Relocation as a Driver of Innovative Activity: A Global Study of Unicorn Founders' Migration

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Abstract

This paper investigates the migration flows of unicorns – private companies that achieve a market value of at least one billion USD within ten years. This concept was recently introduced by professional investors but has actively entered the global expert and political agenda. The ability of national innovation systems to grow unicorns has become a new hallmark of success.

This study uses the most complete sample of companies as of July 2022 (1,357 unicorns), for each of them we identified the founders, their countries of birth, and the educational institutions they graduated from.

Among the main results, it is revealed that 40% of billion-dollar companies were created with the participation of foreign founders. The authors identified three country groups depending on the founders' migration flows direction: "attracting" unicorns, "growing on their own" and "losing everything". A comparative analysis of countries' innovation profiles made it possible to identify the unicorn growth and attraction factors. It is emphasized that universities are a significant resource for both strategies, since most of the founders graduated from the leading world universities and every third foreign entrepreneur was educated in the country of migration. It is shown that the strategy of attracting foreign founders complements the growth strategy and could provide the main flow of unicorn founders. The authors noted that the leading unicorn countries are actively involved in the global migration flow: they not only attract the founders, but also act as their largest suppliers. The authors put forward recommendations for attracting unicorn companies.

Keywords: fast-growing companies; gazelles; scaleups; unicorn companies; unicorn companies' migration; unicorn companies attracting policy

Citation: Kutsenko E., Tyurchev K., Ostashchenko T. (2022) Relocation as a Driver of Innovative Activity: A Global Study of Unicorn Founders' Migration. *Foresight and STI Governance*, 16(4), 6–23. DOI: 10.17323/2500-2597.2022.4.6.23

Introduction

Over the past decade, the number of rapidly growing technology start-ups with a high market capitalization has significantly increased, and their geography has markedly expanded.[1] A special place among them are held by "unicorns": companies whose capitalization has reached one billion USD within ten years of their establishment, while they remained at least three-quarters owned by the original founders and did not make an initial public offering (IPO) (Lee, 2013; Crunchbase, 2022).

High-tech and fast-growing companies have been central to the political agenda and academic discourse in recent years due to their ability to influence the emergence of new industries and create favorable economic and social effects (Baumol, Strom, 2007; Guerrero, Urbano, 2019; Audretsch et al., 2020 ; Autio et al., 2014; Brown, Wiles 2015; Bock, Hackober, 2020). The Organisation for Economic Co-operation and Development (OECD) estimates that about 5% of small and medium-sized fast-growing companies create more than half of new jobs (OECD, 2021). The recognition of these players' contribution to economic growth has contributed to the emergence of a wide range of strategic initiatives the world over, and was reflected in various programs such as Europe 2020,[2] 2030 Digital Compass: the European Way for the Digital Decade,[3] France 2030,[4] and in OECD reports on international business policy,[5] etc. Moreover, some of the initiatives are directly aimed at raising unicorns (e.g., Scale up 100[6] or Baby Unicorn 200 Nurturing Project[7]).

Unicorns and their phenomenal growth attracted a lot of attention from the press, investors, experts, and politicians, but the topic remains insufficiently studied in academic literature. Despite the many publications on the migration of highly skilled professionals and entrepreneurs (Anderson, Platzer, 2006; Chaloff, Lemaître, 2009; Fairlie, Lofstrom, 2014; Blume-Kohout, 2016; etc.), the studies on unicorn migration remain extremely limited, fragmentary (Testa et al., 2022; Anderson, 2022), and incomplete: the sample of one of them included 582 companies established in the United States (Anderson, 2022), while another analyzed 40 unicorn firms which have migrated from the EU (Testa et al., 2022). The focus tends to be on unicorn growth factors, typically based on data for specific countries (Simon, 2016; Bhagavatula et al., 2019), while unicorn founders' global migration flows remain unaddressed. We are not aware of any academic publications offering a systemic analysis of the factors that help attract foreign unicorn founders.

Unlike previously published studies, ours is based on a full global sample of 1,357 unicorns (as of July 2022) and considers the migration flows of these companies' founders (3,190 people) covering all their countries of origin. Unicorn "exporter" and "importer" countries were compared by key development indicators. Open-access information on the universities where the 2,699 unicorn founders were educated was used.

The purpose of the paper is to comprehensively analyze the migration flows of unicorn founders. To achieve it, the following questions were consecutively answered:

1. What were immigrants' contributions to the establishment of unicorn companies compared to those of natives?
2. Is there any correlation between the unicorn company's market value and the presence of an immigrant among its founders?
3. Which countries are the largest exporters of unicorn founders?
4. Which countries are particularly attractive to migrating unicorn founders?
5. Which countries have a nationally diverse composition of foreign unicorn founders, and which ones are dominated by specific diasporas?
6. What are the specific characteristics of countries that attract unicorns? Which country factors attract such companies and promote their creation?
7. Which universities attract foreign unicorn founders and which are their biggest exporters?

Literature Review

The Phenomenon of Rapidly Growing Companies and the Unicorn Concept

Interest in studying enterprises with high growth potential arose in the late 1980s. To describe fast-growing companies, the US economist David Birch suggested the concept of "gazelles". He defined them as firms whose workforce grew on average by more than 20% a year over a three-year period, with the initial number of staff being at least 10 (Birch, 1987). Like the corresponding antelope species, such companies could achieve a high growth rate quickly and maintain it over long distances. Having analyzed data on company and employment growth in the United States in 1969-1976, Birch found that two-thirds of jobs were created by small companies with fewer than 20 employees.

While Birch's research has attracted the attention of academics, international organizations, and govern-

[1] https://www.cbinsights.com/research-unicorn-companies, accessed on 04.10.2022.

[2] https://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf, accessed on 04.10.2022.

[3] https://eur-lex.europa.eu/resource.html?uri=cellar:12e835e2-81af-11eb-9ac9-01aa75ed71a1.0001.02/DOC_1&format= PDF, accessed on 04.10.2022.

[4] https://www.economie.gouv.fr/files/files/2021/France-2030.pdf?v=1641479311, accessed on 04.10.2022.

[5] https://doi.org/10.1787/9789264048782-en, accessed on 04.10.2022.

ments (Coad et al., 2014; Petersen, Ahmad, 2007; Acs et al., 2008), the debates about the reliability of criteria for identifying high-growth companies continued (Stone, Badawy, 2011; Haltiwanger et al., 2010; Coad et al., 2014). The OECD and the Statistical Office of the European Union (Eurostat) consider gazelles as a variety of rapidly growing companies in accordance with the growth criteria originally proposed and validated by other researchers, limiting their age to five years (Ahmad, 2008; Petersen, Ahmad, 2007; OECD/Eurostat, 2008). Company growth is measured both in terms of the number of employees and revenues.

Another type of rapidly growing firm is represented by "scale-ups": dynamic companies established no more than 10 years ago which have attracted funding of at least 1 million euros in total.[8] Some authors consider the concepts of scale-ups and gazelles as synonymous (Seip et al., 2022). Studying them is complicated by the fact that small private companies rarely disclose data on their growth (Petersen, Ahmad, 2007) and funding.

The range of concepts describing the various aspects of fast-growing businesses also includes "hidden champions": these were originally conceptualized by Herman Simon (Simon, 1990) as companies little known to a wide range of consumers, dominating narrow market segments (number one at the national level, or one of the top three in the world), with a relatively small workforce,[9] and revenues of up to 4 billion USD.[10] Such niche leaders favor incremental sustainable innovation over disruptive radical innovation strategies (Simon, 1996; Yoon, 2013) and make a significant contribution to national exports (Fryges, 2006; Kim, Suh, 2015). However, their activities tend to remain in the shadows, which makes it difficult to identify them, while the low recognition criterion itself is hard to formalize (Simon, 1996; Schenkenhofer, 2022).

The "national champions" idea (Maincent and Navarro, 2006; Aubert et al., 2011), which gained wide popularity among politicians, originated in France and proliferated throughout the world. However, unlike the fast-growing company types considered above, criteria for identifying national champions are less clear. There is no consensus on whether this concept applies exclusively to the largest of, or all particularly successful companies regardless of their size, and whether their competitiveness in strategic industries should be taken into account (Maincent, Navarro, 2006). Many researchers include in the number of national (sometimes also called "industry") champions the largest medium- and high-tech corporations in the country (Maincent, Navarro, 2006), which act as agents of strategic national interests on the world market and enjoy state protection (Aubert et al., 2011; Melnik, 2019).

The idea of nurturing national champions was embraced by China's industrial policy, officially announced by the government in the late 1990s. (Poon, 2009). By now China has gained significant experience in this area,[11] among other things through the use of protectionist measures (Hemphill, White, 2013). The country has adopted a high-technology enterprise certification system and now maintains a register of those. Companies that have confirmed their status become more visible for the government and investors, thus increasing their access to tax incentives and other state support measures, and strengthening reputational advantages. At the same time the state's active involvement in promoting national champions has been criticized for interfering with open competition (Simon, 1996; Hemphill, White 2013; Melnik, 2019). It has been proposed to shift the emphasis of support policy from national leaders to small rapidly growing high-technology firms (Maincent, Navarro, 2006).

In this context, the venture investor Aileen Lee published a paper about technology companies which have reached an estimated market value of 1 billion USD and the author called these firms "unicorns" (Lee, 2013). The concept reflected the unique, or very rare nature of an event such as the birth of a billion-dollar company, and since then became firmly established in the professional and academic discourse (Brown, Wiles, 2015; Jinzhi, Carrick, 2019; Bock, Hackober, 2020).

Unicorns are increasingly conquering the world's high-tech markets, but remain quite rare: just one in a hundred companies that have received seed capital becomes a unicorn.[12] In 2013, when this concept emerged, the opportunities to join the club were much more limited: according to one estimate, only six out of a hundred thousand start-ups reached unicorn status.[13] And though the 1 billion USD threshold was rather arbitrary, it has become a kind of psychological marker for investors, entrepreneurs, and the press,[14]

[8] https://eic.ec.europa.eu/news/european-innovation-council-launches-scale-100-call-2022-05-16_en, accessed on 04.10.2022.

[7] www.k-unicorn.or.kr and https://www.mss.go.kr/site/smba/main.do, accessed on 04.10.2022.

[8] https://www.eur.nl/media/100543, accessed on 04.10.2022.

[9] On average 2,000 people, which is 33 times lower than the figure for Fortune Global 500 companies in 2007 (Simon, 1990, 1996).

[10] As examples of hidden champions, Simon names Technogym (world leader in distributing fitness, sports, and health equipment and digital technologies, originally from the Italian village of Gambetolla), Zimmer, DePuy, Biomet (global leaders in orthopedic implants production, originally from the small city of Warsaw, Indiana (USA), the informal world orthopedic capital), Plansee (flagship in production of high-quality materials from refractory metals and composites, based in the Austrian city of Reutte), SAP (leader in developing business software located in the Germany's Walldorf), etc.

[11] The BATX companies (Baidu, Alibaba, Tencent, Xiaomi) are examples of Chinese technology leaders.

[12] https://2020.stateofeuropeantech.com/chapter/state-european-tech-2020/, accessed on 04.10.2022.

[13] https://review.firstround.com/Theres-a-00006-Chance-of-Building-a-Billion-Dollar-Company-How-This-Man-Did-It?utm_source=salesforce&utm_medium=blog, accessed on 04.10.2022.

[14] http://fortune.com/2015/01/22/the-age-of-unicorns/, accessed on 04.10.2022.

and a benchmark for the public sector (Simon, 2016; Testa et al., 2022). Plus, given the non-public nature of these companies, the proposed criteria turned out to be clear and comprehensible, and are now actively used by analytical platforms (such as, e.g., Crunchbase,[15] CB Insights,[16] Dealroom,[17] or Pitchbook[18]).

The key difference between unicorns and other company types considered above is that the former's success is based on venture capitalists' support and their capitalization is estimated on the basis of investments received (which reflect the predicted growth potential, but is not always supported by actual financial performance indicators). Some companies were evaluated by investors at many billions despite them posting major losses[19] (e.g. Uber[20] or Snapchat[21]). Rapid user acquisition rates and offering unique products and services often turned out to be the critical factors here.

On the contrary, scale-ups, gazelles, and national or hidden champions do not rely on professional investors' assessments. Their capitalization is based on the actual dynamics of financial indicators, and the number of jobs created. Hidden champions, unlike unicorns which are focused on business scaling and global reach, prosper in narrow market segments. In turn, national champions are the established leaders who operate in strategic government-supported industries. Being radical innovators, unicorns create new industries pushing mature corporations out, including in manufacturing (Bock, Hackober, 2020). Some researchers define this displacement process as "creative destruction" (Simon, 2016).

Unlike most gazelles, many scale-ups, and some national champions, unicorns' success is based not on the reports with meager information about non-public companies (which tend to be incompatible for international comparison), but on independent assessments by professional investors who have risked their money. This is the key advantage of the unicorn concept, which has made it popular among experts, politicians, and investors.

Unicorns are gradually becoming a symbol of entrepreneurial ecosystems' success, which increases the interest in studying the context of their operations and the many observable and hidden growth factors. A European Commission study (Testa et al., 2022) identified key growth predictors for 1,659 former and current unicorns in 53 countries: the use of high technologies, access to venture capital, high-quality education, and the entrepreneurial experience of their founders. These results confirmed the key findings of a previous European Commission study (Simon, 2016) based on a smaller sample of 23 unicorns.

Researchers from the University of Nottingham have studied the impact of universities on technology entrepreneurship (Ratsinger et al., 2018). On the basis of data about 4,953 digital start-ups, they found that companies' success and chances to attract investments largely depend upon the level of the entrepreneurs' education. The role of universities in unicorns' fate is even more obvious. Almost all unicorn founders have a bachelor's degree, about half of them have a master's or an MBA, and about 12% have a PhD (Testa et al., 2022). The effect of a high-quality university education on raising unicorns can also be traced at the level of individual countries. For example, among the founders of South Korean unicorns, a group of young entrepreneurs - graduates of the Korea Advanced Institute of Science and Technology - stand out, one of the most innovative universities in the country and a leading university in the world (Seoul Business Agency, 2019).

The rapid growth of unicorns was facilitated by the development of mobile internet and relevant applications, the increased availability of software, digital platforms, cloud computing, and business models based on them (Kenney, Zysman, 2019; Bock, Hackober, 2020). The key aspects of unicorn companies' operations include high business scalability and rapid growth (which investors see as indirect indicators of their value) (Kenney, Zysman, 2019; Bock, Hackober, 2020), and increased user coverage, involvement, and retention. Most of these fast-growing companies specialize in software development, AI, cybersecurity, and biotech (Anderson, 2022).

On average, companies in the EU reach unicorn status at the age of ten years (to compare, in the US and China this figure is eight and five years, respectively) (Testa et al., 2022). Between 2008 and the second quarter of 2021, venture capitalists in the EU invested an average of 125 million euros in a unicorn (in the US - 138 million euros, in China - 204 million euros) (Testa et al., 2022). The larger venture investments in the US and China help start-ups attract more funding and reach the billion-dollar mark faster than "Europeans" do. In addition to the size of the venture capital market, the higher speed of achieving unicorn status in China is also due to corporations' (such as Tencent, Alibaba, Huawei, ZTE) targeted efforts to raise new technology leaders (Jinzhi, Carrick, 2019).

Despite their youth, unicorns are able to compete not only with mature corporations, but with entire indus-

[15] https://news.crunchbase.com/unicorn-company-list, accessed on 04.10.2022.

[16] https://www.cbinsights.com/research-unicorn-companies, accessed on 04.10.2022.

[17] https://app.dealroom.co/unicorns, accessed on 04.10.2022.

[18] https://pitchbook.com/news/articles/unicorn-startups-list-trends, accessed on 04.10.2022.

[19] https://hbr.org/2018/02/why-financial-statements-dont-work-for-digital-companies, accessed on 28.10.2022.

[20] https://news.crunchbase.com/startups/understanding-uber-loses-money/, accessed on 28.10.2022.

[21] https://www.theguardian.com/technology/2017/mar/02/snapchat-ipo-valuation-evan-spiegel-bobby-murphy-snap-inc, accessed on 28.10.2022.

tries, and even economies. For example, the total capitalization of all US unicorns exceeds 2 trillion USD, i.e., the value of all companies listed on major stock exchanges in countries such as Argentina, Colombia, Peru, Portugal, Ireland, Russia, etc. (Anderson, 2022). These exceptional results are driving countries into a global race for potential unicorns, and for finding ways to make national entrepreneurial ecosystems more attractive.

The Role of Foreign Talent and Factors Affecting International Unicorn Migration

According to one of the many approaches to studying the reasons for the spatial concentration of economic activities, resources, and production (Porter, 1990; Krugman, 1991), this phenomenon is driven by the desire to share ideas and gain access to local knowledge and lucrative business contacts (Jaffe et al., 1993; Audretsch, Feldman, 2004; Arzaghi, Henderson, 2008). The level of high-tech companies' concentration and entrepreneurial migration depend on the availability of capital and the proximity to cutting-edge scientific achievements, universities, and talent clusters (Calcagnini et al., 2016; Kerr, 2020). Migration promotes further growth of entrepreneurial and innovation activity (Fairlie, Lofstrom, 2014; Blume-Kohout, 2016; Brown et al., 2019; Anderson, 2022) as an object of interest of national authorities, international organizations, and a wide range of researchers (CCG, 2017; Cerna, 2016; Chaloff, Lemaître, 2009; Clemens, 2011).

According to certain estimates, immigrant inventors' contribution to patent activity is higher than that of natives (Kerr, Kerr, 2020b). The most active innovators (with more than 200 registered patents to their credit) emigrate five times more often than their less productive colleagues, thus positively affecting innovation activity in their places of relocation (Akcigit et al., 2016; Zacchia, 2018). One of the most mobile talent pools turns out to be Nobel Prize winners: a third of them work outside their country of origin (Kerr, 2020). Approximately 70% of software engineers in Silicon Valley were born outside the US (Kerr et al., 2016).

Due to immigrants' higher level of business activity (Borjas, 1995; Fairlie, 2012), politicians in many countries see them as a resource for increasing the number of potential entrepreneurs (Kerr, Kerr, 2020a). Immigration is believed to serve as a screening mechanism for people with a greater propensity to take risks (Kerr, 2019). They are more likely to create companies in high-technology sectors than in low-tech ones, more inclined (compared to the natives) to choose STEM (Science, Technology, Engineering, and Mathematics) as their specialization area (Hunt, 2015; Hanson, Liu, 2018; Kerr, Kerr, 2020a), and are more actively involved in research and development (R&D) (Brown et al., 2019; Kerr, Kerr, 2020a). Thus, unsurprisingly, about 40% of the world's Fortune 500 companies which generate the largest revenues were founded by first- or second-generation immigrants (Partnership for a New American Economy, 2011).

The migration of unicorns and of their founders is of particular interest (Simon, 2016). Its geography is determined by factors such as the availability of capital, expertise of universities and R&D centers, the presence of a fruitful, knowledge-intensive environment, access to broadband mobile communications, favorable tax regimes, and innovative infrastructure (Simon, 2016; Guerrero et al., 2019; Testa et al., 2022). Venture capital plays an important role in the level of unicorns' concentration (Testa et al., 2022). This is expressed, in particular, in the way experienced investors select companies with a high growth potential (Bengtsson, Wang, 2010; Achleitner et al., 2013). Start-ups are much more likely to succeed when they have access to expertise and business acumen of highly qualified venture capital investors (Alperovych, Hübner, 2013; Bernstein et al., 2016; Breuer, Pinkwart, 2018). Their reputation promotes the growth of asset portfolio value by reducing information asymmetry between participants (Lee et al., 2011; Achleitner et al., 2013; Hsu, 2004). Meanwhile established investors themselves become even more visible and gain an informational advantage in spotting investment opportunities by attracting additional resources for portfolio companies (Krishnan et al., 2011; Bock, Hackober, 2020). In turn, entrepreneurs are willing to accept a lower valuation of their company to gain access to large investors' capital, anticipating future reputational and financial benefits from such transactions (Hsu, 2004).

Rapidly growing companies seek to benefit from developed entrepreneurial ecosystems (Guerrero et al., 2021) by moving to metropolitan areas with a high concentration of resources. For example, relocating to the San Francisco Bay Area facilitates access to resources, leads to productivity growth by attracting venture capital (3.5 times in six years), increased patent activity (4.7 times), increased sales, and IPO placement (Guzman, 2019). The United States' special position on the global market has led to the emergence of a kind of psychological pattern, when the very move to this country is perceived as increasing technology entrepreneurs' chances for a gainful career.

Data and Methodology

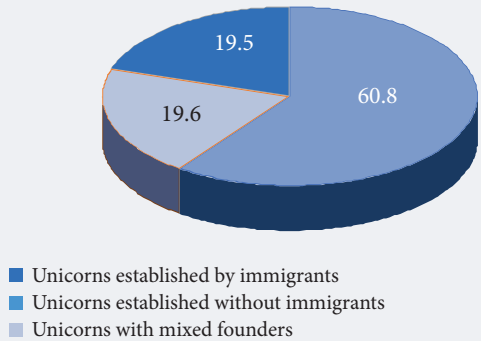
The source of data on unicorn companies used in this study was the largest international platform Crunchbase, which aggregates information about start-ups, investors, and venture deals. As of July 2022, there were 1,357 unicorns in the world registered in 49 countries. Over the course of the study, information on estimated value was collected for each of them: for 1,329 companies (98%), the amount of venture investments they received was determined; and for 1,320 a list of 3,190 entrepreneurs who participated in

the establishment of the original start-ups and acted as their ideological architects was compiled. Such a striking mismatch between the number of unicorns and the number of their founders is due, among other things, to the fact that some companies were founded by 10 or more people: 19 in the case of Lazada Group, 12 for Starburst, and 10 for Oda. On the other hand, the same person could establish several unicorns, e.g., Liu Qiangdong established JD Digits, JD MRO, and JD.ID, or Sebastian Thrun, who founded Cresta, Udacity, and Waymo.

During this study, based on open data available on the internet, all unicorn founders' countries of birth and higher education were determined. The main data sources were their social network profiles and personal websites. The secondary source was unicorn companies' websites, news about them, and interviews with their founders. The country of birth was determined for all 3,190 entrepreneurs, while data on higher education was found for 2,699 of them (84.6%).

Migration flows were traced by comparing unicorn founders' countries of birth with the places of their companies' registration. Depending on migration paths, countries were broken down into three groups: those pulling unicorns in from outside, raising their own, and losing them all. Table 1 presents the typical members of each group and the selection criteria (chosen in such a way as to exclude countries with a small number of unicorns: 11 nations have a single unicorn company, five have two, and six have three). Otherwise, the presence of a foreign founder in one or more unicorns would result in high internationalization values that are unrepresentative in terms of countries' actual appeal.

Figure 1. **Breakdown of Unicorn Companies by Founders' Nationality** (%)



Source: authors.

A systemic approach was applied to analyzing unicorn raising and attraction factors: countries in all of the above groups were compared by such criteria as wellbeing, smart money supply, technological development, institutional conditions, and education and science (Table 2). After collecting the relevant data, the most significant differences between the three country groups were identified. Countries where unicorn founders were educated and where the unicorns were registered were compared separately to determine the role of universities in founders' migration and identify more productive universities in terms of the number of graduates who have subsequently created a unicorn company.

Analysis of Unicorn Founders' Migration Flows

Differences in foreign- and native-founded unicorns' capitalization

A total of 979 of the 3,190 unicorn founders analyzed (30.5%) migrated to another country and created a unicorn there, indicating the high mobility of such entrepreneurs: almost nine times the migration rate for the general population (McAuliffe, Triandafyllidou, 2021), three times for inventors, and comparable to one of the most mobile talent groups, Nobel laureates (Kerr, 2020). In total, immigrants created 517 billion-dollar start-ups (39.3% of the total number of unicorns whose founders are known), 258 were established exclusively by immigrants, and 259 were of "hybrid" origin (i.e., had at least one native founder) (Figure 1).

The total estimated value of the unicorns analyzed during this study was 4.6 trillion USD, half of which (2.3 trillion) is made up by companies with foreign founders. Collectively, unicorn companies raised 833.9 billion USD in venture capital investments, 37.5% of that sum was raised by unicorns with a migrant founder.[23]

Companies established by foreigners (exclusively, or jointly with natives) and without them show very similar investment performance (Figure 2). Unicorns created by migrants attract almost the same amount of venture capital as those established solely by natives, but on average are valued 1.2 times higher. The discrepancy between the mean and median values indicates that the most valuable unicorns tend to have foreign founders. If seven of the 10 top-value unicorns have foreign founders, for the top 100, the

[22] Only three of the 10 top-value unicorns do not have foreign founders: ByteDance internet company (180 billion USD, the highest value among all unicorns); Ant Group payment platform (150 billion USD, 2nd place); and Canva graphic design services (40 billion USD, 7th place). The most valuable foreign-founded billion-dollar startup is SpaceX (125 billion USD, 3rd highest value), followed by the fashion retailer Shein (100 billion USD, 4th place), and the US fintech startup Stripe (95 billion USD, 5th place).

[23] Half of the top 10 companies by the amount of raised capital have a foreign founder (e.g., JULL with 15.1 billion USD, SpaceX with 9.5 billion USD, Northvolt with 7.0 billion USD), while the other half do not (Ant Group with 22 billion USD, Cruise with 15.1 billion USD, and ByteDance with 9.4 billion USD).

Table 1. **Groups of Countries by the Direction of Unicorn Founders' Migration Flows**

Country group	Group basis	Membership criteria	Typical representatives
Pulling unicorns in from outside	Attraction factors	Country must have at least seven unicorns, over 50% of which were founded by migrants	USA, UK, Germany, Canada, Singapore, Switzerland, Mexico, Indonesia
Raising their own unicorns	Raising factors	Same number of unicorns as in the previous group, but less than 30% of them founded by migrants	China, India, France, Israel, South Korea, Australia, Japan, Sweden
Losing all	"Hygienic" factors* whose low level prompts unicorn founders to leave	No unicorns, but more than eight founders were born in the country	Russia, Romania, Poland, Bulgaria, Pakistan, Ukraine, Iran

* This term is explained later on in the paper.
Source: authors.

ratio becomes almost equal: 49 companies do have a foreign founder and 51 do not.

Foreign unicorn founders' nationality and the countries to which they relocate

To analyze unicorn founders' migration, the countries of these entrepreneurs' origin (on the left in Figure 3) were compared with countries where they have chosen to register their companies (on the right). A total of 979 entrepreneurs from 85 countries were identified in the course of the study, mostly from Israel (151 people or 15.4% of all migrant unicorn founders in the world), India (145 or 14.8%), China (63 or 6.4%), the United States (50 or 5.1%), and the UK (46 or 4.7%). Together, these countries account for almost half (46.5%) of all migrant unicorn founders. From 38 countries, two or fewer unicorn founders emigrated; together, they account for 5.6% of the total number of entrepreneurs under consideration (among them are Indonesia, Japan, Finland, and Malaysia). As shown in Figure 3 on the right, the number of countries attractive to unicorn founders is three times smaller (32). The largest numbers have relocated to the US (690 or 71.4%), UK (55 or 5.7%), Singapore (49 or 5.1%), Canada (28 or 2.9%), and China (23 or 2.4%).[24]

Unicorn importer countries are deeply integrated into global migration flows: they not only attract foreign entrepreneurs, but also offer their own to the world. On the other hand, countries that only raise unicorns at home, or only pull them in from outside are relatively rare. Examples include the UAE and Ecuador: not a single unicorn founder has left them, but seven have moved in.

The group of "net" unicorn founder importers comprises 55 countries, which together account for a quarter (25.7%) of all migrant entrepreneurs. In this cohort, the largest numbers of unicorn founders come from Russia (38 people or 3.9%), Ukraine (20 or 2%), Argentina (13 or 1.3%), Portugal (13 or 1.3%), South Korea (12 or 1.2%), Romania and Iran (11 each or 1.1%), and Poland (10 or 1%).

The top 10 countries by number of unicorns located on their territory have different shares of such companies founded by migrants (Table 3). For example, South Korea has none at all, while in Singapore their share reaches 83.3%.[25]

Thus, the number of unicorns in the country does not always depend upon its appeal to founders, since the list of top unicorn hosts includes countries with a high share of foreign entrepreneurs (Singapore), and those with none at all (South Korea). The top five such nations are just as heterogeneous in this regard: 50-55% in the US, UK, and Germany, and 8.0% and 4.2% in China and India, respectively.

The United States is the most diverse country in terms of migrants' origins: unicorn founders from 73 countries have relocated there. In Singapore, billion-dollar start-ups were founded by people from 22 countries, in the UK from 21, in Germany from 15, and in China from 13. An analysis of migrant entrepreneurs' nationalities in countries with their highest concentration revealed the prevalence of several donor nations in the total flow (Figure 4).

Despite the fact that the United States has the highest national diversity of incoming entrepreneurs, it is difficult to single out a clear leader in the total migrant flow: Israel and India account for approximately equal shares, at 19% and 18%, respectively. Immigrants from Israel dominate in the UK, at 22%. Entrepreneurs of Indian origin make up the bulk of immigrants in Singapore, at 20%. The main supplier of unicorn founders to Canada and China is the US, at 32% and 48%, respectively.

Innovation profiles of countries which raise, attract, and lose unicorn companies

Countries that have raised unicorn founders differ in terms of the prevalence of native vs. foreign entre-

[24] Seven countries were identified (Turkey, Nigeria, Austria, Thailand, Finland, Malaysia, and Lithuania) to each of which relocated a single unicorn founder, and 17 more which became home to between one and ten unicorn founders: nine in Brazil, eight each in Mexico and Indonesia, seven in Belgium, five in the Netherlands, etc.

[25] Countries where over half of all registered unicorns have migrant founders include Germany (51.4%), Canada (52%), UK (52.7%), and US (54.2%).

Table 2. **Indicators Applied to Assess National Economies**

No.	Indicator	Data source	Period
	1. Wellbeing		
1.1	Per capita GDP (*USD*)	World Bank [I]	2021
	2. Smart money supply		
2.1	Venture investments (*billion USD*)	Crunchbase	2021
	3. Technological development		
3.1	Number of largest high-tech companies	R&D Scoreboard 2500 [II]	2021
3.2	High-technology exports (%)	World Bank	2021
3.3	Gross domestic R&D expenditures as share in GDP (%)	World Bank	2021
3.4	Number of PCT applications	World Intellectual Property Organisation[III]	2021
3.5	Number of supercomputers	Top500 [IV]	2022
	4. Institutional conditions		
4.1	Number of business registration procedures	World Bank	2021
4.2	International Intellectual Property Index	International Intellectual Property Alliance [V]	2021
4.3	Rule of Law Index	World Bank	2021
	5. Education and science		
5.1	Number of leading universities	QS [VI], Times Higher Education [VII], and ARWU [VIII] rankings	2021
5.2	Enrolment in secondary schools (%)	World Bank	2021
5.3	Number of leading R&D organisations	Nature [IX]	2021
5.4	Number of top business schools	Financial Times [X]	2021
5.5	Number of highly cited scientists	Clarivate [XI]	2021
5.6	Number of Nobel Prize and Fields Medal winners	Official Nobel Prize[XII] and International Mathematical Union[XIII] websites	2021

[I] https://data.worldbank.org/indicator/, accessed on 14.11.2022.
[II] https://iri.jrc.ec.europa.eu/scoreboard/2021-eu-industrial-rd-investment-scoreboard, accessed on 14.11.2022.
[III] https://www.wipo.int/pct/en/, accessed on 14.11.2022.
[IV] https://www.top500.org/lists/top500/, accessed on 14.11.2022.
[V] https://www.propertyrightsalliance.org/ , accessed on 14.11.2022.
[VI] https://www.topuniversities.com/university-rankings, accessed on 14.11.2022.
[VII] https://www.timeshighereducation.com/, accessed on 14.11.2022.
[VIII] https://www.shanghairanking.com/rankings/arwu/2021, accessed on 14.11.2022.
[IX] https://www.nature.com/nature-index/news-blog/leading-research-institutions-science-nature-index-annual-tables-twenty-twenty, accessed on 14.11.2022.
[X] https://rankings.ft.com/home/masters-in-business-administration, accessed on 14.11.2022.
[XI] https://clarivate.com/, accessed on 14.11.2022.
[XII] https://www.nobelprise.org/, accessed on 14.11.2022.
[XIII] https://www.mathunion.org/, accessed on 14.11.2022.

Source: authors.

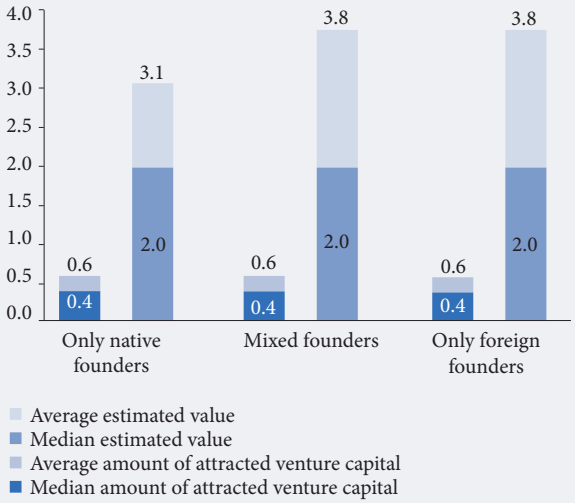
preneurs in this group. Some countries "exported" all their unicorns and could not attract any from abroad. The first two groups of countries presented in Table 1 above succeeded in both pulling unicorns in from the outside and raising their own: 846 (62.3%) of all unicorns in the world were established by founders migrating from abroad, while 412 (30.4%) were founded by native entrepreneurs; together, these 16 countries host 92.7% of all unicorns in the world. On the contrary, the third group does not have a single unicorn company, but these countries have raised a large number of their future founders who subsequently created successful businesses abroad.

Comparing these country groups by indicators reflecting their wellbeing, technological development, science and education levels, and institutional conditions allows one to identify each group's typical features and estimate the importance of various unicorn attraction factors (Table 4).

Significant unicorn attraction factors include developed venture capital markets, the presence of leading universities, R&D organizations, business schools, and highly cited scientists recognized by the international academic community (including Nobel Prize and Fields Medal winners). Together, these factors create an attractive innovation ecosystem. As for raising unicorns, R&D expenditures seem to be more important. Countries with the highest level of such domestic expenditures are particularly successful in creating such companies on their own. Their highly productive technological environment provides a breeding ground for the emergence of unicorns.

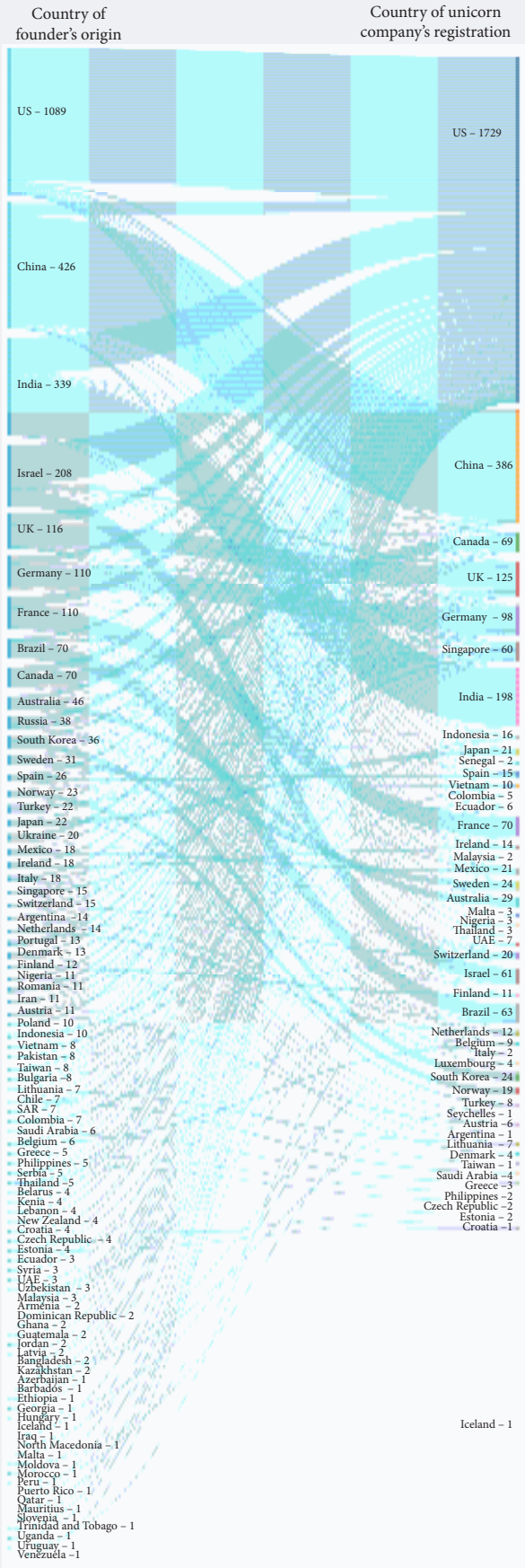
A special remark is deserved by the group of indicators whose values are similar in the countries which pull unicorns in from outside and grow their own, but much lower in those which "lose all". These factors can be called "hygienic" ones: they measure the overall health of the economy and include per capita

Figure 2. **Unicorns' Value Breakdown by Founders' Nationality (*billion USD*)**



Source: authors.

Figure 3. **Global Migration Flows of Unicorn Founders, by Country (*number of people*)**



Source: authors.

GDP, the number of major high-technology companies, high-tech exports, international patent applications (PCT), the availability of supercomputers, intellectual property protection, and rule of law. Insufficient progress in these areas leads to the country losing potential unicorns, as it cannot get closer to the world leaders. Four out of five indicators in the Technological development section turned out to be "hygienic": unicorn founders leave countries where businesses' demand for innovations is weak, the number of manufactured world-class high-technology products is small, and IT infrastructure is backward. The same applies to two out of three institutional factors which assess the legal environment.Meanwhile, there is an indicator group that does not quite fit into the precise classification of the countries presented above. It comprises company registration procedures, the number of leading universities, and enrollment in secondary education, which shows that reducing administrative barriers and providing wide access to secondary and university education remain basic conditions for obtaining competitive advantages in raising and attracting unicorns.

World's leading universities as factories of, and magnets for unicorn founders

Calculations show that universities did not remain outside the unicorn boom: the vast majority of the unicorn founders turned out to be graduates of the world's leading universities. The 20 universities that educated the largest number of unicorn founders account for almost 40% of their total number. These universities are located in just five countries: the US (13), Israel (3), the UK (2), India (1), and China (1). The most popular universities which have "produced" the largest number of unicorn founders are Stanford

Table 3. **Number of Unicorn Companies Whose Founders Include, and Do Not Include Migrants, by Country (*units*)**

Country	Number of unicorn companies	
	No migrant founders	Migrant founders
US	308	365
China	212	17
India	71	3
UK	26	29
Germany	17	18
France	24	3
Canada	12	13
Israel	22	3
Brazil	13	6
Singapore	3	15
South Korea	18	0

Source: authors.

and Harvard, along with the Massachusetts Institute of Technology; together, they account for more than 15% of all founders[26] (Table 5).

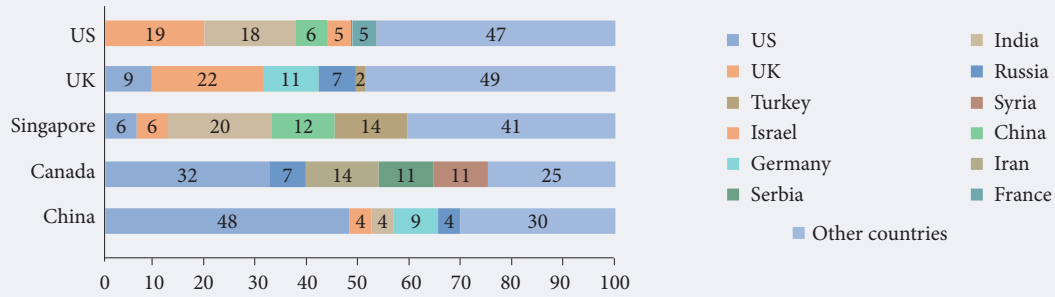
The average value of unicorns created by graduates of the three leading universities is 1.2 times higher than that of all other billion-dollar companies (4.0 vs. 3.4 billion USD). The median value is almost the same, at 2 billion USD, which indicates the founders of the most valuable unicorns are also among these university graduates.

Universities have different appeal for foreign unicorn founders. Some universities are focused on national development, raising successful native entrepreneurs and attracting foreigners to a lesser extent. For example, those universities leading in terms of the number of unicorn founder graduates in India (Indian Institute of Technology Delhi), Israel (Tel Aviv University, Hebrew University of Jerusalem, Technion Israel Institute of Technology), and China (Tsinghua University) have less than 10% shares of foreigners in the total number of graduate unicorn founders.

On the other hand, some universities aim to attract talent from all over the world. Universities with the highest share of foreigners in the total number of graduate unicorn founders include the universities of Waterloo (about 59%), Illinois (44%), and Purdue (about 44%). Their high internationalization is evidenced by both the general heterogeneity of students' national origins (e.g. at the University of Waterloo students come from 120 countries[27]), and the highly diverse "national mix" of graduates - foreign unicorn founders (the ten such graduates of University of Waterloo come from nine countries: China, India, Russia, Romania, Lithuania, Iran, Kenya, Nigeria, and Brazil). Foreign unicorn founder graduates of the University of Illinois come from five countries, and Purdue University alumni come from four.

Universities play a major role in attracting overseas unicorn founders. Every third immigrant who created a billion-dollar company was educated in the country of their migration, most of them (about 87%) in the United States. Universities in Canada and the UK also remain attractive to them, accounting for more than 5% of foreign unicorn founders. The top 20 universities by this indicator are concentrated in the US (15), UK (3), France (1), and Canada (1) (Table 6). At the same time, the 12 universities which attracted the largest number of immigrant unicorn founders also lead in terms of the total number of foreign graduates who created unicorn companies. Some of the entrepreneurs who graduated from these universities have established billion-dollar start-ups in the country of their education, while others have chosen to do business elsewhere. The ratio of these two foreign unicorn founder groups indirectly indicates the strength of business ties and the role of the university entrepreneurial ecosystem in making the decision to open a business in the country of one's education or, on the contrary, the strength of the founder's old con-

Figure 4. **Structure of Migrant Unicorn Founders' Origins in the Top 5 Host Countries (%)**



Source: authors.

Note: for each host country are shown the top five countries of immigrant unicorn founders' origins.

[26] The most successful entrepreneurs: Stanford University graduates include Elon Musk (SpaceX), Adam Bowen (electronic cigarette manufacturer JUUL), and Ryan King (fintech company Chime). Harvard graduates include John Collison (fintech startup Stripe), Demet Mutlu (e-commerce platform Trendyol Group), and Ömer Priel (fintech startup Rapyd). MIT alumni include Patrick Collison, brother of John Collison and co-founder of Stripe, Kyle Vogt (maker of Cruise self-driving cars), and Carlos Cashman (retail brand aggregator Thrasio). Notably, more than half of them are immigrants.

[27] https://uwaterloo.ca/future-students/international-students, accessed on 10.10.2022.

Table 4. **Innovation Profiles of Countries that Raise, Attract, and Lose Unicorn Companies, Based on Various Indicator Groups**

Indicator	Country group			Indicator's effect on unicorn founders' migration
	Attract from abroad	Raise their own	Loose all	
Wellbeing				
Per capita GDP (*USD*)	49 993.0	38 462.9	10 480.6	Important to retain
Smart money supply				
Venture investments (*billion USD*)	59.0	26.1	0.3	Important to attract
Technological development				
Number of major high-tech companies	137.7	138.1	0.6	Important to retain
High-technology exports (*%*)	20.7	19.8	7.2	Important to retain
Share of gross domestic R&D expenditure in GDP (*%*)	1.95	3.04	0.76	Important to raise
Number of patent applications filed under PCT	40 806.3	36 739.8	658.4	Important to retain
Number of supercomputers	12.5	15.6	1.3	Important to retain
Institutional conditions				
Number of procedures required to register a company	6.0	5.4	6.1	Irrelevant
International Intellectual Property Index	6.9	6.8	4.9	Important to retain
Rule of Law Index	1.1	1.0	-0.3	Important to retain
Education and science				
Number of leading universities	64.1	68.8	29.5	Irrelevant
Enrolment in secondary schools (*%*)	93.5	90.7	81.8	Irrelevant
Number of leading R&D organisations	30.7	23.2	0.7	Important to attract
Number of leading business schools	9.1	5.5	0.7	Important to attract
Number of highly cited scientists	528.9	241.0	8.1	Important to attract
Number of Nobel Prize and Fields Medal winners	35.8	5.8	1.8	Important to attract

Note: average indicator values for the country group are presented.
Source: authors.

nections or the attractiveness of the business climate in other locations.

Universities particularly popular with foreign unicorn founders tend to have a significant share of graduates remaining in the country. Almost 75% of foreign graduates have created a unicorn in the country of their education, which is twice the rate for all universities where foreign entrepreneurs have studied. For immigrant Stanford University alumni (the leader in the "production" of foreign unicorn founders, 71 persons) this share is close to 82%. All foreign unicorn founders who graduated from the Universities of Illinois, Texas at Austin, Princeton, and Southern Californiaestablished their unicorns in the country where their alma mater was located. On the other hand, European universities tend to serve as an intermediate point along entrepreneurs' migration route. For example, none of the future billion-dollar start-up founders did this in the country of their education after graduating from the University of Oxford, or from the European Institute of Business Management. Of the University of Cambridge graduates, less than 10% of foreign unicorn founders remained in the country; for the London School of Economics and Political Science, the relevant figure is 13%, while nine out of 10 future foreign unicorn founders left Canada after graduating from the University of Waterloo.

Not only foreign unicorn founders leave after receiving a diploma; some of the future successful entrepreneurs educated in their home country also chose a more attractive one for doing business. The largest "exporters" of such graduates are Israel (115), India (97), and the US (37). But if 71% and 36% of the future unicorn founders have left the first two countries after completing their education, respectively, only about 4% left the US. Seventeen nations remain pure donors (with none of their own unicorns) of founders, of them, Russia and Poland educated the largest number of future billion-dollar start-up creators (Figure 5).

The top five donor universities by the number of unicorn founder graduates in countries which do not have their own unicorns are the M.V. Lomonosov Moscow State University (5), Moscow Institute of Physics and Technology (4), Lisbon University Higher Technical Institute (3), and Universities of Aveiro (3), and Coimbra (3) (Table 7).

Unicorn founders' interest in the world's leading universities, combined with migration from other countries after completing their education indicate that fundamental academic training is an important, but not sufficient condition for raising unicorns. Blending the educational component with research potential creates a synergy: the best researchers and scientists

Table 5. **Top 20 Universities by Number of Graduates – Unicorn Founders (*persons*)**

University (country)	Number of unicorn founders
Stanford University (US)	238
Harvard University (US)	143
Massachusetts Institute of Technology (US)	106
University of California Berkeley (US)	97
Indian Institute of Technology Delhi (India)	70
University of Pennsylvania (US)	64
Tel Aviv University (Israel)	51
Columbia University (US)	45
Yale University (US)	44
Tsinghua University (China)	43
Oxford University (UK)	42
Carnegie Mellon University (US)	42
New York University (US)	41
Cornell University (US)	38
Hebrew University of Jerusalem (Israel)	37
Technion – Israel Institute of Technology (Israel)	36
University of Cambridge (UK)	32
University of Southern California (US)	32
University of Washington (US)	30
Princeton University (US)	29

Source: authors.

attract those engaged in developing breakthrough products and services. In turn, access to large venture investors' capital helps attract and retain founders of promising technology companies.

Conclusions and Recommendations

Immigrants make a significant contribution to creating unicorn companies: about 40% of billion-dollar businesses were established with the participation of foreign founders. Migration allows talent to choose areas with a high concentration of human, financial, and infrastructural resources, acquire local knowledge, make business contacts, and receive the best education in the world. To implement their breakthrough ideas, entrepreneurs seek to find a place (city or country) with the best combination of these factors. When talent moves into a highly productive environment, new unicorns emerge.

An analysis of countries' innovation profiles and unicorns founders' migration flows revealed that the strategy of pulling them in from the outside does not contradict the strategy of raising one's own but complements it, and can even maximize the influx of such entrepreneurs. This thesis is confirmed by the examples of leading countries in the number of unicorns, primarily the United States where immigrants created more than half of all billion-dollar companies, and other nations that have succeeded in attracting them, such as Singapore (more than 80% of unicorns there have foreign founders), the UK, Canada, and Germany (over 50% in each). These findings are consistent with those of a recent study of immigrants' role in unicorn creation in the US (Anderson, 2022). Also, an analysis of a database of all active unicorns revealed the significant contribution of immigrants to the creation of billion-dollar companies. The importance of taking unicorn founders' high mobility into account in the strategies for attracting them was substantiated (more than 30% of them created a billion-dollar business outside their country of origin). The most valuable unicorns in the world have been established by international entrepreneur teams with diverse business and cultural backgrounds.

The countries that attract unicorn founders are also their largest exporters: the 32 countries to which such entrepreneurs relocated account for more than 70% of their "exports", i.e., they not only absorb the global migration flow, but also actively contribute to distributing it. Countries differ in the national diversity of incoming migrants, with some of them exchanging unicorn founders between one another: China provides 6% of the migration flow to the US (41 founders), while the US, in turn, accounts for 48% of all foreign unicorn founders in China (11 people).

Based on the prevalence of unicorns created with the participation of migrants, countries were broken down into three groups: those pulling unicorns in from the outside (US, UK, Germany, etc.), raising their own (China, India, France, etc.), and losing all future founders (Russia, Ukraine, Iran, etc.). If in the first group more than half of the unicorns were established with the participation of immigrants, in the second, on the contrary, native entrepreneurs dominate. The third group has the least favorable position compared to the first two; it comprises countries that have raised founders of billion-dollar companies, but failed to either retain them or attract new ones.

The amount of venture investments is the key factor in attracting unicorn founders, along with the presence of high-quality science and education attributes in the country, such as leading research organizations, business schools, and highly cited scientists (including Fields Medal and Nobel Prize winners). The countries in the first group pull unicorn founders in with their research potential and outstanding scientists - top-class researchers without whom no breakthrough innovations can be created. These nations' wealth allows them to allocate significant resources for high-risk venture investments, which attracts technology entrepreneurs from other countries with more modest venture markets. The obtained results confirm other researchers' conclusions about the importance of venture capital (Bock, Hackober, 2020; Testa et al., 2022), and of founders' education for unicorn creation (Simon, 2016; Anderson, 2022), supplementing them with the thesis that the world's leading scientists and universities also play a prominent role in attracting such entrepreneurs.

Table 6. **Top 20 Universities by Number of Foreign Graduates – Unicorn Founders (*persons*)**

University (country)	Number of foreign graduates – unicorn founders	
	Total	Remainers*
Stanford University (US)	71	58
Harvard University (US)	34	23
University of California Berkeley (US)	29	26
Massachusetts Institute of Technology (US)	28	24
University of Pennsylvania (US)	19	17
Carnegie Mellon University (US)	15	11
Yale University (US)	12	10
University of Illinois (US)	11	11
University of Waterloo (Canada)	10	1
University of Texas at Austin (US)	9	9
INSEAD (France)	9	0
University of Southern California (US)	8	8
Princeton University (US)	8	8
London School of Economics and Political Science (UK)	8	3
Purdue University (US)	7	5
University of Cambridge (UK)	7	3
Cornell University (US)	6	5
Northwestern University (US)	6	5
New York University (US)	6	4
Oxford University (UK)	6	0

* Established a unicorn in the country of education. Calculations based on data on people who were educated, and created a unicorn company outside the country of birth.

Source: authors.

Countries that *raise their own unicorns* have a high share of domestic R&D expenditures in GDP. These funds are not allocated through market mechanisms like venture investments, aimed exclusively at making a profit and therefore insensitive to unicorn founders' origins, but through state and corporate innovation development programs primarily aimed at supporting native companies and start-ups.

Countries with low values of "hygienic" indicators find it difficult to raise unicorn creators, and even more so to pull them in from the outside; ultimately they *lose all* potentially successful entrepreneurs due to fundamental reasons. These economies have a low level of well-being (measured as per capita GDP), which hampers effective demand for innovative products. They lack major high-tech companies which could become unicorns' partners or clients and they are insufficiently involved in global trade in high-tech products, which is expressed in low export volumes. Finally, the lack of advanced digital infrastructure (supercomputers, etc.) negatively impacts innovation and the retention of talent. Our findings confirm the hypothesis suggested in the European Commission study (Simon, 2016) that the outflow of unicorns from the EU countries could have been caused by their lagging behind in the development of broadband mobile communication technologies, which is an important element of digital infrastructure. "Hygienic" indicators also include the quality of the legal environment measured by the global Rule of Law Index[28]: successful venture capitalists prefer jurisdictions with a high level of legal protection.

Some factors do not obviously affect countries' prospects for raising and attracting unicorns. Many nations make significant efforts to simplify company registration procedures, but appreciable gaps remain between them regarding property protection regimes, including intellectual property rights. The quality of education, both secondary and higher, also turned out not to be a differentiating characteristic. On the contrary, its high level promotes the emergence of successful technology entrepreneurs who may subsequently emigrate to a country with better conditions.

Unicorn founders are educated at the world's best universities. The top 20 universities by the number of graduates who have created billion-dollar start-ups account for about 40% of the total number of such businessmen. Graduates of these universities not only become successful entrepreneurs but create the most valuable unicorns: for the top three universities, Stanford, Harvard, and Massachusetts Institute of Technology, the average value of unicorns established by their graduates is 1.2 times higher than the average for all other unicorns. The role of fundamental aca-

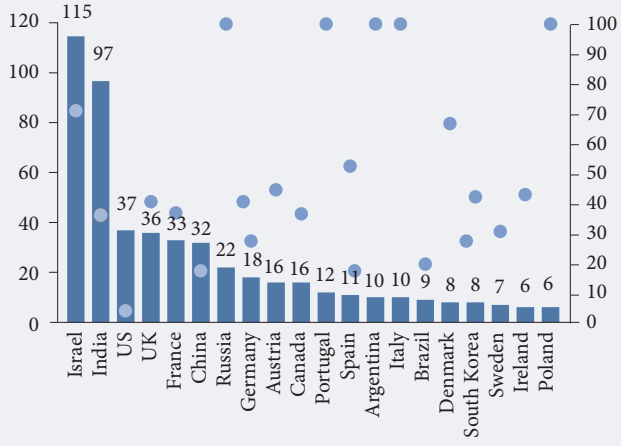
Table 7. **Donor Universities Which Have Two or More Graduates – Unicorn Founders**

University (country)	Number of graduates – unicorn founders
M.V. Lomonosov Moscow State University (Russia)	5
Moscow Institute of Physics and Technology (Russia)	4
Lisbon University Higher Technical Institute (Portugal)	3
University of Aveiro (Portugal)	3
University of Coimbra (Portugal)	3
Novosibirsk State University (Russia)	2
Wroclaw University of Technology (Poland)	2
Warsaw University (Poland)	2
University of Auckland (New Zealand)	2
Mihai Viteazul National College (Romania)	2
Belarusian State University of Informatics and Radioelectronics (Belarus)	2
University of Belgrade (Serbia)	2

Source: authors.

[28] https://worldjusticeproject.org/rule-of-law-index/, accessed on 28.10.2022.

Figure 5. **Countries from Which the Largest Number of Future Unicorn Founders Emigrated after Completing Their Education and Their Share in the Total Number of Unicorn Founder Graduates**



Source: authors.

demic training in unicorn raising is appreciable both globally and nationally, in countries where the best universities turn out to be most productive (e.g., the Indian Institute of Technology Delhi, Tsinghua University, Tel Aviv University, Oxford University, etc.).

Universities not only raise native unicorn founders, but also attract foreign ones. Some of them have a high proportion of foreigners in relation to the total number of unicorn founder graduates (e.g., about 59% for the University of Waterloo, 44% for the University of Illinois, and about 44% for the Purdue University), which reflects these universities' focus on global leadership.

A third of all foreign unicorn founders created their companies in the country of their education. Graduates of the top 20 universities most popular among foreign entrepreneurs establish start-ups in the country where they studied more often (at 75%) than all foreign university graduates do on average. Offering specialized educational programs, scholarships, and visas for talented foreign students, improving the international ranking of national universities, and strengthening their involvement in the international academic community helps countries use this resource to the maximum possible extent. The business contacts that foreign future unicorn founders establish during their studies, access to unique local knowledge, favorable research-intensive environment, the presence of outstanding scientists, and developed venture capital markets help retain those who, having completed their education, leave the country in search of more attractive conditions for doing business.

An analysis of migration flows revealed that unicorn founders tend to be quite sensitive not only to technological, but also institutional and general economic factors. At the same time "pulling in from the outside" strategies require major efforts from countries wishing to direct part of the migration flow toward themselves, while "raising one's own unicorns" strategies do not fully substitute the other kind. The leading economies successfully avoid polarized approaches by raising their own unicorns, exporting them, and attracting them from abroad.

Countries which lose all, i.e., those that do not pull foreign founders in nor raise their own unicorns, find themselves in a particularly vulnerable position. This group includes Russia, which is ahead of other countries in terms of the number of unicorn founders who have left it (38 people). To move out of the outsider group, its authorities need to focus on raising their own global leaders, developing a high-technology environment, and encouraging investments in corporate R&D. At the same time, the appeal of the national entrepreneurial ecosystem for foreign unicorn founders must be increased, by promoting the development of financial markets for high-tech businesses, increasing venture capital investments, integrating universities into the international academic community, developing programs to attract foreign students, promoting science, and supporting outstanding scientists. To attract foreign technology entrepreneurs, investors, and talented professionals who want to work for promising companies, the experience of other countries that use start-up/scale-up visas can be taken into account, such as, e.g., France,[29] the UK,[30] or Canada.[31] It is important to provide comfortable institutional conditions for doing business and stay ahead of global infrastructure trends. As part of a pulling in strategy, most favored status could be introduced for highly mobile Chinese, Indian, and Israeli entrepreneurs.

Paying attention to potential unicorns, studying the factors that contribute to their emergence and relocation, and understanding how these processes can be supported are integral parts of the current innovation policy of countries striving for global technological leadership.

[29] https://lafrenchtech.com/en/how-france-helps-startups/french-tech-visa/, accessed on 03.10.2022.

[30] https://immigrationbarrister.co.uk/personal-immigration/long-term-work-visas/scale-up-visa/, accessed on 03.10.2022.

[31] https://www.canada.ca/en/immigration-refugees-citizenship/services/immigrate-canada/start-visa.html, accessed on 03.10.2022.

References

Achleitner A.-K., Engel N., Reiner U. (2013) The performance of venture capital investments: Do investors overreact? *Review of Financial Economics*, 22(1), 20–35. https://doi.org/10.1016/j.rfe.2012.10.001

Acs Z., Parsons W., Tracy S. (2008) High-impact firms: Gazelles revised. *Small Business Research Summary*, 328, 1–43.

Ahmad N. (2008) A Proposed Framework for Business Demography Statistics. In: *Measuring Entrepreneurship* (ed. E. Congregado), Heidelberg, Dordrecht, London, New York: Springer, pp. 113–174. https://doi.org/10.1007/978-0-387-72288-7_7

Akcigit U., Baslandze S., Stantcheva S. (2016) Taxation and the international mobility of inventors. *American Economic Review*, 106(10), 2930–2981. https://doi.org/10.1257/aer.20150237

Alperovych Y., Hübner G. (2013) Incremental impact of venture capital financing. *Small Business Economics*, 41(3), 651–666. https://doi.org/10.1007/s11187-012-9448-6

Anderson S. (2022) *Immigrant Entrepreneurs and U.S. Billion Dollar Companies* (NFAP Policy Brief), Arlington, VA: National Foundation for American Policy. https://nfap.com/wp-content/uploads/2022/07/2022-BILLION-DOLLAR-STARTUPS.NFAP-Policy-Brief.2022.pdf, accessed 30.09.2022.

Anderson S., Platzer M. (2006) *The Impact of Immigrant Entrepreneurs and Professionals on U.S. Competitiveness*, San Francisco, CA: National Venture Capital Association. http://www.contentfirst.com/AmericanMade_study.pdf, accessed: 30.09.2022.

Arzaghi M., Henderson J.V. (2008) Networking off Madison Avenue. *The Review of Economic Studies*, 75(4), 1011–1038. https://www.jstor.org/stable/20185068

Aubert C., Falck O., Heblich S. (2011) Subsidizing national champions: An evolutionary perspective. In: *Industrial policy for national champions* (eds. O. Falck, L. Woessmann, C. Gollier), Cambridge, MA: The MIT Press, pp. 63–88.

Audretsch D.B., Feldman M.P. (2004) Knowledge spillovers and the geography of innovation. In: *Handbook of Regional and Urban Economics* (eds. J.V. Henderson, J.F. Thisse), vol. 4, Amsterdam: Elsevier, pp. 2713–2739. https://doi.org/10.1016/S1574-0080(04)80018-X

Audretsch D., Colombelli A., Grilli L., Minola T., Rasmussen E. (2020) Innovative start-ups and policy initiatives. *Research Policy*, 49(10), 104027. https://doi.org/10.1016/j.respol.2020.104027

Autio E., Kenney M., Mustar P., Siegel D., Wright M. (2014) Entrepreneurial innovation: The importance of context. *Research Policy*, 43(7), 1097–1108. https://doi.org/10.1016/j.respol.2014.01.015

Baumol W.J., Strom R.J. (2007) Entrepreneurship and economic growth. *Strategic Entrepreneurship Journal*, 1, 233–237. https://doi.org/10.1002/sej.26

Bengtsson O., Wang F. (2010) What Matters in Venture Capital Evidence? Evidence from Entrepreneurs Stated Preferences. *Financial Management,* 39(4), 1367–1401. https://doi.org/10.2139/ssrn.1455483

Bernstein S., Giroud X., Townsend R.R. (2016) The Impact of Venture Capital Monitoring. *The Journal of Finance*, 71(4), 1591–1622. https://doi.org/10.1111/jofi.12370

Bhagavatula S., Mudambi R., Murmann J. (2019) Innovation and Entrepreneurship in India: An Overview. *Management and Organization Review,* 15(3), 467–493. https://doi.org/10.1017/mor.2019.52

Birch D. G. (1987) *Job creation in America: How our smallest companies put the most people to work*, New York: Free Press.

Bock C., Hackober C. (2020) Unicorns — what drives multibillion-dollar valuations? *Business Research*, 13(3), 949–984. https://doi.org/10.1007/s40685-020-00120-2

Borjas G. (1995) The economics of immigration. *Journal of Economic Literature*, 32(4), 1667–1717. https://www.jstor.org/stable/2728791

Breuer W., Pinkwart A. (2018) Venture capital and private equity finance as key determinants of economic development. *Journal of Business Economics,* 88(3), 319–324. https://doi.org/10.1007/s11573-018-0892-x

Brown J.D., Earle J.S., Kim M.J., Lee K.-M. (2019) *Immigrant Entrepreneurs and Innovation in the US High Tech Sector* (IZA Discussion Paper), Bonn: IZA. https://docs.iza.org/dp12190.pdf, accessed 03.10.2022

Brown K.C., Wiles K.W. (2015) In Search of Unicorns: Private IPOs and the Changing Markets for Private Equity Investments and Corporate Control. *Journal of Applied Corporate Finance*, 27(3), 34–48. https://doi.org/10.1111/jacf.12127

Calcagnini G., Favaretto I., Giombini G., Perugini F., Rombaldoni R. (2016) The role of universities in the location of innovative start-ups. *The Journal of Technology Transfer*, 41(4), 670–693. https://doi.org/10.1007/s10961-015-9396-9

CCG (2017) *Attracting skilled international migrants to China: A review and comparison of policies and practices*, Beijing: Centre for China and Globalization (CCG). https://publications.iom.int/system/files/pdf/attracting_skilled_en_0.pdf, accessed 03.10.2022.

Cerna L. (2016) The crisis as an opportunity for change? High-skilled immigration policies across Europe. *Journal of Ethnic and Migration Studies*, 42(10), 1610–1630. https://doi.org/10.1080/1369183X.2016.1162355

Chaloff J., Lemaître G. (2009) *Managing Highly-Skilled Labour Migration: A Comparative Analysis of Migration Policies and Challenges in OECD Countries* (OECD Social, Employment and Migration Working Paper 79), Paris: OECD Publishing. https://doi.org/10.1787/225505346577

Clemens M. (2011) Economics and Emigration: Trillion-Dollar Bills on the Sidewalk? *Journal of Economic Perspectives*, 25(3), 83–106. https://doi.org/10.2307/23049424

Coad A., Daunfeldt S.O., Hölzl W., Johansson D., Nightingale P. (2014) Highgrowth firms: Introduction to the special section. *Industrial and Corporate Change,* 23(1), 91–112. https://doi.org/10.1093/icc/dtt052

Fairlie R. (2012) *Immigrant Entrepreneurs and Small Business Owners, and Their Access to Financial Capital* (SBA Office of Advocacy Report), Washington D.C.: U.S. Small Business Administration. https://www.microbiz.org/wp-content/uploads/2013/07/Immigrant-Entrepreneurs-and-Small-Business-Owners-and-their-Access-to-Financial-Capital.pdf, accessed 03.10.2022.

Fairlie R., Lofstrom M. (2014) Immigration and Entrepreneurship. In: *Handbook on the Economics of International Migration* (eds. B. Chiswick, P. Miller), Amsterdam: Elsevier, pp. 877–911.

Fryges H. (2006) *Hidden champions – How young and small technology-oriented firms can attain high export-sales ratios* (ZEW Discussion Paper 06–045), Mannheim, Germany: Centre for European Economic Research. https://madoc.bib.uni-mannheim.de/1369/1/dp06045.pdf, accessed 04.10.2022.

Guerrero M., Urbano D. (2019) Effectiveness of technology transfer policies and legislation in fostering entrepreneurial innovations across continents: An overview. *The Journal of Technology Transfer*, 44, 1347–1366. https://doi.org/10.1007/s10961-019-09736-x

Guerrero M., Urbano D., Herrera F. (2019) Innovation practices in emerging economies: Do university partnerships matter? *The Journal of Technology Transfer,* 44, 615–646. https://doi.org/10.1007/s10961-017-9578-8

Guerrero M., Liñán F., Cáceres-Carrasco F.R. (2021) The influence of ecosystems on the entrepreneurship process: A comparison across developed and developing economies. *Small Business Economics*, 57, 1733–1759. https://doi.org/10.1007/s11187-020-00392-2

Guzman J. (2019) *Go West Young Firm: Agglomeration and Embeddedness in Startup Migrations to Silicon Valley* (Columbia Business School Research Paper), New York: Columbia Business School. http://dx.doi.org/10.2139/ssrn.3175328

Haltiwanger J.C., Jarmin R.S., Javier M (2010) *Who Creates Jobs? Small vs. Large vs. Young* (NBER Working Paper w16300), Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w16300/w16300.pdf, accessed 04.10.2022.

Hanson G.H., Liu C. (2018) High-skilled immigration and the comparative advantage of foreign-born workers across US occupations. In: *High-skilled migration to the United States and its economic consequences* (eds. W.R. Kerr, S. Turner), Cambridge, MA: National Bureau of Economic Research, pp. 7–40.

Hemphill T.A., White III G.O. (2013) China's national champions: The evolution of a national industrial policy — or a new era of economic protectionism? *Thunderbird International Business Review*, 55(2), 193–212. https://doi.org/10.1002/tie.21535

Hsu D.H. (2004) What Do Entrepreneurs Pay for Venture Capital Affiliation? *The Journal of Finance*, 59(4), 1805–1844. https://doi.org/10.1111/j.1540-6261.2004.00680.x

Hunt J. (2015) Are Immigrants the Most Skilled US Computer and Engineering Workers? *Journal of Labor Economics*, 33(S1), 39–77. https://doi.org/10.1086/678974

Jaffe A.B., Trajtenberg M., Henderson R. (1993) Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. *The Quarterly Journal of Economics*, 108(3), 577–598. https://doi.org/10.2307/2118401

Jinzhi Z., Carrick J. (2019) The Rise of the Chinese Unicorn: An Exploratory Study of Unicorn Companies in China. *Emerging Markets Finance and Trade,* 55(15), 3371–3385. https://doi.org/10.1080/1540496X.2019.1610877

Kenney M., Zysman J. (2019) Unicorns, Cheshire Cats, and the New Dilemmas of Entrepreneurial Finance. *Venture Capital*, 21(1), 35–50. https://doi.org/10.1080/13691066.2018.1517430

Kerr W.R. (2019) *The Gift of Global Talent: How Migration Shapes Business,* Stanford, CA: Stanford University Press.

Kerr W.R. (2020) *The Gift of Global Talent: Innovation Policy and the Economy* (NBER Working Paper w25875), Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w25875/w25875.pdf, accessed 03.10.2022.

Kerr S.P., Kerr W.R. (2020a) *Immigrant entrepreneurship in America: Evidence from the survey of business owners 2007 & 2012* (NBER Working Paper w24494), Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w24494/w24494.pdf, accessed 03.10.2022.

Kerr S.P., Kerr W.R. (2020b) *Immigration Policy Levers for US Innovation and Start-Ups* (NBER Working Paper w27040), Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w27040/w27040.pdf, accessed 03.10.2022.

Kerr S.P., Kerr W.R., Özden Ç., Parsons C. (2016) Global talent flows. *Journal of Economic Perspectives*, 30(4), 83–106. https://doi.org/10.1257/jep.30.4.83

Kim Y.G., Suh J. (2015) What determines small champions' export performance? Evidence from Korea firm-level data. *Asian Economic Papers,* 14(2), 138–155. https://doi.org/10.1162/ASEP_a_00356

Krishnan C.N.V., Ivanov V.I., Masulis R.W., Singh A.K. (2011) Venture Capital Reputation, Post-IPO Performance, and Corporate Governance. *The Journal of Financial and Quantitive Analysis,* 46(5), 1295–1333. https://doi.org/10.1017/S0022109011000251

Krugman P. (1991) *Geography and Trade,* Cambridge, MA: MIT Press.

Lee A. (2013) *Welcome to The Unicorn Club: Learning from Billion-Dollar Startups*. https://techcrunch.com/2013/11/02/welcome-to-the-unicorn-club/, accessed 04.10.2022.

Lee P.M., Pollock T.G., Jin K. (2011) The contingent value of venture capitalist reputation. *Strategic Organization*, 9(1), 33–69. https://doi.org/10.1177/1476127011400505

Maincent E., Navarro L. (2006) *A Policy for Industrial Champions: From Picking Winners to Fostering Excellence and the Growth of Firms*, Brussels: European Commission. https://ec.europa.eu/docsroom/documents/1923/attachments/1/translations/en/renditions/native, accessed 04.10.2022.

McAuliffe M., Triandafyllidou A. (eds.) (2021) *World Migration Report 2022,* Geneva: International Organization for Migration (IOM). https://publications.iom.int/system/files/pdf/WMR-2022_0.pdf, accessed 18.10.2022.

Melnik J. (2019) China's "National Champions": Alibaba, Tencent, and Huawei. *Education About Asia*, 24(9), 28–33. https://www.asianstudies.org/wp-content/uploads/chinas-national-champions-alibaba-tencent-and-huawei.pdf, accessed 04.10.2022.

OECD (2021) *Understanding Firm Growth: Helping SMEs Scale Up*, Paris: OECD. https://doi.org/10.1787/fc60b04c-en

OECD/Eurostat (2008) *Eurostat-OECD Manual on Business Demography Statistics*, Paris: OECD. https://doi.org/10.1787/9789264041882-en

Partnership for a New American Economy (2011) *The "New American" Fortune 500*, New York: Partnership for a New American Economy. https://www1.nyc.gov/html/om/pdf/2011/partnership_for_a_new_american_economy_fortune_500, accessed 03.10.2022.

Petersen D.R., Ahmad N. (2007) *High-growth enterprises and gazelles: Preliminary and summary sensitivity analysis*, Paris: OECD. https://www.oecd.org/sdd/business-stats/39639605.pdf, accessed 04.10.2022.

Poon D. (2009) *China's evolving industrial policy strategies and instruments: Lessons for development* (TIPS Working Paper 2–2009), Pretoria: Trade and Industrial Policy Strategies. https://www.tips.org.za/research-archive/trade-and-industry/item/download/1108_d5a6a0704da527d4052d4085e811f4b2, accessed 04.10.2022.

Porter M. (1990) *The Competitive Advantage of Nations*, New York: Free Press.

Ratzinger D., Amess K., Greenman A., Mosey S. (2018) The impact of digital start-up founders' higher education on reaching equity investment milestones. *The Journal of Technology Transfer,* 43, 760–778. https://doi.org/10.1007/s10961-017-9627-3

Schenkenhofer J. (2022) Hidden champions: A review of the literature and future research avenues. *Management Review Quarterly,* 72, 417–482. https://doi.org/10.1007/s11301-021-00253-6

Seip M., Van der Heijden A., Bax M. (2022) Scale-ups and intellectual property right: The role of technological and commercialization capabilities in firm growth. *International Journal of Innovation Management*, 26(4), 2250033. https://doi.org/10.1142/S1363919622500335

Seoul Business Agency (2019) *Workshop on Tech Start-ups Support Program in Asia and the Pacific,* Seoul: Seoul Business Agency. https://events.development.asia/sites/default/files/course/2019/Knowledge%20Brochure%20Series%209_Tech%20Startup%20FINAL.pdf, accessed 04.10.2022.

Simon H. (1990) Hidden Champions: Speerspitze der deutschen Wirtschaft. *Zeitschrift für Betriebswirtschaft*, 60(9), 875–890.

Simon H. (1996) *Hidden Champions: Lessons from 500 of the World's Best Unknown Companies*, Boston, MA: Harvard Business School Press.

Simon J.P. (2016) *How to Catch a Unicorn: An Exploration of the Universe of Tech Companies with High Market Capitalization*, Brussels: ERC Joint Research Centre. https://data.europa.eu/doi/10.2791/893975, accessed 04.10.2022.

Stone A., Badawy L.T. (2011) *SME Innovators and Gazelles in MENA: Educate, Train, Certify, Compete!,* Washington, D.C.: World Bank. https://openknowledge.worldbank.org/bitstream/handle/10986/10867/645020BRI0MENA00Box0361538B0PUBLIC0.pdf?sequence=1&isAllowed=y, accessed 04.10.2022.

Testa G., Compañó R., Correia A., Rückert E. (2022) *In search of EU unicorns – What do we know about them?,* Luxembourg: Publications Office of the European Union. https://doi.org/10.2760/ 843368

Yoon B. (2013) How do hidden champions differ from normal small and medium enterprises (SMEs) in innovation activities. *Journal of Applied Sciences Research*, 9(13), 6257–6263. http://www.aensiweb.com/old/jasr/jasr/2013/6257-6263.pdf, accessed 04.10.2022.

Zacchia P. (2018) Benefiting Colleagues but not the City: Localized Effects from the Relocation of Superstar Inventors. *Research Policy*, 47(5), 992–1005. https://doi.org/10.1016/j.respol.2018.03.004