CHAPTER 3.3

BUSINESS DYNAMICS AND ITS CONTRIBUTION TO STRUCTURAL CHANGE AND PRODUCTIVITY GROWTH

KEY FIGURES

20 %
EU business churn rate

1 in 10
active enterprises in the EU are high-growth enterprises

12 %
of EU high-growth enterprises in HT, MHT manufacturing and HT knowledge-intensive services

7 %
of 'today's unicorns' are based in the EU

2 %
of EU unicorn founders are women

7/30
top global startup ecosystems are in the EU

What can we learn?

- **The decline of business dynamism may hamper productivity growth**.
- **Most jobs created by new firms emerged in less-productive sectors** of the economy albeit some progress over time.
- **Slightly more than 1 in 10 enterprises in the EU are high-growth enterprises;** only a small share is 'high-tech'.
- **EU's scaling-up performance lags behind the United States and China**, including in the presence of tech scaleups and unicorn companies.
- **Unicorns are very geographically concentrated**: in the EU in Germany, in the US in California, in China in Beijing. Looking into **'hidden' radical innovators** broadens the understanding of the state of innovation across the EU and its regions.
- **'EU DNA' unicorns** with headquarters in the United States and the United Kingdom and their (co-)founders tend to keep strong connections 'back home' with benefits also to the country of origin.
- There are considerable **intra-EU differences in entrepreneurial quality and motivation**.
- **The EU has seven ecosystems in the world's 'top 30' startup ecosystems** compared to 12 in the United States and only 3 in China.
- Despite some progress, a **gender gap remains among founders of innovative startups**.
- The **presence of zombie firms** is still problematic in some EU Member States.

What does it mean for policy?

- **Improve overall framework conditions for innovation**, including access to risk finance and deepening the Single Market to ensure the scaling-up of 'made in EU' disruptive ideas, and their permanence in the EU, while maintaining a global outreach.
- **Tackle the startup gender gap**, beyond the classical market failures.
- **Boost the resilience and integration of startup ecosystems to reach greater critical mass**, with a strategic vision that builds upon the EU's industrial strengths and tackles societal challenges linked to the ambitions of the EU Green Deal.
- A **'tech-with-a-purpose' approach** would leverage R&I to create the solutions that match the urgency of the environmental and social challenges of our time.

1. Declining business dynamism may hamper productivity growth

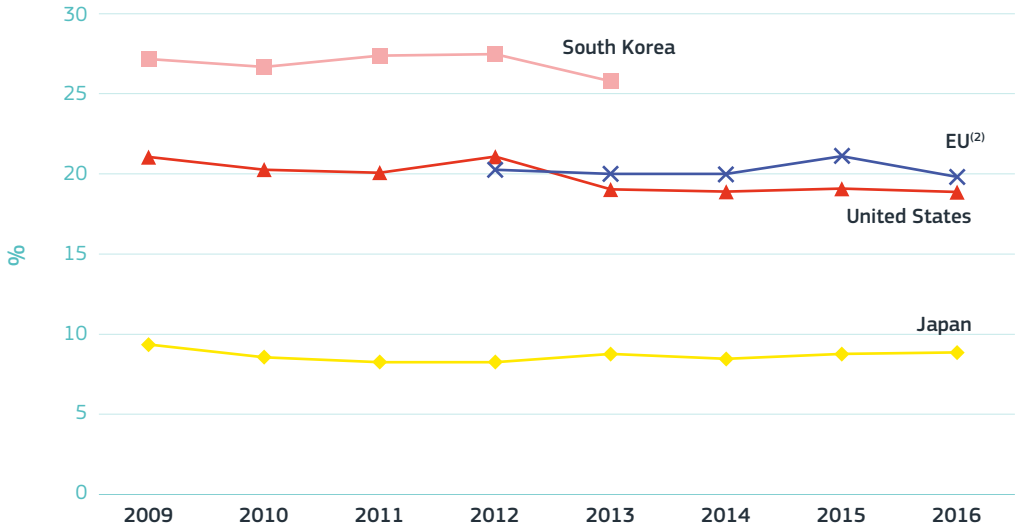
Business dynamism, via the process of creative destruction, can contribute to productivity growth and a more robust economy. An economy's business dynamism can be examined through a set of different measures, such as firm entry and exit rates, churn, and job reallocation rates (i.e. the simultaneous creation and destruction of jobs (Calvino et al., forthcoming)). Economic theory shows that an economy that exhibits higher firm dynamics will in principle be more innovative and productive.

Joseph Schumpeter coined the term 'creative destruction' in 1942. Acemoglu (2008) also refers to the importance of creative destruction for growth. The thesis is that an economy where resources move from less-productive to more-productive businesses within industries will show higher productivity growth (Decker et al., 2016) via a more efficient allocation of resources in the economy. Put differently, it assumes that new businesses will introduce new products and services and challenge older businesses to adapt and compete and will eventually replace them. Bauer (2020) found that higher entry rates improve productivity growth and that net entry contribution is an important driver of productivity. Moreover, Criscuolo et al. (2014) highlight the role of startups in job creation by demonstrating that young firms contribute disproportionately to net employment creation.

In this chapter, we look into recent and longer-term trends across different measures of business dynamism in Europe, benchmarking with other major economies, and we discuss the implications these developments may have for innovation, productivity and growth prospects. In addition, we analyse the state of play of innovative entrepreneurship on the continent as well as some enabling conditions for the success of European entrepreneurs.

In recent years, business dynamism has stagnated and even declined in the EU and/or its international competitors. This may limit its contribution to productivity growth. Figure 3.3-1 depicts the evolution of business churn in the EU and in other major economies between 2009 and 2016, depending on data availability. Business dynamism is highest in South Korea and lowest in Japan. Over time, churn rates seem to have stagnated in Japan and the EU, while in the United States and South Korea a slight decline is more evident after 2012.

Figure 3.3-1 Business churn of employer enterprises (%)[1] by region, 2009-2016



Science, research and innovation performance of the EU 2020

Source: Eurostat (online data code: bd_9fh_sz_cl_r2), DG Joint Research Centre, OECD

Notes: (1)Business churn is the sum of birth and death rates of employer enterprises i.e. enterprises, with at least 1 employee. (2)EU was estimated by DG Research and Innovation.

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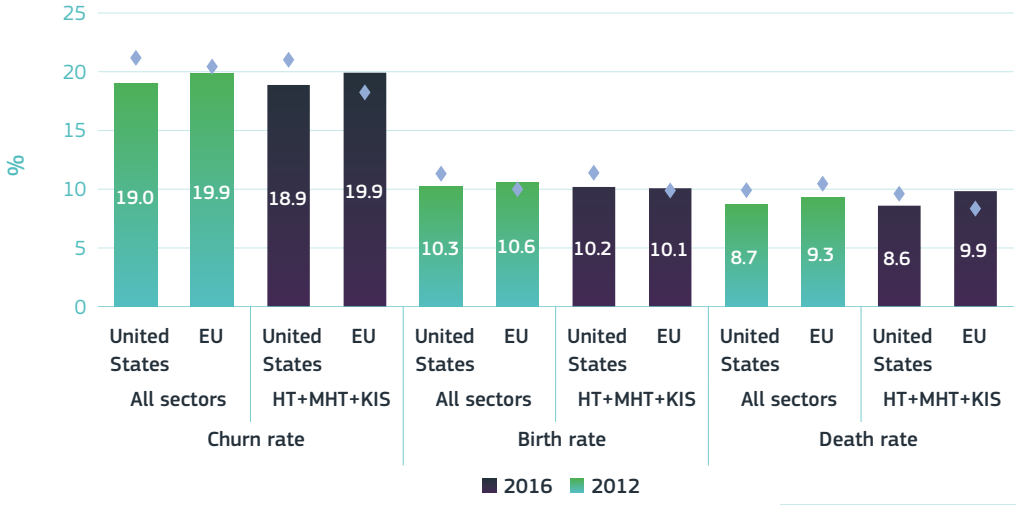
The EU exhibits slightly higher business dynamism than the United States. The combined dynamics in high- and medium-high-tech manufacturing and knowledge-intensive services are similar to those of the overall economy. In 2016, the EU's economy was somewhat more 'dynamic' than the United States, both in all sectors and in high- and medium-high-tech manufacturing (HT, MHT) and knowledge-intensive services (KIS) sectors (Figure 3.3-2). This was mainly due to slightly higher company death rates in the EU. Between 2012 and 2016, there appears to have been a stagnation in EU business dynamism, and a small increase in the HT, MHT and KIS sectors derived from higher death rates in these sectors. The United States experienced a decline in business churn activity between 2012 and 2016 due to a slight contraction in both birth and death rates.

Some EU Member States have seen a decline in business churn activity over recent years, while overall increases were more visible in EU-13 countries. Figure 3.3-3 depicts the evolution of churn rates between 2010 and 2017. Business churn declined in some Member States during this period. Hungary, Poland, Bulgaria, Estonia and Croatia had the highest churn in 2017, while Belgium, Ireland, Greece and Malta showed the lowest business dynamism and have not made any progress compared to 2010. The largest increases were in Hungary (mainly due to much higher company death rates), Poland and Romania. Denmark stands out as a country with high birth rates and relatively low death rates. The United Kingdom and Norway registered increases in business churn, while Turkey experienced the largest decline in the group of associated countries represented in the graph.

Figure 3.3-2 EU-US comparison of churn, birth and death rates, all sectors and in high- and medium-high-tech manufacturing, and knowledge-intensive sectors, 2012 and 2016



Science, research and innovation performance of the EU 2020

Source: Eurostat (online data code: bd_9fh_sz_cl_r2), DG Joint Research Centre

Note: (1)EU was estimated by DG Research and Innovation and excludes Cyprus.

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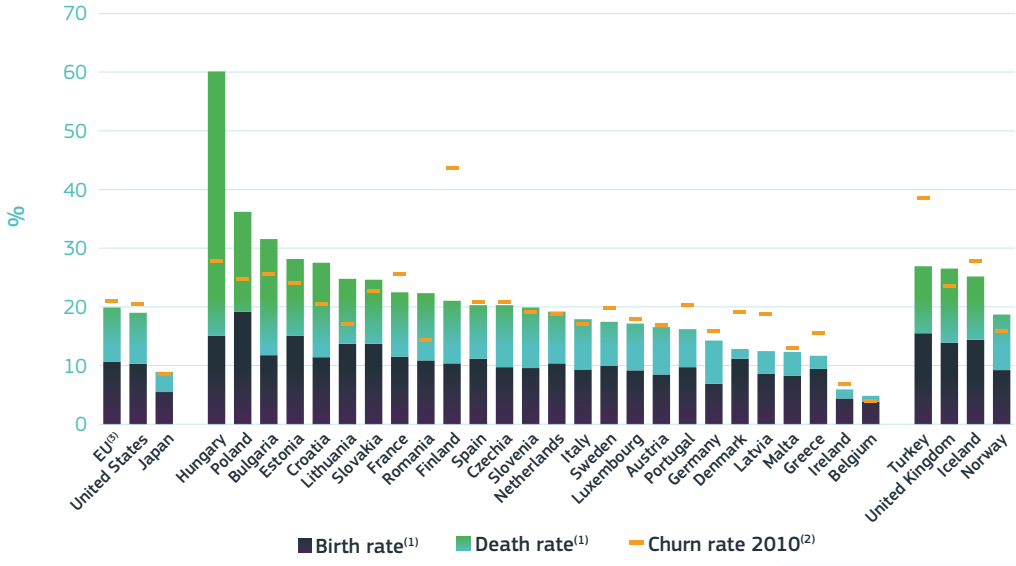
Figure 3.3-3 Churn rate (birth rate plus death rate) of employer enterprises, 2017 and total churn rate 2010(1)



Science, research and innovation performance of the EU 2020

Source: Eurostat (online data code: bd_9fh_sz_cl_r2), DG Joint Research Centre, OECD

Notes: (1) EU, CZ, IE, FR, HU, MT, PL, RO, SK, TR, US, JP: 2016. (2)EU, BE, BG, DK, DE, HR, MT, PL, SK, FI, SE, UK, NO, TR: 2012. IE: 2014 EL: 2015. (5)EU was estimated by DG Research and Innovation and excludes Cyprus.

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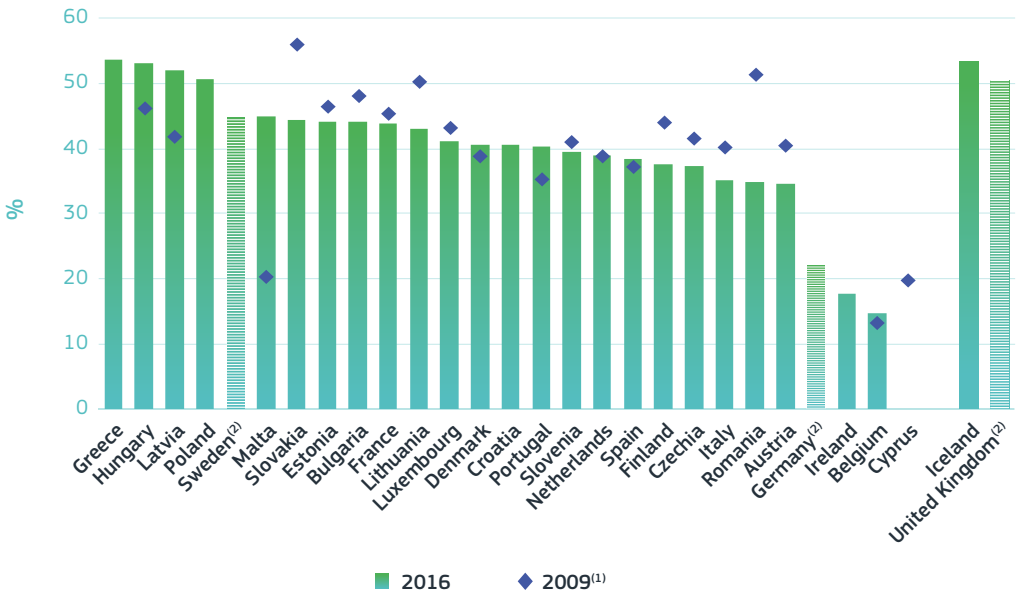
The presence of young companies in EU Member States ranges from more than half in Greece to only slightly over 10% of employer enterprises in Belgium. Startups (defined here as young companies up to five years old) constitute more than half of employer enterprises in Greece, Hungary and Latvia, and less than one fifth in Ireland, Belgium and Cyprus (Figure 3.3-4). In Iceland and the United Kingdom, startups comprise more than 50% of enterprises. In most EU Member States (for which either 2009 or the earliest year is available) the share of startups in the economy contracted. The biggest declines were registered between 2009 and 2016 in Romania, Slovakia and Lithuania, while increases were more pronounced in Malta, Latvia and Hungary. Chapter 8 - Framework conditions provides an overview of the framework and market conditions that may partly explain these cross-country differences.

The evolution of enterprise birth rates across the EU reveals a mixed pattern. As expected, the evolution of job creation by new firms correlates positively with birth rates. There are considerable cross-country differences in terms of job creation rates. Employer enterprise birth rates have not yet reached pre-crisis rates in some EU Member States such as France, Luxembourg, Latvia, Romania and Slovenia. On the other hand, in Spain, Lithuania, Estonia, Slovakia and Hungary, birth rates have surpassed those before the crisis. In a few Member States, like Austria, Belgium, Germany, Portugal and Sweden, birth rates seem to be relatively stable. In 2017 (or latest year available), enterprise birth rates ranged from 19% in Poland to only around 4% in Belgium and Ireland (Figure 3.3-4). In the United States, following a rise in 2012, birth rates appear to have slightly declined again.

Figure 3.3-4 Share of startups (up to 5 years old) in total employer enterprises, 2009 and 2016



Source: Eurostat (online data code: bd_9fh_sz_cl_r2)

Notes: (1)BE, BG, DK, CY, MT, NL, FI: 2012. FR, SK: 2013. (2)SE, DE and UK do not include the share of employer enterprises that are 5 years old due to data unavailability.

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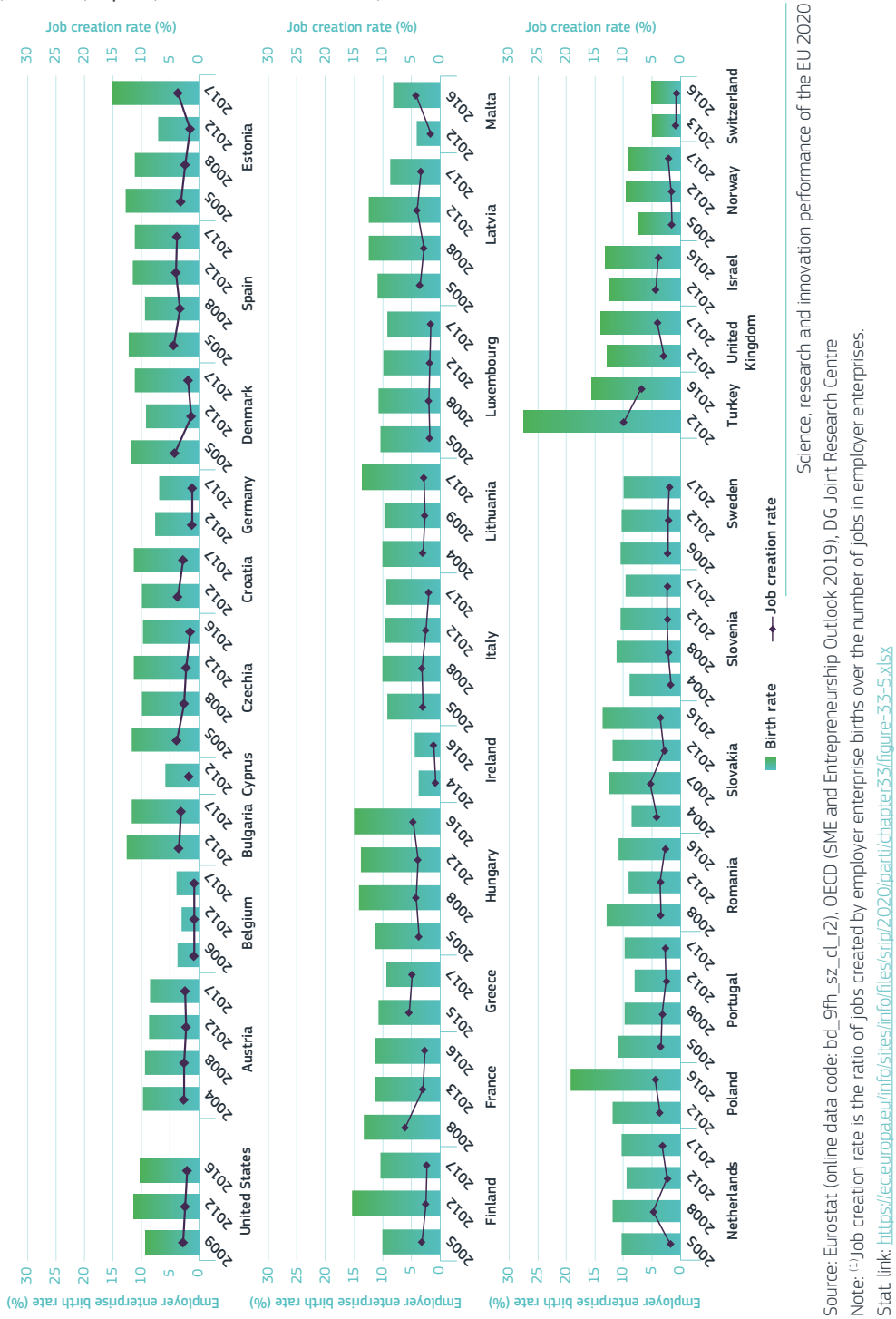
As expected, the evolution of job-creation rates among new employer enterprise births has more or less followed the evolution of enterprise birth rates. Job creation rates are the highest (above 4 %) in Hungary, Greece, Spain, Poland and Slovakia, compared to job-creation rates by the newly created enterprises covered of just 1 % or less in Belgium, Germany and Ireland. In the United States, job creation by new firms seems to be declining slightly.

Figure 3.3-5 Employer enterprise birth rates and job creation rates[1] (%), by country



Source: Eurostat (online data code: bd_9fh_sz_cl_r2), OECD (SME and Entrepreneurship Outlook 2019), DG Joint Research Centre for Science, research and innovation performance of the EU 2020

Note: [1] Job creation rate is the ratio of jobs created by employer enterprise births over the number of jobs in employer enterprises.

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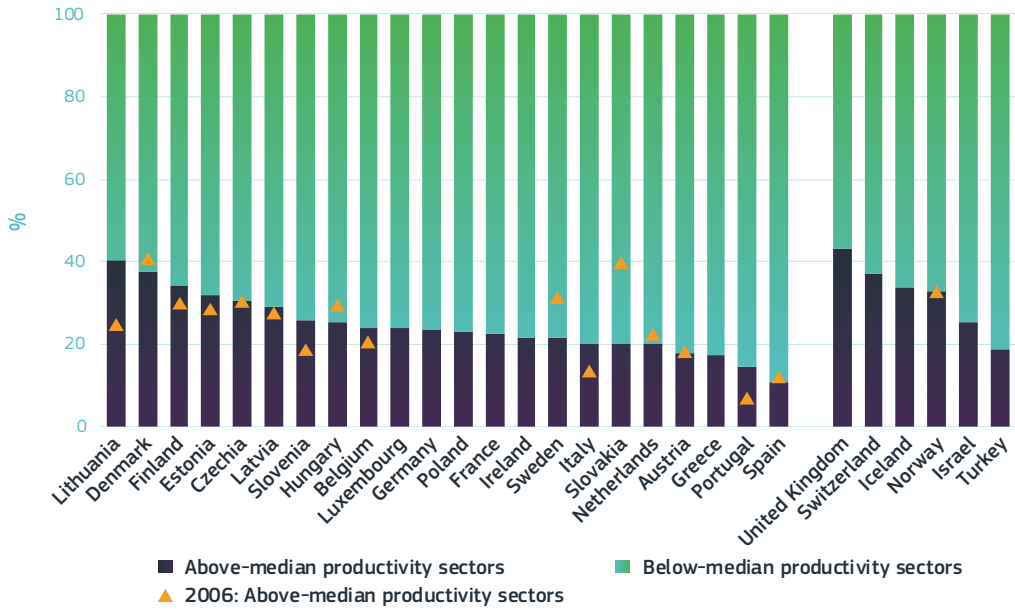
Most jobs created by new firms emerged in less-productive sectors of the economy. However, in some countries, there has been progress towards job creation in more-productive sectors. Figure 3.3-6 depicts the share of jobs created by new firms in above- and below-median productivity sectors in 2016 and compares it with 10 years ago (whenever country-level data is available). Lithuania, Denmark, Finland, Estonia and Czechia registered the highest percentages of new jobs created by new firms in above-median productivity sectors, with 30-40% of new jobs being created in sectors with higher productivity. A similar picture applies to the United Kingdom, Switzerland, Iceland and Norway. On the other hand, over 80% of jobs created by firm births in Spain, Portugal, Greece, Austria and the Netherlands were in lower-productivity sectors.

Nonetheless, since 2006, there has been an increase in the shares of jobs being created by new firms in more productive sectors in some countries. This is the case in Lithuania, Finland, Estonia, Czechia, Latvia, Belgium, Italy, Austria, Portugal and Spain. In the case of Lithuania, this increase almost doubled in percentage points. In other countries, such as Denmark, Hungary, Sweden, Slovakia, and the Netherlands, the contribution to new job creation from more productive sectors appears to have declined.

Overall, considering the link between productivity and wage-setting, it seems that most jobs created by new firms were in lower-productivity sectors and hence, in principle, were lower-paid jobs. As mentioned in OECD (2019), this may provide an explanation for

Figure 3.3-6 Percentage of jobs created by firm births in above- and below-median productivity sectors(1), 2016(2) and comparison with 2006 share for above-median productivity sectors



Source: OECD SME and Entrepreneurship Outlook 2019

Notes: (1)Median productivity (as measured by valued added per person employed) is calculated at the sectoral level (ISIC Rev4) for each country and year. (2)2016 or latest year available.

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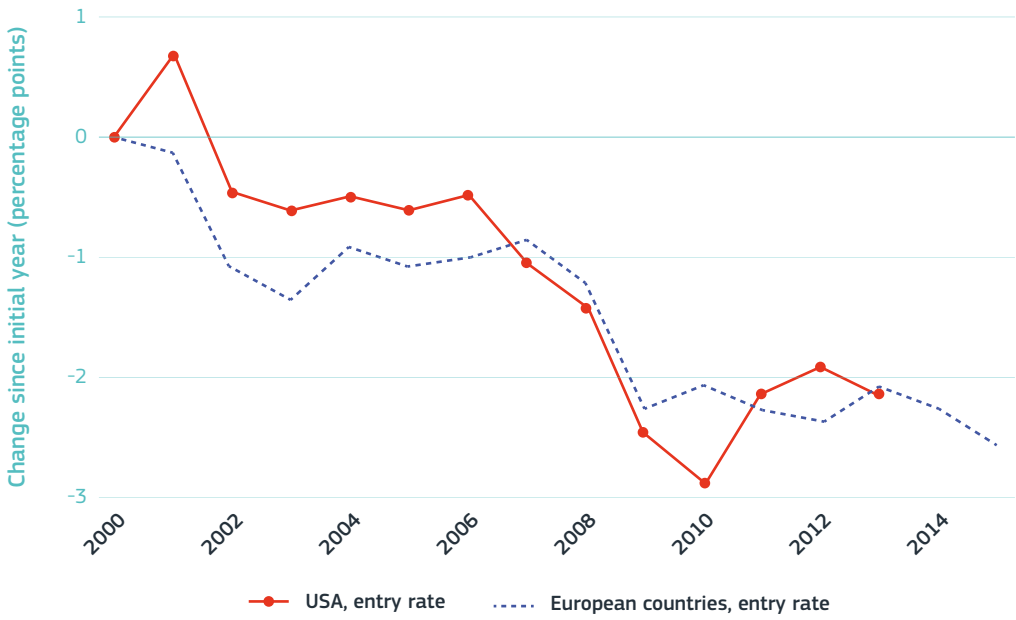
wage stagnation in many countries, despite the improvement in economic indicators, such as GDP growth and employment rates, since the crisis.

Longer-term analyses based on firm-level data are needed to better understand the evolution and impact of changes in business dynamism in the economy. Research points towards a decline of business dynamism in both Europe and the United States. As mentioned above, according to economic theory, stronger business dynamism can lead to a higher productivity-enhancing reallocation of resources in an economy and consequently can be a source of growth. Decker et al. (2016) showed the decline of business dynamism in the United States as well as a *reduction in high-growth entrepreneurship in the United States in the post-2000 period*. Calvino et al. (forthcoming) use microdata for a set of European countries and the United States to compute firm-level business dynamics within industries. Figure 3.3-7 confirms that since 2000 there has also been a decline in business dynamism, as measured by entry rates, in Europe. Bijnens and Konings (2018) found similar results for Belgium using 30 years of firm-level data.

Figure 3.3-7 Average cumulative changes in entry rates, selected European countries and comparison with the United States, 2000-2015



Source: Calvino et al (forthcoming)

Note: This figure reports within-country-industry trends of entry rates, based on the year coefficients of regressions within country-sector, for the period 2000-2015, conditional on data availability. European countries include BE, ES, IT, NL, AT, PT, SE, FI, UK, NO. Each point represents cumulative change in percentage points since 2000.

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However, understanding the direct causes and impact of declining business dynamism since 2000 is a complex exercise. Disentangling the impact of the slowing pace of job reallocation and entry rates on innovation and productivity, with certainty, can be a challenging task. For example, Decker et al. (2018) argue that to get the full picture about the slowing business dynamism it is important to consider the hypothesis that *changes in the business model within sectors may imply less need for a high pace of business formation and reallocation dynamics to achieve productivity growth*. Hence, existing firms may continue to be productive because of process, organisational and business model innovation. In fact, Aghion et al. (2016) showed that *innovation by existing firms contributed more to productivity growth than did innovation by entering firms*. Akcigit and Ates (2019) found that the explanation for declining business dynamism in the United States may lie in a decline in knowledge diffusion.

Business dynamics in digital sectors have received closer scrutiny in the literature due to concerns over market concentration in the digital sectors (Andrews et al., 2018). Calvino et al. (forthcoming) found that the higher the digital intensity of the sector, the larger the decline in entry and job reallocation rates (see Chapter 2 - Changing dynamics of innovation in the age of digital transformation). On finding a similar picture, Decker et al. (2016) concluded that there has been a decline in the contribution from reallocation to productivity growth since 2000, which has been particularly true in the high-tech sector.

Calvino et al. (forthcoming) shed more light on the impact of changes in the competitive environment on business dynamism measured by entry rates and job reallocation rates. On the impact of the business cycle, they find that it *plays an important role but the observed declines in dynamism do not seem to be a cyclical phenomenon only*. Furthermore, greater efficiency in contract enforcement and business regulations was found to be associated with stronger business dynamism. The authors also identified a negative association between the administrative burden on startups and entry rates. These aspects are further explored in Chapter 8 - Framework conditions.

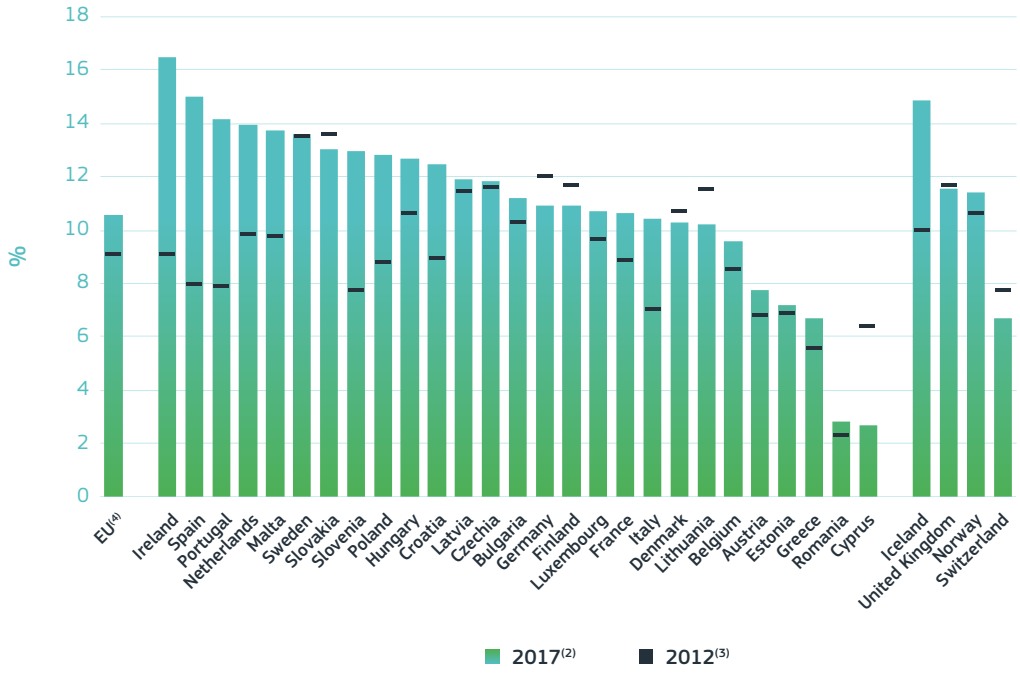
2. Europe's scaling-up performance needs revamping

Slightly more than 1 in 10 enterprises in the EU are high-growth companies. In many EU Member States, the representation of high-growth firms in the economy has increased. High-growth enterprises can be measured either in terms of employment or turnover growth. Since data are more commonly available for employment, this is the criteria we have applied – a high-growth enterprise has at least 10 employees and an average annualised employment growth of 10% or more per annum over a three-year period – which also follows the definition of Eurostat and the OECD. Grover Goswami et al. (2019) from the World Bank found that *high-growth firms are not only powerful engines of job and output growth but also create positive spillovers for other businesses along the value chain*. Daunfeldt et al. (2014) show that high-growth firms contribute disproportionately to new job creation. In the European Innovation Scoreboard, the European Commission (2019) also includes an indicator for employment in fast-growing innovative enterprises, following

the rationale that the spread of these high-growth enterprises in the most innovative sectors can potentially lead to structural change (see Chapter 6.3 – Innovation output and knowledge exploitation and valorisation).

Overall, the share of high-growth enterprises in Europe has increased between 2012 and 2017 (Figure 3.3-8). In 2017, in the EU, 10.6 % of the companies were recognised as high-growth enterprises. The share of high-growth firms ranged from nearly 17 % in Ireland to slightly less than 3 % in Cyprus. Between 2012 and 2017 (or 2016 depending on data availability), the largest increases occurred in Ireland, Spain and Portugal[1], while absolute declines were most pronounced in Cyprus, Lithuania and Germany[2].

Figure 3.3-8 Share of high-growth enterprises(1) in total active enterprises with at least 10 employees, 2012 and 2017



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Source: Eurostat (online data code: bd_9pm_r2)

Notes: (1)Enterprises with at least 10 employees at the beginning of their growth and having an average annualised growth in number of employees greater than 10 % per annum, over a three-year period. (2)EU, CY, CH: 2016. (3)FI: 2013. EL, CH: 2014. (4)EU was estimated by DG Research and Innovation.

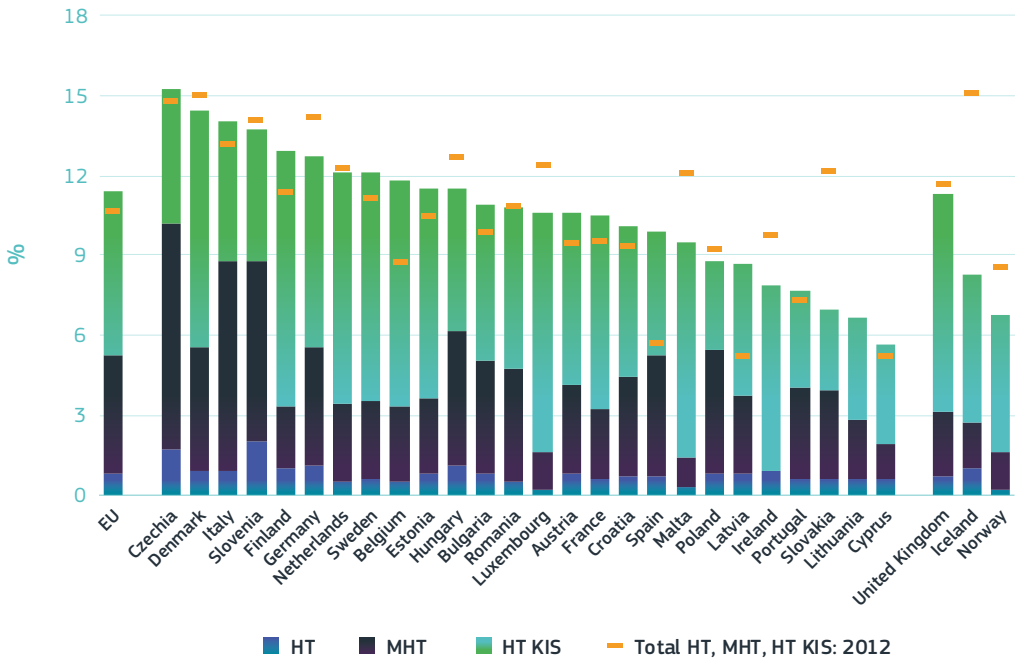
Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-8.xlsx

1 This may reflect business cycle fluctuations.

2 For more on high-growth firms see as well https://publications.jrc.ec.europa.eu/repository/handle/JRC119788

Less than 12% of all high-growth enterprises in the EU are in high-tech, medium-high-tech manufacturing and high-tech knowledge-intensive services, although there has been an increase in recent years. Figure 3.3-9 shows that most high-growth enterprises do not occur in high-tech, medium-high-tech manufacturing and high-tech knowledge-intensive services (KIS). In fact, their share ranges from around 15% in Czechia to 6% in Cyprus. There are also intra-EU differences in terms of the representation of high-tech KIS and high-tech and medium-high-tech manufacturing, which also reflects countries' economic structure. For example, in central, eastern and south-eastern European countries, such as Czechia, Slovenia, Hungary, Slovakia and Poland, medium-high-tech manufacturing accounts for almost half of the shares. On the other hand, in Ireland, Luxembourg, the Netherlands, Belgium, Sweden and France, high-tech KIS make the greatest contribution, of at least 70%. High-tech KIS also play an important role in the United Kingdom, Iceland and Norway. High-tech manufacturing has the lowest share in all countries.

Figure 3.3-9 Share of high-growth enterprises(1) in high-tech (HT) and medium-high-tech (MHT) manufacturing, and high-tech knowledge-intensive services (HT KIS) in total high-growth enterprises, 2017 and 2012 without breakdown



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on Eurostat (online data code: bd_9pm_r2)

Note: (1)Enterprises with at least 10 employees at the beginning of their growth and having an average annualised growth in number of employees greater than 10% per annum, over a three-year period.

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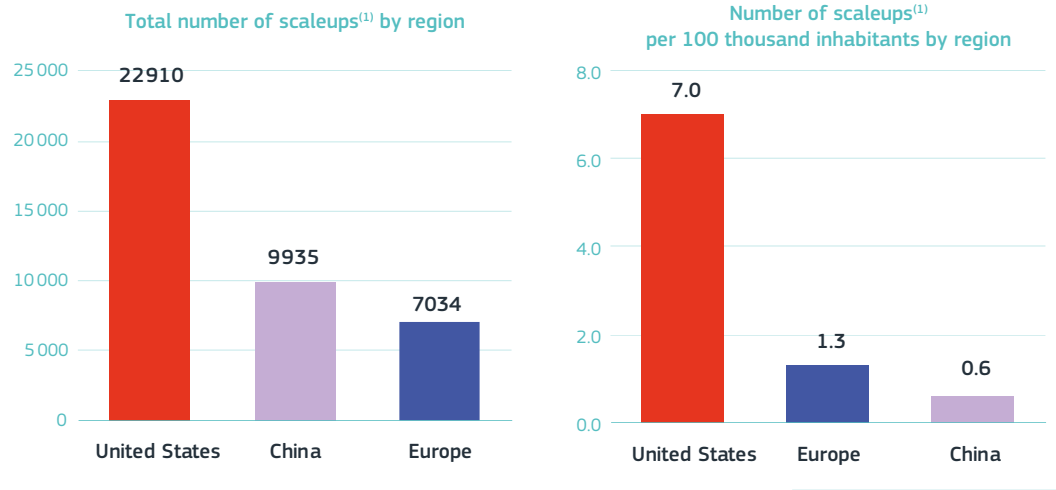
An alternative way to look into high growth concerns the amount of funding raised. Europe lags considerably behind the United States as regards the presence of tech scaleups. A scaleup is defined by Mind the Bridge (2019) as a tech company that has raised more than EUR 1 million in funding. Figure 3.3-10 compares the absolute and relative presence of these companies in Europe, the United States and China. Europe has a lower number of tech scaleups than the United States and China and, when standardised by population, it still lags behind the United States. As of 2018, there were 1.3 scaleups per 100 000 inhabitants in Europe compared to seven scaleups in the United States.

Figure 3.3-10 Total number of scaleups(1) and number of scaleups per 100 000 inhabitants, as of 2018



Source: Mind the Bridge - Tech Scaleup Europe 2019 Report

Note: (1)A scaleup is a tech company (i.e. a company - operating in Tech & Digital industries, founded in the New Millennium, with at least one funding event since 2010.Biotech, Life Sciences and Pharma, Semiconductors are currently not included in the scope of research) which has raised more than EUR 1 million in funding, as defined by Mind the Bridge (2019). (2) Europe includes EU Member States, and 18 other European countries (LI, NO, CH, RS, ME, BA, MD, XK, AL, IS, UA, BY, MK, UK, SM, MC, AD, VA). Removing the Top 5 non-EU Member States reduces the number of scaleups in the European aggregate substantially, to 4295.

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France, Germany and Sweden represent half of all tech scaleups in the EU. Figure 3.3-11 examines the distribution of tech scaleups within the EU. Just five EU Member States – France, Germany, Sweden, Spain and the Netherlands – account for nearly two thirds of all scaleups identified in the EU[3]. Furthermore, the number of UK and Israeli tech scaleups is higher than any EU Member State.

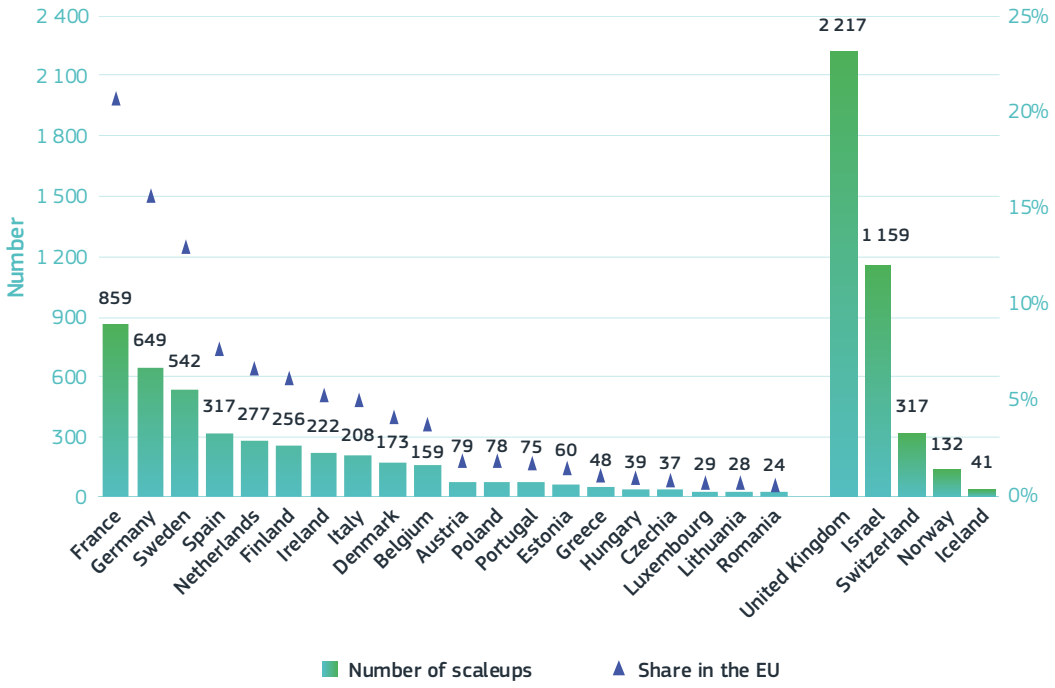
When it comes to transformational entrepreneurship with a global outreach, the EU trails behind the United States and China. For example, for each private

3 These are mostly the largest Member States in terms of population, firms and GDP, so it would be expected that they also account for more tech scaleups as well (size effect).

unicorn in the EU, there are seven in the United States and four in China. As mentioned by the European Commission (2018), the term 'unicorn' was first coined by Aileen Lee in 2013[4] following the emergence of a 'rare' group of companies that was experiencing spectacular growth and had reached a post-money valuation of more than USD 1 billion.

As of January 2020, there are 439 companies worldwide with private unicorn status. Of those, nearly half (or 215) are based in the United States, around a quarter in China (or 101), and 7 % (or 29) are in the EU (Figure 3.3-12). This gap is also evident when looking into the geographical distribution of the total valuation of private unicorns: US unicorns account for 49 %, Chinese unicorns for 29 %, and EU unicorns are only 4 % of the total. When standardising the number of unicorns per million population, the gap relative to both the United States and China remains although the EU's performance comes very close to China[5].

Figure 3.3-11 Total number of scaleups(1) and share in the EU (%), as of 2018



Science, research and innovation performance of the EU 2020

Source: Mind the Bridge - Tech Scaleup Europe 2019 Report

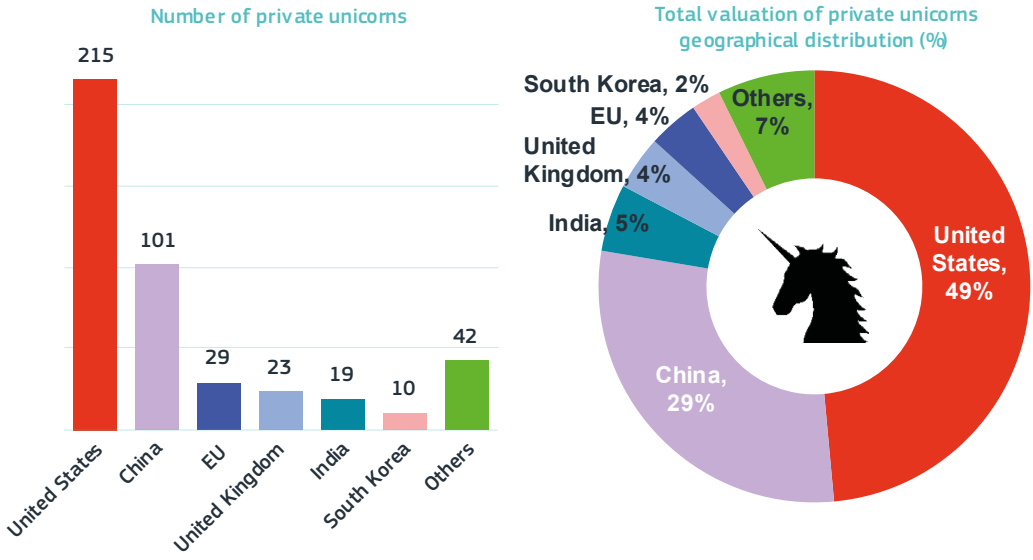
Notes: (1)A scaleup is a tech company which has raised more than EUR 1 mn in funding. (2)EU average was calculated with the available countries.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-11.xlsx

4 https://techcrunch.com/2013/11/02/welcome-to-the-unicorn-club/

5 Using population data for 2018 from the World Development Indicators, we find the following results for unicorns per million population: United States (0.7), China (0.07) and EU (0.06).

Figure 3.3-12 Private unicorns[(1)], January 2020



Science, research and innovation performance of the EU 2020

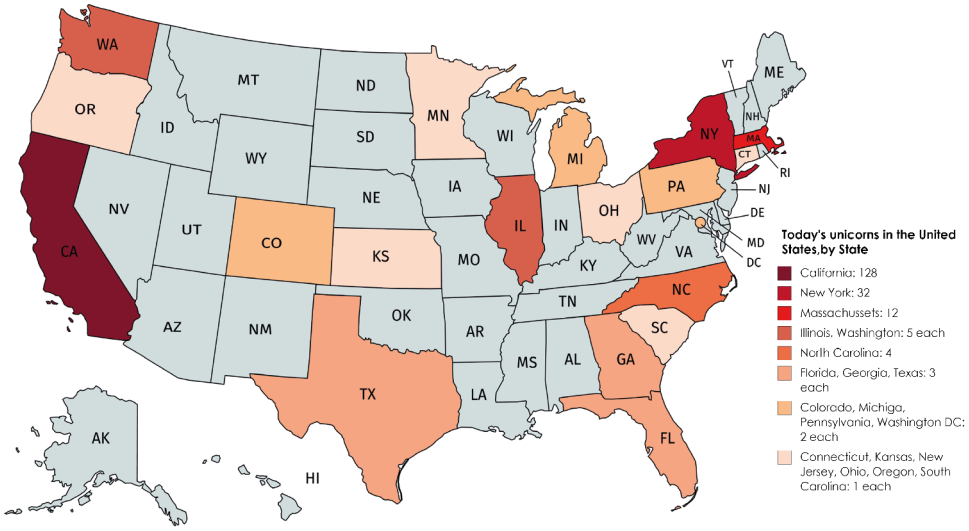
Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on CB Insights-Unicorn tracker, accessed on 24 January 2020

Note: [(1)]A private unicorn is a private company with a post-money valuation (i.e. 'after funding') valuation of more than USD 1 billion. Even though Kaseya and Collibra are not counted as private unicorns in CB Insights database, after checking Crunchbase and Linkedin company data a decision was made to include them as they are based in the EU. Image © martialred, #125077712; 2019. Source: stock.adobe.com

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-12.xlsx

'It's all about California'. The United States is home to most unicorns worldwide but they are highly concentrated in just three states – California, New York and Massachusetts. Together, these three states account for 82% of the country's current unicorns, with California alone being home to 60% of all US private unicorns (Figure 3.3-13). New York comes next with 31, followed by Massachusetts with 12 private unicorns. Of the 50 states, 20 (less than half) have at least one private unicorn. In California, San Francisco stands out thanks to the city's strong tech ecosystem which includes, for example, an experienced network of venture capital investors, a vibrant tech community and a pool of tech talent.

Figure 3.3-13 Today's 'unicorn land' in the United States



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on CB Insights-Unicorn Tracker, accessed on 6 January 2020. Created with mapchart.net©

Note: Today's unicorns are private unicorns at the date of extraction of the data. A private unicorn is a private company with a post-money valuation (i.e. 'after funding') of more than USD 1 billion.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-13.xlsx

'Unicorns: a tale of concentration'. The spatial concentration of unicorns is not only visible in the United States but also in the EU and China. Unicorns are usually 'born' in well-connected hubs where risk finance and talent are also more widely available. Unicorn companies are very capital-intensive and usually connected to global markets from the start (i.e. 'born-global' companies). For this reason, they tend to emerge in the top entrepreneurial cities where the network of investors, partners and academia is well established. Figure 3.3-14 shows the attractiveness of Germany, France and Sweden (in particular, Berlin, Paris and Stockholm) in the EU as together they account for 66 % of the EU's current unicorns. Moreover, as mentioned above, California (and notably San Francisco) is home to more than half of all US private unicorns and, together with the states of New York and Massachusetts, they represent 82 % of the US unicorn landscape. The high spatial concentration of unicorns in top urban centres also holds for China, with the municipality of Beijing currently home to almost half of all Chinese unicorns. Cumulatively, 82 % of Chinese private unicorns are based in Beijing, Shanghai and the province of Guangdong.

Unicorns are mostly present in fintech, internet software and services, e-commerce and, more recently, in artificial intelligence. Figure 3.3-15 displays the top 15 sectors where private unicorns can be found. Slightly more than half are in the top five sectors, i.e. fintech, internet software and services, e-commerce, artificial intelligence and health.

Figure 3.3-14 Top hubs of 'today's unicorns' by region, and share in the region (%)

Region	Top unicorn hubs	Share (% of 🦄 in region)
	**Top Member State: Germany**	**41 %**
	Top 3 Member States: Germany, France, Sweden/Spain	72 %
	**Top state: California**	**60 %**
	Top 3 states: California, New York, Massachusetts	82 %
	**Top province/municipality: Beijing municipality**	**46 %**
	Top 3 provinces/municipalities: Beijing, Shanghai, Guangdong	81 %

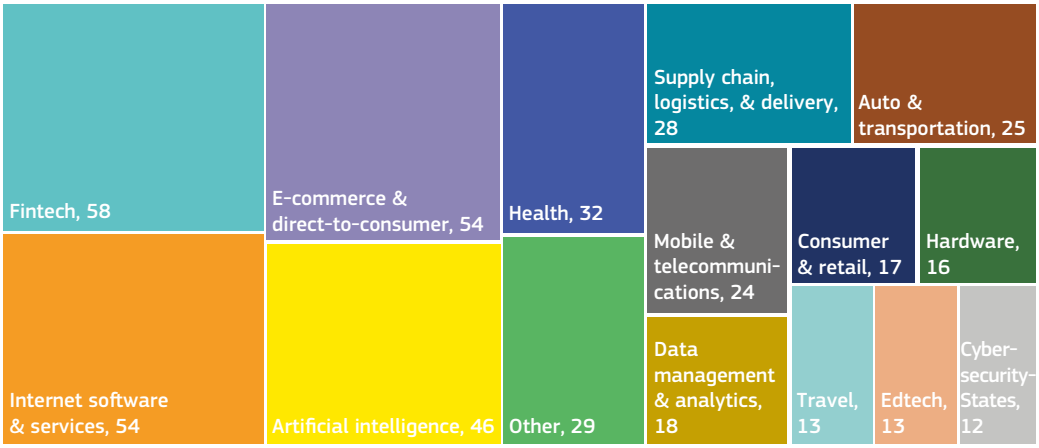
Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on CB Insights-Unicorn Tracker, accessed on 6 January 2020

Note: Today's unicorns are private unicorns at the date of extraction of the data. A private unicorn is a private company with a post-money valuation (i.e. 'after funding') of more than USD 1 billion.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-14.xlsx

Figure 3.3-15 Top 15 sectors(1) of private unicorns(2), January 2020



Science, research and innovation performance of the EU 2020

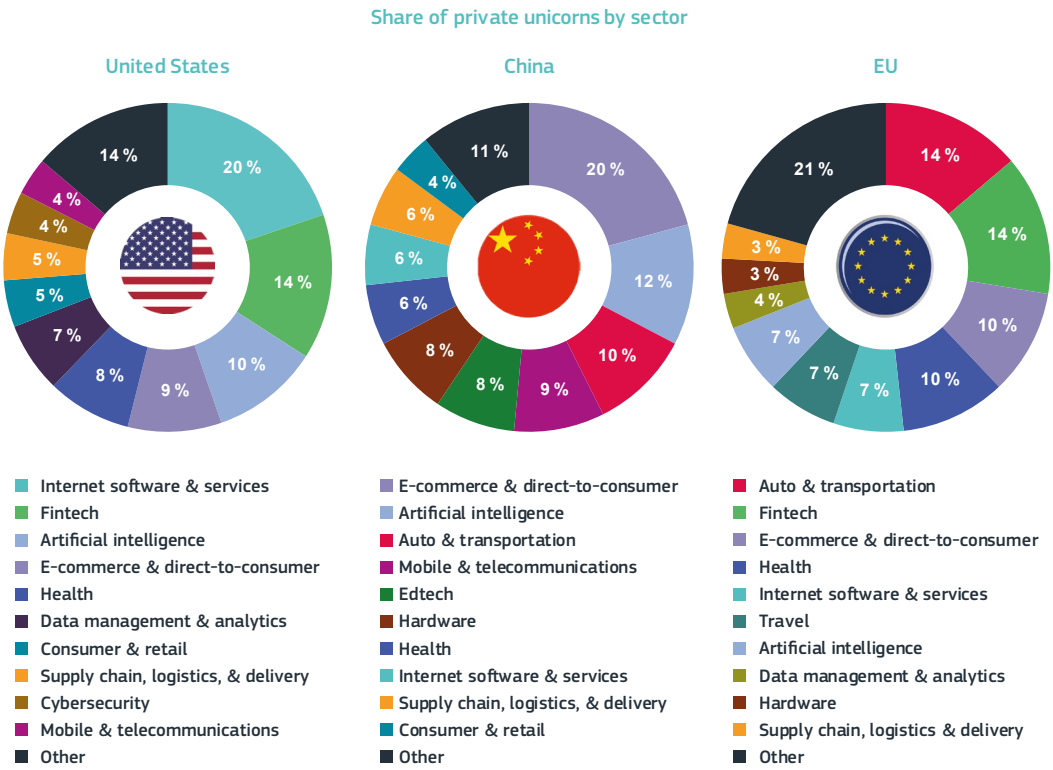
Source: Calculations based on CB Insights-Unicorn tracker, accessed on 21 January 2019

Notes: (1)Sectors were defined according to CB Insights classification. (2)A private unicorn is a private company with a post-money valuation (i.e. 'after funding') of more than USD 1 billion.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-15.xlsx

Figure 3.3-16 looks at the **sectoral distribution of private unicorns in the EU, United States and China**, with the same colours identifying the different sectors. The 29 EU private unicorns seem to be mainly present in auto and transportation (14%), fintech (14%), e-commerce (10%), health (10%), internet software and services (7%), and travel (7% each). In the United States, internet software and services (20%), fintech (14%), AI (10%), e-commerce (9%) and health (8%) are the 'top five' sectors accounting for slightly more than 60% of the country's current unicorns. The sectoral representation is somewhat different in China, where e-commerce (20%), AI (12%), auto and transportation (10%), mobile and telecomm (9%), educational technology, and hardware (8% each) have the largest weights, representing close to 70% of the current Chinese unicorn landscape.

Figure 3.3-16 Top 10 sectors of private unicorns (%) by region, January 2020



Science, research and innovation performance of the EU 2020

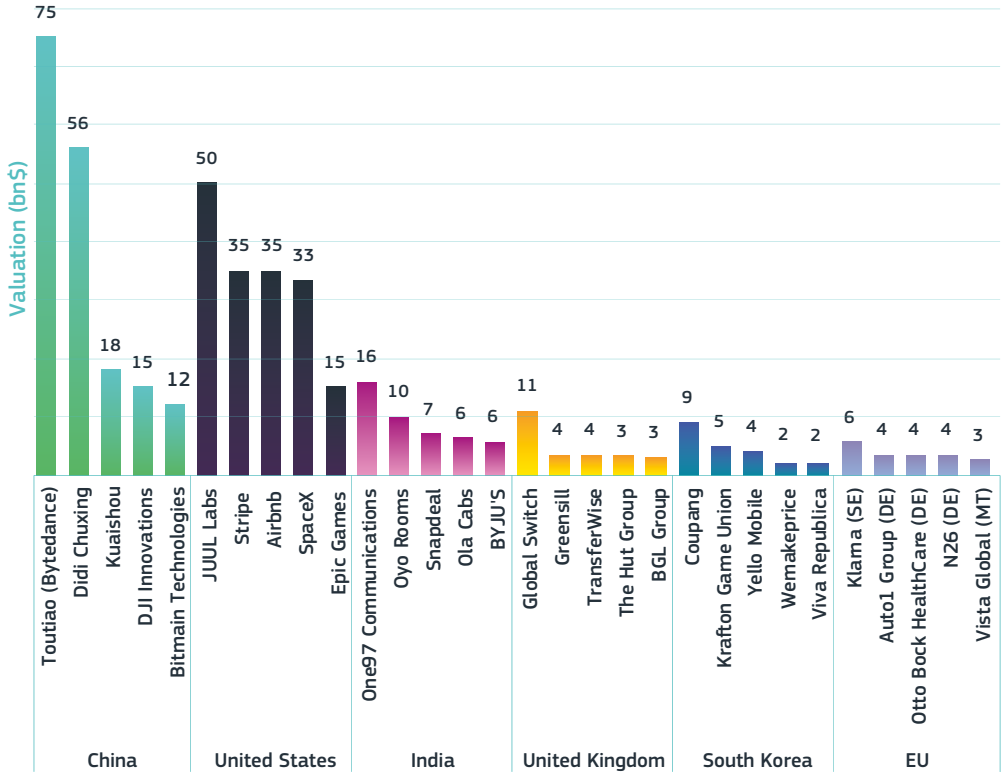
Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on CB Insights-Unicorn tracker, accessed on 21 January 2020

Note: A private unicorn is a private company with a post-money valuation (i.e. 'after funding') of more than USD 1 billion.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-16.xlsx

The gap between the EU and the United States and China becomes even more evident in the top most-valuable unicorns. The 'top five' private unicorns ranked by valuation in USD billion by region are presented in Figure 3.3-17. It can be seen that the most valuable private unicorns in the EU have significantly lower valuations when compared to other major economies such as the United States, China and India.

Figure 3.3-17 Top 5 private unicorns[(1)] in terms of valuation (USD bn) by region, January 2020



Science, research and innovation performance of the EU 2020

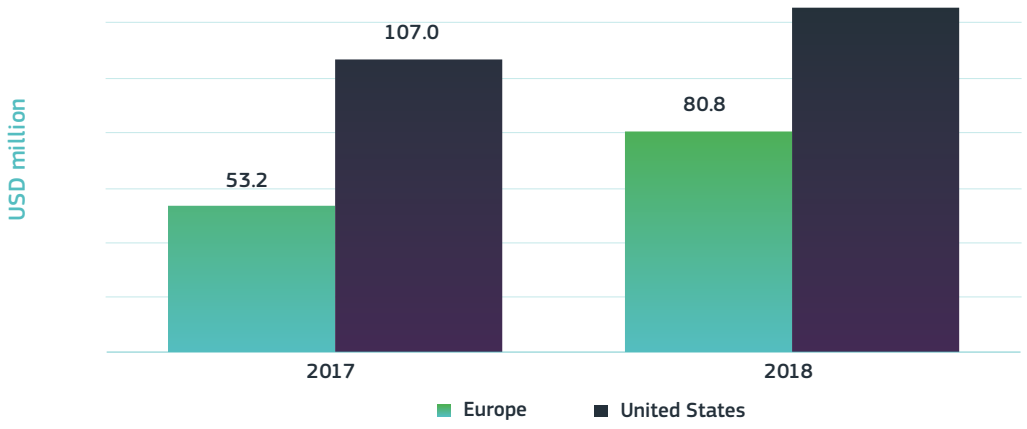
Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on CB Insights-Unicorn tracker, accessed on 21 January 2020

Note: [(1)]A private unicorn is a private company with a post-money valuation (i.e. 'after funding') of more than USD 1 billion.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-17.xlsx

Despite the gap in unicorns compared to the United States, European companies seem to have a 'greater efficiency at scaling' prior to reaching unicorn status at USD 1 billion. Figure 3.3-18 indicates that, prior to reaching unicorn status, European companies seem to be more capital efficient, i.e. they manage to reach the USD 1 billion valuation with less available capital. In other words, US unicorns seem to 'burn more cash' when developing their businesses before joining the unicorn club.

Figure 3.3-18 Median funding (in USD million) required prior to reaching private unicorn(1) status



Science, research and innovation performance of the EU 2020

Source: TechCrunch article 16/04/2019 'Unicorns a tale of two continents' based on Pitchbook

Note: The median funding secured prior to (not including) the round in which tech companies in the US and Europe achieved a USD 1 billion valuation during 2017/18.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-18.xlsx

When adding exited unicorns to the current number of private unicorns, the ratio relative to the United States increases slightly to 1:8 and improves relative to China. The previous figures only considered private unicorns. However, since 2009, there have been other unicorns that were either acquired or are no longer private because they went through an initial public offering (IPO).

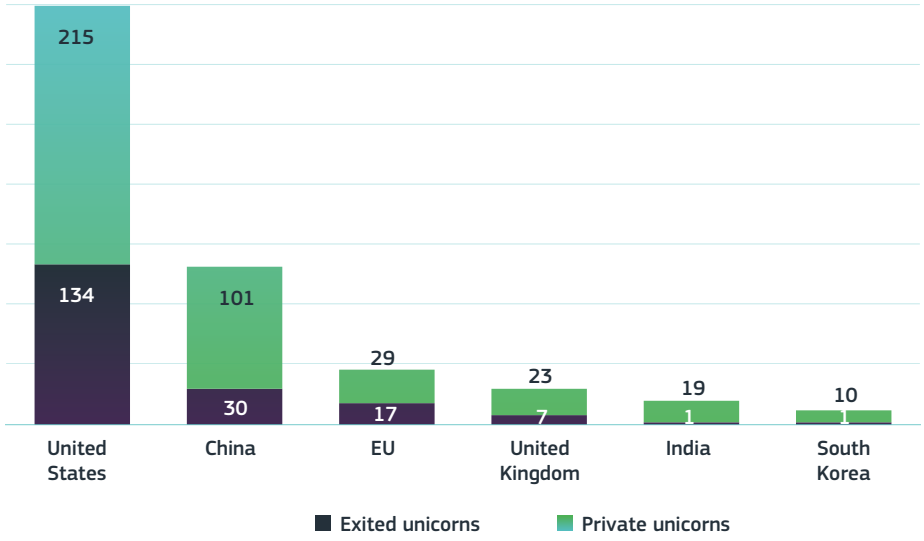
In Figure 3.3-19, we assess whether the gap relative to the United States and China would be smaller if the definition of a unicorn was expanded to include those that went public or were acquired by other companies. Thus, the ratio of EU unicorns to the United States slightly increases to 1:8, while relative to China it improves to 1:3.

In the EU, Germany is home to nearly 40% (or 17) of all unicorns. France and the Netherlands come next with six and five unicorns, respectively. Taking into consideration both private and exited unicorns, Figure 3.3-20 indicates that not all EU Member States have generated at least one unicorn; in fact, that has only happened in half of them. Nevertheless, as is highlighted later in this chapter, there is a group of 'EU DNA' unicorns which, even though they currently have their main headquarters in the United States or the United Kingdom, the (co)-founders have EU nationality and, in some cases, even started the company in a EU Member State.

Germany leads in the creation of unicorns with 5 exited unicorns (HelloFresh, Delivery Hero, Ganymed Pharmaceuticals, Rocket Internet and Zalando) and 12 private unicorns (Auto1 Group, Otto Bock Healthcare, CureVac, N26, NuCom Group, Celonis, About You, Omio, FlixBus, GetYourGuide, Deposit Solutions and wefox Group). France follows with six unicorns – BlaBlaCar, Deezer, Doctolib, OVH, Meero and Criteo – and the Netherlands with five – Adyen, Takeaway.com, Acerta Pharma, Dezima Pharma and Bitfury. The four Swedish unicorns are Spotify, iZettle, Klarna and Northvolt. The most well-known Finnish unicorns are Rovio

Entertainment and Supercell. Cabify and Glovo are the two Spanish unicorns. Ireland is represented by King Digital Entertainment and Kaseya[6]. Nine other EU Member States have produced (or are the headquarters of) one unicorn each: Avast Software (CZ), Sitecore (DK), Bolt (also known as Taxify) (EE), OCSiAl (LU), VistaJet (MT), OutSystems (PT) and Vinted (Lithuania), and Collibra (BE).

Figure 3.3-19 Exited(1) and private unicorns(2) by region, January 2020



Science, research and innovation performance of the EU 2020

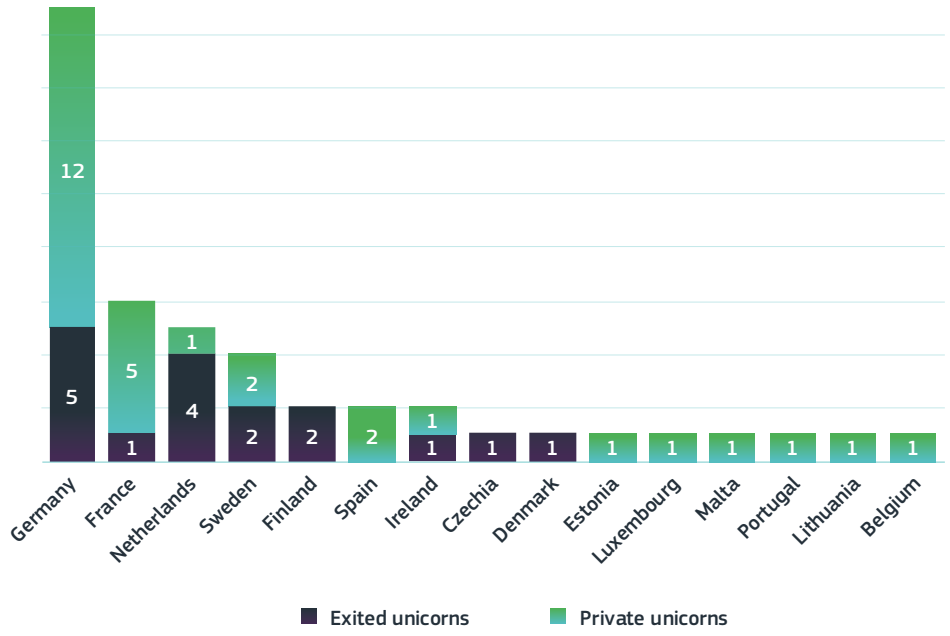
Source: CB Insights-Unicorn Tracker & The Unicorn Exits Tracker, accessed on 21 January 2020

Notes: (1)Exited unicorns since 2009 include private unicorns with one of the following exit strategies: IPO, Acquisition, Corporate majority, Merger, and Reverse Merger. CB Insights tracker includes first exits only. (2)A private unicorn is a private company with a post-money valuation (i.e. 'after funding') of more than USD 1 billion.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-19.xlsx

6 Kaseya was founded in the United States but is now Dublin-based.

Figure 3.3-20 Total unicorns - exited[(1)] and private[(2)] - in EU Member States, January 2020



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on CB Insights-Unicorn Tracker & The Unicorn Exits Tracker, accessed on 21 January 2020

Notes: [(1)]Exited unicorns since 2009 include private unicorns with one of the following exit strategies: IPO, Acquisition, Corporate majority, Merger, and Reverse Merger. CB Insights tracker includes first exits only. [(2)]A private unicorn is a private company with a post-money valuation (i.e. 'after funding') of more than USD 1 billion.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-20.xlsx

From north to south, east to west, there are examples of 'EU DNA' unicorns whose founders have established or moved their headquarters to the United Kingdom or the United States because of access to capital, market size or the intense network of investors and entrepreneurs. Some unicorn founders studied at top US universities and decided to start their companies in the United States. As mentioned before, the criteria typically used to attribute a country to each unicorn is the (current) location of the headquarters[7]. We have compiled a list of unicorns that are global successes and have EU-DNA – i.e. founders with EU nationality and/or who decided to start, or establish, or move their headquarters to the United Kingdom or the United States (Figure 3.3-21). However, this list may not be exhaustive.

For example, Farfetch´s Portuguese founder, Jose Neves, started the online luxury fashion platform in Portugal, with its headquarters currently in the United Kingdom. TransferWise, a fintech business, was created in Estonia by the Estonians Kristo Kaarmann and Taavet Hinrikus before being relocated to the United Kingdom even though their largest office

7 According to CB Insights and Crunchbase. Other sources attribute other criteria such as the place where the company reached unicorn status.

with over 800 people is in Estonia[8]. Unity technologies, a game development platform, was founded in Copenhagen in 2005 by David Helgason, Nicholas Francis and Joachim Ante, and is currently San-Francisco-based. The Irish brothers John and Patrick Collision founded Stripe in the United States after studying at Harvard University and the Massachusetts Institute of Technology (MIT). Stripe is currently one of the highest valued private unicorns which builds economic infrastructure for the internet.

One of Udacity's co-founders is an immigrant from Germany that started Udacity, an online education company based in the United States. Even though UiPath's headquarters are now in New York, the company keeps a very strong presence in Bucharest, where two Romanian entrepreneurs founded it. The founders of these unicorns typically hold diplomas from top US and European universities, and many of them had previous entrepreneurial activities and experiences.

Figure 3.3-21 Unicorns with 'EU DNA' in the United States and the United Kingdom

Unicorn	Type of EU DNA	Short company description	HQ	Valuation (USD bn)(1)	Founded in	Number of employees
1. Shazam	Co-founder Company born in the UK	App to identify any music playing around you	UK	1**	2000	n.a
2. Just Eat	Founders Company HQ relocated from DK to the UK	Access to delivery restaurants and online food orders	UK	6.6*	2001	1 970
3. Tradeshift	Founders Company relocated HQ from DK to the US	Cloud-based business network connecting buyers and suppliers	US	1.1	2009	976
4. Unity Technologies	Co-founder Founded in CPH, moved HQ to US	Game development platform	US	3	2004	2 605
5. TransferWise	Founders Company HQ relocated from EE to the UK	Money transfer service without hidden charges	UK	1.6	2011	1 400
6. Eventbrite	Co-founder Co-founder studied at Cornell Univ. Company born in the US	Self-service ticketing platform for events	US	1.5*	2006	1 075
7. Symphony Communica-tion Services	Founder Company born in the US	Integrated messaging platform	US	1	2014	346

8 https://transferwise.com/community/nextgeneration

Unicorn	Type of EU DNA	Short company description	HQ	Valuation (USD bn)[1]	Founded in	Number of employees
8. Tango	Co-founder Co-founder studied at Stanford Univ. Company born in the US	Mobile messaging service	US	1.1	2009	128
9. Oscar Health Insurance	Co-founder Co-founder studied at Harvard (MBA) Company born in the US	Health insurance	US	3.2	2012	973
10. Palantir Technologies	Co-founder Co-founder studied at Stanford Univ. Company born in the US	Software to connect 'data, technologies, people and environments'	US	11	2004	2 510
11. Udacity	Co-founder Company born in the US	Online education company	US	1.1	2011	2 112
13. Ginkgo Bioworks	Co-founder Co-founder studied at the MIT Company born in the US	Design custom microbes for customers across multiple markets	US	1	2009	264
14. Intercom	Founders Company born in the US	Develop and publish communications technology to monitor user behaviour	US	1.3	2011	882
15. Stripe	Founders Founders studied in Harvard and the MIT Company born in the US	Build economic infrastructure for the internet	US	35	2010	2 134
16. Compass	Co-founder Company born in the US	Technology-driven real estate platform	US	4.4	2012	n.d.
17. OfferUp	Co-founder Co-founder studied at the Univ. of Washington Company born in the US	Online classifieds	US	1.2	2011	326

Unicorn	Type of EU DNA	Short company description	HQ	Valuation (USD bn)[1]	Founded in	Number of employees
18. AppNexus	Co-founder Company born in the US	Cloud-based software for online advertising	US	2**	2007	n.a
19. Farfetch	Founder Company started in PT, HQ in the UK	Online luxury fashion retail platform	UK	2.9*	2007	3 232
20. Talkdesk	Founders Company born in the US	Enterprise Contact Center Platform	US	1	2011	704
21. UiPath	Founders Company relocated HQ from RO to the US	Design and develop robotic process automation software	US	3	2005	+3 000
22. Letgo	Founders Company relocated HQ from ES to the US	Second-hand shopping app to help users buy and sell locally	US	1	2015	321
23. Warby Parker	Co-founder Co-founder born in Sweden, raised in San Diego Co-founder studied at UC Berkeley, Wharthon School Company born in the US	Online prescription glasses and sunglasses	US	1.2	2010	1 322

Source: DG Research and Innovation, Unit for the Chief Economist - R&I Strategy & Foresight, based on multiple sources: Craft (access in December 2019), CB Insights, Crunchbase, LinkedIn profiles, companies' websites, the National Foundation for American Policy (2018), online news and media articles

Note: [1]All unicorns listed in the figure are private and hence the values correspond to post-money valuations. Exceptions are indicated with * concerning exited unicorns via an IPO (valuation corresponds to market capitalisation), and ** concerning exited unicorns that were acquired (valuation corresponds to the exit valuation before the acquisition took place). Information displayed in the figure is not exhaustive, so if corrections are needed please contact the authors. Figure displays unicorns ordered by country alphabetic order.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-21.xlsx

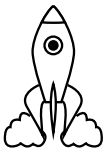
Nevertheless, in general EU DNA unicorn companies and (co-)founders tend to keep strong connections 'back home', which also benefits the country of origin. More generally, the European Commission (2017) investigated the growing phenomenon of dual companies (Onetti and Pisoni, 2016), i.e. high-tech startup companies founded in European countries before relocating their headquarters to outside of the EU, notably the United States. However, they typically maintain a presence (such as R&D labs) in their home country which benefits from positive externalities such as new job creation. The study concluded that 13% of European scaleups follow this 'dual model', and that for 83% of them the United States (in particular Silicon Valley) is the destination, a trend already mentioned in this chapter. For those that relocate within Europe, the United Kingdom is the top choice.

Although there are different reasons for relocating headquarters to the United States or United Kingdom, the most commonly identified are closer proximity to capital markets, an intense and experienced network of investors, and a larger market (see Chapter 8 - Framework conditions). Moreover, the authors' findings suggest that the more mature startup ecosystems (such as Germany, France, Sweden and the UK) show below-average numbers of dual companies (in the 11% to 13% range).

In this context, there are positive externalities to the 'home country' even when headquarters are relocated. This hypothesis holds true in the cases listed below (Figure 3.3-22). Benefits to the country of origin can include employing highly skilled professionals, as in the Tradeshift Frontiers Innovation Lab in Copenhagen or Stripe's new engineering hub in Dublin, participating as angels or seed investors in new startups, such as the founders of Talkdesk and TransferWise, or sponsoring digital education in less-developed regions, like UiPath in Romania, etc.

Some unicorns are highly R&D-intensive and have made it to the top global R&D investors, some despite their young age. Their presence is mainly in software and computer services and on average they have higher market capitalisation than the other top R&D-intensive companies in the sector. They are also less labour-intensive. Only 6 out of the 65 unicorns in the world ranking are from the EU.

Figure 3.3-22 Benefits and positive externalities to the EU country of origin

Type of benefit/positive externality to the home country		Examples from EU DNA unicorns with HQ in the USA and UK
	**Job creation**	**Offices and subsidiary(ies) in the home country[9]:** ▸ Farfetch: 1 500+ employees in Portugal ▸ Transferwise: 700+ employees in Estonia ▸ Letgo: 100+ employees in Spanish subsidiary ▸ Stripe: 100+ employees in Ireland ▸ UiPath: 700+ employees in Romania
	**Support of the startup ecosystem**	**Advice and mentoring from founders:** ▸ OfferUp: Co-founder is a startup advisor in the Netherlands **Seed and early-stage capital:** ▸ Talkdesk: Co-founder is an early-stage investor in Portugal ▸ Transferwise: Participation in seed capital funding for innovations including in secondary education in Estonia
	**R&D and innovation hubs**	**Launch of tech hubs in the home country:** ▸ Tradeshift: Tradeshift Frontiers Innovation Lab in Denmark ▸ Farfetch: Plans for a technology and operations campus in Porto ▸ Stripe: Engineering hub in Dublin ▸ UiPath: Immersion lab in Bucharest ▸ Intercom: large R&D team based at its Dublin office
	**Education and research**	**Education and cutting-edge research:** ▸ Tradeshift: Sponsors a PhD programme in machine learning in a Danish university ▸ UiPath: Foundation supports digital education in Romania ▸ Transferwise: Supports NGO Eesti 2.0 and practical mentoring to its students from Transferwise co-founder and others.

Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Unit of the Chief Economist - R&I Strategy & Foresight, based on ORBIS database as of September 2019, companies' websites, online news and media articles

Note: Information on employment was gathered from ORBIS database, accessed on 29-08-2019; Employment data for Farfetch (31/12/2018), Letgo (31/122017), Stripe (31/12/2017), UiPath (31/12/2017). The information displayed in the table is not exhaustive and might be outdated at the time of publication of the report. Should you identify any mistakes in the data please do not hesitate to contact the authors. Images © M.Style, _#125948076; 2019. Source: stock.adobe.com

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-22.xlsx

9 According to CB Insights and Crunchbase. Other sources attribute other criteria such as the place where the company reached unicorn status.

BOX 3.3-1 Zooming in on the top R&D-intensive unicorns

The criteria for being 'highly-R&D intensive' is based on a company's presence in the European Commission R&D Industrial Scoreboard which collects data on the world top 2 500 R&D investors. We start by looking at the spectrum of all unicorns (private and exited) since 2009 which are part of the top global R&D investors. This gives a total of 64 unicorns, up from 40 in the 2018 edition of this report (Figure 3.3-23). Figure 3.3-24 shows that a large majority (80 %) of these very R&D-intensive unicorns can be found in the United States, while only 5 (or 8 %) are in the EU, namely Spotify (Sweden), Yandex[10] (Netherlands), Zalando (Germany), Criteo (France), and AVAST Software (Czechia). As mentioned before, there is a considerable gap between the United States and the EU in terms of the creation of unicorn companies, which is also reflected in this analysis.

Figure 3.3-23 Number of unicorns in the world top R&D investors, SRIP 2018 vs. SRIP 2020

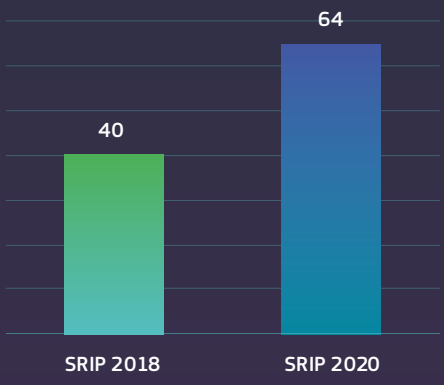
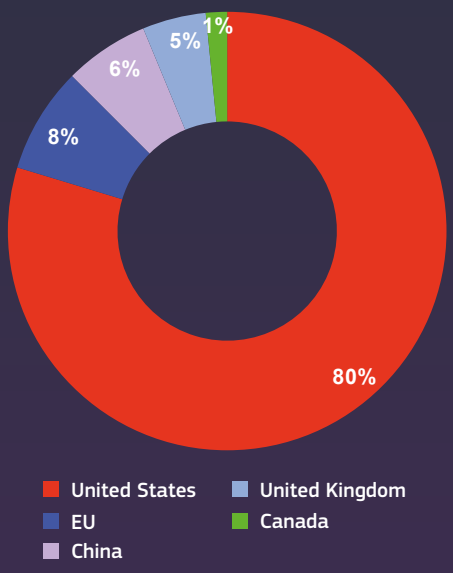


Figure 3.3-24 Geographical distribution of the 65 unicorns in the world top R&D investors



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on CB Insights - Unicorn and Unicorn Exit Trackers; European Commission (2019), R&D Industrial Scoreboard 2018

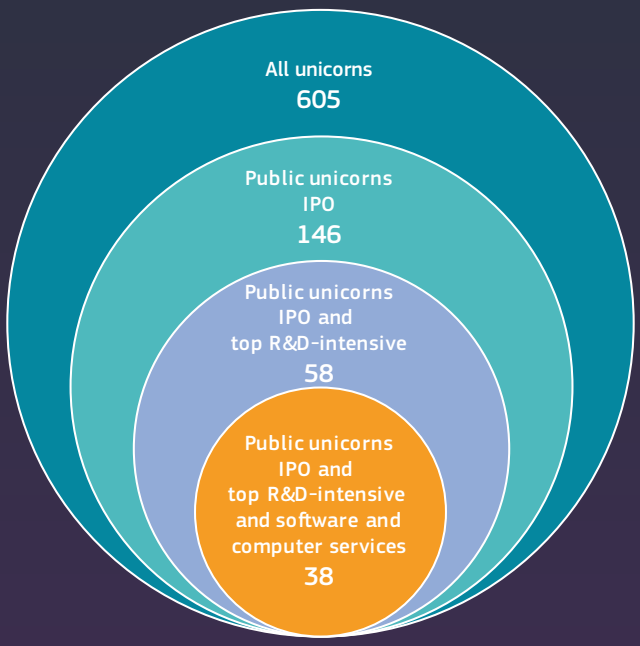
Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-23-24.xlsx

10 There may be methodological differences in country attribution. For instance, the R&D Scoreboard associates Yandex with the Netherlands, while Crunchbase with Russia

Guzman and Stern (2016) developed a new approach for estimating entrepreneurial quality by linking the probability of a growth outcome (e.g. achieving an IPO or a significant acquisition) as a startup characteristic observable at or near the time of the initial registration of the business. Hence, we focus on unicorn companies that are public and highly R&D-intensive (since acquired companies will not appear in the Scoreboard).

In the next stage, we focus on the software and computer services sector (since this is the sector where we found most unicorns in the R&D Scoreboard). This gives a total of 38 unicorns (Figure 3.3-25) which we then compare with the 268 companies in the R&D Scoreboard in the same sector (although there are definitely some caveats with this analysis).

Figure 3.3-25 Zooming in on the top R&D-intensive unicorns

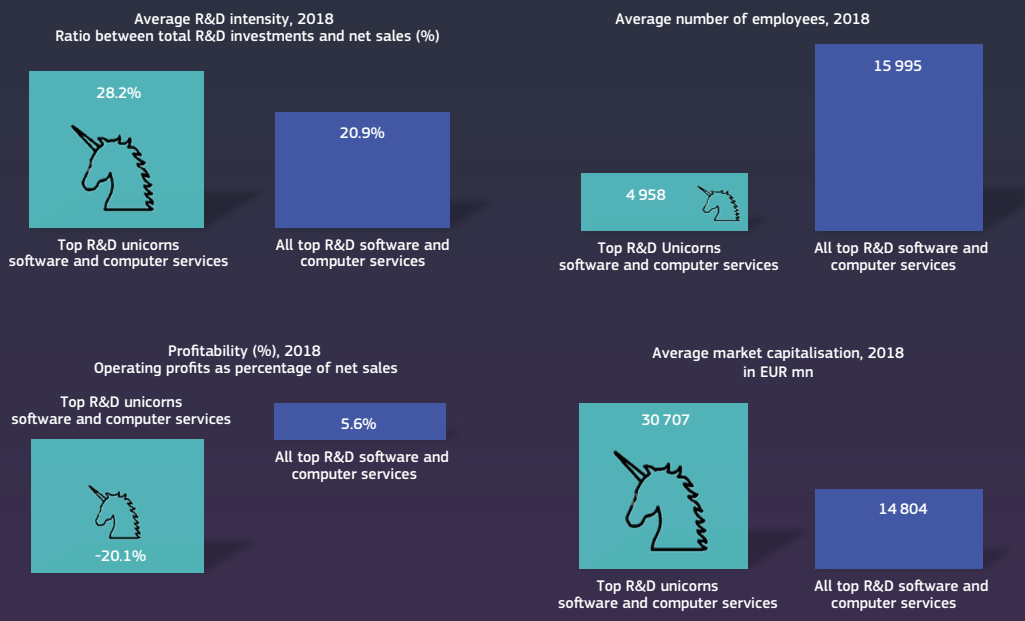


Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on R&D Industrial Scoreboard 2018, and CB Insights Unicorn Tracker (exits)

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-25.xlsx

Figure 3.3-26 shows the results of this exercise. It seems that, on average, the 'top R&D unicorn investors' are more R&D-intensive, have around four times fewer employees, a negative profitability, and 1.5 times higher market capitalisation than others in the same sector.

Figure 3.3-26 Comparison of the top R&D-intensive unicorns with the top R&D-intensive companies in software and computer services



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit, based on R&D Industrial Scoreboard 2018, and CB Insights Unicorn Tracker (exits)

Note: Higher standard deviations in R&D intensity and number of employees found for non-unicorns, but higher standard deviations in profitability and market capitalisation found for unicorns. Image © martialred, #125077712; 2019. Source: stock.adobe.com

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-26.xlsx

Global Innovation Champions are radical innovators that have introduced a 'world-first' product innovation. They broaden our understanding of the state of innovation.

BOX 3.3-2 Beyond unicorns: evidence on European Global Innovation Champions

In search of European Global Innovation Champions', chapter 6 in Vértesy and Damioli (2020).

This pilot work by the Joint Research Centre provides new evidence on radical European innovator companies, in particular on the relatively small share of exporters that introduced a 'world-first' product innovation – referred to here as 'Global Innovation Champions' (GICs). Radical innovators are typically seen as important for shaping the direction of technological change and for job creation (Pianta, 2003; Lucchese and Pianta, 2012). While there is a rich body of literature on the innovative and economic performance of large corporations that account for the bulk of business R&D expenditure (Montresor and Vezzani, 2015; Bogliacino, 2014; Ortega-Argilés et al., 2009), evidence on small- or medium-sized radical innovator enterprises in Europe remains limited.

Yet, analysing European Innovation Survey data shows that about half of the European GICs are small- or medium-sized enterprises (SMEs) that are not part of a corporate group. This suggests a similarity with 'hidden champions', a term introduced by Simon (1996) to describe highly specialised SME world leaders in a niche market, which have been the subject of substantial research (e.g. Audretsch et al., 2018; Witt and Carr, 2013; Simon, 2009; Fryges, 2006). In particular, analogously to hidden champions, GICs might have specific strategies and behaviour that may easily fall under the radar in spite of their relevance for policy.

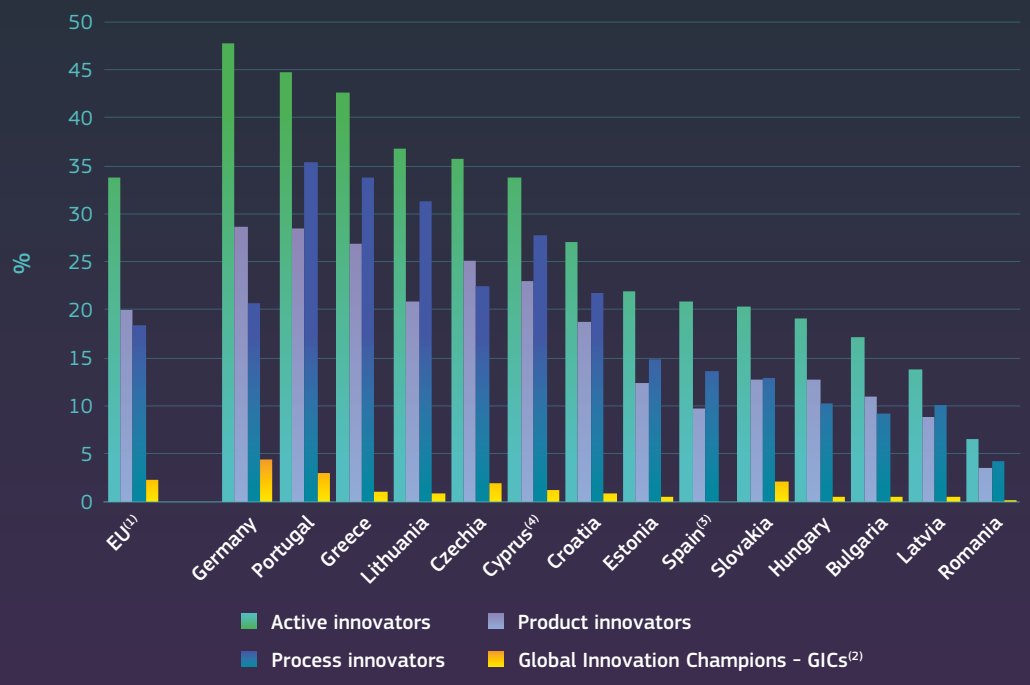
Based on Community Innovation Survey (CIS 2014) data, 1 710 companies were identified as GICs across 12 EU Member States and Norway. This implies that, on average, GICs constitute 3% of all enterprises, 8% of active innovators (companies that have introduced or have an ongoing product and/or process innovation) and 13% of product innovators.

Figure 3.3-27 shows that the share of GICs is particularly high in Germany (4.4%), and generally quite limited in eastern and Baltic Member States.

Other findings of the analysis:

- **GICs have stronger export performance than other types of innovators**: analogously to the high correlation with product innovations, this is due to the definition of GICs which requires a company to export, besides having introduced a world-first product innovation.
- Although the share of GICs over the population of general and innovative companies is larger for large ones than for SMEs, **the majority (55 %) of GICs are SMEs**.
- **GICs outperform active innovators in most IPR-related activities and MSs**, supporting the idea that the GICs definition identifies technologically intensive radical innovators.

Figure 3.3-27 Share of innovators by type (%), 2014



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Source: Figure 14 in Vértesy and Damioli (2020)

Notes: (1)EU was estimated by DG JRC based on data availability for EU Member States. (2)Global Innovation Champions are product innovators that are 'world first' and exporters, and typically leaders in niche markets. (3)CIS questionnaire does not cover 'world first' product innovation in Spain. (4)Breakdown by size not available for Cyprus.

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3. Cross-country variation in entrepreneurial attitudes in the EU: a startup gender gap remains

Four EU Member States are in the 'top 10' in the Global Entrepreneurship Index. However, the intra-EU dispersion of scores is quite significant, especially between the top and the lowest performers. The Global Entrepreneurship Index aims to assess and benchmark the 'health' of entrepreneurial ecosystems across 137 countries. It not only reflects attitudes and propensity towards entrepreneurship, but also the enabling socio-economic conditions underpinning the development of the startup ecosystem. Figure 3.3-28 shows that the top 3 enabling entrepreneurial ecosystems can be found in the United States, Switzerland and Canada. Denmark, Ireland, Sweden and France are in the top 10, while Bulgaria, Croatia and Hungary have the lowest scores at the EU level, quite a long way from the top scores. Overall, there seems to be room in most EU Member States for improving the health of their entrepreneurial ecosystems.

Figure 3.3-28 Global Entrepreneurship Index(1) – top 10 and positioning of EU Member States, 2018

Rank	Country	GEI
1	United States	83.6
2	Switzerland	80.4
3	Canada	79.2
4	United Kingdom	77.8
5	Australia	75.5
6	**Denmark**	74.3
7	Iceland	74.2
8	**Ireland**	73.7
9	**Sweden**	73.1
10	**France**	68.5
11	**Netherlands**	68.1
12	**Finland**	67.9
14	**Austria**	66.0
15	**Germany**	65.9
17	**Belgium**	63.7
20	**Luxembourg**	58.2

(...)Rank	Country	GEI
23	**Estonia**	54.8
25	**Slovenia**	53.8
29	**Lithuania**	51.1
30	**Poland**	50.4
31	**Portugal**	48.8
32	**Cyprus**	48.0
34	**Spain**	45.3
36	**Slovakia**	44.9
38	**Czechia**	43.4
42	**Italy**	41.4
44	**Latvia**	40.5
46	**Romania**	38.2
48	**Greece**	37.1
50	**Hungary**	36.4
54	**Croatia**	34.0
69	**Bulgaria**	27.8

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Source: Global Entrepreneurship Development Institute - Global Entrepreneurship Development Institute- 2018 Global Entrepreneurship Index

Note: (1)The Global Entrepreneurship Index is an annual index that measures the 'health of the entrepreneurship ecosystems' in each of 137 countries. It then ranks the performance of these against each other. The GEDI methodology collects data on the entrepreneurial attitudes, abilities and aspirations of the local population and then weights these against the prevailing social and economic 'infrastructure' – this includes aspects such as broadband connectivity and the transport links to external markets. This process creates 14 'pillars' which GEDI uses to measure the health of the regional ecosystem.

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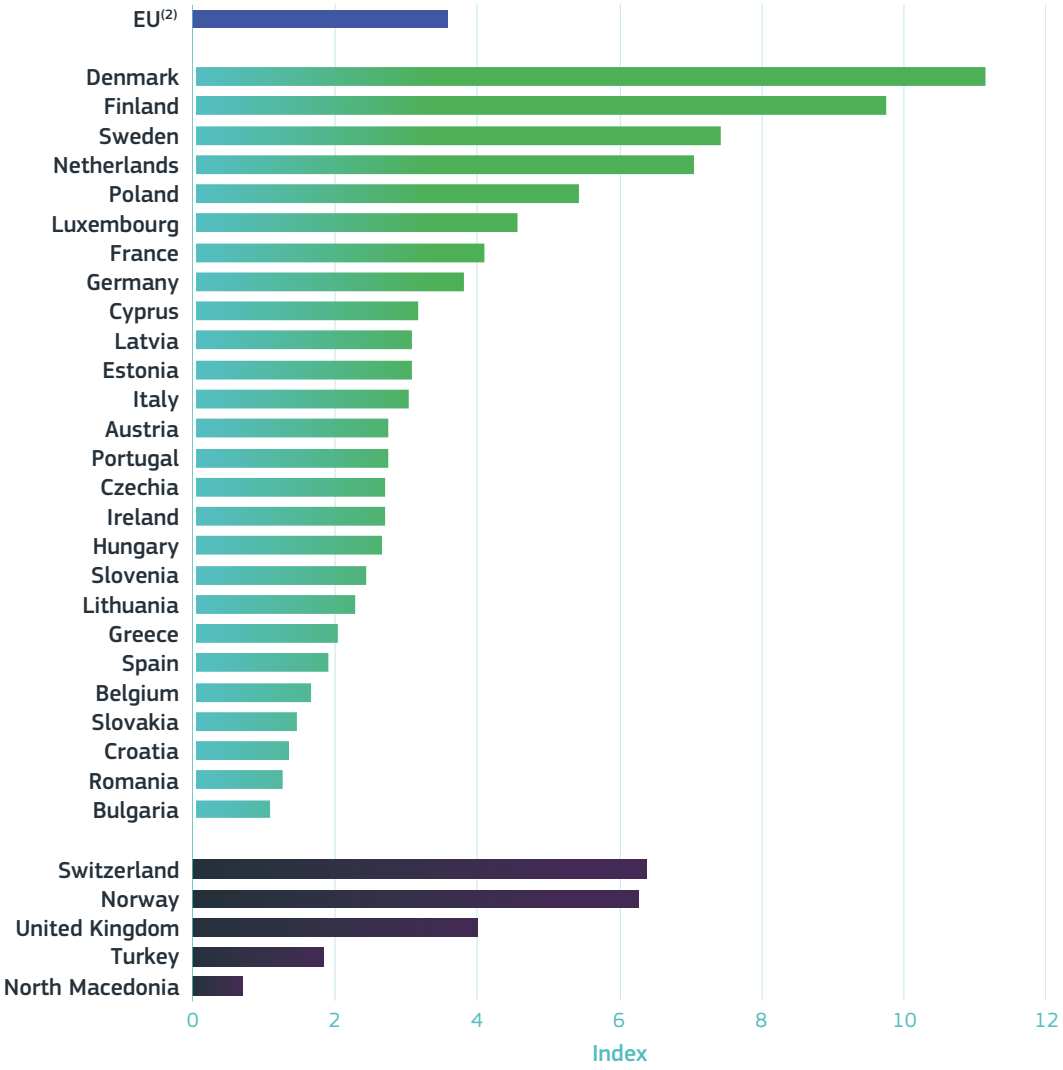
In the EU, 'innovation leader' entrepreneurs are more attracted by an opportunity in the market, while in southern and eastern European countries necessity remains an important factor driving the decision to become an entrepreneur. The Global Entrepreneurship Monitor distinguishes between entrepreneurs who *are pulled to entrepreneurship by opportunity and because they desire independence or to increase their income*, and those who are pushed to entrepreneurship out of necessity or those who sought only to maintain their income. The results are depicted in Figure 3.3-29. Building a tolerant and learning culture from 'failure', which is widespread in the EU, is also paramount when it comes to innovation.

Overall, innovation leader countries (Denmark, Finland, Sweden) exhibit a higher prevalence of opportunity-driven entrepreneurship due, in principle, to more opportunities and choices provided by the market to make a living. On the other hand, where the ratios are lowest (in countries such as Bulgaria, Romania and Croatia), it seems that necessity is still an important driver to become an entrepreneur.

Figure 3.3-29 Opportunity-driven entrepreneurship[(1)] by country, 2018



Source: European Innovation Scoreboard 2019

Notes: [(1)]The opportunity-driven entrepreneurship index is calculated as the ratio between the share of people involved in improvement-driven entrepreneurship and the share of people involved in necessity-driven entrepreneurship; three-year averages were used (EIS2019). [(2)]EU is the average value of Member States and does not include Malta.

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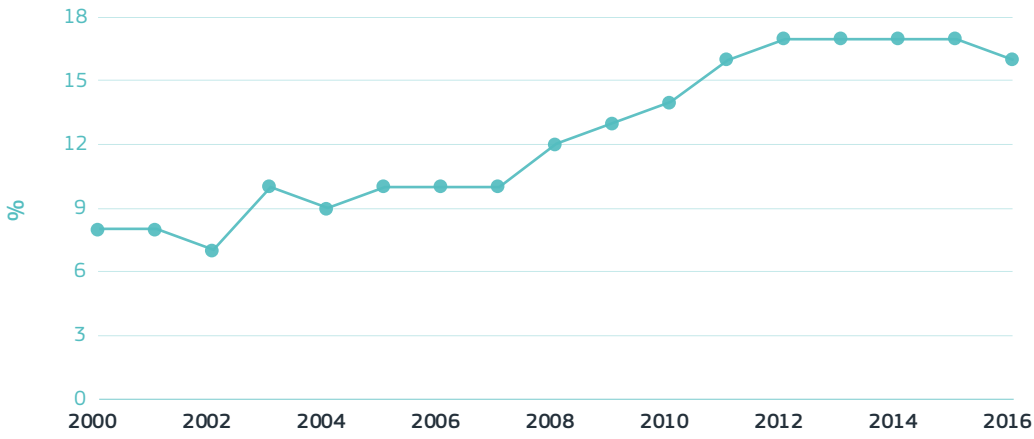
Despite some progress, a pronounced gender gap remains in the creation of innovative startups. There are also cross-country differences. Overall, female startup founders remain under-represented in the creation of startups despite having doubled their representation from 8% in 2000 to 16% in 2016 (Figure 3.3-30). Lassébie et al. (2019) show that *the gender gap in innovative high-potential startups is thus much larger than the gender gap in entrepreneurship in general*.

Moreover, a study by the Global Entrepreneurship Monitor indicated that Europe has the lowest female involvement, only 6 %, in the early stages of entrepreneurial activities. Rossetti et al. (2018) also found a gender imbalance in the Startup Europe initiative, where 90 % of digital startups supported by the Startup Europe Initiative had a male founder. This figure was found to increase with the age and the development stage of the firms.

Figure 3.3-30 Evolution of the share of innovative startups with at least one female founder, 2000-2016



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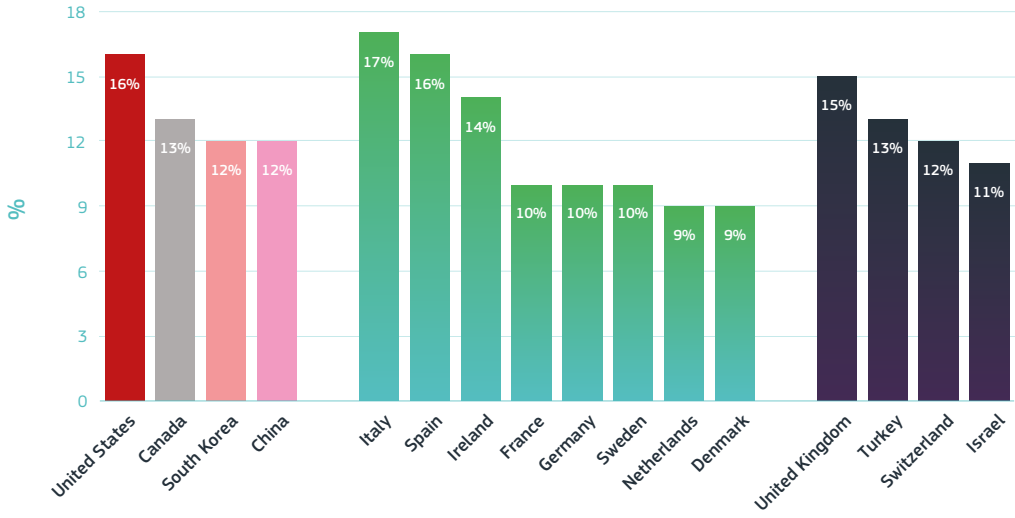
Source: Adapted from OECD estimates on Lassébie et al. (2019) and computed from Crunchbase data

Note: The sample is restricted to companies located in OECD, Colombia, and BRICS countries, founded between 2000 and 2017, and for which the gender of at least one founder can be identified.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-30.xlsx

Figure 3.3-31 shows the **gender gap in startup creation across countries**. Taking into account the countries with available data, the share of innovative startups with at least one female founder is highest in the United States, Italy, Spain and the United Kingdom, and lowest in Ireland, France, Germany, Sweden, the Netherlands and Denmark.

Figure 3.3-31 Share of innovative startups founded between 2000 and 2017 with at least one female founder per country



Science, research and innovation performance of the EU 2020

Source: OECD estimates based on Lassébie et al. (2019), computed from Crunchbase data

Note: The sample is restricted to companies located in OECD, Colombia, and BRICS countries, founded between 2000 and 2017, and for which the gender of at least one founder can be identified. Figures reported only for the top 20 countries in terms of number of startups.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-31.xlsx

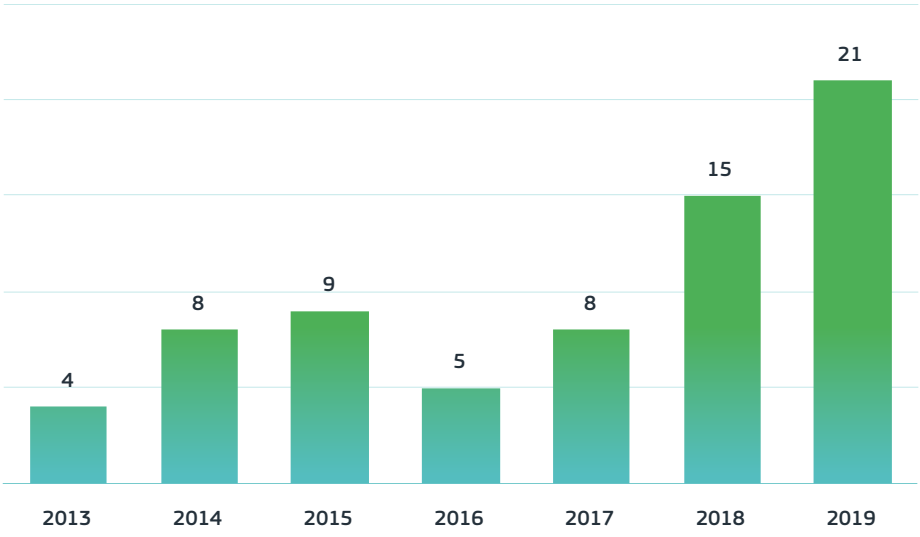
Female-founded unicorns are still rare, despite recent improvements. Figure 3.3-32 depicts the evolution of private unicorns with at least one female founder between 2013 and 2019 (until May) based on Crunchbase. It shows that the rate of new female-founded unicorns has increased at a greater speed in recent years although this remains a relatively rare phenomenon. In fact, in 2018, of the 127 new unicorns that joined the 'unicorn leaderboard'[11], only around 9% (12) had at least one female founder.

When considering the economic and social benefits of gender balance in economic activities, understanding the reasons for the gap in female-founded startups is an issue that deserves policymakers' attention. Verheul and Thurik (2006) showed that higher female engagement in entrepreneurial activities can improve the quality of entrepreneurship as it increases firms' creativity and ultimately their innovation activities. Moreover, it also offers the potential for greater diversity in consumer insights, leading to the introduction of new products and processes.

The economic and social benefits being clear, Lassebie et al. (2019) summarise some of the potential explanations for the gender gap in innovative entrepreneurship in the literature. Gender differences in STEM education may explain why male founders have been more present in STEM-related (and also more tech fields) than women (see Chapter 4.1 –

11 According to CB Insights, accessed on 2 December 2019.

Figure 3.3-32 Number of unicorns(1) with at least one female founder, by year of first round of equity raised, 2013-2019



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Source: Crunchbase News - More Female-Founded Unicorns Were Born In 2019 Than Before, Data Shows, 18 December 2019

Note: (1)A private unicorn is a private company with a post-money (i.e. 'after funding') valuation of more than USD 1 billion.

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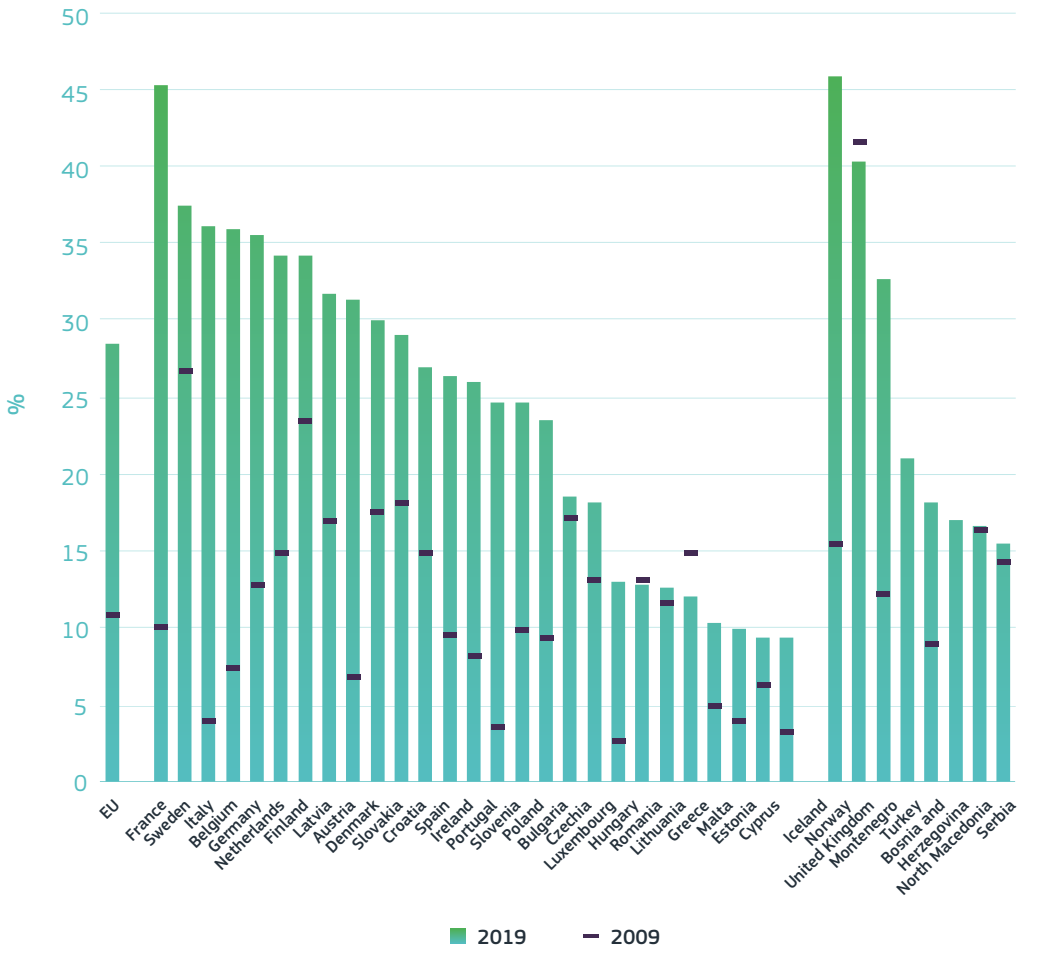
Innovation, the future of work and inequality). Furthermore, since venture capital tends to be more associated with STEM areas, this could also hint at the existing gender funding gap of innovative startups (see Chapter 8 - Framework conditions). Also, there may be factors of a sociological nature. For instance, some studies have documented differences in the personality traits ascribed to women and those attributed to the entrepreneur. This refers to, for instance, risk-taking behaviour and confidence in a negotiation. Increasing the number of female role models and mentors can raise the interest of women in the entrepreneurial path from an early age, and also balance out differences in aspirations.

A gender gap in management positions also remains in the EU and is even more evident at the top management level. However, there has been some progress over time, although substantial differences across the EU persist. According to the European Institute for Gender Equality (EIGE) and Eurostat, women accounted for 37 % of management positions in 2019, which compares with lower shares of 18 % for women as senior executives and 28.4% as board members in the largest publicly-listed companies. To note, however, that there has been progress over time. For instance, the share of women sitting on the board of the largest publicly listed companies in the EU has more than doubled in over a decade, from 10.9% in 2009 to 28.4% in 2019 (Figure 3.3-33). Nevertheless, progress at the EU aggregate level ´hides´ some differences across EU Member States. The share of women as board members is highest in France (45.2%), Sweden (37.5%) and Italy (36.1%), and lowest in Cyprus (9.4%), Estonia (9.4%) and Malta (10%).

Figure 3.3-33 Share of female board members in the largest publicly listed companies



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Source: Eurostat (sdg_05_60), based on European Institute for Gender Equality (EIGE)

Note: The indicator measures the share of female board members in the largest publicly listed companies. Publicly listed means that the shares of the company are traded on the stock exchange. The largest companies are taken to be the members (max. 50) of the primary blue-chip index, which is an index maintained by the stock exchange and covers the largest companies by market capitalisation and/or market trades. Only companies which are registered in the country concerned are counted. Board members cover all members of the highest decision-making body in each company (i.e. chairperson, non-executive directors, senior executives and employee representatives, where present). The highest decision-making body is usually termed the supervisory board (in case of a two-tier governance system) or the board of directors (in a unitary system).

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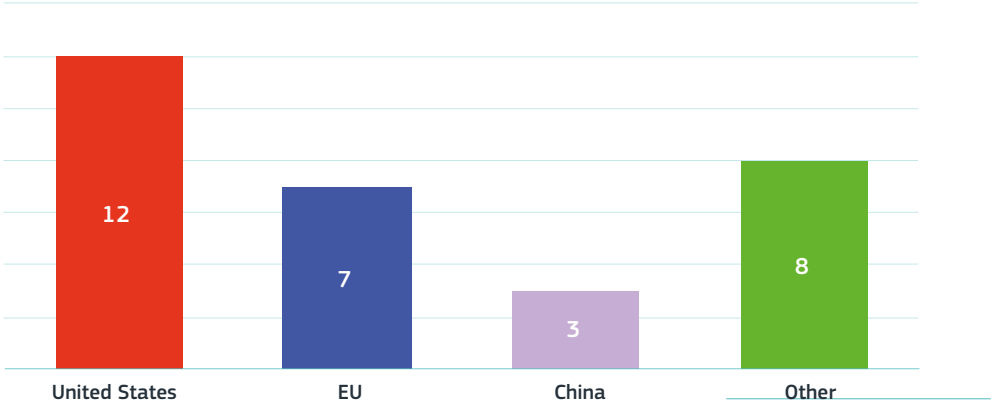
4. In the global technological race, Europe could benefit from developing its startup ecosystems further to reach a greater critical mass

The EU has seven ecosystems in the world top 30 startup ecosystems, compared to 12 in the United States and only three in China. Startup Genome (2019) uses data from over 1 million companies across 150 cities to rank startup ecosystems in terms of performance, funding, market reach, talent and startup experience[12]. Figure 3.3-34 shows that the United States leads in the number of quality startup ecosystems, with 12 in the top 30 world startup ecosystems. The EU comes next, with seven ecosystems, then China with three.

The EU's top ecosystems are Paris, Berlin, Stockholm, Amsterdam-StartupDelta, Barcelona, Dublin and Munich (Figure 3.3-35). Paris ranks high in terms of access to funding and quality, global connectedness, quality of the tech talent, and access to talent in life sciences. Berlin's relative strengths seem to be in global reach and in the quality of its tech talent. Stockholm also stands out for its global connectedness and quality of its talent. The quality of the tech talent and access to life sciences talent are key strengths found in Amsterdam-StartupDelta.

In the top 3 global startup ecosystems are two US ecosystems – Silicon Valley and New York – and London. As mentioned above, the high quality of these ecosystems across most dimensions assessed below justifies the move or relocation of unicorns originating in the EU to the United States and the United Kingdom for a greater market reach, access to funding and often to tech and life sciences talent.

Figure 3.3-34 Number of startup ecosystems in the top 30 by region, 2019



Science, research and innovation performance of the EU 2020

Source: STARTUP GENOME (2019), Global Startup Ecosystem Report 2019

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-34.xlsx

12 Performance includes startup output, exits, valuations, early-stage success, growth-stage success, and overall ecosystem value. Funding concerns growth in early-stage investments and funding quality through the presence of experienced venture capital firms. Market reach is linked to global connectedness and global and local reach, based on the startups' proportion of foreign customers and the national GDP. Talent refers to the access, cost and quality of talent. Finally, startup experience refers to the team and ecosystem experience in terms of knowledge and networks available from which startups can develop.

Figure 3.3-35 2019 Global Startup Ecosystem Ranking, by category

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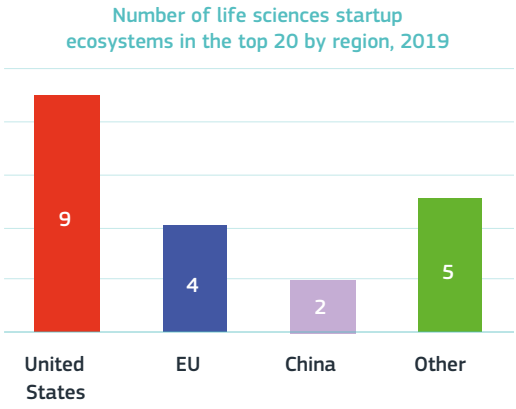
Four of the 20 most developed startup life sciences ecosystems can be found in the EU. The United States leads with nine ecosystems in the top 20. Figure 3.3-36 shows the ranking of the top life sciences ecosystems. The United States leads with nine ecosystems. The four EU ecosystems in the top 20 are Munich, Amsterdam-Startup Delta, Paris and Stockholm. China has only two ecosystems in the list.

Figure 3.3-36 Top 20 Life Sciences Ecosystems 2019, ranking and regional distribution

Ranking	Life sciences startup ecosystem
1	Silicon Valley
2	Boston
3	San Diego
4	New York City
5	London
6	Los Angeles
7	Lausanne-Bern-Geneva
8	Jerusalem-Tel Aviv
9	Shanghai
10	Washington DC
11	Beijing
12	Chicago
13	Seattle
14	Munich
15	Amsterdam-StartupDelta
16	Paris
17	Toronto-Waterloo
18	Stockholm
19	Singapore
20	Austin



Source: STARTUP GENOME (2019), Global Startup Ecosystem Report 2019

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Even though the EU trails behind the United States in some aspects related to the quality of startup ecosystems, the EU is a leader in terms of fast-growing ecosystems across different maturity phases. Figure 3.3-37 depicts the top high-growth ecosystems in the world by phase of the ecosystem life cycle, namely activation, globalisation and attraction[13]. The EU leads with one fast-growing ecosystem – Western Denmark – in the activation phase, three in the globalisation phase – Paris, Antwerp and Copenhagen – and two in the attraction phase – Amsterdam-StartupDelta and Stockholm. The six EU high-growth ecosystems compare with none in the United States and three in Asia.

Figure 3.3-37 Fastest-growing ecosystems(1) by maturity phase of the ecosystem life cycle(2)

	Fastest-growing ecosystems by phase
Activation	1 Western Denmark
	2 Belgrade and Novi Sad
	3 Taipei City
	4 Atlantic Canada
	5 Manila
Globalisation	1 Paris
	2 Montreal
	3 Antwerp
	4 Sydney
	5 Copenhagen
Attraction	1 Amsterdam-StartupDelta
	2 Bangalore
	3 Stockholm

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Source: STARTUP GENOME (2019), Global Startup Ecosystem Report 2019

Notes: (1)Based on growth in funding, exits and number of startups. (2)The Global Startup Ecosystem report defines four main phases in the life cycle of a startup ecosystem: activation, globalisation, attraction, integration.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-37.xlsx

The top 'ecosystems to watch' in the EU are notably present in fintech, cleantech, agritech and advanced manufacturing and robotics. The EU lags behind in blockchain and artificial intelligence. Figure 3.3-38 displays the top 'ecosystems to watch' by technology field, according to Startup Genome. The EU stands out in fintech with seven ecosystems to watch – Berlin, Copenhagen, Estonia, Frankfurt, Lithuania,

13 According to Startup Genome, the activation phase is characterised by limited startup experience, low startup output of around 1 000 or fewer startups. The globalisation phase means that increased startup experience led to the production of a series of regionally impressive 'triggers', usually over USD 100 million, and with an output of 800 to 1 200 startups. Finally, in the attraction phase, there are usually more than 2 000 startups (depending on population), a series of globally impressive triggers that could be unicorns, and exits above USD 1 billion which generate global resource attraction. At this stage, very few success factor gaps remain.

Madrid and Paris. This compares with only three in the United States. As regards cleantech, the Amsterdam-StartupDelta and Stockholm stand out. In agritech and new food, the Amsterdam-StartupDelta also stands out, as does the Mid-East region of Ireland. Furthermore, three EU ecosystems – Paris, Rhineland and Western Denmark – emerge in the field of advanced manufacturing and robotics.

However, where the EU seems to lag behind is in the fields of blockchain and artificial intelligence (see Chapter 7 - R&I enabling artificial intelligence). In the case of AI, only Berlin and Greater Helsinki are mentioned.

Figure 3.3-38 Top 'ecosystems to watch'(1) in selected technology fields, by region

Technology field	Region	'Ecosystems to watch'
Fintech	European Union	Berlin
		Copenhagen
		Estonia
		Frankfurt
		Lithuania
		Madrid
		Paris
	United States	Chicago
		New York City
		Silicon Valley
	Other	São Paulo
		Bahrain
		Tel Aviv
		London
		Nur-Sultan
		Bengaluru
		Beijing
		Jakarta
		Manila
		Singapore
		Sydney
		Tokyo
Cleantech	European Union	Amsterdam-StartupDelta
		Stockholm
	United States	Houston
		New York City
		Silicon Valley
		Austin
	Canada	Calgary
		Vancouver

Technology field	Region	'Ecosystems to watch'
Agritech & new food	European Union	Amsterdam-StartupDelta
		Mid-East Region, Ireland
	United States	Denver-Boulder
		New York City
		Silicon Valley
	Other	London
		New Zealand
Advanced manufacturing & robotics	European Union	Paris
		Rhineland
		Western Denmark
	United States	Boston
		New York City
		San Bernardino County
		Silicon Valley
	Other	Montreal
		Tel Aviv
		Shenzen
		Taipei City
		Tokyo
Blockchain	United States	Silicon Valley
		New York City
	Canada	Toronto-Waterloo
		Vancouver
	Other	London
		Belgrade and Novi Sad
		Singapore
Artificial Intelligence	European Union	Greater Helsinki
		Berlin
	United States	Silicon Valley
		Boston
		Chicago
		Houston
		New York City
		Seattle
	Other	Edmonton
		Montreal
		Québec City
		London
		Tel Aviv
		Jerusalem
		Beijing
		Taipei City

Source: STARTUP GENOME (2019), Global Startup Ecosystem Report 2019

Note: [1]According to STARTUP GENOME criteria based on startup output, exits, and funding.

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5. Presence of zombie firms is still problematic in some Member States, while others have undertaken a de-leveraging process

Rigidities in the market limiting their well-functioning may lead to capital and resources locked in so-called 'zombie firms'. This means that these resources could have improved economic performance had they been redirected towards higher-productivity firms. Overall, the shares of zombie firms have increased in the aftermath of the crisis and while there has been progress in some countries in recent years via, for example, a more effective deleveraging process, in others zombie firms continue to rise, especially in the services sector. Zombie firms are companies that survive in the market without being profitable in the long run because of external support that 'keeps them artificially alive' (European Commission, 2018). The consequence is the use of resources by non-productive firms that might otherwise have been used by more-productive companies, ultimately leading to productivity growth.

Figure 3.3-39 shows the **evolution of the average shares of zombie firms during three different periods, both in manufacturing and services**[14]. Right in the aftermath of the crisis (i.e. 2008-2010) the shares of zombies in the manufacturing sector were highest in Portugal, Italy and Spain, and zombie firms were mostly prevalent in the services sector in Portugal, Sweden and Spain. Looking at their evolution over time, overall shares have continued to rise, particularly in the services sector; exceptions include Portugal, for example. Even though the incidence of zombie firms is typically higher in manufacturing, the gap with services is limited apart from Finland.

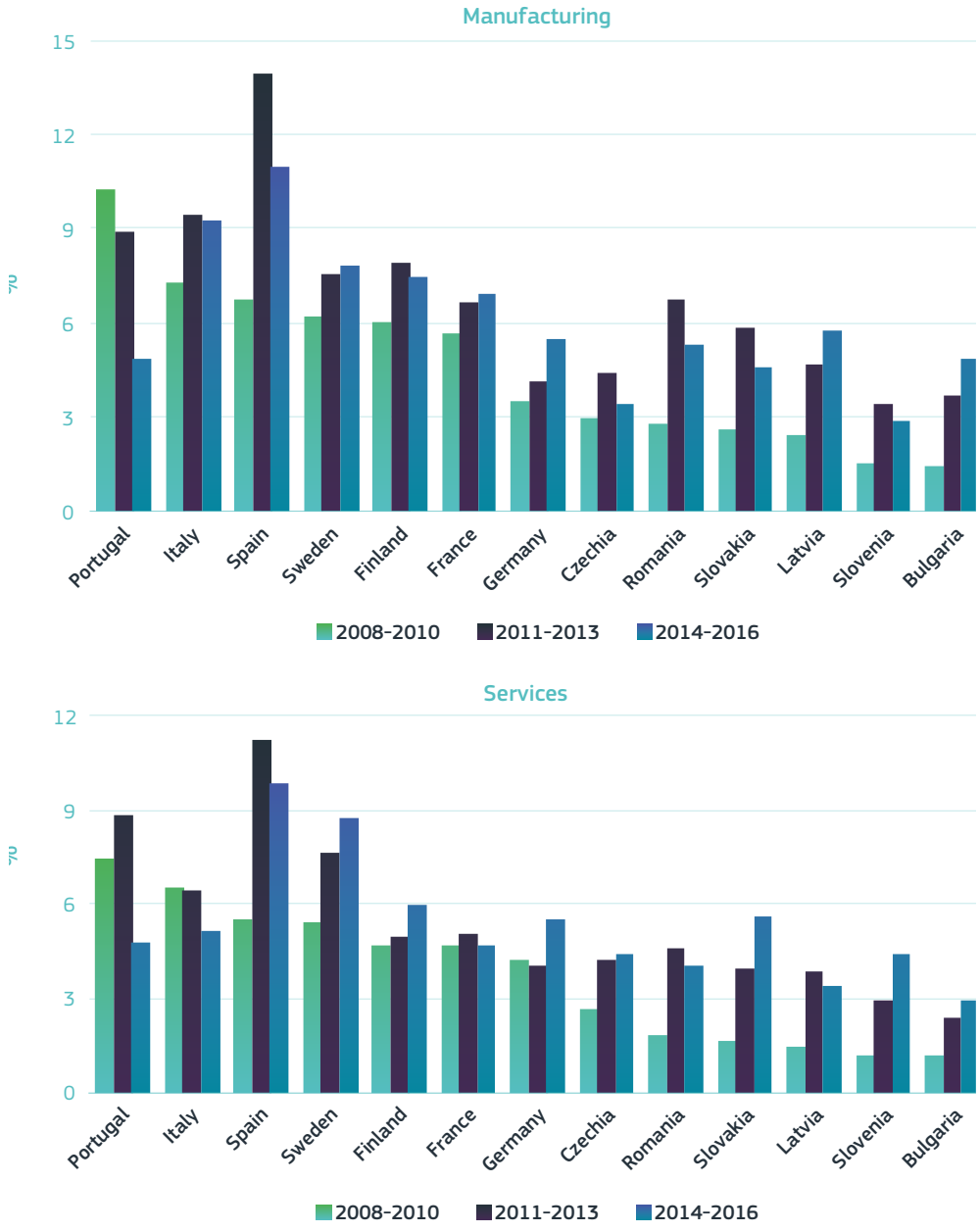
The EU Member States with the highest incidence of zombie firms in the period 2011-2013, namely Spain, Italy and Portugal, have more recently experienced a decline in their share across sectors, the largest drop being reported by Portugal. This phenomenon was accompanied by an increase in the firms' profitability as well as the de-leveraging of zombie firms[15]. Since 2013, the weight of zombie firms has been on the decline in Spain, Italy and Portugal, for all the sectors covered by Figure 3.3-39. These EU Member States had the highest shares in 2008-2010.

Zombie firms were found mainly in the construction – real estate sector but were less common in the information and communication sector. Portugal, in particular, saw the largest drop in zombie firms after 2013.

14 See Bauer et al. (2020).

15 Source: Hallak et al. (2018).

Figure 3.3-39 Evolution over time of the share of zombie firms[1] in total firms in the manufacturing and services sectors[2], 2008-2016



Source: JRC estimations based on Orbis data

Notes: [1]A zombie firm is a firm that is at least 10 years old and has an interest coverage ratio below 1. This latter term suggests that the firm does not make enough profit to pay debt obligations on bank loans. This is the OECD definition. [2]The figure reports the time variation of the share of zombies in each country in our sample. We report three-year averages in manufacturing and services in the periods: 2008-2010 (left), 2011-2013 (middle), 2014-2016 (right). Countries are sorted by the zombie shares in the figure according to the last period 2014-2016.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-39.xlsx

Figure 3.3-40 Evolution over time of the share of zombie firms[1] in Spain, Italy and Portugal[2] by sector, 2008-2016

Source: JRC estimations based on Orbis data

Notes: [1]A zombie firm is a firm that is at least 10 years old and has an interest coverage ratio below 1. This latter term suggests that the firm does not make enough profit to pay debt obligations on bank loans. This is the OECD definition. [2]The figure reports the yearly share of zombies in Spain, Italy, and Portugal in the period 2008-2016, in six broad sectors. Italy, Spain and Portugal report the top three zombie shares in the sample in the period 2011-2013.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter33/figure-33-40.xlsx

6. A 'tech-for-good' approach to match the urgent challenges of our time

Technological progress is behind many scientific and technological breakthroughs that have, for instance, significantly increased life expectancy worldwide from just 34 years in 1913 to 60 in 1973 and 71 in 2019. Incomes have risen and technology has also 'freed' workers from certain routine and/or dangerous tasks, thereby providing more leisure time[16]. But living longer also means that there is a greater concern about living healthier lives and improved well-being. Economic growth has also benefitted strongly from technologies that have boosted resource efficiency and productivity across all sectors (see Chapter 3.1 - Productivity puzzle and innovation diffusion).

While innovation has resulted in greater choice from the growth in products and services, there is an ongoing debate as to whether all innovation has created value (and proven its relevance) for society. Kalff and Renda (2020) revised academic literature on the role of innovation and noted that 'not all innovation is equally relevant for society', arguing that entrepreneurship and innovation should be the means to address the most pressing challenges of our time (see Chapter 1 - Megatrends and sustainability).

Moreover, tech with a social purpose can also drive profit as consumers are now demanding a shift in the mission of businesses towards social good[17]. As highlighted in Chapter 2 - Changing innovation dynamics in the age of digital transformation, consumers increasingly want social impact to be integrated into companies' missions so as to achieve 'economic value that is inclusive and sustainable'[18]. Putting the emphasis on responsible and ethical tech does not mean that products and services will not be scalable. On the contrary, it provides a business model in which consumers will have more trust. As a result, it also creates new opportunities for profit that can maximise social value, too.

Activating a global mindset which directs innovation activities towards solutions that effectively address societal challenges is challenging but certainly necessary and collectively achievable. The World Economic Forum (2020) refers to a set of enablers which include: responsible technology governance, leadership to mobilise commitment and standards, partnerships for collaboration and collective action, public policy and regulation for the Fourth Industrial Revolution, finance mechanisms to stimulate market solutions, breakthrough innovation, including collaborative R&D agendas, managing data and tools, and capacity development and skills. The EU is well-positioned to lead in this 'tech-with-a-purpose' approach thanks to its new growth strategy – the EU Green Deal – the prominence of the partnership approach in its Framework Programmes, the support of market-creating innovation with the European Innovation Council (EIC), etc.

16 https://www.mckinsey.com/featured-insights/future-of-work/tech-for-good-using-technology-to-smooth-disruption-and-improve-well-being

17 https://technation.io/insights/tech-for-social-good/

18 https://www.weforum.org/agenda/2020/01/davos-2020-heres-what-you-need-to-know-about-tech-for-good/

7. Conclusions

Business dynamism plays an important role in promoting creative destruction in the economy, which may ultimately raise productivity growth. For this reason, **the decline of business dynamism (notably in terms of entry rates) in Europe and other parts of the globe may hamper current and future productivity growth**, although the reasons for such a decline can be multiple. Moreover, **most jobs created by new firms emerged in less-productive sectors of the economy and hence were, in principle, lower-paid jobs**. However, in some countries there has been progress towards new job creation in more-productive sectors.

Europe´s scaling-up performance needs to be revamped. While the share of high-growth enterprises has increased over time in most EU Member States, there is only a small share in high-tech, medium-high-tech manufacturing and high-tech knowledge-intensive services, although this has increased in recent years. Furthermore, our analysis shows that **when it comes to tech scaleups and unicorn companies, a pronounced scaling-up gap remains when compared to the United States and (sometimes) China**. In particular, 1.3 scaleups per 100 000 inhabitants in the EU compares with 7 scaleups in the United States. Moreover, for each private unicorn in the EU, there are seven in the United States and four in China. In other words, the EU only accounts for around 7 % of all private unicorns worldwide. The EIC in Horizon 2020 and Horizon Europe, the VentureEU programme, and the different financial instruments available via the European Investment Bank aim to tackle the scaling-up needs in terms of capital among EU startups. Europe should capitalise on its strong science and richness of ideas for innovation to play a role on the global scene **reflecting the EU's values and ambitions to lead in the fight against climate change, healthy societies, and in the digital age**, to name but a few. Indeed, **a tech-with-a-purpose approach could integrate social and environmental concerns in businesses' missions to ensure that new products and services bring** both economic and societal value.

The **New Industrial Strategy for Europe**[19] stresses that 'relevant players should work together to create lead markets in clean technologies and ensure our industry is a global frontrunner'. This includes regulation, public procurement, rules for fair competition and involving SMEs, too. In addition, the Strategy also encourages place-based innovation and experimentation so that regions can develop and test new solutions with the involvement of both SMEs and consumers, capitalising on their local strengths and specificities.

Our research also identifies a group of 'EU DNA' unicorns that have started or moved their operations to the United States and the United Kingdom because of the greater availability of capital, the intense network, market size and other benefits. However, EU DNA unicorns tend to keep strong connections 'back home'. Although this could be seen as a normal consequence of globalisation and the new phenomenon of 'dual companies', at the same time it reflects the lower availability of risk capital in the EU and barriers to scaling up related to the yet to be fully completed Single Market. In addition, in the digital age, digital infrastructure, notably 5G, will also be a determinant in shaping innovation and its speed in the future. Research and other physical infrastructure also play an important role.

19 https://ec.europa.eu/commission/presscorner/detail/en/ip_20_416

Although there are resilient, high-quality and interconnected ecosystems in the EU, the United States still appears to lead globally. The EU has fewer startup ecosystems in the top world ecosystems, including in the life sciences. However, Europe appears to score well in fintech, cleantech, agritech and advanced manufacturing and robotics. By incentivising science-business collaboration, creating and attracting talent, pooling public and private resources, promoting strategic public-private partnerships, etc. the EU can reach greater critical mass and lead the way.

There is substantial cross-country variation in entrepreneurial attitudes in the EU. This calls for a culture of more tolerance towards startup failure, widespread entrepreneurship education, and improving the business environment in aspects including the ease of starting a business, availability of capital, innovation-friendly regulations, etc. The European Institute of Technology and the different Knowledge and Innovation Communities have also played an important role in this respect.

A pronounced startup gender gap remains in the creation of innovative enterprises worldwide, including in Europe. The share of female (co)-founders is still low, despite some progress over time. This calls for policies promoting the wider involvement of women in entrepreneurial activities, starting at an early age at school, the promotion of 'female role-models', a better work-life balance, greater female participation in STEM activities, and tackling the documented gender bias in the attribution of private funding, among other aspects.

Zombie firms remain prevalent in some Member States, especially in services. Although there has been a delivering process in some countries since the crisis, in others the presence of zombies has been aggravated. This requires careful consideration of the economic and financial conditions in each country.

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