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Financial Efficiency of Unicorns: Regional and Sector Related Aspects

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The curiosity of how startups become unicorns is increasing. Only one-fifth of unicorns operating in the world trade their shares publicly. Financial data from the balance sheets and profit (loss) statements of 97 unicorns, which had IPOs between 2009–2018, was collected with the aim to analyse what specific characteristics of financial ratios over a particular IPO related period can be identified for unicorns operating in different regions and sectors. ANOVA was used to analyse the financial efficiency from different perspectives: (I) the financial profile of a unicorn, (II) the financial efficiency of a unicorn based on the business sector (Software; Products and Services; Technology; Internet and Healthcare sectors), and (III) the financial efficiency of a unicorn based on the region of origin (US+, Europe and Asia). Research showed that unicorns are mostly financed by investors, but remain unprofitable. Positive profitability was found in Europe, and the highest liquidity - in Healthcare sector.

Keywords: *Unicorns; Financial Efficiency; IPO; Business Sector; Region.*

Introduction

The phenomenon of startups has been noticed for many years. The lack of knowledge on how such fast growing companies, characterized by uncharacteristic data (Laitinen, 2017) and extreme uncertainty (Moroni *et al.*, 2015; Tripathi *et al.*, 2019), manage to become unicorns, is still a mystery. Nevertheless, there are constant efforts made to solve this puzzle. As the number of new startups is growing, the increasing number of their studies are identifying the characteristics of startups' success as well as their failure, financial issues being among the most frequent ones in case of the latter . No formula exists to turn such companies into successful unicorns and elite startups (Lehmann et al., 2018) of at least 1 billion USD market value (Bock & Hackober, 2020). Only a small number of startups grow into unicorns and start trading their shares publicly during later stages of their development. The number of unicorn startups has increased over the last decade (CB Insights, 2020a) and so has the number of versatile studies analysing governmental decisions affecting unicorns (McNeill, 2016), public IPO (Initial public offering) and private IPO investments into unicorns (Brown & Wiles, 2015), investments into unicorns' human capital (Lehmann *et al.*, 2018), performance measurement (Gao *et al.*, 2019), post-money valuations (Gornall & Strebulaev, 2020), factors affecting IPO (Kengelbach *et al.*, 2018) and startups' financial state (Demartini, 2018; Laitinen, 2017).

Financial data analysis-based IPO efficiency assessment before and after the issuing of shares receives plenty of attention (Yalcın & Unlu, 2018). Further growth ability of a startup is related to the IPO, which increases the IPO's importance for startups, investors, businesspersons and shareholders (Y. Kim & Heshmati, 2010). IPO is considered to be the best option for investors to receive returns on investments (Bock & Schmidt, 2015; Wonglimpiyarat, 2009), to gain profit (Bock & Hackober, 2020) and one of the best exits for startups, alongside with the acquisition option (Chemmanur *et al.*, 2011). IPO is the first issuing of shares of a private company publicly (Kungu & Iraya, 2017), used for raising capital for growth, expansion and for the exchange of shares for cash (Y. Kim & Heshmati, 2010; Kungu & Iraya, 2017). The amount of investments attracted within this period contributes highly to further rapid development of a startup. Moreover, it is the process of the startups' transition from private to public company (Y. Kim & Heshmati, 2010) and the best time for startups to become unicorns (Andaleeb & Singh, 2016).

However, startups are characterized by extreme uncertainty (Dellermann *et al.*, 2018; Fuertes-Callen *et al.*, 2020; E. Kim *et al.*, 2020), which is frequently related to their survival, possibilities to attract investments or unpredictable financial performance. There is evidence that startups with better financial ratios at earlier periods of their development have more possibilities to further develop the business (Fuertes-Callen *et al.*, 2020). Nevertheless, most of the IPO seeking startups (84 %) are unprofitable (Gao et al., 2013), although the number of IPOs has increased significantly throughout the decade (CB Insights, 2020b). This contradictory unicorn startups' phenomenon is contrary to the traditional approach of companies' development from the financial performance perspective. The findings in literature, such as the decline in operational performance (Y. Kim & Heshmati, 2010), productivity or innovative activity and differences in asset growth after IPO between startups in Japan and America (Nishimura *et al.*, 2019), prompt the analysis of the financial efficiency of unicorns during the IPO period and suggest differentiating unicorn startups based on regions of origin and business sectors for more precise analysis. Moreover, the tendencies in the dynamics of financial ratios of successful unicorns might be highly related to IPO, suggesting the insights for successful growth of other startups.

IPO is an important strategic decision for startups. Increased market share, amount of investments received and growth are related to this period. Attraction of IPO-related investments suggests that investors and shareholders trust in further business development, growth and survival of a startup. Moreover, startups and unicorns are private companies unless their shares begin to be sold publicly (although other exit strategies also exist). The possibility to access startup-related financial data opens with the IPO. Nevertheless, the concentration of unicorn startups based on different regions and business sectors suggests that companies operating under different conditions possibly have unequal possibilities to become unicorns. Thus, the research question was formed to find out what specific characteristics (if they are) of financial ratios over a particular IPO period can be identified for unicorns operating in different regions and sectors.

Considering the uniqueness of unicorn startups and with the purpose of answering the research question, further research covers unicorns' financial efficiency analysis from four different perspectives: (I) the financial performance profile during all IPO periods, (II) the financial performance profile during IPO year only, (III) the financial differences based on business sectors' analysis and (IV) the financial differences based on regions' specifics. Such an approach is primarily based on high financial uncertainty related to unicorn startups. There is an opinion that not all unicorns perform as well as they are expected to (Casnici, 2021), and despite the high company valuation some of them stay unprofitable (Kenney & Zysman, 2019). For this reason, the analysis of the financial profile related to IPO period should contribute to clearer picture of such companies' financial performance during one of the most important periods of their development. Existing IPO related impact on companies' financial performance observed in literature (Alanazi *et al.*, 2011; Bernstein, 2015; Pagano *et al.*, 1998) leads to the necessity of analysing unicorn startups' financial profile during IPO year, which should highlight how the IPO event affects unicorns' financial performance. The differences among unicorn startups are analysed in the literature (Casnici, 2021) with the aim to identify the factors of their success during transition into unicorns (Dellermann *et al.*, 2018). With the aim of performing a more precise analysis and attempting to fill the existing gap in knowledge on the factors affecting unicorns' financial performance, the differences and dynamics among unicorn startups' financial ratios from the perspectives of regions of origin and business sectors were analysed in this research. The aim of this analysis is to observe the dynamics of unicorns' financial performance during IPO related periods based on sectoral and regional specifics, which might provide insights on the leading sectors and regions to develop the business.

Literature Review

Existing differences in financial performance show the effect of regional financial support on investments into unicorns (Y. Lu *et al.*, 2018). Different programs used to support startups are applied in countries like Japan (Yoshino & TaghizaDeh-heSary, 2019) which promote creation and development of startups, usually with support at the most riskier and money-intensive initial business establishment phase. However, Silicon Valley is the most recognizable region of the ecosystem of startups. The impact of American Silicon Valley on creation of unicorns (Bock & Hackober, 2020) is highly noticed as startups operating in the Valley attract more attention and support from investors comparatively to other regions. The higher concentration of startups close to financial centres with attempts to raise capital (Pan & Yang, 2018), as well as higher likelihood of venture capitalists to invest in startups which are closer to their geographic location resulting smaller costs of monitoring (Tian, 2011) was found. Nevertheless, loans of banks are usually considered more reliable in Asian countries instead of venture capital investments, which are more difficult for startups to receive (Yoshino & TaghizaDeh-heSary, 2019) and regional distribution of startups in China is mostly based on financing (both, credit and equity) (Pan & Yang, 2018). Continuing the discussion on the Asian region, only a small share of unicorns in internet sector in China (10 %) is technology-oriented, opposite than in America (Guo et al., 2020) but business environment in the greatest cities of China – Beijing, Shanghai and Shenzhen, is preferable for high-technology startups (Pan & Yang, 2018). The latter statement allows making assumptions that differences in the financial performance of unicorns exist based not only on region of operation but on business sector as well.

It is considered that technology startups have higher value added, attract more attention from investors, have higher growth possibilities indicated as ability to reach maturity stage within 5 years (Berman *et al.*, 2011; Bertoni *et al*., 2011) and higher riskiness (Hsu et al., 2014) comparatively to other sectors. Different research found that, for example, business angels, who prefer to invest in startups at later stages of their development, finance ICT (information and communication technology) startups more frequently comparatively to companies in Biotech or Healthcare sectors (Dibrova, 2015). Moreover, the financial potential of startups highly depends on their innovativeness, thus investors are seeking for startups which have patents – the sign of future profitability (Zhang *et al*., 2019). The variety in number of patents granted among different business sectors exists (Conti *et al.*, 2013). This suggests a different level of innovativeness and different financial performance based on the investments attracted. IPO is reached faster and the performance after the IPO found to be better by startups which have patents and operate in high-technology sectors (Y. Kim & Heshmati, 2010). On the other hand, technology startups generate losses for several years (Fuertes-Callen *et al.*, 2020) until innovative activity becomes profitable. Those losses are related to the investments in innovation (Coad & Rao, 2008) and patent activity because of the existing gap between investments and returns. Lower returns, slower growth and in this case probably worse financial results in less technology intensive sectors are expected to be less risky and less attractive for investors. Moreover, the riskiness and the financial performance of startups also depend on the stage of their development and the choice of exit strategy.

Different exit possibilities for startups exist among which, mergers, acquisitions or IPO are the most frequently found. The focus of interest in this paper is on the IPO. The importance of the IPO for startups is emphasized as the possibility to fund expansion, to use investments for balancing of the accounts, to invest in further growth or with the aim of the owners to sell a company after the issuance of shares (Jain & Kini, 1999). Large amounts of investments received at this period have a huge impact on the financial state of startups. Authors, who have analysed IPO-related financial efficiency, emphasized the changes in the financial performance of companies during this period. The significant decline in financial ratios of companies after the IPO and the decline in financial performance after the IPO in emerging markets were noticed (Y. Kim & Heshmati, 2010; Nishimura *et al.*, 2019; Yalcın & Ünlü, 2018). However, the profitability associated to the IPO exit (Bock & Hackober, 2020), the possibility to increase company market value (Jain & Kini, 1999) and new opportunities opened for business development prompt the increase in the number of IPOs and the necessity to analyse the change in financial performance of unicorns which is related to this period. IPO related financial data analysis of unicorns is usually limited by a small data samples. The time frame which is used by different authors for the analysis is usually short, e.g. from the data of 1 year (Yalcın & Unlu, 2018) to 3 years (Y. Kim & Heshmati, 2010) before and after the IPO. The short time period of analysis is firstly related to the lifecycle of unicorns. Different authors show rapid development of startups (Berman *et al.*, 2011; Neumann *et al.*, 2019) which is usually defined by the period of 5 years (European Commission, 2019; Steigertahl & Mauer, 2018) until becoming a mature company. Data limitation is another reason for small data samples. Private companies are not required to announce the financial statements publicly (Bock & Hackober, 2020). However, this becomes an obligation after public exit, which opens an opportunity to analyse the financial performance of unicorn startups more detailed.

Financial efficiency is considered to be the best option of using inputs and outputs to achieve the best financial performance (Alperovych *et al.*, 2015; Baek & Neymotin, 2016; Lan *et al.*, 2019). Four groups of ratios (profitability, solvency, liquidity and turnover) are used for financial health estimation (see Table A1). Different authors suggest using profitability ratios such as ROA, Profit margin, ROI, Cash flow ratio, Profitability (EBITDA/sales) (Bjuggren *et al.*, 2017; Cantele & Zardini, 2018; Demartini, 2018; Fuertes-Callen et al., 2020; Kaiser & Kuhn, 2020; Kwon *et al.*, 2018; Laitinen, 2017; Rompho, 2018; Tang *et al.*, 2018; Zhang *et al.*, 2020) for profit and returns generation of startups. Solvency - Leverage (debt/total assets), Debt to EBITDA, Interest expense to revenue, Debt coverage, Cash flow to total liabilities, Debt to equity ratios, Equity multiplier (assets/equity) (Demartini, 2018; Fuertes-Callen *et al.*, 2020; Hanssens *et al.*, 2016; Kwon *et al*., 2018; Lan *et al.*, 2019; Martinez-Alonso *et al.*, 2020; Nicotra *et al.*, 2019; Sabetti, 2016; Signore, 2016; Tang *et al.*, 2018) – for ability to pay liabilities to identify. Liquidity - Working capital, Cash, Current and Quick ratios (Demartini, 2018; Fuertes-Callen *et al*., 2020; Nicotra *et al*., 2019) – for ability to cover short-term liabilities. And turnover: Accounts receivable, Working capital and Asset turnovers (Chen *et al.*, 2019; Demartini, 2018; Gloor *et al.*, 2020; Lan *et al.*, 2019; Tang e*t al.*, 2018; Wu, 2010) – for the usage speed of resources to analyse. The systematic view on the combination of ratios is necessary in order to define the financial performance picture of unicorn startups.

Considering what was mentioned before, and with the aim to answer the research question - what specific characteristics (if they are) of financial ratios over a particular IPO period can be identified for unicorns operating in different regions and sectors - unicorns were analysed by raising additional questions. First, what is the financial profile of the unicorn? Second, what are the regional and sectoral differences for operational performance measures of unicorns? To answer the questions, ratios of financial efficiency of unicorn startups were analysed. The insights on the financial state of unicorns operating in different regions and sectors based on the IPO are expected to be made.

Research Methodology and Data

The list of approximate 500 unicorns in the world since 2010 with the annual two digits increase in number of unicorns (e.g., from 18 new unicorns in 2014 to 90 in 2020) was provided in CB Insights (2020a) database at the end of 2020. Despite the growing number of unicorns, only a small share of them had IPOs (CB Insights, 2020b) and even of less of them (N=97) financial information for the analysis was available through Compustat and Bloomberg databases. Data was collected based on the list of startups exits found in CB Insights (CB Insights, 2020b) by filtering only companies which had IPOs. Data from both databases was merged for data consistency and sufficiency assurance. 97 unicorns with IPOs from 2009 to 2018 were included in the dataset (see Table 1). Most of unicorns are established in North America (i.e., United States, except 1 unicorn is from Canada, thus hereafter region will be noted as US+), while only 9 are located in Europe. Information of countries of establishment is presented in the original list (CB Insights, 2020b), but due to the small number of unicorns in some countries, they were grouped by country into 3 regions (US+, Asia and Europe). Grouping into 5 business sectors was also made. The distribution of unicorns within sectors and regions varies highly.

Table 1

Sample size for Analysis of the IPO Year, Region and Business Sector of Operation of Unicorns

Total number of unicorns analysed	**97**									
Distribution of unicorns based on IPO year	**2009** 1	**2010** 8	**2011** 12	**2012** 7	**2013** 10	**2014** 14	**2015** 8	**2016** 5	**2017** 16	**2018** 16
Distribution of unicorns based on region		**US+** 67			**Asia** 21				**Europe** 9	
Distribution of unicorns based on business sector	**Software** 8		**Products and services** 5			**Technology** 20		**Internet** 56		**Healthcare** 8

Source: made by the authors based on CB Insights (2020b)

Thus, the analysis is based on the IPO, IPO year data was the main requirement for companies to be included in the analysis. IPO year was used as a starting point in order to analyse the IPO effect on the financial performance of unicorns. The data of each unicorn was organized not by the calendar year, but based on the IPO year as IPO is the zero year, one year before the IPO is IPO-1, one year after the IPO is IPO+1 and etc. Data sample was reduced to 5 periods: 2 years before the IPO, IPO year and 2 years after the IPO, due to data sufficiency assurance. Not all unicorns have the data of all 5 periods as well as full data at each year, which results the different number of ratios analysed. Nevertheless, companies with incomplete data are also included in the analysis.

Financial ratios (19 in total) which are used for the financial efficiency of startups to analyse and those named in the literature review were counted by the authors themselves based on the formulas found in different studies (see Table A1). Several formulas were adjusted based on the dataset specifics. The adjusted formulas and the units of measurement of each ratio are provided in the separate columns in the same table. ANOVA was used to search for significant differences in means between the groups analysed (Block *et al*., 2019; Cox et al., 2017; H. Kim *et al.*, 2021). This method tests the hypotheses for the similarity of dispersions and means of financial ratios between groups (tested by the criterions of Gabriel and Games-Howell, which are suitable for small data samples and unequal sample sizes noticed in the dataset) (IBM Documentation, 2021). ANOVA was used to distinguish ratios from all analysed which differ among unicorns in order to discuss the insights about the financial profile and efficiency of unicorns.

The Financial Performance Profile of Unicorns

The financial performance profile of unicorns is provided from two perspectives: as the average values of all IPO periods analysed (n=459) and during IPO year only (n=97) (see Table 2). High deviations for several ratios are found, which indicates of existing outliers in the data. The highest deviations are found in terms of profit margin, profitability, debt to equity, equity multiplier or working capital turnover during all IPO periods, which however, disappear during IPO year suggesting of several random outliers existing during different IPO periods. Nevertheless, the high deviations of ROI or accounts receivable turnover remain during IPO year.

Table 2

The Financial Performance Profile of Unicorns During all IPO Periods (left) and During IPO Year (Right)

	All IPO periods				IPO			
	N	**Mean**	**Median**	**Std. Dev.**	**N**	**Mean**	**Median**	**Std. Dev.**
ROA	459	-0.160	-0.092	0.385	97	-0.105	-0.077	0.217
Profit_margin	444	-3.426	-0.125	53.354	93	-0.347	-0.112	0.802
ROI	459	-5.624	-1.897	29.769	97	-5.854	-1.383	47.127
Cash_flow_ratio	459	0.088	0.060	0.268	97	0.251	0.225	0.229
Profitability	444	-2.916	-0.039	50.859	93	-0.229	-0.027	0.703
Leverage	459	0.146	0.009	0.303	97	0.089	0.000	0.170
Debt_to_EBITDA	456	1.064	0.000	24.399	97	0.737	0.000	3.638
Interest_expense_to_revenue	444	0.619	0.002	11.630	93	0.023	0.002	0.075
Debt_coverage_ratio	458	-0.296	-0.158	0.862	97	-0.322	-0.189	1.072
Cash_Flow_to_Total_Liabilities	458	0.359	0.123	1.197	97	1.126	0.600	1.562
Debt_to_Equity	459	2.442	0.003	30.573	97	0.242	0.000	1.694
Equity_multiplier	459	39.057	1.762	758.724	97	1.734	1.548	3.130
Working_capital_ratio	459	0.358	0.363	0.288	97	0.460	0.488	0.255
Cash_ratio	449	1.683	1.001	2.301	95	2.404	1.596	2.822
Current_ratio	449	3.356	2.145	3.647	95	4.307	3.027	4.480
Quick_ratio	449	2.159	1.443	2.428	95	2.844	1.988	2.863
Accounts_receivable_turnover	440	17.380	4.991	92.688	93	11.943	4.976	25.460
Working_capital_turnover	449	3.921	1.357	25.045	95	1.921	1.083	7.596
Asset_turnover	459	0.776	0.542	0.711	97	0.668	0.485	0.607
Revenue	458	964.334	278.870	2979.644	97	910.778	277.335	2344.559

Source: authors' calculations based on the methodology

The results provided in the table indicate that on average unicorns are unprofitable and their returns are highly negative (especially in terms of ROI -5.62) during all IPO periods analysed. The performance of unicorns highly depends on debt capital (average equity multiplier 39.05) which is an issue for companies to cover. Approximately 85 % of assets are financed by investors. However, companies have not enough short term assets to pay short term debts (working capital ratio 0.35) but are able to cover short term liabilities with cash or other liquid assets. Working capital is used to generate revenues several times a year but inefficient usage of assets is noticed as asset turnover is only 0.77. Higher level of accounts receivable turnover and the mean values of liquidity ratios indicate that unicorn startups are tend to work on a cash basis during later stages of their development.

The total average loss is lower during IPO year in comparison to the results of all IPO periods. The highest differences among profitability ratios are found in profit margin and profitability indicator. Both ratios are still negative, but the loss is reduced during IPO. High differences are also found in debt to equity and equity multiplier comparatively to the whole sample. On average, solvency and liquidity ratios are better during IPO. However, all turnover ratios are comparatively lower during this period. The level of cash usage for performance assurance is decreased during IPO year as average revenues remain comparatively similar in both cases.

As the average financial performance profile of unicorn startups is found, the further step based on the research questions is to search for regional and sectoral differences in the financial performance of unicorns which will be discussed in the next sections.

The Financial Performance of Unicorns Based on Business Sector Analysis

The analysis of unicorns revealed that differences in financial performance based on business sector exist. Descriptive statistics of all IPO periods and significant differences identified by ANOVA based on sectoral analysis are provided in appendices (see Tables A2 and A3). Considering the deviations in ratios discussed in the previous section the dynamics of the financial ratios of unicorns would reveal not only the financial efficiency of different sectors, but the change in the financial performance of unicorns before and after the IPO more clearly. Only ratios for which the significant differences based on business sectors were found will be discussed in this section (see Figure 1). It is assumed in the paper that unicorns do not differentiate in other financial ratios.

Unicorns in Products and Services sector are characterized by the highest asset turnover (on average 1.37) which, however, has a decreasing tendency during all periods analysed. Inefficient asset usage is found in all other sectors.

Although, high deviation in accounts receivable turnover in the whole data sample exists, high increase in ratio appears only in Healthcare (of 23.56 at IPO+1) and Internet (53.54 at IPO+2) sectors after the IPO. This finding explains the distortion found in the dataset. The ratio in other sectors remains constant during all IPO periods.

Working capital ratio is at low level in all sectors. However, the highest ratio is found in Healthcare sector during almost all periods (on average 0.43). Working capital ratio is increased during IPO year when reaches the peak in all sectors except Software and decreases one year after the IPO, but short-term assets are insufficient for short-term debt coverage during all periods analysed.

Similar tendencies between cash and current ratios among all sectors are found. Healthcare sector differs by the highest values of both ratios with the peak during IPO (for comparison, cash ratio 6.34 and current ratio 10.63) when the ratios are more than two times higher comparatively to other sectors. The differences in current ratio among other sectors are low and based on ANOVA results are not significantly different from one another. Cash ratio is at low level for Products and Services sector (the average cash ratio 0.91) but current ratio (on average 2.81) is sufficient.

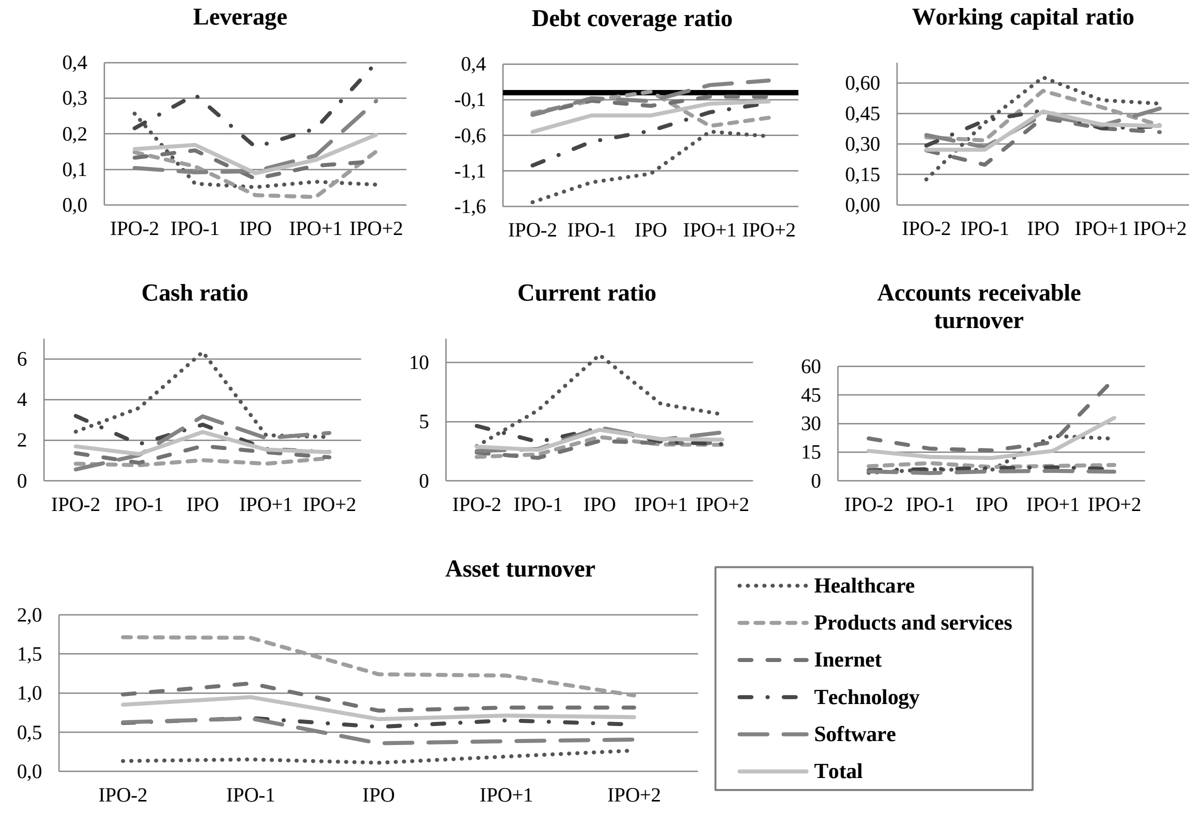

Figure 1. The Dynamics of Financial Ratios of Unicorns Based on Business Sectors During Different IPO Periods (Units of Measurement are Provided in Table A1)

Source: authors' calculations based on the methodology

Almost all assets in Products and Services, Internet and Healthcare sectors are financed by investors (on average varying from 88-91 % based on sector leverage). The greatest share of debt capital is found in Technology sector (on average of 26 %) which increases significantly after the IPO. The increase in leverage in Software and Products and Services sectors after the IPO is also noticed However, debt coverage ratio identifies debt coverage problems for all sectors, especially Healthcare and Technology. Ratio is negative in almost all sectors and periods analysed. The increasing tendency in all sectors is found, but Software sector is the only one with low, although positive value of the ratio after the IPO.

To sum up, financial differences among unicorn startups operating in different business sectors exist. Differences in asset or accounts receivable turnovers, working capital, cash, current, debt coverage ratios and leverage were found resulting different financial performance of unicorns operating in different business sectors.

The Analysis of Regional Financial Efficiency of Unicorns

Existing differences in the financial performance of unicorns based on regional specifics were confirmed by ANOVA. The differences in regional financial performance of unicorns are summarized in Tables A4 and A5 in appendices and the dynamics of significantly different ratios is provided in Figure 2.

The significant differences in short term liquidity ratios were found before the IPO, as the differences in profitability, turnover and solvency ratios appear during IPO and the following periods (see Table A5).

Cash, current and quick ratios are the highest in Asia (on average respectively of 2.00; 4.26; 2.72). The peak in ratios is reached in all regions during IPO year. A lack of cash is found only in Europe before the IPO. However, all these ratios, with the exception in terms of cash ratio in Europe, are sufficient for unicorns to cover short term liabilities.

Ratios of profitability are negative in most of regions and IPO periods. Low positive ROA is found only in Europe during several periods. Asian unicorns start generating very low, but positive returns only several years after the IPO, while in US+ ROA is negative during all IPO periods. The total average ROA show loss varying from -8 % to -18 % based on region.

The aforementioned high deviations of ROI are noticed in regional analysis. Positive ROI is found in Europe during several IPO periods. Although the total average ROI of the region is approximately 48 % (see Table A4), but returns of the region varies highly during different IPO periods (from -627 % during IPO-2 to 579 % during IPO+1, see Figure 2). However, ROI is highly negative in Asia until IPO+2, while in US+ it is negative during all periods. For comparison, the total average ROI for US+ is -592 % and for Asia -713 % (see Table A4).

Asset turnover is the highest in Europe (on average 1.10) and the lowest in Asia (on average 0.58) with the lowest values in all regions during IPO year. Assets are used inefficiently in Asia and US+ during all IPO periods.

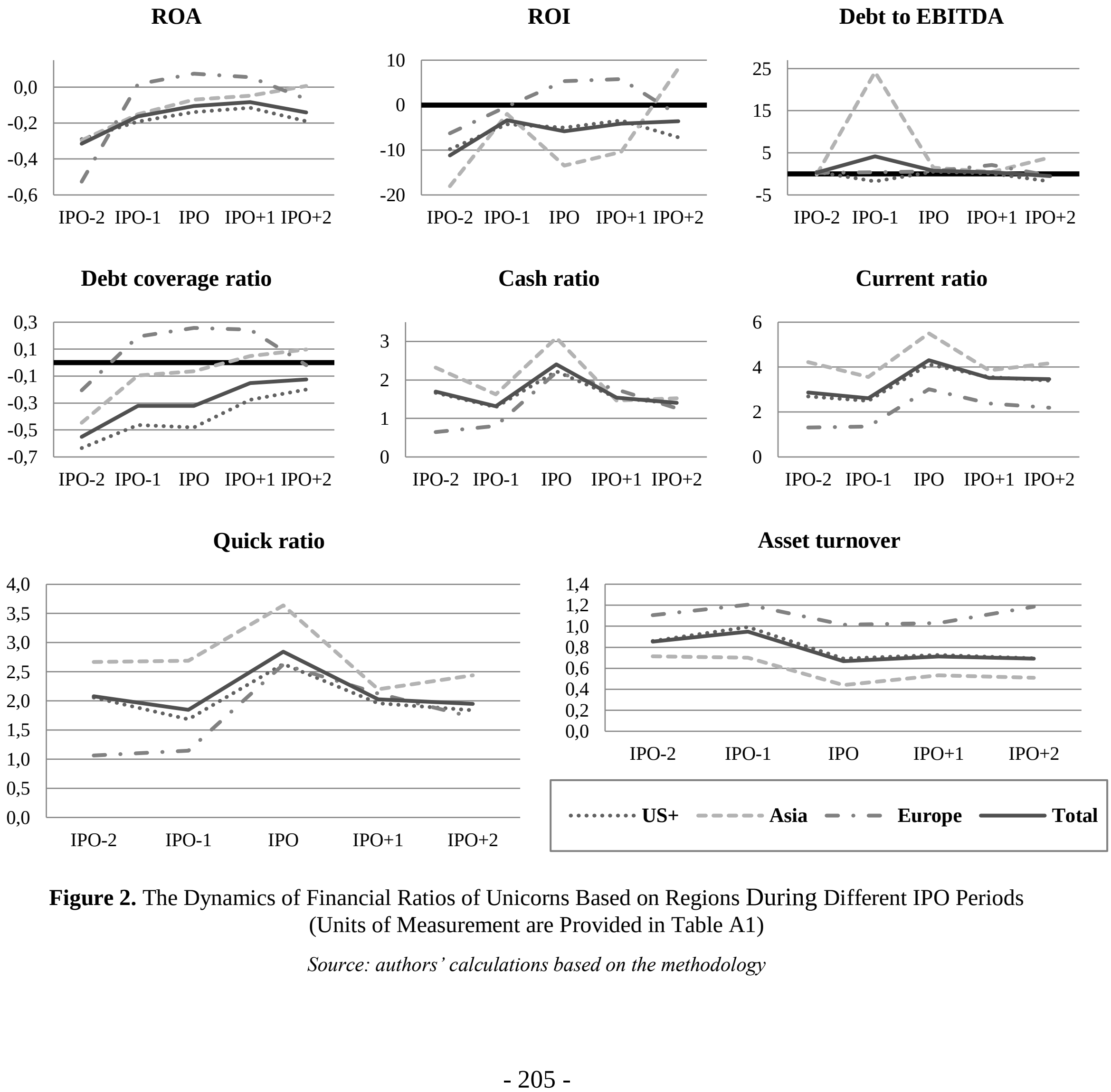

Figure 2. The Dynamics of Financial Ratios of Unicorns Based on Regions During Different IPO Periods (Units of Measurement are Provided in Table A1)

Source: authors' calculations based on the methodology

Unicorns operating in Europe are the only with positive, although low, debt coverage ratio which, however decreases after the IPO. The tendencies of this ratio in other regions are negative but increasing during most of IPO periods. Asian unicorns manage to generate low positive debt coverage ratio after the IPO.

The average values of debt to EBITDA ratio highly fluctuate among all periods and for all regions. A very high value of the ratio separates Asia from other regions before the IPO, which decreases significantly during IPO year. The total average result for this region is highly affected by the high increase in ratio before the IPO. Negative average debt to EBITDA ratio (of -0.50) in US+ might indicate that unicorns operating in this region have negative EBITDA.

To summarize, differences in profitability, solvency and turnover ratios of unicorns based on regional analysis were found. Profitability is found only in Europe, but solvency ratios are better by Asian unicorns.

Discussion and Conclusions

The fast growth and development of unicorn startups is widely discussed and analysed in the literature. However, still no answer exists as to what financial results might indicate the efficient financial performance of such companies. The phenomenon of unicorn startups' and the existing contradiction between their financial performance development and IPO, noticed in literature, was the reason, which led to the more detailed unicorn startups' analysis from the financial perspective. The comprehensive analysis was done in order to see unicorns' financial state and financial performance dynamics during IPO related periods. The comprehensive approach used for this research – to analyse unicorn startups' financial performance from four perspectives, is rarely met in other studies. Unicorns were analysed from different perspectives: (I) the financial performance profile during all IPO periods, (II) the financial performance profile during IPO year only, (III) the financial differences based on business sectors' analysis and (IV) the financial differences based on regions' specifics. Summarizing the results of all IPO periods, unicorns are unprofitable and generate negative returns. Most of unicorns' assets are financed by investors, but they work on a cash basis and suffer from the lack of resources for short-term liabilities' coverage. The financial profile of unicorns during IPO year is characterized by lower level of loss, lower turnover ratios, decreased equity funded by debt capital or better solvency and liquidity ratios comparatively to unicorn profile of all 5 IPO periods'. Less cash was used by unicorns for performance assurance, but average revenues remained approximately similar to the whole sample results.

Existing differences in unicorns' financial performance based on sectors' and regions' specifics were confirmed by ANOVA analysis. Unicorns in products and services sectors are characterized by higher asset turnover. Most of the assets in Products and services, and Internet and Healthcare sectors are financed by investors. Technology sector uses more debt capital in relation to investors' funding comparatively to other sectors. However, lower debt coverage ratio is found in Technology and Healthcare sectors. Cash as well as current and working capital ratios are higher for Healthcare sector unicorns. High increase in accounts receivable turnover in Healthcare and Internet sectors is found after IPO.

Asian unicorns are characterized by higher cash, and current and quick ratios during most of IPO periods. Lower asset turnover and positive returns are generated several years after the IPO. European unicorns suffer from the lack of cash before the IPO. Nevertheless, positive ROI and low positive ROA during different IPO periods are found only for Europe's unicorns. ROI is highly negative in other regions. Higher asset turnover and lower, although positive, debt coverage ratio are generated by European companies. Negative returns and inefficient asset usage by companies operating in the US+ are noticed.

Similarly to existing literature (Y. Kim & Heshmati, 2010; Nishimura *et al.*, 2019; Yalcın & Unlu, 2018), we found the decreasing tendencies in most of the ratios after IPO. But this might be related to highly increased values of ratios during IPO year. However, we observe the decrease in asset turnover even before IPO with approximately similar level or even increasing tendencies in ratio after IPO, which is different from the decrease in assets after IPO found by Nishimura et al. (2019) and does not allow confirming similar tendencies, which requires more detailed analysis. Our findings contradict to the existing literature in terms of profitability ratios, as we got the mixed results in dynamics of ROA and ROI after the IPO, which is different from the decrease in profitability after the IPO found by other authors (Alanazi *et al*., 2011; Pagano *et al*., 1998).

Considering the results from the practical perspectives, our findings might be, firstly, relevant to investors who are searching for unicorn startups to invest in. As financial ratios are used widely among investors for investment target selection, these findings might be useful for them to know the possible dynamics of specific ratios, the possible time for the generation of returns or might indicate possible financial difficulties by investing in specific unicorns. Moreover, IPO related dynamics of financial ratios might be useful for younger startup companies, their managers, stockholders or investors who are considering IPO exit possibility. The general tendencies in ratios' dynamics, which are common to several sectors or regions duringthe specific IPO period might provide some insights into possible financial performance of younger startups and might help in predicting their future financial perspectives.

Although the research results allowed summarizing unicorn startups' financial performance profile based on different perspectives, limitations exist as well. A rather small number of unicorn startups operate in the world comparatively to the total amount of existing companies. Besides, most unicorns are private companies, which limits data collection possibilities. The financial data of unicorns is usually inconsistent with a short time series. The period of 5 years, which is defined based on existing definition of startups, usually limits the analysis, which also caused the reducing of dataset to 5 IPO periods.Low availability of data in all other pre- and post-IPO periods is a limitation to obtain more reliable results.

Annexes

Table A1

Ratios Used for the Analysis

Ratio	Formulas suggested by authors analysed	Authors	Formulas modified based on dataset specifics	Units of measurement
ROA	ROA = net income / total assets (Kwon et al., 2018)	(Bjuggren et al., 2017; Fuertes-Callen et al., 2020; Kaiser & Kuhn, 2020; Kwon et al., 2018; D. Zhang et al., 2020)		Coefficient
Profit margin	Profit margin = pretax income / sales (Tang et al., 2018)	(Bjuggren et al., 2017; Cantele & Zardini, 2018; Laitinen, 2017; Tang et al., 2018)		Coefficient
ROI	ROI= income / investment (Habib et al., 2010)	(Cantele & Zardini, 2018; Habib et al., 2010; Laitinen, 2017; Rompho, 2018)	ROI= net income / capital expenditures	Coefficient
Cash flow ratio	Cash flow ratio = cash flow / total assets (W. C. Lu & Jhuang, 2014)	(Laitinen, 2017; W. C. Lu & Jhuang, 2014)	Cash flow ratio = (operating activities + investing activities + financing activities) / total assets	Coefficient
Profitability (or ROS)	Profitability = EBITDA / total sales (Yalcın & Ünlü, 2018)	(Demartini, 2018; Yalcın & Ünlü, 2018)	Profitability = (EBIT + depreciation and amortization) / total sales	Coefficient
Leverage	Leverage = debt / total assets (Martinez-Alonso et al., 2020)	(Fuertes-Callen et al., 2020; Kwon et al., 2018; Martinez-Alonso et al., 2020)		Coefficient
Debt to EBITDA ratio	Debt to EBITDA ratio = Debt / EBITDA	(Nicotra et al., 2019)	Debt to EBITDA ratio = debt / (EBIT + depreciation and amortization)	Coefficient
Interest expense to revenue ratio	Interest expense to revenue ratio = total interest expenses / total revenues	(Demartini, 2018)		Coefficient
Debt coverage ratio	Debt coverage ratio = EBIT / total liabilities	(Fuertes-Callen et al., 2020)		Coefficient
Cash Flow/Total Liabilities	Cash flow to total liabilities ratio = cash flow / total liabilities	(Fuertes-Callen et al., 2020)	Cash Flow to Total Liabilities= (operating activities + investing activities + financing activities) / total liabilities	Coefficient
Debt to equity ratio	Debt to equity ratio = debt / equity	(Lan et al., 2019; Sabetti, 2016; Signore, 2016; Tang et al., 2018)		Coefficient
Equity multiplier	Equity multiplier = total assets / total equity	(Demartini, 2018)		Coefficient
Working capital ratio	Working capital ratio = (current assets – current liabilities) / total assets	(Fuertes-Callen et al., 2020)	Working capital ratio = working capital / total assets	Coefficient
Cash ratio	Cash ratio = cash / current liability	(Fuertes-Callen et al., 2020)		Coefficient
Current Ratio	Current ratio = current assets / current liabilities (Demartini, 2018)	(Demartini, 2018; Nicotra et al., 2019)		Coefficient
Quick ratio	Quick ratio = (Cash equivalents + marketable securities + accounts receivable) / current liabilities	(Demartini, 2018)	Quick ratio = (Cash + marketable securities + receivables) / current liabilities	Coefficient
Accounts receivable turnover ratio	Accounts receivable turnover ratio = sales / average accounts receivable (Chen et al., 2019)	(Chen et al., 2019; Lan et al., 2019; Tang et al., 2018; Wu, 2010)	Accounts receivable turnover ratio = revenues / receivables	Times a year
Working capital turnover ratio	Working capital turnover ratio =net annual sales (or revenue) / average amount of working capital	(Demartini, 2018)	Working capital turnover ratio = revenues / working capital	Times a year
Asset turnover	Asset turnover = sales / total assets (Tang et al., 2018)	(Demartini, 2018; Gloor et al., 2020; Lan et al., 2019; Tang et al., 2018)		Coefficient

Source: authors' calculations based on the methodology

Table A2

Mean Values of Ratios During all IPO Periods Analysed Based on Business Sector

	Healthcare					Internet					Products and services				
	Mean	**Std. Dev.**	**Min.**	**Max.**	**Med.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Med.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Med.**
ROA	-0.371	0.466	-1.297	0.078	-0.142	-0.100	0.205	-0.705	0.406	-0.079	-0.104	0.180	-0.318	0.097	-0.056
Profit_margin	-3.133	4.695	-11.429	0.200	-0.984	-0.214	0.649	-3.375	0.554	-0.092	-0.339	0.728	-1.623	0.092	-0.050
ROI	-14.132	17.612	-49.470	1.085	-6.558	-4.447	31.052	-172.086	85.724	-1.406	-2.381	4.596	-7.931	2.526	-0.777
Cash_flow_ratio	0.082	0.428	-0.696	0.572	0.038	0.083	0.202	-0.495	0.585	0.063	0.075	0.146	-0.137	0.253	0.094
Profitability	-2.984	4.618	-11.122	0.281	-0.814	-0.135	0.621	-3.338	0.585	-0.022	-0.263	0.661	-1.426	0.139	-0.007
Leverage	0.098	0.152	0.000	0.391	0.014	0.119	0.217	0.000	0.982	0.008	0.091	0.099	0.009	0.239	0.068
Debt_to_EBITDA	-1.514	3.886	-10.332	0.162	-0.009	1.873	18.099	-24.914	124.238	0.000	0.214	1.913	-2.143	2.714	0.000
Interest_expense_to_revenue	0.026	0.037	0.004	0.092	0.009	0.010	0.023	0.000	0.139	0.001	0.014	0.027	0.000	0.062	0.003
Debt_coverage_ratio	-1.020	1.233	-3.160	0.469	-0.428	-0.146	0.535	-1.843	1.478	-0.144	-0.241	0.679	-1.343	0.311	-0.079
Cash_Flow_to_Total_Liabilities	0.874	2.005	-0.918	5.125	0.066	0.259	0.737	-1.282	3.397	0.125	0.135	0.335	-0.352	0.522	0.169
Debt_to_Equity	8.484	23.828	-0.143	67.320	0.018	2.269	16.379	-7.200	118.807	0.004	-1.302	4.234	-8.729	1.468	0.084
Equity_multiplier	408.221	1148.965	0.716	3251.259	1.589	4.188	20.706	-32.844	140.663	1.792	2.091	13.545	-17.866	20.167	2.064
Working_capital_ratio	0.434	0.308	-0.115	0.798	0.462	0.326	0.245	-0.189	0.859	0.317	0.417	0.197	0.214	0.717	0.395
Cash_ratio	3.352	3.081	0.616	9.279	1.789	1.303	1.254	0.094	6.615	0.860	0.919	0.549	0.433	1.783	0.841
Current_ratio	6.327	5.254	2.009	16.531	3.437	2.816	2.604	0.743	14.178	1.808	2.811	2.174	1.398	6.623	1.974
Quick_ratio	3.697	3.349	0.825	10.341	2.275	1.757	1.545	0.295	9.010	1.325	1.424	0.602	0.872	2.255	1.231
Accounts_receivable_turnover	12.267	18.009	0.618	48.884	5.973	25.762	90.396	0.487	569.058	5.292	8.028	6.317	3.360	18.559	5.984
Working_capital_turnover	0.438	0.848	-0.861	1.616	0.643	5.683	26.379	-55.381	148.651	1.724	5.880	4.873	0.310	12.640	3.108
Asset_turnover	0.171	0.182	0.010	0.491	0.195	0.902	0.751	0.103	3.963	0.622	1.371	0.766	0.223	2.186	1.379
Revenues (mln. USD)	48.134	56.048	0.000	180.828	26.678	1422.240	3867.429	4.154	37465.310	361.825	850.461	623.600	9.161	2169.461	901.284

Source: authors' calculations based on the methodology

Table A2. (Continued)

	Software					Technology				
	Mean	**Std. Dev.**	**Min.**	**Max.**	**Med.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Med.**
ROA	-0.117	0.211	-0.476	0.105	-0.075	-0.278	0.478	-1.745	0.305	-0.142
Profit_margin	-0.389	0.765	-1.899	0.286	-0.090	-13.749	59.108	-262.501	0.345	-0.247
ROI	-9.289	24.536	-64.491	10.949	-1.876	-4.743	18.240	-61.701	33.230	-3.000
Cash_flow_ratio	0.108	0.240	-0.261	0.430	0.094	0.085	0.238	-0.351	0.525	0.043
Profitability	-0.176	0.519	-1.013	0.478	-0.056	-11.728	51.397	-228.664	0.596	-0.153
Leverage	0.145	0.224	0.000	0.570	0.000	0.261	0.459	0.000	1.799	0.017
Debt_to_EBITDA	-0.432	2.520	-3.095	3.987	0.000	0.191	7.502	-17.196	19.691	0.000
Interest_expense_to_revenue	0.028	0.052	0.000	0.147	0.002	2.722	11.870	0.000	52.928	0.003
Debt_coverage_ratio	-0.047	0.566	-0.799	0.894	-0.098	-0.534	1.074	-3.641	1.239	-0.213
Cash_Flow_to_Total_Liabilities	0.460	1.161	-1.116	2.540	0.183	0.404	1.044	-1.423	2.689	0.064
Debt_to_Equity	2.738	5.929	-0.081	15.926	0.000	0.959	2.650	-1.658	9.591	0.003
Equity_multiplier	4.399	12.121	-8.539	26.852	1.557	2.842	4.343	-3.532	15.670	1.741
Working_capital_ratio	0.387	0.283	-0.048	0.775	0.423	0.387	0.333	-0.348	0.836	0.531
Cash_ratio	1.893	1.774	0.292	5.516	0.984	2.154	2.619	0.127	10.253	1.204
Current_ratio	3.455	2.863	0.750	9.526	2.625	3.755	3.700	0.333	14.882	3.066
Quick_ratio	2.406	1.993	0.527	6.313	1.456	2.726	2.777	0.202	10.960	1.881
Accounts_receivable_turnover	4.776	2.183	2.024	8.458	4.267	6.247	5.278	0.137	22.158	5.312
Working_capital_turnover	2.069	5.141	-3.411	11.898	0.808	0.978	5.644	-14.575	10.156	1.205
Asset_turnover	0.490	0.282	0.163	0.943	0.410	0.624	0.529	0.004	1.782	0.624
Revenues (mln. USD)	246.760	231.604	33.658	871.100	143.637	393.690	454.386	0.000	2214.253	252.250

Source: authors' calculations based on the methodology

Table A3

Significant Differences of Financial Ratios between Different Business Sectors

Dependent Variable	Criteria	(I) Sector	(J) Sector	Mean Diff. (I-J)	Std. Error	Sig.	95% Confidence Interval		Period
Asset_turnover	Gabriel	Products and services	Healthcare	1.579*	0.429	0.004	0.354	2.806	IPO-2
Asset_turnover	Gabriel	Products and services	Technology	1.096*	0.370	0.025	0.082	2.111	IPO-2
Asset_turnover	Gabriel	Internet	Healthcare	0.850*	0.295	0.020	0.083	1.617	IPO-2
Asset_turnover	Gabriel	Products and services	Healthcare	1.552*	0.453	0.008	0.264	2.841	IPO-1
Asset_turnover	Gabriel	Internet	Healthcare	0.970*	0.300	0.006	0.187	1.755	IPO-1
Accounts_receivable_turnover	Games-Howell	Internet	Software	12.766*	4.421	0.042	0.306	25.227	IPO-1
Working_capital_ratio	Gabriel	Technology	Internet	0.217*	0.073	0.026	0.015	0.420	IPO-1
Cash_ratio	Games-Howell	Internet	Products and services	0.695*	0.216	0.018	0.086	1.304	IPO
Cash_ratio	Games-Howell	Technology	Products and services	1.752*	0.552	0.036	0.090	3.415	IPO
Asset_turnover	Gabriel	Products and services	Healthcare	1.128*	0.323	0.007	0.209	2.049	IPO
Asset_turnover	Gabriel	Internet	Healthcare	0.665*	0.214	0.010	0.106	1.226	IPO
Leverage	Games-Howell	Internet	Products and services	0.088*	0.025	0.013	0.014	0.162	IPO+1
Leverage	Games-Howell	Technology	Products and services	0.192*	0.064	0.045	0.003	0.382	IPO+1
Current_ratio	Gabriel	Healthcare	Internet	3.337*	1.003	0.005	0.701	5.974	IPO+1
Current_ratio	Gabriel	Healthcare	Technology	3.193*	1.113	0.042	0.071	6.316	IPO+1
Asset_turnover	Games-Howell	Internet	Healthcare	0.625*	0.109	0.000	0.315	0.936	IPO+1
Asset_turnover	Games-Howell	Internet	Software	0.430*	0.106	0.002	0.130	0.730	IPO+1
Asset_turnover	Games-Howell	Technology	Healthcare	0.463*	0.120	0.006	0.110	0.816	IPO+1
Leverage	Gabriel	Technology	Internet	0.277*	0.091	0.025	0.022	0.533	IPO+2
Debt_coverage_ratio	Gabriel	Internet	Healthcare	0.551*	0.180	0.013	0.075	1.029	IPO+2
Debt_coverage_ratio	Gabriel	Software	Healthcare	0.782*	0.237	0.014	0.100	1.465	IPO+2

* The mean difference is significant at the 0.05 level

Source: authors' calculations based on the methodology

Table A4

Mean Values of Ratios During all IPO Periods Analysed based on Region

	US+					Asia					Europe				
	Mean	**Std. Dev.**	**Min.**	**Max.**	**Med.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Med.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Med.**
ROA	-0.185	0.301	-1.660	0.369	-0.134	-0.112	0.296	-0.950	0.200	-0.003	-0.089	0.463	-1.140	0.331	0.057
Profit_margin	-4.708	33.622	-263.869	0.412	-0.192	-0.279	0.884	-3.043	0.545	-0.005	-0.701	2.263	-6.599	0.264	0.054
ROI	-5.923	15.097	-76.693	42.005	-2.595	-7.138	48.703	-164.484	82.323	-0.175	0.477	11.836	-21.414	17.527	0.987
Cash_flow_ratio	0.089	0.229	-0.544	0.687	0.059	0.085	0.202	-0.288	0.559	0.058	0.062	0.318	-0.558	0.441	0.075
Profitability	-4.025	29.286	-230.088	0.595	-0.099	-0.083	0.653	-2.001	0.603	0.042	-0.635	2.306	-6.591	0.446	0.086
Leverage	0.134	0.241	0.000	1.342	0.005	0.206	0.359	0.000	1.329	0.028	0.106	0.172	0.000	0.489	0.020
Debt_to_EBITDA	-0.507	7.255	-31.887	28.930	0.000	5.982	27.123	-7.593	119.724	0.000	0.567	2.656	-2.014	6.703	0.000
Interest_expense_to_revenue	0.864	6.685	0.000	52.928	0.001	0.036	0.098	0.000	0.419	0.003	0.011	0.029	0.000	0.086	0.001
Debt_coverage_ratio	-0.411	0.841	-4.266	1.424	-0.245	-0.092	0.673	-1.642	0.952	0.008	0.094	0.643	-1.062	1.131	0.125
Cash_Flow_to_Total_Liabilities	0.341	1.033	-1.581	5.605	0.132	0.394	1.031	-1.040	2.783	0.096	0.281	0.607	-0.509	1.423	0.135
Debt_to_Equity	1.586	11.861	-15.298	84.253	0.001	5.778	25.784	-1.482	117.367	0.018	0.209	0.893	-0.927	1.798	0.025
Equity_multiplier	51.466	407.475	-49.579	3291.349	1.799	8.505	29.446	-1.791	134.206	1.498	2.535	2.612	-0.679	7.179	1.829
Working_capital_ratio	0.363	0.263	-0.343	0.865	0.371	0.385	0.293	-0.141	0.856	0.379	0.258	0.313	-0.318	0.604	0.288
Cash_ratio	1.621	1.780	0.140	10.402	0.985	2.006	2.910	0.053	11.266	0.895	1.334	1.097	0.303	3.628	1.001
Current_ratio	3.253	3.028	0.763	17.375	2.157	4.264	4.782	0.409	19.161	2.576	2.051	1.366	0.634	4.833	1.545
Quick_ratio	2.035	1.806	0.369	10.598	1.412	2.727	3.461	0.155	14.036	1.543	1.736	1.178	0.571	4.008	1.360
Accounts_receivable_turnover	21.304	80.270	0.211	569.058	4.976	8.356	13.253	0.379	56.262	4.491	13.083	15.080	2.087	48.285	8.633
Working_capital_turnover	4.350	20.416	-37.660	136.396	1.521	1.954	11.629	-17.085	33.300	0.814	5.658	15.479	-11.551	39.320	2.978
Asset_turnover	0.793	0.727	0.004	3.963	0.622	0.580	0.563	0.053	2.219	0.410	1.108	0.624	0.048	1.825	1.246
Revenues (mln. USD)	536.207	996.885	0.000	12466.000	196.702	2050.065	5860.881	0.000	37465.310	196.702	1636.447	2114.216	0.000	9498.442	691.350

Source: authors' calculations based on the methodology

Table A5

Significant Differences of Financial Ratios between Different Regions of Operation

Dependent Variable	Criteria	(I) Region	(J) Region	Mean Diff. (I-J)	Std. Error	Sig.	95% Confidence Interval		Period
Cash_ratio	Games-Howell	US+	Europe	1.016*	0.269	0.001	0.371	1.663	IPO-2
Current_ratio	Games-Howell	US+	Europe	1.379*	0.371	0.001	0.491	2.269	IPO-2
Quick_ratio	Games-Howell	US+	Europe	0.992*	0.275	0.002	0.331	1.654	IPO-2
Current_ratio	Games-Howell	US+	Europe	1.144*	0.403	0.016	0.179	2.110	IPO-1
ROA	Gabriel	Europe	US+	0.214*	0.074	0.006	0.051	0.378	IPO
ROI	Games-Howell	Europe	US+	10.344*	3.720	0.028	1.028	19.661	IPO
Asset_turnover	Gabriel	Europe	Asia	0.574*	0.237	0.044	0.012	1.137	IPO
ROA	Gabriel	Europe	US+	0.170*	0.068	0.021	0.020	0.321	IPO+1
ROI	Games-Howell	Europe	US+	9.210*	2.843	0.020	1.519	16.902	IPO+1
Debt_coverage_ratio	Gabriel	Europe	US+	0.519*	0.228	0.041	0.015	1.024	IPO+1
ROI	Gabriel	Asia	US+	15.313*	3.767	0.000	6.523	24.104	IPO+2
Debt_to_EBITDA	Gabriel	Asia	US+	5.715*	2.231	0.027	0.509	10.922	IPO+2
Debt_coverage_ratio	Gabriel	Asia	US+	0.297*	0.126	0.048	0.002	0.592	IPO+2

* The mean difference is significant at the 0.05 level

Source: authors' calculations based on the methodology

References

Alanazi, A. S., Liu, B., & Forster, J. (2011). The financial performance of Saudi Arabian IPOs. *International Journal of Islamic and Middle Eastern Finance and Management*, *4*(2), 146–157. https://doi.org/10.1108/17538391111144533

Alperovych, Y., Hübner, G., & Lobet, F. (2015). How does governmental versus private venture capital backing affect a firm's efficiency? Evidence from Belgium. *Journal of Business Venturing*, *30*(4), 508–525. https://doi.org/10.1016/j.jbusvent.2014.11.001

Andaleeb, U., & Singh, S. (2016). A study of Financing Sources for Start-up Companies in India. *International Review of Business and Finance*, *8*, 1–4.

Baek, H. Y., & Neymotin, F. (2016). International Involvement and Production Efficiency among Startup Firms. *Global Economic Review*, *45*(1), 42–62. https://doi.org/10.1080/1226508X.2015.1084240

Berman, R., Eesley, C., & Blank, S. (2011). Startup genome report 01. In *A new framework for understanding why startups succeed, Technical report*.

Bernstein, S. (2015). Does Going Public Affect Innovation? *The Journal of Finance*, *70*(4), 1365–1403. https://doi.org/10.1111/JOFI.12275

Bertoni, F., Colombo, M. G., & Grilli, L. (2011). Venture capital financing and the growth of high-tech start-ups: Disentangling treatment from selection effects. *Research Policy*, *40*(7), 1028–1043. https://doi.org/10.1016/j.respol.2011.03.008

Bjuggren, P. O., Nordstrom, L., & Palmberg, J. (2017). Are female leaders more efficient in family firms than in non-family firms? *Corporate Governance*, *18*(2), 185–205. https://doi.org/10.1108/CG-01-2017-0017

Block, J., Fisch, C., Vismara, S., & Andres, R. (2019). Private equity investment criteria: An experimental conjoint analysis of venture capital, business angels, and family offices. *Journal of Corporate Finance*, *58*, 329–352. https://doi.org/10.1016/j.jcorpfin.2019.05.009

Bock, C., & Hackober, C. (2020). Unicorns-what drives multibillion-dollar valuations? *Business Research*, *1*(36). https://doi.org/10.1007/s40685-020-00120-2

Bock, C., & Schmidt, M. (2015). Should I stay, or should I go? - How fund dynamics influence venture capital exit decisions. *Review of Financial Economics*, *27*, 68–82. https://doi.org/10.1016/j.rfe.2015.09.002

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://www.researchgate.net/profile/Ken-Wiles-2/publication/318420591_In_Search_of_Unicorns_Private_IPOs_and_the_Changing_Markets_for_Private_Equity_Investments_and_Corporate_Control/links/59a47a43a6fdcc773a374393/In-Search-of-Unicorns-Private-IPOs-and-t

Cantele, S., & Zardini, A. (2018). Is sustainability a competitive advantage for small businesses? An empirical analysis of possible mediators in the sustainability–financial performance relationship. *Journal of Cleaner Production*, *182*, 166–176. https://doi.org/10.1016/j.jclepro.2018.02.016

Casnici, C. V. C. (2021). The Rise of Unicorn Companies: A Magical Growth? In S. H. Park, M. A. Gonzalez-Perez, & D. E. Floriani (Eds.), *The Palgrave Handbook of Corporate Sustainability in the Digital Era* (pp. 581–593). Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-42412-1_29

CB Insights. (2020a). *The Complete List of Unicorn Companies*. https://www.cbinsights.com/research-unicorn-companies

CB Insights. (2020b). *Top Unicorn Exits Tracker*. https://www.cbinsights.com/research-unicorn-exits

Chemmanur, T. J., Krishnan, K., & Nandy, D. K. (2011). How does venture capital financing improve efficiency in private firms? A look beneath the surface. *Review of Financial Studies*, *24*(12), 4037–4090. https://doi.org/10.1093/rfs/hhr096

Chen, G., Zhang, J. J., & Pifer, N. D. (2019). Corporate Governance Structure, Financial Capability, and the R&D Intensity in Chinese Sports Sector: Evidence from Listed Sports Companies. *Sustainability*, *11*(23), 6810. https://doi.org/10.3390/su11236810

Coad, A., & Rao, R. (2008). Innovation and firm growth in high-tech sectors: A quantile regression approach. *Research Policy*, *37*(4), 633–648. https://doi.org/10.1016/j.respol.2008.01.003

Conti, A., Thursby, J., & Thursby, M. (2013). Patents as Signals for Startup Financing. *The Journal of Industrial Economics*, *61*(3), 592–622. https://doi.org/10.1111/joie.12025

Cox, K. C., Lortie, J., & Gramm, K. (2017). The investment paradox: why attractive new ventures exhibit relatively poor investment potential. *Venture Capital*, *19*(3), 163–181. https://doi.org/10.1080/13691066.2016.1247982

Dellermann, D., Ebel, P., Lipusch, N., Popp, K. M., & Leimeister, J. M. (2018). Finding the Unicorn: Predicting Early Stage Startup Success through a Hybrid Intelligence Method. *ICIS 2017: Transforming Society with Digital Innovation*, 1–12. https://doi.org/10.2139/ssrn.3159123

Demartini, P. (2018). Innovative Female-Led Startups. Do Women in Business Underperform? *Administrative Sciences*, *8*(4), 70. https://doi.org/10.3390/admsci8040070

Dibrova, A. (2015). Business Angel Investments: Risks and Opportunities. *Procedia - Social and Behavioral Sciences*, *207*, 280–289. https://doi.org/10.1016/j.sbspro.2015.10.097

European Commission. (2019). *Annual Report on European SMEs 2018/2019. Research & Development and Innovation by SMEs*. https://doi.org/10.2826/500457

Fuertes-Callen, Y., Cuellar-Fernández, B., & Serrano-Cinca, C. (2020). Predicting startup survival using first years financial statements. *Journal of Small Business Management*, 1–37. https://doi.org/10.1080/00472778.2020.1750302

Gao, X., Ritter, J. R., & Zhu, Z. (2013). Where have all the IPOs gone? *Journal of Financial and Quantitative Analysis*, *48*(6), 1663–1692. https://doi.org/10.1017/S0022109014000015

Gao, Y., Zhu, Y., & Niu, C. (2019). Performance Measurement of the Unicorns Based on Balanced Scorecard. *2019 International Conference on Economic Management and Cultural Industry (ICEMCI 2019)*, 231–238. https://www.atlantis-press.com/proceedings/icemci-19/125927550

Gloor, P. A., Fronzetti Colladon, A., Grippa, F., Hadley, B. M., & Woerner, S. (2020). The impact of social media presence and board member composition on new venture success: Evidences from VC-backed U.S. startups. *Technological Forecasting and Social Change*, *157*, 120098. https://doi.org/10.1016/j.techfore.2020.120098

Gornall, W., & Strebulaev, I. A. (2020). Squaring venture capital valuations with reality. *Journal of Financial Economics*, *135*(1), 120–143. https://doi.org/10.1016/j.jfineco.2018.04.015

Guo, H., Wang, C., Su, Z., & Wang, D. (2020). Technology Push or Market Pull? Strategic Orientation in Business Model Design and Digital Start-up Performance. *Journal of Product Innovation Management*, *37*(4), 352–372. https://doi.org/10.1111/jpim.12526

Habib, M. A., Rahman, M. M., & Sultana, S. (2010). Managerial Effectiveness and Financial Performance of an MNC in Bangladesh. *ASA University Review*, *4*(1), 81–96. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1068.4750 &rep=rep1&type=pdf

Hanssens, J., Deloof, M., & Vanacker, T. (2016). The evolution of debt policies: New evidence from business startups. *Journal of Banking and Finance*, *65*, 120–133. https://doi.org/10.1016/j.jbankfin.2016.01.008

Hsu, P. H., Tian, X., & Xu, Y. (2014). Financial development and innovation: Cross-country evidence. *Journal of Financial Economics*, *112*(1), 116–135. https://doi.org/10.1016/j.jfineco.2013.12.002

IBM Documentation. (2021). *One-Way ANOVA Post Hoc Tests*. https://www.ibm.com/docs/en/spss-statistics/23.0.0?topic =anova-one-way-post-hoc-tests

Jain, B. A., & Kini, O. (1999). The life cycle of initial public offering firms. *Journal of Business Finance & Accounting*, *26*(9–10), 1281–1307. https://doi.org/https://doi.org/10.1111/1468-5957.00298

Kaiser, U., & Kuhn, J. M. (2020). The value of publicly available, textual and non-textual information for startup performance prediction. *Journal of Business Venturing Insights*, *14*(e00179), 1–21. https://doi.org/10.1016/j. jbvi.2020.e00179

Kengelbach, J., Berberich, U., Schmid, T., Degen, D., & Dickenbrok, A. (2018). Success in IPOs: What Really Matters for a Premium IPO Valuation? In *The Boston Consulting Group*. https://image-src.bcg.com/Images/BCG-What-Really-Matters-for-a-Premium-IPO-Valuation-July-2018_tcm96-196864.pdf

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

Kim, E., Euh, Y., Yoo, J., Lee, J. G., Jo, Y., Lee, D., & Bellisario, D. P. (2020). Which business strategy improves ICT startup companies' technical efficiency? Which business strategy improves ICT startup companies' technical efficiency? *Technology Analysis & Strategic Management*, *33*(7), 1–14. https://doi.org/10.1080/09537325. 2020.1849612

Kim, H., Jo, Y., & Lee, D. (2021). R&D, Marketing, Strategic Planning, or Human Resources? Which CEO Career Is Most Helpful for the Economic Sustainability of ICT Startups in South Korea? *Sustainability*, *13*(5), 2729. https://doi.org/10.3390/su13052729

Kim, Y., & Heshmati, A. (2010). Analysis of Korean IT startups' initial public offering and their post-IPO performance. *Journal of Productivity Analysis*, *34*(2), 133–149. https://doi.org/10.1007/s11123-010-0176-0

Kungu, G., & Iraya, C. (2017). Initial Public Offer Pricing and Stock Returns: A Critical Literature Review. *International Journal of Humanities and Social Science*, *7*(11), 201–208. https://d1wqtxts1xzle7.cloudfront.net/55466941/ijhss_2017-with-cover-page-v2.pdf?Expires=1635407174&Signature=CzNFpxy7jM6WErSzKzEYNEFMJx8JWXBnMLRhbKNKRRDwGFxMyuXKZ CUdLqKHaNZEJhP9s8icsatA1luElnR38HTZOLuUioY2xTuGbW2rj4HFUf8QRhRBL6YFpAPNeREDP2ystnbkHjj3FColD

Kwon, O., Lim, S., & Lee, D. H. (2018). Acquiring startups in the energy sector: a study of firm value and environmental policy. *Business Strategy and the Environment*, *27*(8), 1376–1384. https://doi.org/10.1002/bse.2187

Laitinen, E. K. (2017). Profitability Ratios in the Early Stages of a Startup. *The Journal of Entrepreneurial Finance*, *19*(2), 1–28. https://digitalcommons.pepperdine.edu/jef/vol19/iss2/3

Lan, S., Yang, C., & Tseng, M. L. (2019). Corporate sustainability on causal financial efficiency model in a hierarchical structure under uncertainties. *Journal of Cleaner Production*, *237*, 117769. https://doi.org/10.1016/j.jclepro.2019.117769

Lehmann, E. E., Schenkenhofer, J., & Wirsching, K. (2018). Hidden champions and unicorns: a question of the context of human capital investment. *Small Business Economics*, *52*(2), 359–374. https://doi.org/10.1007/s11187-018-0096-3

Lu, W. C., & Jhuang, R. L. (2014). Cash flow and growth considering different ownership structure. *Journal of Modelling in Management*, *9*(1), 5–17. https://doi.org/10.1108/JM2-04-2011-0028

Lu, Y., Meng, Q., & Cai, Y. (2018). Research on the Relationship between R&D Investment and Corporate Value of "Unicorn" Companies: Based on the Financial Flexibility of Artificial Intelligence Company Data. *Open Journal of Business and Management*, *06*(04), 953–962. https://doi.org/10.4236/ojbm.2018.64070

Martinez-Alonso, R., Martinez-Romero, M. J., & Rojo-Ramirez, A. A. (2020). The impact of technological innovation efficiency on firm growth: The moderating role of family involvement in management. *European Journal of Innovation Management*, *23*(1), 134–155. https://doi.org/10.1108/EJIM-09-2018-0210

McNeill, D. (2016). Governing a city of unicorns: technology capital and the urban politics of San Francisco. *Urban Geography*, *37*(4), 494–513. https://doi.org/10.1080/02723638.2016.1139868

Moroni, I., Arruda, A., & Araujo, K. (2015). The design and technological innovation: how to understand the growth of startups companies in competitive business environment. *Procedia Manufacturing*, *3*, 2199–2204. https://doi.org/10.1016/j.promfg.2015.07.361

Neumann, M., Hintzen, D., Riel, A., Waldhausen, G., & Dismon, H. (2019). Startup Engagement as Part of the Technology Strategy Planning–How Rheinmetall Automotive Increases Innovation by Using Corporate Venturing. *European Conference on Software Process Improvement*, *1060,* 743–755. https://doi.org/10.1007/978-3-030-28005-5_58

Nicotra, M., Schillaci, C. E., & Romano, M. (2019). Innovative family startups: an emerging research field. *Sinergie Italian Journal of Management*, *37*(1), 125–148. https://doi.org/10.7433/s108.2019.08

Nishimura, J., Tsai, Y., & Nagaoka, S. (2019). Impact of initial seeds on the growth of biotechnology startups: evidence from the U.S. and Japan. *Economics of Innovation and New Technology*, *28*(7), 695–721. https://doi.org/10.1080/10438599.2018.1557410

Pagano, M., Panetta, F., & Zingales, L. (1998). Why do companies go public? An empirical analysis. *Journal of Finance*, *53*(1), 27–64. https://doi.org/10.1111/0022-1082.25448

Pan, F., & Yang, B. (2018). Financial development and the geographies of startup cities: evidence from China. *Small Business Economics*, *52*, 743–758. https://doi.org/10.1007/s11187-017-9983-2

Rompho, N. (2018). Operational performance measures for startups. *Measuring Business Excellence*, *22*(1), 31–41. https://doi.org/10.1108/MBE-06-2017-0028

Sabetti, L. (2016). University Knowledge Spillovers and Innovative Startup Firms. In *Productivity and Efficiency Analysis* (pp. 203–209). Springer, Cham. https://doi.org/10.1007/978-3-319-23228-7_12

Signore, S. (2016). *EIF Research & Market Analysis The European venture capital landscape: an EIF perspective Volume II: Growth patterns of EIF-backed startups*. http://www.eif.org/news_centre/research/index.htm

Steigertahl, L., & Mauer, R. (2018). *European Startup Monitor*. http://startupmonitor.eu/EU-Startup-Monitor-2018-Report-WEB.pdf

Tang, C. P., Huang, T. C. K., & Wang, S. T. (2018). The impact of Internet of things implementation on firm performance. *Telematics and Informatics*, *35*(7), 2038–2053. https://doi.org/10.1016/j.tele.2018.07.007

Tian, X. (2011). The causes and consequences of venture capital stage financing. *Journal of Financial Economics*, *101*(1), 132–159. https://doi.org/10.1016/j.jfineco.2011.02.011

Tripathi, N., Oivo, M., Liukkunen, K., & Markkula, J. (2019). Startup ecosystem effect on minimum viable product development in software startups. *Information and Software Technology*, *114*, 77–91. https://doi.org/10.1016/j.infsof.2019.06.008

Wonglimpiyarat, J. (2009). The influence of capital market laws and initial public offering (IPO) process on venture capital. *European Journal of Operational Research*, *192*(1), 293–301. https://doi.org/10.1016/j.ejor.2007.09.007

Wu, W. W. (2010). Beyond business failure prediction. *Expert Systems with Applications*, *37*(3), 2371–2376. https://doi.org/10.1016/j.eswa.2009.07.056

Yalcın, N., & Unlu, U. (2018). A multi-criteria performance analysis of initial public offering (IPO) firms using critic and vikor methods. *Technological and Economic Development of Economy*, *24*(2), 534–560. https://doi.org/10.3846/20294913.2016.1213201

Yoshino, N., & TaghizaDeh-heSary, F. (2019). Application of Distributed Ledger Technologies to Improve Funding in the Startup Ecosystem. In N. Nemoto & N. Yoshino (Eds.), *Fintech for Asian SMEs* (pp. 30–55). Asian Development Bank Institute.

Zhang, D., Zhuge, L., & Freeman, R. B. (2020). Firm dynamics of hi-tech start-ups: Does innovation matter? *China Economic Review*, *59*, 101370. https://doi.org/10.1016/j.chieco.2019.101370

Zhang, L., Guo, Y., & Sun, G. (2019). How patent signals affect venture capital: The evidence of bio-pharmaceutical start-ups in China. *Technological Forecasting and Social Change*, *145*, 93–104. https://doi.org/10.10 16/j.techfore. 2019.05.013

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