Rate of Digitalization: Current Situation**

While the European Commission seeks to improve the digital level of all countries, the performance is anything but homogeneous. Countries can be grouped into high, average, and lagging performers by comparing their average rank across the 4 points of Europe's Digital Compass in 2021 (Connectivity, Digital Public Services, Human Capital, and Integration of Digital Technology) (European Commission, 2021-a). High performers (Finland, the Netherlands, Denmark, Ireland, Sweden, Spain, and Malta) have an average rank better than 9 and a Total Digitalization Score above 3.0. Average performers (Luxembourg, Austria, Slovenia, Estonia, France, Germany, Portugal, Italy, Belgium, Lithuania, Czechia, Croatia, Cyprus, Latvia) have a rank between 9 and 20 and a Total Digitalization Score of 2.4 or higher. Lagging performers (Hungary, Slovak Republic, Greece, Poland, Bulgaria, and Romania) have a rank of 20 or above and a Total Digitalization Score of 2.2 or lower (see Table 1).

**Table 1***DESI scores across European countries (European Commission, 2022-a)*

Country	Connectivity Score 2022	Rank	Digital Public Services Score 2022	Rank	Human Capital Score 2022	Rank	Digital Technology Score 2022	Rank	Total Digitalization Score	Digitization Ranking
Finland	0.757	8	1.092	2	0.892	1	0.739	1	3.480	3
Netherlands	0.876	2	1.052	4	0.789	2	0.651	4	3.368	3
Denmark	0.964	1	1.038	8	0.740	5	0.725	2	3.467	4
Ireland	0.769	6	1.043	6	0.783	3	0.542	7	3.137	5.5
Sweden	0.753	9	1.030	9	0.775	4	0.703	3	3.261	6.25
Spain	0.871	3	1.044	5	0.642	10	0.482	11	3.039	7.25
Malta	0.663	16	1.073	3	0.707	7	0.602	5	3.044	7.75
Luxembourg	0.741	11	1.042	7	0.722	6	0.437	18	2.943	10.5
Austria	0.706	14	0.901	12	0.637	11	0.490	10	2.734	11.75
Slovenia	0.749	10	0.869	13	0.553	17	0.498	9	2.669	12.25
Estonia	0.556	26	1.140	1	0.674	8	0.456	15	2.826	12.5
France	0.802	5	0.842	15	0.623	12	0.399	20	2.666	13
Germany	0.842	4	0.793	18	0.562	16	0.448	16	2.644	13.5
Portugal	0.645	18	0.849	14	0.574	14	0.470	12	2.538	14.5
Italy	0.765	7	0.731	19	0.457	25	0.509	8	2.463	14.75
Belgium	0.498	27	0.809	16	0.609	13	0.599	6	2.515	15.5
Lithuania	0.617	23	1.022	10	0.531	20	0.466	13	2.636	16.5
Czechia	0.659	17	0.806	17	0.570	15	0.423	19	2.457	17
Cyprus	0.735	12	0.719	20	0.522	21	0.442	17	2.418	17.5
Croatia	0.601	24	0.670	23	0.648	9	0.459	14	2.377	17.5
Latvia	0.626	20	0.985	11	0.552	18	0.323	23	2.486	18
Hungary	0.720	13	0.718	21	0.481	23	0.270	25	2.188	20.5
Slovak Republic	0.623	21	0.650	24	0.552	19	0.348	21	2.172	21.25
Greece	0.620	22	0.492	26	0.502	22	0.333	22	1.947	23
Poland	0.581	25	0.697	22	0.463	24	0.286	24	2.027	23.75
Bulgaria	0.634	19	0.649	25	0.407	26	0.194	26	1.884	24
Romania	0.690	15	0.263	27	0.386	27	0.189	27	1.529	24

Two countries immediately stand out from this initial comparison (see Table 1): the Netherlands, as its rank in each of the four categories is never lower than 4, and Finland, which is ranked first in both Human Capital and Integration of Digital Technology but 8th in Connectivity (dragging its average rank down). Denmark, Ireland, and Sweden round out the countries that are ranked 9th or higher across all 4 categories. Estonia, earning the 1<sup>st</sup> place rank in Digital Public Services, placed 26<sup>th</sup> in Connectivity, showing that just because one metric ranked highly, it does not guarantee a good ranking in other metrics.

### 3.2 StartupBlick’s Ecosystem Scores and Current Situation

When examining the top six Total Ecosystem Scores, Estonia stands out as the only country outside of western Europe and as the only country with a population below 1.5 million (see Table 2). Sweden is the only country to be ranked first across multiple categories (ecosystem quality and business). No country in the top five has any rankings below 11, showing that in StartupBlick’s methodology, when a country performed well in one category performed well, it was likely to perform well in others too.

**Table 2**

*StartupBlick’s ecosystem scores across European countries (StartupBlick, 2022)*

Country	Quantity Score	Rank	Quality Score	Rank	Business Score	Rank	Total Ecosystem Score	Eco-system Ranking
Sweden	4.68	8	20.03	1	3.8	1	28.502	3.33
Germany	4.96	4	16.84	2	3.53	4	25.334	3.33
France	4.82	7	12.77	3	3.4	6	20.994	5.33
Netherlands	4.42	9	12.71	4	3.38	7	20.505	6.67
Finland	3.99	13	10.18	6	3.68	3	17.852	7.33
Estonia	4.14	11	10.77	5	3.34	8	18.243	8.00
Denmark	3.06	16	7.45	8	3.69	2	14.193	8.67
Ireland	3.88	14	8.54	7	3.49	5	15.914	8.67
Spain	5.71	1	6.07	10	2.71	17	14.481	9.33
Lithuania	4.07	12	7	9	3.13	11	14.194	10.67
Austria	2.46	19	4.5	12	3.26	9	10.221	13.33
Belgium	2.71	17	5.29	11	2.8	15	10.806	14.33
Latvia	5.38	2	1.68	18	0.63	23	5.383	14.33
Croatia	5.12	3	1.3	20	0.97	21	5.115	14.67
Italy	2.56	18	2.49	15	3.04	13	8.09	15.33
Portugal	2.2	22	4.08	13	3.11	12	9.39	15.67
Slovenia	4.87	5	1.28	21	0.92	22	4.87	16.00
Czechia	1.33	26	3.61	14	3.15	10	8.087	16.67
Greece	4.83	6	1.04	24	1.39	20	4.834	16.67
Poland	1.86	24	2.31	16	3.02	14	7.182	18.00
Hungary	4.3	10	1.2	23	0.62	24	4.3	19.00
Luxembourg	1.42	25	1.98	17	2.05	19	5.447	20.33
Romania	1.09	27	1.6	19	2.76	16	5.449	20.67
Bulgaria	2.15	23	1.21	22	2.6	18	5.961	21.00
Cyprus	3.32	15	0.83	25	0.58	25	3.318	21.67
Slovak Republic	2.45	20	0.69	27	0.3	26	2.449	24.33
Malta	2.26	21	0.73	26	0.28	27	2.262	24.67

### **3.3 Creating the Triple Helix Rankings**

To make sure that the Triple Helix Rankings were not just explained by population, the differences between population rank, Triple Helix Rank, and StartupBlick's Ecosystem Rank for each country was compared. The average difference from the Triple Helix Rankings to StartupBlick's Ecosystem Rankings was 3.41- smaller than the average difference between triple helix rankings to population rankings (4.38) and the average difference between StartupBlick's Ecosystem Rankings to population rankings (6.94) (see Appendix Table 6).

Interestingly, at a first look in the Triple Helix Rankings (see Table 3), no country had consistently high rankings- from the metrics selected, the smallest average rank was Denmark at 8.8. The next three (Belgium, Sweden, and Cyprus) were the only countries to have an average rank above 10. The lowest average rank went to Romania, with 22.7 across the three arms- showing that when all the selected metrics for the triple helix ranking are examined, some metrics perform very well while others perform quite poorly- unlike in StartupBlick's rankings.

**Table 3**  
*Triple Helix Rankings Across the Three Arms*

Country	Government Arm	University Arm	Industry Arm	Triple Helix Rankings
Netherlands	8.8	5.75	3.9	6.1
Finland	5.4	7.5	7.0	6.6
Denmark	6	12.75	4.9	7.9
Spain	10.8	8.25	10.1	9.7
Sweden	12.2	10	8.4	10.2
Estonia	3.2	15.25	12.4	10.3
Lithuania	6.6	11.5	13.7	10.6
Austria	13.2	11.5	8.9	11.2
Belgium	10.8	11.5	11.7	11.3
France	12	10	15.1	12.4
Luxembourg	8.4	18	12.4	12.9
Portugal	14	13.25	12.9	13.4
Malta	2.6	18	20.7	13.8
Slovenia	15.2	15	13.4	14.5
Ireland	19.4	10.25	14.1	14.6
Latvia	5.8	17	21.1	14.6
Germany	19	12.25	12.7	14.7
Italy	18.6	12.75	13.3	14.9
Czechia	16.8	19	9.7	15.2
Cyprus	19.6	12	16.4	16.0
Greece	22.4	13.25	16.3	17.3
Poland	22.2	11	19.0	17.4
Hungary	18.2	17	18.1	17.8
Slovak Republic	19.2	20.75	13.7	17.9
Croatia	19.4	16.5	17.9	17.9
Bulgaria	20.2	16	21.4	19.2
Romania	25.6	20.5	22.1	22.7

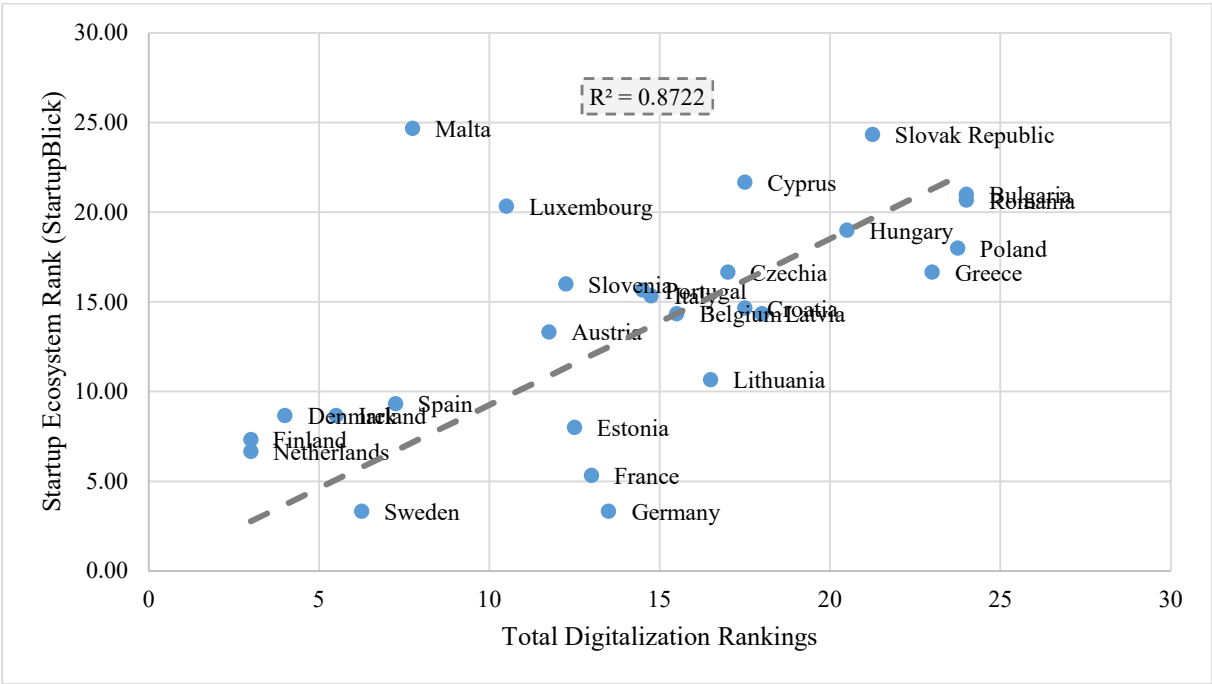
### 3.4 Connecting the Dots between Investment in Digitalization and Startup Ecosystems

To begin the analysis, this paper sought to examine the correlation between the Total Digitalization Scores and StartupBlick’s Ecosystem Scores. When visualized on maps (see Appendix Figure 2), it is clear to see that both the Total Digitalization Score and the Total Ecosystem Score (from StartupBlick) are higher in Western Europe and in the Nordics.

When plotted against each other, the Total Digitalization Scores and Total Ecosystem Scores from StartupBlick have an R2 value of 0.3498 (see Appendix Figure 3). When the intercept is fixed at (0, 0), the R2 value increases to 0.776 (see Appendix Figure 4). Here there is already a hint that digitalization and startup ecosystem scores have a high correlation.

It was found that the highest correlation comes from when not the scores, but the rankings are correlated. This supports the methodology with which the model was created- to avoid assumptions, a comparative system is best. In other words, it is more significant not what scores are given, but how each country performs among its peers. When comparing the total digitalization rankings and startup ecosystems rankings and fixing the intercept at (0, 0), the R2 value is 0.8722 (see Figure 5). This shows that while causation cannot be inferred, how a country performs in relation to its peers over the metrics of digitalization and startup ecosystems is correlated (using StartupBlick’s scores).

**Figure 5**  
*Correlation between StartupBlick Ecosystem Rankings and Total Digitalization Rankings*



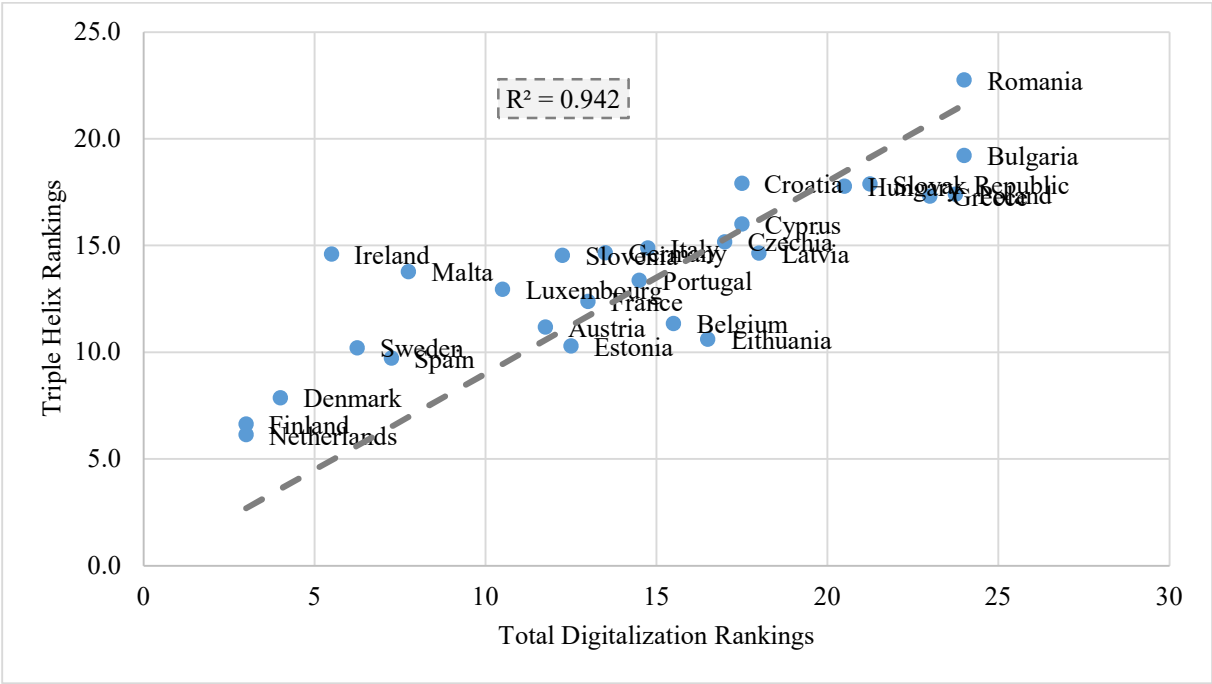
*Note.* R2 value of 0.8722 with intercept set to (0,0). Own depiction, based on Total Digitalization Rankings and StartupBlick Ecosystem Rankings.

Figure 5 considers the potential correlation between the Total Digitalization Rankings and StartupBlick’s total score ranking. While some correlation has been found, this paper is interested in supporting the Triple Helix theory, and therefore will also look at the correlation between the Triple Helix Rankings and Total Digitalization Rankings.

When examining the created Triple Helix Rankings to Total Digitalization Rankings, the R2 value is still higher, indicating that when the digitalization ranking is higher, the Triple Helix Ranking (defined in this paper) tends to be higher as well. This is a very interesting finding and warrants further analysis. However, this paper will focus is on what exactly gave the countries that did so well on this chart such a good ranking.

The correlation between the Triple Helix Rankings and Total Digitalization Rankings yielded the highest R2 value of all: 0.942 (see Figure 7). This suggests that, while there should be improvement and refinement to the triple helix rankings (discussed later in this paper), there is indeed a significant correlation between the three arms of the startup helix and investment in digital.

**Figure 7**  
*Correlation between Triple Helix Rankings and Total Digitalization Rankings*



Note. R2 value of 0.942 with intercept set to (0,0).

Interestingly, when each arm of the Triple Helix was compared to the Total Digitalization Rankings, none of the correlations were as high- Government and Total Digitalization Rankings had an R2 value of 0.8833, Universities and Total Digitalization Rankings had an R2 value of 0.8821, and Industry and Total Digitalization Rankings had an R2 value of 0.9184 (see Appendix Figures 8-10). From the three arms of the helix, the industry rankings correlate the closest to each country's investment in digitalization. This suggests that the industry metrics may be a key building block in both digitalization and startup ecosystems.

## **4.0 Real World Application of the Triple Helix Model**

### **4.1 Trends in Rate of Digitalization**

While looking at the current situation certainly provides valuable insights, the trends and history which brought each firm to its current ranking cannot be ignored. This part of the analysis aims to identify the biggest and smallest changes on both the digitalization and the startup ecosystem sides.

When looking at each dimension in the Digital Compass individually, there are several countries that appear more than once. Greece has the largest CAGR in Connectivity from 2017 to 2022 (+25.5%) and the second largest change in Digital Public Services (+8.6%). Italy has the third largest change in Connectivity (+21%) and the second largest change in Integration of Digital Technology (+10.5%). Greece (+25.5%), Cyprus (+22.7%), and Italy (+21.0%), which were the largest gainers in Connectivity, were also the largest total gainers: Italy (+9.8%), Greece (9.7%), and Cyprus (+8.8%).

This shows that countries who invest in digitalization do not do so over just one year- it is an effort over several years. Digitalizing a country or improving its startup ecosystem are long-term investments. Countries can be comforted by the fact that, once they've put in the effort to improve, they do not slip back to what they once were. None of the DESI scores for

any country ever decreased over time. Likely, this is also due to increased public awareness and demand- once residents, entrepreneurs, and businesses become accustomed to a certain standard, they will likely not settle for something less.

However, the rankings are fluid. Year to year, the rankings for Digital Public Services, Human Capital, and Integration of Digital Technology stayed fairly consistent, with countries changing no more than 4 rankings. The Connectivity ranking, however, saw large swings from year to year: from 2021 to 2022, for example, Italy moved up 16 spots in the rankings while Estonia fell down 8. This does not indicate a decline (in fact, Estonia's Connectivity score saw an increase from 0.501 to 0.556 from 2021 to 2022), but that in this time, Estonia's Connectivity score grew slower than in other countries. In total scores, Latvia saw the largest positive change (+7 spots) and Italy saw the largest decline (-7 spots) (see Appendix Figure 11). As these comparisons are among countries in the European Union, this speaks to the high levels of competition between EU countries.

#### **4.2 A Leader in Startup Ecosystems: Sweden**

A country of best practices when evaluating both investment in digitalization and startup ecosystems is Sweden. Having produced 35 unicorns through 2022, including Spotify, Klarna, and VOI, the country is clearly a cradle for successful companies (Dealroom.co, 2021). Why has it been so successful with a population of only approximately 10 million inhabitants? The answer may be found in examining the 3 arms of the startup helix- government, industry, and university.

On the educational side, Sweden has several internationally recognized universities. There are approximately 50 universities and colleges in the country, the majority of them state funded (Swedish Institute, 2021). There are approximately 2.8 times as many students attending public institutions vs private (77k vs 27.5k respectively in 2020) (European Commission, 2022-

b). If students are not able to afford Swedish tuition, the government has multiple scholarships available. Sweden's population is heavily concentrated in and around Stockholm, where about 15% of the population resides (Statistics Sweden, 2020) and several world-renowned universities have their campuses in Stockholm- the most noteworthy being Stockholm University, KTH Royal Institute of Technology, Stockholm School of Economics, and the Karolinska Institut. Sweden has 12 universities ranked in the top 1000 worldwide and comes in 7th among its European country peers in this regard (Webometrics, 2021). 39.7% of Sweden's population has a tertiary degree, ranking it 5th and tied with Belgium (behind Ireland, Luxembourg, Cyprus, and Lithuania respectively) (European Commission, 2022-c).

Sweden's success may be in large part due to its government agencies and actions. *Vinnova* is Sweden's innovation agency and is part of the Ministry of Enterprise and Innovation. Their mission is to "build Sweden's innovation capacity, contributing to sustainable growth. [They] make it possible for organizations to address challenges together by enabling innovation that makes a difference" (Vinnova, 2022). Vinnova supports and streamlines government funding over various focuses- currently there is funding available for projects on innovative social benefits using IoT and preparatory projects on next generation strategic innovation programs (Vinnova, 2022). Funding ranges from 200k to 2m SEK (approximately 18k to 183k EUR) for certain projects (Vinnova, 2022). This program helps get businesses that are just starting off the ground so that the founders are able to implement their ideas. Spotify, one of Sweden's most well-known startups, was funded by Vinnova back in 2011. Sweden's government spends 7.0% of its GDP on education, ranking it 1st among its peers for this metric (European Commission, 2022-d).

It is critical not to forget the positive feedback cycle that Sweden has entered. Judging by its history of unicorns, of which it has the most per capita of any European country (Dealroom.co, 2018), new founders may not know what exactly had made Sweden such a cradle

for successful companies, but they know that it works. Sweden has the highest amount of VC funding per capita (approx. 136 USD per person in 2018, according to Dealroom.co, 2018) and the 4th highest GDP per person (only behind Luxembourg, Ireland, and Denmark) (The World Bank Group, 2022-a). The more successful Swedish startups are, the more mentors that are available to offer advice, and the more investors that are willing to give funding to new businesses, and the startup ecosystem continues to grow.

### **4.3 Country to Watch: Estonia**

Estonia is certainly a country to watch when it comes to both digitalization (where it ranked 1st in digital public services, 8th in human capital, 15th in integration of digital technology, and 26th in connectivity) and startup ecosystems. Estonia, being a small country in the Baltics, does not immediately strike as a hub for startups. However, there are some key success factors hidden in its triple helix.

On the university side, Estonia has 31 universities (Webometrics, 2021) and the largest growth in number of university students attending a public institution out of its EU peers with a CAGR of 21.8% from 2013 to 2020 (European Commission, 2022-b). Its top university is the University of Tartu, whose students study Business Administration, Science and Technology, Medicine, and Natural Sciences and Mathematics (Study.eu, 2022).

Estonia, like Sweden, also benefits from a government agency: *Startup Estonia*. Startup Estonia is an “initiative aimed to supercharge the Estonian startup ecosystem for it to be the birthplace of many more startup success stories in the future” (Startup Estonia, 2022). They pursue this effort over 4 areas: Strong Ecosystem, Smart People, Smart Money, and Friendly Regulations (Startup Estonia, 2022). It is interesting to see that, while there is no international guideline on how to support a strong startup ecosystem, Estonia has chosen a system related to the Triple Helix concept (albeit concentrated on the government arm). Beyond the funding and

support provided by the industry, Startup Estonia lists concrete reasons for entrepreneurs to have their roots in Estonia- among them: Estonians are techies, Estonia itself has an uncomplicated tax system with zero corporate income tax, eGovernment systems are prioritized, and more (Startup Estonia, 2022).

The amount of funding given to Estonian startups is where the country really stands out. Not only is it ranked first in Seed funding per capita and 8<sup>th</sup> in Startup and other early-stage funding per capita, it has the highest average CAGR across the Venture Capital investment per capita (due to lack of data, Lithuania lost its top spot). The Triple Helix model shows that Estonia is clearly a country on the way up.

Estonia is in a positive feedback loop when it comes to startups. The country is the birthplace of many unicorns, among them Bolt, Starship, Wise, and Skype (which matured in 2011 and is widely considered to be a pioneer of the Estonian startup ecosystem). Estonia is becoming a top destination for startups, and by nature of having so many successful unicorns and graduated startups, continues to draw more mentors, advisors, and entrepreneurs.

#### **4.4 Underperforming Expectations: Germany**

Germany is the leader of the European Union in many ways- largest population (approx. 83 million) (The World Bank Group, 2022-b), largest number of top universities (54) (Webometrics, 2021), and the largest GDP (4.2 trillion USD) (The World Bank Group, 2022-a). However, just being the biggest does not indicate the best startup ecosystem. While Germany may have the resources, the application of them has not yielded as great a success as Sweden's has. What may be a factor is Germany's segmentation. It has 16 federal states, operating on a high degree of individuality. Germany's Total Digitalization Ranking is quite low, with a Digital Public Services ranking of 18<sup>th</sup>, Human Capital ranking of 16<sup>th</sup>, and Integration of Digital Technology ranking of 14<sup>th</sup>. The only ranking among the four aspects of DESI with a

ranking higher than 10<sup>th</sup> is its Connectivity rank (4<sup>th</sup>), which includes the % of households subscribing to fixed broadband take-up and amount of spectrum assigned and ready for 5G use, among other metrics.

Germany's universities are widely considered to be hubs for startups and innovation. Technical University of Munich and RWTH Aachen, for example, each have their own startup incubators. These are both large universities with renowned international standings and low tuition fees, making them accessible to anyone to attend. Germany's average ranking across the university arm of the triple helix is 12.25, placing it 12<sup>th</sup> among its peers. Dragging down its ranking is the low 27.2% of its population with a tertiary degree (ranked 19<sup>th</sup>).

Germany's government spends only 4.7% of its GDP on education, ranking it 20<sup>th</sup> among EU countries. Its eGovernment scores are also low in comparison to its peers, ranking 19<sup>th</sup> on average. Germany's government arm of its triple helix ranking is the lowest of its three arms with an average ranking of 19.2.

Germany's industry ranking is in the middle of the pack. Keeping its average up are GDP per capita (9<sup>th</sup>), Later stage investment per capita in 2021 (8<sup>th</sup>), Seed investment per capita in 2021 (10<sup>th</sup>), and Startup and other early-stage investment in 2021 (9<sup>th</sup>).

Not all is lost. Even though Germany ranked lower than expectations from this model does not mean that there is no hope for its startup scene- on the contrary, Germany is ranked as one of the most innovative countries in the world (Schwab, K., & Zahidi, S., 2020). Startups have their home bases all over Germany, but the three states with the most are North Rhein-Westphalia with 19.8%, Berlin with 19.1%, and Munich with 13.6% (Startup Verband, 2022). In a survey of startups, it was noted that proximity to universities and network to other founders were aspects that German founders found helpful (Startup Verband, 2022). Germany's founders are able to get mentorship from one of Germany's many successful startups- N26, FlixMobility, and Celonis are only a few of the most well-known.

#### **4.5 Roadblocks to Growing Either in Digitalization or in Ecosystem Scores**

Why are some countries ranked so highly in digitalization, in their startup ecosystem, or in both, while others are not? One of the most common roadblocks is a lack of infrastructure, such as a lack of broadband internet access or lack of digital literacy, which are both goals to improve from the European Commission’s Digital Compass (European Commission, 2021-a). Other roadblocks include a lack of financial resources to digitalize, a lack of expertise and know-how, or a lack of political will to invest in digitalization. Slow policy updates can also impede the ability of startups to take advantage of new technologies.

Furthermore, the existing landscape is naturally siloed: innovation hubs pop up in large cities, full of eager university graduates, funding, and easy access to government support- but countries interested in bettering their ecosystems would do well to look beyond the main cities which drive innovation. Paris and Berlin are two startup hotspots, for example, but France and Germany’s performance in the triple helix model gives the countries some room to become more digital and simultaneously encourage better startup ecosystems.

#### **5.0 Limitations to Research**

The impact of one helix arm on another is extremely complex. Each country’s arms overlap to different degrees, reflective of their individual populations, budgets, histories, and goals. There is no perfect formula, and this paper accepts that and attempts to build a “first draft” model. The purpose is not to create a perfect model, but rather support the triple helix theory and to select metrics with merit- as well as correlate it with the investment in digitalization per country.

Correlation is not causation, and there is no way to rule out that this is a coincidence without a control group. Therefore, it cannot be definitely proven that if a country invests more in digital over its triple helix of government, universities, and industry, that it will immediately

or over a longer period of time achieve a better startup ecosystem among any of its subsections of quality, quantity, or business scores. This means that the different aspects selected are not independent and therefore building a prediction tree is impossible. To build a more holistic model, much more data will have to be collected from each of the three arms of the helix over time to clearly see the impact of each aspect and its development. However, the crucial part of the startup helix is, in fact, its interdependencies, which are extremely intricate.

This is shown particularly in the Government arm of the triple helix rankings. The metrics chosen include Cost to register a new business, Share of GDP spent on education, and four metrics over the eGovernment score (user centricity, transparency, key enablers, cross border services). Having a digital government helps startups get on their feet, in terms of being able to register more easily, having a hand in finding support (mentorship or financial), or just in their speed of development. However, this overlaps heavily with the DESI scoring, which considers how digital different European countries are- and especially the point Digital Public Services on the European Commission's Digital Compass. If anything, this further suggests that startup growth and digitalization are deeply intertwined.

A further developed way to discover the most influential aspects of each startup ecosystem's success is to consider far more aspects- however this is not possible in this pragmatic approach of this paper. While StartupBlick's ecosystem scores are a useful proxy, in an ideal world, far more effort should be dedicated to truly understanding each country's startup helix, as well as how some factors may influence each other. As there is no control group, there is no way to eliminate confounding factors- and in fact the triple helix score was found to improve in accuracy when it included the population of the countries (to a certain degree). There is no utopian dataset, but efforts should be made to add more metrics and consider their changes over time to get a more holistic view.

While this paper ranks countries against each other, each country does not improve or

decrease its scores or rankings in a vacuum. There are far more influencing factors than those described here. This paper has also assumed, for the sake of simplification, that each country's neighbors do not heavily influence each other- which in the real world is clearly not true (considering especially smaller countries like Luxembourg or Belgium, which are likely heavily influenced by their neighbors).

## **6.0 Takeaways and Actions for Countries**

While especially the industry arm of the triple helix may be influenced by a country's neighbors, the government and university arms are comparatively less so. In particular, the share of a country's GDP a government decides to invest in education varies widely. Sweden, Denmark, Belgium, and Estonia rank the highest for this metric respectively, while Bulgaria, Ireland, Romania, and Italy round out the bottom 4 (European Commission, 2022b).

This paper intentionally gave equal weight to every metric per triple helix arm, so it cannot be said definitively that % of GDP spent on education has an impact on startup ecosystems- however, it would be a very interesting next step and could be useful for countries who are interested in boosting their startup ecosystems to know.

## **7.0 Potential Future Research**

A clear next step in building this model would be to evaluate the metrics which are used to calculate the triple helix ranking, as well as to select more metrics to make this ranking more holistic and better representative of the current situation for each of the three arms. Research should also be conducted to understand to which degree some of the metrics may affect each other and to try and eliminate any confounding variables present.

A variable which would improve the accuracy of the model would be to identify the existing top startup hubs per country, with additional information to their size, number of members, successful startups, and funding available, and measure the connection to local

startups. This could include the physical distance, but more interestingly could include the proximity that founders feel. This metric would most likely have to be documented via numerous surveys with startup founders in each country and would be very time consuming—thus was not performed for this paper and its initial model.

Beyond just the triple helix model, the model could also be adapted to contain metrics of the culture of each country. While hard to capture, insights about the level of entrepreneurial risk each country is comfortable with would provide valuable insights. This is touched upon in the Global Competitiveness Report but does not fall within the scope of this paper and is thusly not discussed (World Economic Forum, 2020).

This research could additionally be continued by evaluating the impact of digital funding per European country by examining additional benefits, such as the development of European Digital Innovation Hubs (EDIH), which are part of the Europe Digital Programme. The EDIHs will be distributed over Europe and will “help companies improve business/production processes, products, or services using digital technologies. They also provide innovation services, such as financing advice, training, and skills development that are needed for a successful digital transformation” (Vlaanderen, 2022).

While this model has shown that the university arm is most closely correlated with each country’s digital growth, more work needs to be done to be able to identify which metrics within the arm have the most impact and are worthwhile to invest in to improve the startup ecosystem of each country.

In conclusion, more research is needed in order to improve the accuracy of the triple helix model. This research should include more metrics to the triple helix model, identifying the top startup hubs per country, and measuring entrepreneur’s connections to local startups.

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## Appendix

**Table 3**  
*Triple Helix Rankings (Government arm)*

Country	% of GDP spent on education	Rank	eGov: User centricity	Rank	eGov: Transparency	Rank	eGov: Key enablers	Rank	eGov: Cross border services	Rank	Government Avg Rank
Malta	5.9	5	100.00	1	97.10	1	92.49	4	84.31	2	2.60
Estonia	6.6	2	98.33	3	83.54	3	92.42	5	84.25	3	3.20
Finland	5.9	5	98.40	2	64.07	10	88.16	6	84.13	4	5.40
Latvia	5.9	5	93.80	10	75.62	6	95.12	2	70.74	6	5.80
Denmark	6.4	4	98.19	4	72.82	8	94.91	3	61.64	11	6.00
Lithuania	5.2	13	95.49	7	77.89	4	97.17	1	66.85	8	6.60
Luxembourg	5	17	94.54	9	90.03	2	77.94	13	89.92	1	8.40
Netherlands	5.3	12	93.42	11	77.66	5	79.32	11	72.53	5	8.80
Spain	4.6	21	97.96	5	72.98	7	77.88	14	67.13	7	10.80
Belgium	6.6	2	91.69	16	60.29	14	78.19	12	62.12	10	10.80
France	5.5	10	95.22	8	63.11	12	79.43	10	45.24	20	12.00
Sweden	7	1	92.81	12	51.68	17	74.39	16	53.28	15	12.20
Austria	5.1	15	89.84	21	65.23	9	85.50	8	56.00	13	13.20
Portugal	5	17	92.18	15	63.47	11	83.43	9	45.86	18	14.00
Slovenia	5.8	9	92.44	14	58.94	15	55.98	19	45.85	19	15.20
Czechia	5.1	15	85.81	23	54.33	16	60.00	18	59.81	12	16.80
Hungary	4.7	19	90.50	19	41.60	23	86.75	7	43.08	23	18.20
Italy	4.3	24	96.24	6	46.85	19	55.13	20	37.88	24	18.60
Germany	4.7	19	90.87	18	46.81	20	53.03	21	48.82	17	19.00
Slovak Republic	4.6	21	92.48	13	38.43	26	76.54	15	44.25	21	19.20
Ireland	3.1	27	87.13	22	62.78	13	33.93	26	62.81	9	19.40
Croatia	5.4	11	89.93	20	43.26	22	52.11	22	43.25	22	19.40
Cyprus	5.9	5	71.65	27	31.05	27	38.02	25	53.83	14	19.60
Bulgaria	4	25	79.53	25	51.20	18	60.69	17	53.05	16	20.20
Poland	5.2	13	84.02	24	40.25	25	50.54	23	28.94	26	22.20
Greece	4.5	23	90.92	17	44.14	21	48.21	24	20.50	27	22.40
Romania	3.7	26	74.03	26	41.36	24	29.06	27	34.98	25	25.60

*Note.* These rankings were created for the purpose of this paper.

**Table 4**  
*Triple Helix Rankings (University arm)*

Country	# of Top 1000 Universities	Rank	# Public University Students / Population	Rank	# Private University Students / Population	Rank	% Educated (with Tertiary Degree) in 2021	Rank	University Avg Rank
Netherlands	13	5	4.39%	3	1.57%	7	36.6	8	5.75
Finland	9	9	2.80%	14	5.07%	3	39.8	4	7.50
Spain	37	3	2.76%	15	1.59%	6	36	9	8.25
France	37	3	2.53%	19	1.47%	8	35.3	10	10.00
Sweden	12	7	3.77%	5	0.51%	22	38.3	6	10.00
Ireland	6	12	4.10%	4	0.30%	24	42.8	1	10.25
Poland	13	5	2.58%	18	2.21%	5	28.9	16	11.00
Lithuania	1	18	3.41%	7	0.80%	16	38.7	5	11.50
Belgium	8	11	1.83%	24	4.98%	4	37.6	7	11.50
Austria	10	8	3.04%	10	0.86%	13	31.3	15	11.50
Cyprus	1	18	1.04%	25	5.77%	2	40.2	3	12.00
Germany	54	1	3.35%	8	0.58%	21	27.2	19	12.25
Denmark	6	12	4.64%	2	0.02%	25	33.7	12	12.75
Italy	46	2	2.82%	13	1.17%	10	17.9	26	12.75
Portugal	6	12	2.88%	11	1.29%	9	25.4	21	13.25
Greece	9	9	7.52%	1	0.00%	26	28.5	17	13.25
Slovenia	1	18	2.67%	16	0.93%	12	31.5	14	15.00
Estonia	1	18	3.14%	9	0.47%	23	35.2	11	15.25
Bulgaria	1	18	2.87%	12	0.83%	14	25.6	20	16.00
Croatia	1	18	3.76%	6	0.77%	17	22	25	16.50
Latvia	0	27	0.00%	27	6.96%	1	33.2	13	17.00
Hungary	6	12	2.32%	22	1.00%	11	23.6	23	17.00
Malta	1	18	2.45%	21	0.83%	15	28.1	18	18.00
Luxembourg	1	18	1.04%	26	0.00%	26	40.9	2	18.00
Czechia	5	16	2.65%	17	0.63%	19	22.1	24	19.00
Romania	2	17	2.49%	20	0.71%	18	16.2	27	20.50
Slovak Republic	1	18	2.20%	23	0.59%	20	23.9	22	20.75

*Note.* These rankings were created for the purpose of this paper.

**Table 5**  
Triple Helix Rankings (Industry arm)

Country	Implemented multiple digital technologies 2020	Rank	Implemented a single digital technology 2020	Rank	Implemented digital parts of business organised around 2020	Rank	GDP per capita 2021	Rank	Later stage venture investment size per capita 2021	Rank	Seed investment size per capita 2021	Rank	Start-up and other early stage investment size 2021	Rank	Avg Industry Rank
Netherlands	2.22	5	1.90	3	4.12	3	58061.00	5	8.76E-05	2	9.69E-06	2	2.71E-05	7	3.9
Denmark	2.23	4	1.70	13	3.92	4	67803.05	3	6.61E-05	5	7.06E-06	4	9.06E-05	1	4.9
Finland	2.31	3	1.49	22	3.80	8	53982.61	6	1.34E-04	1	9.26E-06	3	2.81E-05	6	7.0
Sweden	2.00	8	1.48	23	3.48	11	60238.99	4	6.80E-05	4	6.83E-06	5	2.94E-05	4	8.4
Austria	1.88	10	1.82	7	3.69	9	53267.93	7	8.43E-05	3	1.80E-06	11	7.07E-06	15	8.9
Czechia	2.44	2	1.93	1	4.36	1	26378.50	17	1.19E-06	17	6.71E-07	17	9.76E-06	13	9.7
Spain	2.15	6	1.75	11	3.90	5	30115.71	14	2.15E-05	9	1.26E-06	14	1.05E-05	12	10.1
Belgium	1.81	12	1.57	21	3.38	13	51767.79	8	9.19E-06	11	1.71E-06	12	2.87E-05	5	11.7
Estonia	1.58	14	1.31	24	2.90	18	27280.66	16	5.82E-05	6	2.07E-05	1	2.61E-05	8	12.4
Luxembourg	0.98	25	1.64	17	2.62	23	135682.79	1	7.06E-06	13	4.68E-06	6	4.91E-05	2	12.4
Germany	1.31	18	1.62	18	2.93	17	50801.79	9	3.46E-05	8	2.43E-06	10	1.94E-05	9	12.7
Portugal	1.93	9	1.92	2	3.85	7	24262.18	18	9.36E-08	20	1.18E-06	15	3.83E-06	19	12.9
Italy	1.85	11	1.71	12	3.57	10	35551.28	11	1.34E-06	16	9.85E-07	16	4.90E-06	17	13.3
Slovenia	2.48	1	1.64	16	4.12	2	29200.82	15	1.40E-07	19	3.37E-07	19	0.00E+00	22	13.4
Lithuania	1.29	19	1.82	8	3.11	16	23433.39	19	3.26E-06	15	3.12E-06	8	1.39E-05	11	13.7
Slovak Republic	2.04	7	1.83	6	3.87	6	21087.85	20	3.80E-06	14	0.00E+00	22	2.72E-06	21	13.7
Ireland	1.28	20	1.28	26	2.57	25	99152.10	2	1.83E-05	10	1.63E-06	13	3.82E-05	3	14.1
France	1.23	21	1.31	25	2.54	26	43518.54	10	3.52E-05	7	3.54E-06	7	1.43E-05	10	15.1
Greece	1.51	15	1.81	10	3.32	14	20276.54	22	5.55E-09	21	3.50E-07	18	7.09E-06	14	16.3
Cyprus	1.36	17	1.90	4	3.25	15	30798.48	13	0.00E+00	22	0.00E+00	22	0.00E+00	22	16.4
Croatia	1.59	13	1.81	9	3.40	12	17398.77	25	0.00E+00	22	0.00E+00	22	0.00E+00	22	17.9
Hungary	1.04	24	1.61	19	2.64	22	18772.67	23	7.30E-06	12	2.45E-06	9	4.83E-06	18	18.1
Poland	0.97	26	1.87	5	2.83	19	17840.92	24	1.86E-07	18	2.90E-07	21	3.14E-06	20	19.0
Malta	1.41	16	1.19	27	2.60	24	33257.42	12	0.00E+00	22	0.00E+00	22	0.00E+00	22	20.7
Latvia	0.75	27	1.64	15	2.39	27	20642.17	21	0.00E+00	22	3.25E-07	20	5.69E-06	16	21.1
Bulgaria	1.08	23	1.69	14	2.78	20	11634.97	27	0.00E+00	22	0.00E+00	22	0.00E+00	22	21.4
Romania	1.11	22	1.61	20	2.71	21	14861.91	26	0.00E+00	22	0.00E+00	22	0.00E+00	22	22.1

*Note.* These rankings were created for the purpose of this paper.

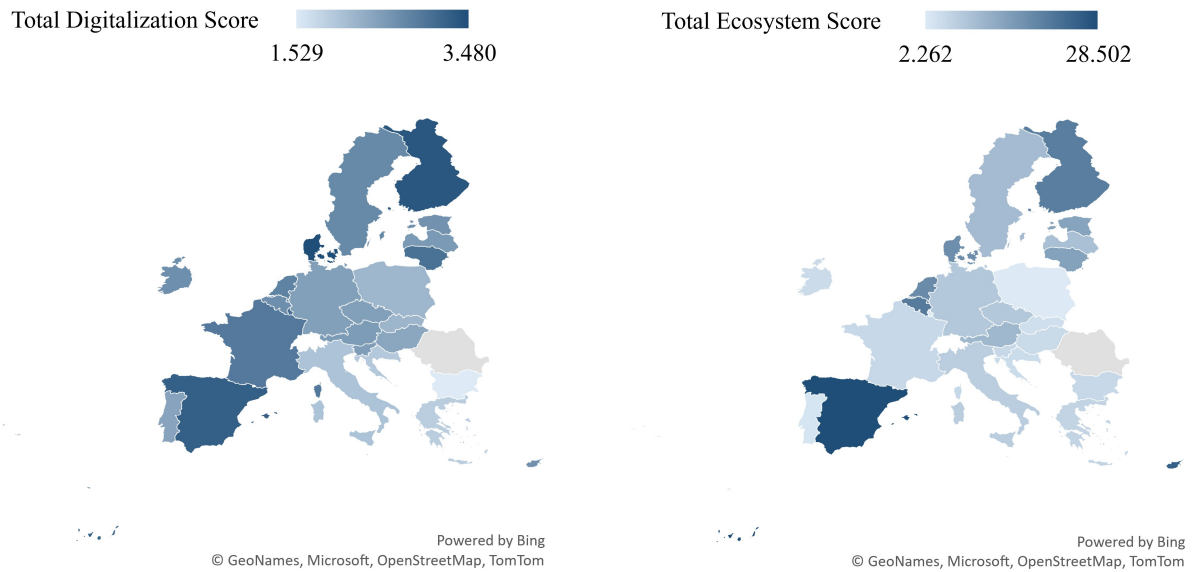
**Table 6**  
*Triple Helix Rankings*

Country	Avg Rank of Triple Helix Arms	Avg. Rank When Equal Weight Given to Three Arms and Population	Avg. Rank (StartupBlick scores)
Denmark	7.2	11.6	9
Finland	7.2	12.1	7
Netherlands	7.4	7.2	7
Estonia	8.8	16.4	8
Lithuania	9.9	15.4	11
Spain	10.6	7.3	9
Sweden	11.2	11.1	3
Austria	11.2	12.6	13
Belgium	11.5	9.8	14
France	11.9	7.0	5
Luxembourg	11.9	19.0	20
Malta	12.4	19.7	25
Ireland	13.4	16.2	9
Slovenia	13.5	17.8	16
Latvia	13.6	18.3	14
Portugal	13.7	12.9	16
Cyprus	14.5	19.7	22
Germany	15.3	8.2	3
Czechia	15.5	12.3	17
Italy	16.7	9.9	15
Poland	17.3	11.1	18
Slovak Republic	17.5	17.8	24
Hungary	17.9	15.4	19
Croatia	18.2	19.1	15
Greece	18.2	14.1	17
Bulgaria	19.7	17.3	21
Romania	23.5	14.7	21

*Note.* These rankings were created for the purpose of this paper.

**Figure 2**

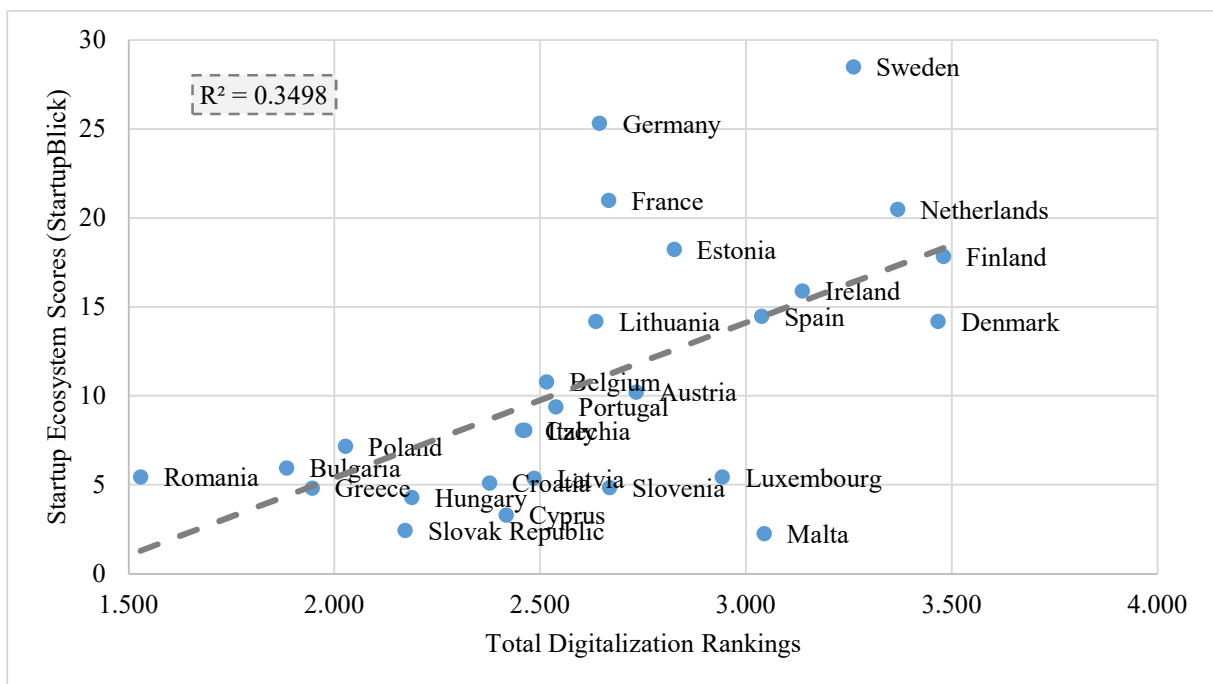
Total Digitalization Scores (left, source: DESI) and Total Ecosystem Scores (right, source: StartupBlick)



Note. Superimposed onto a map of Europe, higher scores are darker. Own depiction.

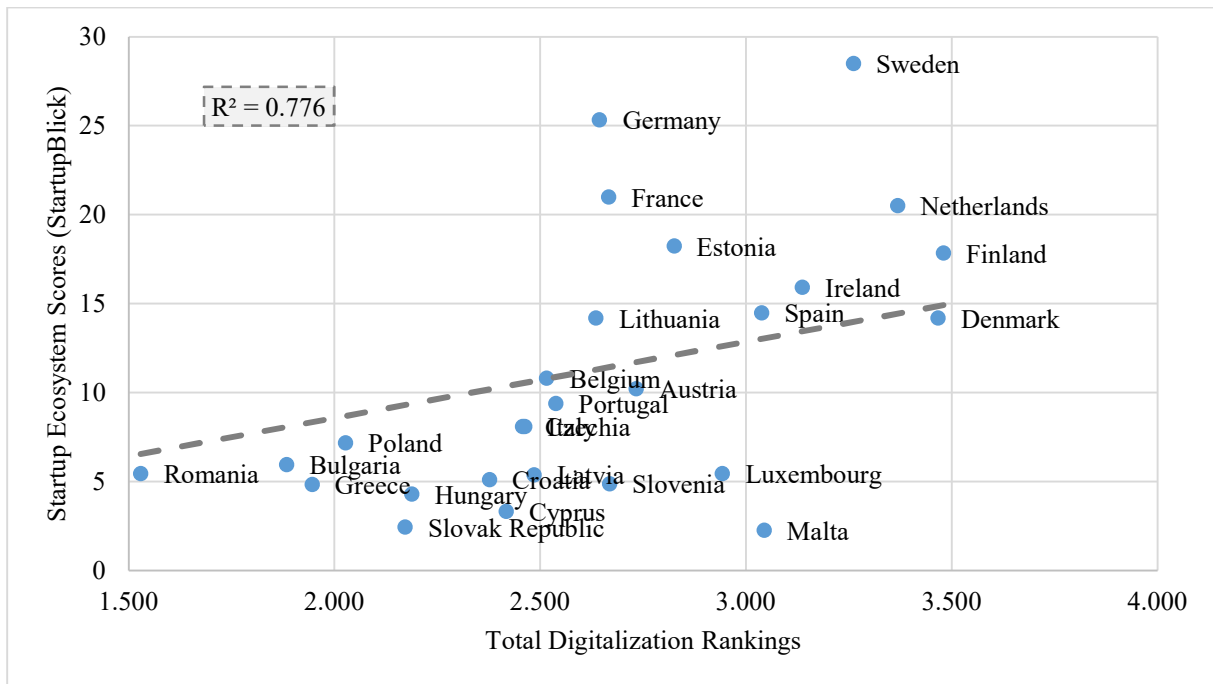
**Figure 3**

Correlation between StartupBlick Scores and Total Digitalization Rankings without Fixed Intercept



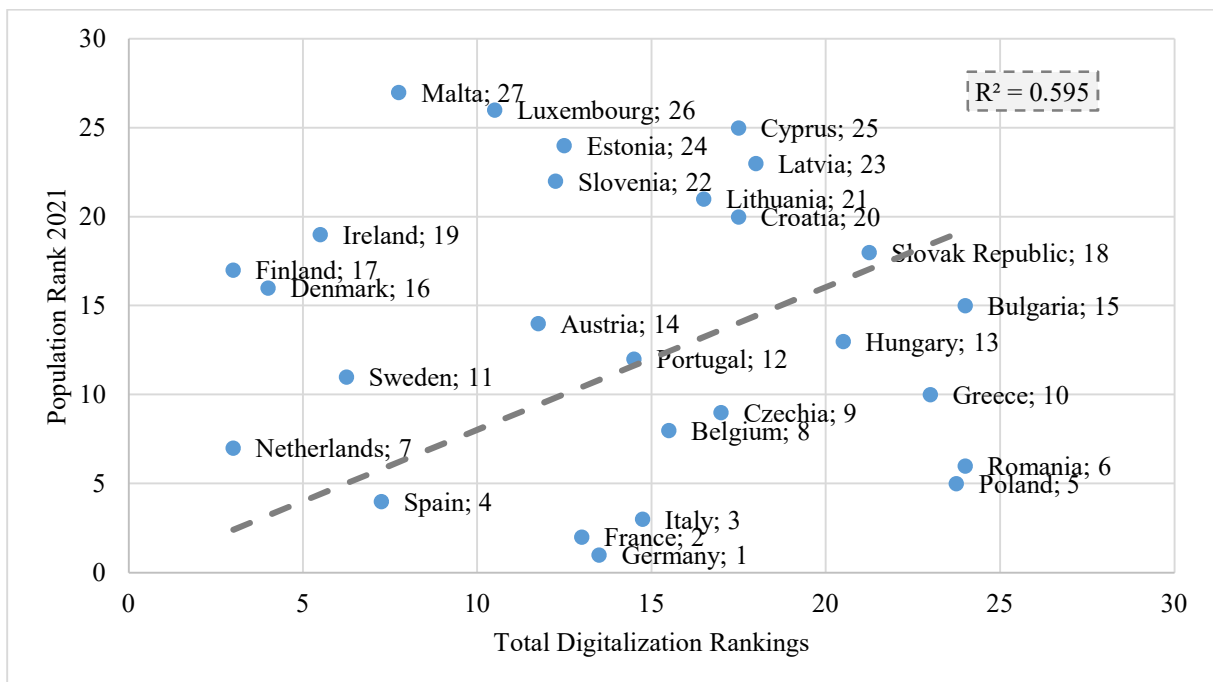
Note. R2 value of 0.3498, intercept not fixed.

**Figure 4:**  
*Correlation between StartupBlick Scores and Total Digitalization Rankings with Fixed Intercept*



Note. R2 value of 0.776 with intercept set to (0,0).

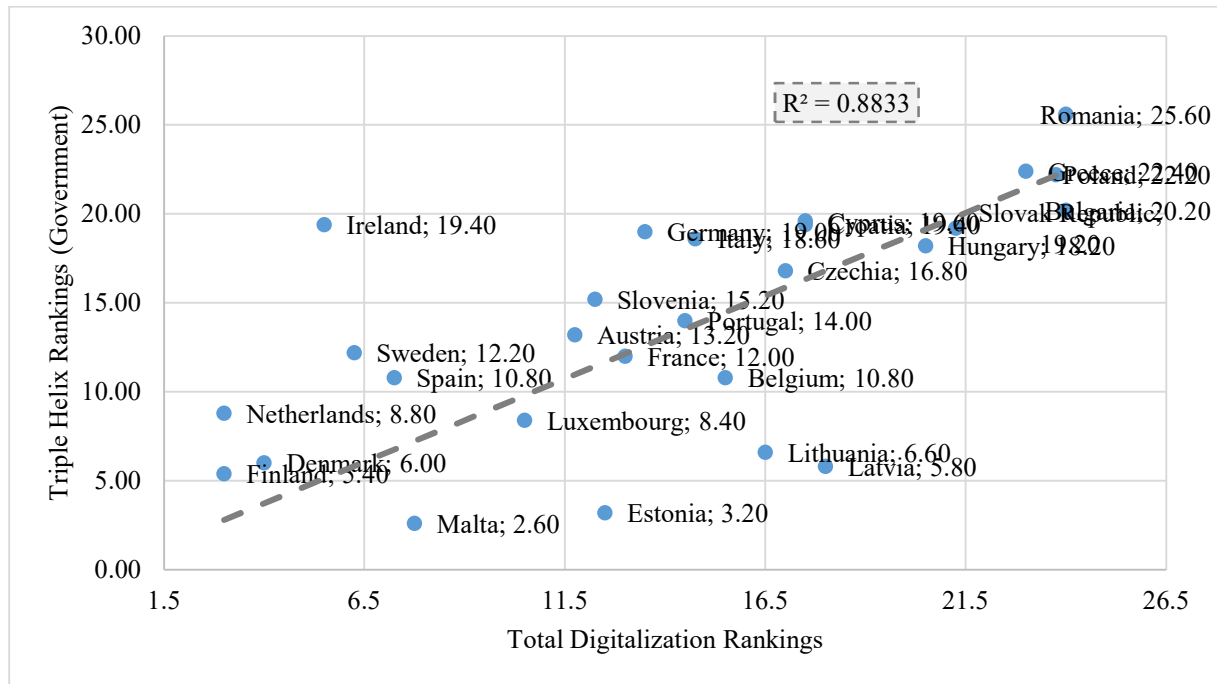
**Figure 6**  
*Correlation between Population Rankings and Total Digitalization Rankings*



Note. R2 = 0.595 with intercept set to (0,0).

**Figure 8**

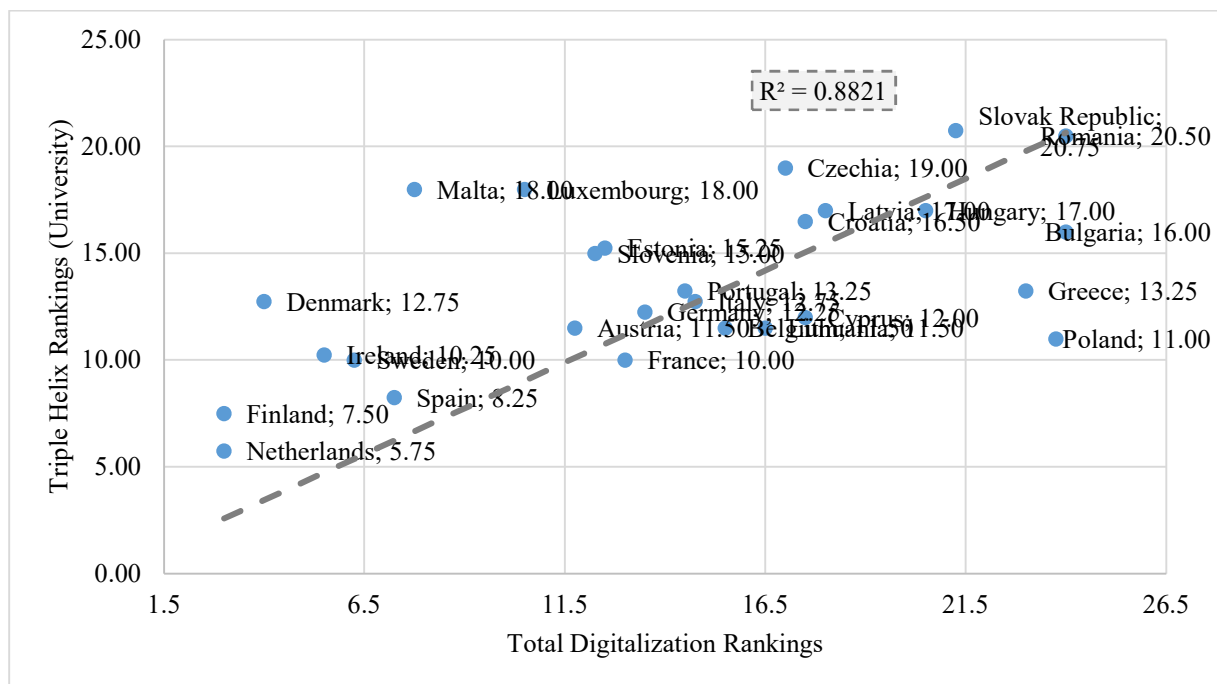
*Correlation between Triple Helix Rankings (Government) and Total Digitalization Rankings*



Note. R2 value of 0.7104 with intercept set to (0,0).

**Figure 9**

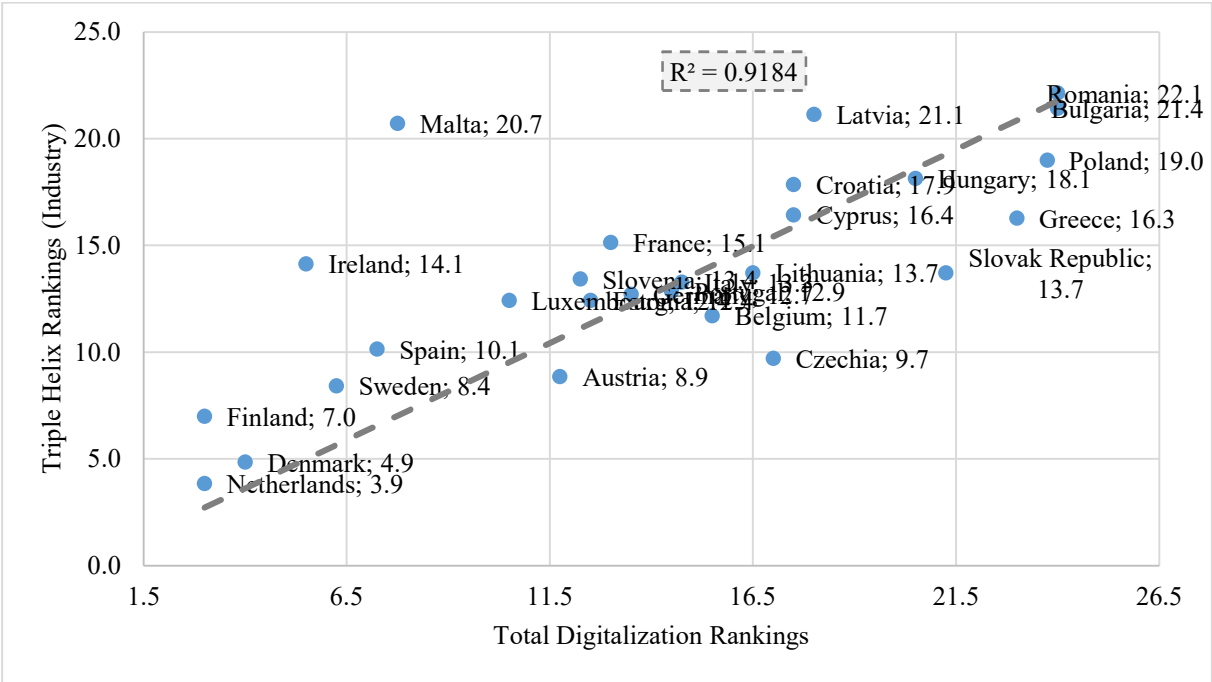
*Correlation between Triple Helix Rankings (University) and Total Digitalization Rankings*



Note. R2 value of 0.8432 with intercept set to (0,0).

**Figure 10**

*Correlation between Triple Helix Rankings (Industry) and Total Digitalization Rankings*



*Note.* R2 value of 0.7811 with intercept set to (0,0).

**Figure 11**  
*Total Digitalization Rankings Over Time per Country*

