

Startup valuation by venture capital investors

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Abstract

Purpose – Startups (SUs) are companies that operate in a scenario of great uncertainty, which makes it difficult to raise funds and survive. This study aims to investigate the main factors that affect the valuation of SUs from the perspective of venture capital investors (VCIs).

Theoretical framework – The valuation of SUs faces unique challenges such as the lack of historical financial data. As a result, entrepreneurs find it difficult to obtain a favorable valuation from VCIs. Mitigating information asymmetry in the valuation of SUs depends mainly on non-financial information.

Design/methodology/approach – More than 50,000 financing rounds – between January 1, 2010 and December 31, 2022 – of SUs located in Brazil, China, India, Indonesia and South Africa are analyzed. The hypotheses arising from the research objective are tested using hedonic regression.

Findings – It is found that the age and stage of development of SUs, as well as the level of investment in research and development and the size of the sector are factors that impact their valuation.

Practical & social implications of research – These results help SUs, VCIs and the market to identify non-financial determinants that can enable a more appropriate assessment of projects. Governments and regulators can consider this information when defining policies to promote investment.

Originality/value – This study innovates by presenting non-financial indicators that are considered by startup investors in emerging markets, thus enabling their effective potential up until the IPO phase.

Keywords: Startups, venture capital investors, valuation, emerging markets, hedonic regression.

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I Introduction

A startup (SU) is an emerging private company or a newly formed business based on a perceived demand for its product or service. It aims to grow rapidly in size, revenue and influence by offering something that fills a specific gap in the market. However, SUs face difficulties in raising capital at different stages of their life cycle. Because they have no significant accounting history – due to the low or non-existent level of assets and revenues – their equity value is irrelevant, making it difficult to raise funds from third parties. When they do raise equity, they do so through family, friends and venture capitalists (Hsu, 2007; Köhn, 2018).

Therefore, venture capital is an important source of financing for the operations and organizational development of SUs – especially given the high levels of information asymmetry, cash requirements and risks involved in this process. In turn, VCIs promote economic growth. They provide financial resources, knowledge and market expertise to entrepreneurs with innovative and scalable projects. This pool of assets is known as smart money. When making this investment decision, their goal is to increase the chances of getting a high return in the long term (Laitinen, 2019).

According to Gornall and Strebulaev (2020), SUs supported by VCIs are more successful than those without this source of funding. They find that SUs tend to go public within three to eight years of their initial fundraising. There are different types of VCIs, including corporations, mutual funds, angel investors, specialized venture capital funds, and crowdfunding (Falconieri et al., 2019). On the other hand, divestment in an SU – and the consequent return of the VCI – occurs when: i. new rounds of fundraising are carried out, ii. a new stage of growth is reached, iii. its stake is sold, and iv. an IPO (initial public offering) takes place (Lam & Seidel, 2020).

Even with the financial and administrative support that VCIs provide to SUs, many promising ventures fail in their early years. Another negative aspect relates to the lack of regulatory requirements for new ventures to disclose their information with maximum publicity, which increases information asymmetry between entrepreneurs and investors (Hidayat et al., 2022). These facts make it difficult to evaluate SUs, which still have an incipient accounting history and little time in operation. In view of the above, VCIs consider qualitative and quantitative aspects in alternative – or unconventional – methodological

approaches to defining the value of SUs (Koenig & Tennert, 2022).

This difficulty in identifying the most appropriate assumptions means that traditional business valuation methods – such as discounted cash flow and multiples – bias the calculation of the correct value of SUs. Therefore, elements that help mitigate the uncertainties involved in this process contribute to a more appropriate valuation. These elements include: i. the presence of VCIs in financing rounds, ii. the capacity and experience of the management team and founders, iii. the quality of external relationships, iv. the potential for forming strategic alliances, and v. attractive divestment alternatives (Miloud et al., 2012; Campani et al., 2021; Koenig & Tennert, 2022; Montanaro et al., 2022).

These issues have been discussed in other empirical studies. However, they are limited to analyzing the determinants of SUs in developed countries – such as the United States and France (Miloud et al., 2012) – and not necessarily from the perspective of VCIs (Sathaworawong et al., 2018; Campani et al., 2021). On the contrary, this study broadens this scope by investigating the following research problem: What are the main factors that influence the valuation of SUs – located in emerging markets – from the perspective of VCIs?

The final sample consists of 55,085 financing rounds of 36,565 SUs for the value variable (VALUE) and 2,498 financing rounds of 2,014 SUs for the pre-money valuation variable (PRMV), located in the key partner countries of the Organization for Economic Cooperation and Development (OECD) – Brazil, China, India, Indonesia and South Africa. The data were obtained from the Capital IQ database for the period from January 1, 2010 to December 31, 2022 (Supplementary Data 1 – PRMV Database). The hypotheses arising from the research objective are tested using hedonic regression.

This study contributes to academia by confirming the corporate finance theories of information asymmetry, signaling, and agency applied to early-stage emerging market firms. Furthermore, due to the lack of consistent historical financial information on SUs, the analysis of their age and stage of development, as well as the volume of investment in research and development and the size of the sector in which they operate, allows investors to more accurately assess their real potential for expansion.

Identifying the relevance of these factors encourages SUs to monitor them more closely in order to raise these funds from VCIs, enabling them to reach their true potential

by the IPO stage. In turn, governments and regulators can take this information into account when defining policies to encourage investment in research and development in sectors that are more strategic for the country and better serve the interests of the markets and society. Finally, one of the differentials of this research is the analysis of the characteristics of the SUs – and the sectors in which they operate – in emerging economies. An alternative to the technological leap already established in developed countries is to invest in SUs that insert emerging markets more affirmatively into Industry 5.0, characterized by the integration of humans and artificial intelligence.

2 Literature review

A company can be understood as a network of contracts – implicit or explicit – that define functions and the rights and obligations of all parties (Jensen & Meckling, 1976). A starting point for a VCI to deploy resources – in a new ecosystem – is the designed contractual structure. This mechanism allows the VCI to manage the extreme uncertainty surrounding the success of the venture and the information asymmetry between entrepreneurs and investors. These elements can threaten investment or make it unfeasible, especially in the early stages (Mishra & Bag, 2020).

To mitigate these problems, VCIs rely on a variety of mechanisms, such as information screening, due diligence, and SU monitoring. These mechanisms allow them to explore all available information in order to estimate the most appropriate value. In addition, these control tools influence entrepreneurs to act in accordance with the interests of VCIs (Koenig & Tennert, 2022), thereby reducing conflicts of interest between the parties.

Spence (1973) mentions that information asymmetry can be mitigated if one party signals information about its decisions to the other. VCIs consider each new piece of information from entrepreneurs and incorporate it into their evaluation process, especially during financing rounds. This set of information signals whether the SU is at a more advanced stage in its life cycle. In addition, more specific information allows for more efficient monitoring and is associated with higher valuations (Koenig & Tennert, 2022).

According to Sathaworawong et al. (2018), the valuation of SUs faces unique challenges such as a lack of historical data and a high degree of uncertainty about the nature of the business. This scenario makes their valuation

an even more challenging process. Hidayat et al. (2022) corroborate this statement by pointing out that traditional valuation models are developed for mature companies operating in efficient capital markets. However, new ventures have a high degree of subjectivity and uniqueness – making it impossible to estimate multiples.

In addition, these companies have only been in operation for a short period of time, making it difficult to determine an appropriate discount rate. As a result, valuing them using future cash flows discounted to present value produces inaccurate results. Finally, equity valuation ignores growth opportunities and focuses on tangible assets. However, the assets of SUs consist mainly of intangibles. Therefore, the valuation of SUs must take into account strategic variables related to internal and industry resources, as well as their network of relationships (Dhochak & Doliya, 2020; Gao et al., 2021; Prashantham, 2021; Majumdar & Mittal, 2023; Dhochak et al., 2024).

Despite the recent increase in empirical studies on the valuation of SU by VCIs, the literature is still in its infancy, especially in the case of emerging markets. In these countries, the studies are limited to questionnaires and a review of the literature on strategy theories (Doll et al., 2022; Majumdar & Mittal, 2023). Thus, there is a lack of integrated finance studies that analyze the combined impact of (non-)financial factors on the value of SUs from a VCI perspective. Non-financial factors include those related to the characteristics of: i. the SUs – age and stage of development (Sathaworawong et al., 2018; Malyy et al., 2021; Montanaro et al., 2022; Hidayat et al., 2022; Koenig & Tennert, 2022) and ii. the sector – investment in advertising, research and development, growth, size and profitability (Miloud et al., 2012).

In terms of the age of SUs, new businesses are particularly prone to failure. Many of them do not have a minimally viable product to justify their existence. On the other hand, younger firms also have greater opportunities for growth if they overcome the initial challenges (Behrens et al., 2012; Montanaro et al., 2022). Hidayat et al. (2022) point out that firms that have been in the market for a longer period of time signal less uncertainty, with a lower degree of information asymmetry between entrepreneurs and VCIs. Therefore, they may receive a higher valuation. Thus, it follows that: *H1 – The age of the SU is positively related to its valuation.*

As for the stage of development of the SU, this indicates the paths that the venture must take to achieve success. New ventures – with high growth potential – have

evolutionary stages that affect the amounts raised in funding rounds. With each new stage reached, the SU is expected to present more tangible results, reflecting its effective operational capacity (Malyy et al., 2021). In addition, this maturity – reflected in the funding rounds – reduces the level of information asymmetry and increases the valuation of the SU (Koenig & Tennert, 2022). Thus, it follows that: *H2 – The stage of development of the SU is positively related to its valuation.*

Regarding investment in advertising, it can be seen that advertising or publicizing SUs contributes to their visibility, creating the need to consume the product or service offered. In turn, Que and Zhang (2021) argue that investment in advertising increases the exposure of the firm to consumers, which can attract the attention of potential investors. Thus, high spending on advertising is directly related to the valuation of SUs and the attention of their investors. For Miloud et al. (2012), the level of investment in advertising in the sector signals the market's perception of product differentiation. Therefore, it follows that: *H3 – The level of investment in advertising in a sector is positively related to the valuation of startups in that sector.*

In addition, innovative companies constantly invest in research and development (R&D) in search of competitive advantage and new business opportunities. This attitude enables them to gain market share from their non-innovative competitors by differentiating their products (Ho et al., 2016). However, investments in innovation do not necessarily produce tangible results, such as a new patent (Chen et al., 2021). Nevertheless, these investments signal to VCIs that the SU's competitive performance is stronger than that of its competitors, thereby increasing firm value. Thus, it follows that: *H4 – The level of investment in research and development in a sector is positively related to the valuation of startups in that sector.*

In turn, factors such as investment in dissemination and R&D, as well as the level of competitiveness of the sector, can contribute to its growth and thus affect the value of the SUs operating in it. Miloud et al. (2012) point out that the performance of sectors is constantly monitored by VCIs, with a particular focus on the most profitable ones. On the other hand, SUs operating in sectors with many uncertainties, uncertain technologies and unknown products in the early stages generate greater information asymmetry with VCIs, reducing their valuation. Thus, it follows that: *H5 – The growth rate of a sector is positively related to the valuation of startups in that sector.*

Regarding the size of the sector, this indicates the maximum capacity of the SU – within the sector – to generate revenue, signaling to VCIs the growth potential of the business. According to Miloud et al. (2012), VCIs evaluate SUs operating in a fast-growing sector more favorably. This is because the favorable conditions in this sector allow entrepreneurs to make a few mistakes without significantly altering their sales. In contrast, in a low-growth sector, such mistakes can be fatal for the business, making the investment more risky. In this regard, Jordan and Smith (2019) point out that knowing the estimated size of the sector is part of the “story” to be presented to VCIs. Therefore, this aspect can determine the value of the SU in a financing round. Thus, it follows that: *H6 – The size of a sector is positively related to the valuation of startups in that sector.*

Finally, the profitability of a sector signals whether it is able to generate enough cash flow to meet its operating needs. Sometimes SUs are unable to generate consistent cash flows because they have not reached their break-even point. In this case, the profitability of the sector is a thermometer for VCIs to make their investment decisions. Menon and James (2022) found that less than 10% of SUs – characterized as unicorns – are profitable and have higher valuations than traditional companies. Miloud et al. (2012) understand that the investment decision of VCIs takes into account the expected profitability or return of the sector – at the time of divestment of the SU operating in it. Thus, it follows that: *H7 – The profitability of a sector is positively related to the valuation of startups in that sector.*

Table 1 presents a summary of the results of empirical studies – with related topics – where the dependent variable is value.

In turn, Table 2 shows the results of similar empirical studies where the dependent variable is pre-money valuation.

In summary, Table 1 shows that the variables age and stage of the SU mostly have a positive and statistically significant relationship with value, confirming H1 and H2 of this study. Table 2 again shows a positive and statistically significant relationship between the age and stage of the SU and PRMV. The study of Miloud et al. (2012) shows a similar result for the SU sector variables, confirming hypotheses H3 to H7 of this study.

Table 1
Summary of empirical results for the dependent variable value

| Variables | HYP | ES | Wasserman (2017) | | Sathaworawong et al. (2018) | | Hidayat et al. (2022) | | Wise et al. (2022) | |
|---------------------------------|-----|----|------------------|------|-----------------------------|------|-----------------------|------|--------------------|------|
| | | | Sign | Sig. | Sign | Sig. | Sign | Sig. | Sign | Sig. |
| Independent variables – startup | | | | | | | | | | |
| AGE | H1 | + | + | 1% | + | 1% | + | 1% | - | 1% |
| STAGE | H2 | + | n/a | n/a | + | 1% | n/a | n/a | n/a | n/a |
| Independent variables – sector | | | | | | | | | | |
| AD | H3 | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| RD | H4 | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| SG | H5 | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| SS | H6 | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| PROF | H7 | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Control variables – country | | | | | | | | | | |
| SI | n/a | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| WGI | n/a | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| GDP | n/a | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

Notes: HYP - Hypotheses; ES - Expected signs; Sig. - Statistical significance level; n/a - Not applicable; AGE – Age; STAGE – Stage; AD - Sector advertising investment; RD - Sector research and development investment; SG - Sector growth; SS - Sector size; PROF – Sector profitability; SI - Stock market index; WGI - Worldwide Governance Indicators; GDP - GDP per capita growth rate.

Table 2
Summary of empirical results for the dependent variable pre-money valuation

| Variables | HYP | ES | Hsu (2007) | | Miloud et al. (2012) | | Sievers et al. (2013) | | Que e Zhang (2021) | |
|---------------------------------|-----|----|------------|------|----------------------|------|-----------------------|------|--------------------|------|
| | | | Sign | Sig. | Sign | Sig. | Sign | Sig. | Sign | Sig. |
| Independent variables – startup | | | | | | | | | | |
| AGE | H1 | + | + | 5% | + | 1% | + | s/s | n/a | n/a |
| STAGE | H2 | + | n/a | n/a | + | 1% | n/a | n/a | - | 1% |
| Independent variables - sector | | | | | | | | | | |
| AD | H3 | + | n/a | n/a | + | 5% | n/a | n/a | n/a | n/a |
| RD | H4 | + | n/a | n/a | + | 5% | + | s/s | n/a | n/a |
| SG | H5 | + | n/a | n/a | + | 10% | n/a | n/a | n/a | n/a |
| SS | H6 | + | n/a | n/a | + | 1% | n/a | n/a | n/a | n/a |
| PROF | H7 | + | n/a | n/a | + | 5% | n/a | n/a | n/a | n/a |
| Control variables – country | | | | | | | | | | |
| SI | n/a | + | n/a | n/a | + | 1% | n/a | n/a | + | s/s |
| WGI | n/a | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| GDP | n/a | + | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

Notes: HYP - Hypotheses; ES - Expected signs; Sig. - Statistical significance level; n/a - Not applicable; s/s - Not statistically significant; AGE - Age; STAGE - Stage; AD - Sector advertising investment; RD - Sector research and development investment; SG - Sector growth; SS - Sector size; PROF - Sector profitability; SI - Stock market index; WGI - Worldwide Governance Indicators; GDP - GDP per capita growth rate.

3 Methodology

This study aims to identify the main factors that influence the valuation of SUs by VCIs. These factors are related to the following characteristics and hypotheses: *i. Startup characteristics: H1 – The age of the startup is positively related to its valuation and H2 – The stage of development of the startup is positively related to*

its valuation; ii. Sector characteristics: H3 – The level of investment in advertising in a sector is positively related to the valuation of startups in that sector, H4 – The level of investment in research and development in a sector is positively related to the valuation of startups in that sector, H5 – The growth rate of a sector is positively related to the valuation of startups in that sector, H6 – The size of a sector is positively related to the valuation of startups in that

sector, and H7 – *The profitability of a sector is positively related to the valuation of startups in that sector.*

The final sample consists of two sub-samples, one for the dependent variable value (VALUE) and the other for pre-money valuation (PRMV). In the case of the VALUE sub-sample, it consists of 55,085 financing rounds of 36,565 SUs. The PRMV sub-sample consists of 2,498 financing rounds of 2,014 SUs. The difference in the size of the two sub-samples is due to the limited number of observations provided by the database for the PRMV variable in the period analyzed.

The SUs are private companies located in Brazil, China, India, Indonesia and South Africa. The OECD considers these five major economies in the world to be its key partners because these countries are located on three continents and represented 42.69% of the world's population and 25.07% of the world's gross domestic product (GDP) in 2021. In addition, international organizations predict that these countries will grow faster than the world average in the coming years and will be the largest economies in the near future. Thus, the results obtained for companies in these countries can be extended to other emerging economies, given their relevance in the current scenario and their role as global leaders in the coming years (Organization for Economic Cooperation and Development, 2021; Goldman Sachs, 2022).

The data were obtained from the Capital IQ Pro database, which belongs to Standard & Poor's, and the World Bank for the period from January 1, 2010 to December 31, 2022. The hypotheses arising from the research objective are tested by means of a hedonic regression, presented in the model of Equation 1, whose variables are described in Table 3. The tests were carried out using Stata software (Supplementary Data 2 – Stata Output VALUE, Supplementary Data 3 – Output Stata_PRMV, Supplementary Data 4 – Stata Output VALUE. Pdf).

$$\text{Valuation}_{it} = \alpha_0 + \beta_1 \text{Startup}_{it} + \beta_2 \text{Sector}_{jt} + \beta_3 \text{Country controls}_{kt} + \theta_j + \mu_{ijkt} \quad (1)$$

Where: i = company, t = time or date of financing round, j = sector, k = country, θ_{jt} = sector fixed effect; μ_{ijkt} = residuals

In finance, hedonic regression is a method used to estimate the demand for a good or its value to consumers. It divides the item under study into its constituent characteristics and obtains estimates of the

contributory value of each characteristic. In addition, the value of this good – as well as the vector of characteristics of the associated model – can be captured over several periods (Rosen, 1974; Ekeland et al., 2002). Among the tests of its assumptions are the analysis of the absence of autocorrelation and heteroscedasticity of the residuals and problems of multicollinearity for the explanatory variables (Supplementary Data 5 – Stata Scripts PRMV, Supplementary Data 6 – Stata Output VALUE.do). In addition, a sector fixed effect dummy variable is included to capture any endogeneity due to omitted variables (Ebbes et al., 2022).

4 Analysis of results

Table 4 presents the descriptive statistics for the variables in Equation 1. Panel A (B) shows the sub-sample data for the dependent variable VALUE (PRMV). In the case of Panel A, the average amount raised in the 55,085 financing rounds is \$18.28 million. The average age of the SUs is 7.7 years. However, there are SUs raising money that are up to 25 years old. This may be related to the development of new innovative products that still attract the interest of VCIs. Regarding the level of investment in advertising (R&D) in the sector, the average SU invests around 1.10% (3.05%) of its turnover.

The average growth rate (SG) is 13.69%. In turn, the average size of the sector (SS) is \$68.69 million. As for profitability (PROF), the sector average is 6.42%. The average growth rate of gross domestic product per capita (GPD) is 5.52%. Finally, the average global governance indicator (WGI) is negative at -0.3262, which is a characteristic of emerging markets.

The data in Panel B are similar to those in Panel A, except for the dependent variable (PRMV) and sector growth (SS). In the case of the PRMV variable, there are fewer data available in the CIQ database than for the amounts raised in financing rounds (VALUE). As a result, only 2,498 observations were identified. However, their amounts are higher, as they are obtained from the difference between the total value of the SU – after the financing round – minus the amount raised in that round. On average, the value of PRMV is \$462.31 million. Finally, with regard to the sector growth variable (SS), its percentage is lower than that of the sub-sample with the dependent variable VALUE. This is because the sector data refer to the sum of the data of the SUs in the sample.

Table 3
Description of variables

| Acronym | Name | ES | Formula | Components | References |
|--|---|-----|--|--|--|
| Dependent variables – Valuation | | | | | |
| VALUE | Value | n/a | $VALUE = nl (1 + VL)$ | nl = Neperian logarithm VL = Amount of funds raised in US\$ millions | Wasserman (2017); Sathaworawong et al. (2018); Hidayat et al. (2022); Wise et al. (2022) |
| PRMV | Pre-money valuation | n/a | $PRMV = nl [1 + (POMV - VL)]$ | nl = Neperian logarithm POMV = Post-money valuation in US\$ millions VL = Amount of funds raised in US\$ millions | Hsu (2007); Miloud et al. (2012); Sievers et al. (2013); Que and Zhang (2021) |
| Independent variables related to the startups | | | | | |
| AGE | Startup age | + | $AGE = nl \text{ AGE (Date of the funding round - Date of incorporation)}$ | nl = Neperian logarithm AGE = Age of SU at the time of the funding round | Hsu (2007); Miloud et al. (2012); Sievers et al. (2013); Wasserman (2017); Sathaworawong et al. (2018); Hidayat et al. (2022); Wise et al. (2022) |
| STAGE | Startup stage | + | STAGE = 1 to 4 | 1 = Initial (a) 2 = Development (b) 3 = Expansion (c) 4 = Profitability (d) | Miloud et al. (2012); Sathaworawong et al. (2018); Que and Zhang (2021) |
| Independent variables related to the sectors (c) | | | | | |
| AD | Sector advertising investment | + | $AD = ADE/REV$ | ADE = Total sector advertising expenses REV = Total sector sales revenue | Miloud et al. (2012); Que and Zhang (2021) |
| RD | Sector research and development investment | + | $RD = RDE/REV$ | RDE = Total sector research and development expenses REV = Total sector sales revenue | Miloud et al. (2012); Sievers et al. (2013) |
| SG | Sector growth | + | $SG = (REV_t - REV_{t-1}) / REV_{t-1}$ | REV _t = Total sector sales revenue of the current year REV _{t-1} = Total sector sales revenue of the previous year | Miloud et al. (2012) |
| SS | Sector size | + | $SS = \ln (REV)$ | nl = Neperian logarithm REV = Total sector sales revenue | Miloud et al. (2012) |
| PROF | Sector profitability | + | $PROF = EBIT (1 - T) / IE$ | EBIT = Earnings before interest and taxes T = Taxes IE = Investment expenditure (Short- and long-term debts + Equity) | Miloud et al. (2012) |
| Control variables related to the countries | | | | | |
| SI | Stock exchange index (f) | + | $SI = \ln (IB)$ | nl = Neperian logarithm IB = Closing points of the main stock market index in the market in which the SU operates on the date of the funding round (g) | Miloud et al. (2012); Que and Zhang (2021) |
| GDP | Gross domestic product per capita growth rate | + | $GDP = (GDPT / GDPt-1) - 1$ | GDPT = Gross domestic product per capita of current year GDPt-1 = Gross domestic product of previous year | Gompers et al. (1998) |
| WGI | Worldwide Governance Indicator | + | WGI = Varies between -2.5 and 2.5. The higher the regulatory environment index, the better | The index is derived from the average six-dimensional estimate - control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law and voice and accountability. The estimate gives the country score, for each dimension, in units of a standard normal distribution. | Kaufmann et al. (2011) |

Notes: ES - Expected sign. a) Initial stage: This is associated with the first fundraising - seed capital - obtained from family, friends and angel investors. Capital at this stage can be used for market research or product development. CIQ Pro classifies this type of financing as early stage; b) Development stage: This is associated with financing to build an initial customer base or a minimum viable product (MVP). MPV means the development of a product prototype to materialize the delivery of a value proposition before its launch. CIQ Pro classifies this type of financing as venture; c) Expansion stage: This is associated with financing for scale production of products and expansion of the customer base. CIQ Pro classifies this type of financing as growth; d) Profitability stage: This is associated with financing to optimize operations in preparation for going public. These companies reach a profitable operating level. CIQ Pro classifies this type of financing as mature; e) For the independent variables related to the sector, both public and private companies are considered in the composition of the final sector sample; f) For the control variable stock exchange index, the following indices are considered for each country in the sample: 1. South Africa - Johannesburg Stock Exchange (JSE) - J203 Index; 2. China - Shanghai Stock Exchange (SSE) - SSCI Index; 3. Brazil - Brasil, Bolsa, Balcão (B3) - Ibovespa; 4. India - Bombay Stock Exchange (BSE) - SENSEX Index; 5. Indonesia - Indonesia Stock Exchange (IDX) - LQ45 Index; g) For SUs in which the day of the financing round does not coincide with a stock exchange trading day, the previous trading day is taken into account.

Table 4
Descriptive statistics

| Variables | Observations | Mean | Stand. Dev. | Minimum | Maximum |
|-----------|--------------|---------|-------------|---------|----------|
| Panel A | | | | | |
| VALUE | 55,085 | 18.28 | 30.97 | 0.10 | 120.09 |
| AGE | 28,587 | 7.7738 | 6.3128 | 2 | 25 |
| AD | 47,763 | 0.0110 | 0.0155 | 0.0001 | 0.0626 |
| RD | 33,738 | 0.0305 | 0.0388 | 0.0004 | 0.1353 |
| SG | 52,769 | 0.1369 | 0.3108 | -0.4037 | 0.9890 |
| SS | 54,506 | 68.6989 | 102.3870 | 0.1300 | 382.360 |
| PROF | 52,523 | 0.0642 | 0.0471 | 0.0107 | 0.1897 |
| GPD | 55,085 | 0.0552 | 0.0221 | 0.0052 | 0.0835 |
| WGI | 55,085 | -0.3262 | 0.1336 | -0.5655 | -0.0675 |
| Panel B | | | | | |
| PRMV | 2,498 | 462.31 | 912.71 | 0.13 | 3,500.00 |
| AGE | 1,209 | 7.1175 | 5.1629 | 2 | 21 |
| AD | 2,159 | 0.0146 | 0.0210 | 0.0002 | 0.0772 |
| RD | 1,275 | 0.0279 | 0.0371 | 0.0003 | 0.1353 |
| SG | 2,397 | 0.0999 | 0.3665 | -0.5186 | 1.0770 |
| SS | 2,457 | 26.0505 | 47.4905 | 0.0300 | 181.2900 |
| PROF | 2,357 | 0.0843 | 0.0677 | 0.0128 | 0.2729 |
| GPD | 2,498 | 0.0435 | 0.0385 | -0.0673 | 0.0818 |
| WGI | 2,498 | -0.2363 | 0.1234 | -0.4765 | -0.0675 |

Notes: The VALUE, PRMV and SS variables are in US\$ million. The AGE variable is in years. The WGI score varies between -2.5 and +2.5. The other variables are in percentages.

In turn, Table 5 shows the number of funding rounds by country, year and stage of the SU – for the two sub-samples with the dependent variables VALUE and PRMV. In the case of countries, there are more data from SUs located in China (India) for the VALUE (PRMV) sub-sample. This shows that China (37,749 or 68.5%) has more recent data, while India (1,264 or 50.6%) has more historical data on its SUs.

Regarding the phases of the SUs, the VALUE sub-sample has a higher number of financing rounds in the development phase (29.136 or 52.9%). In the case of the PRMV sub-sample, there is a balance in the number of financing rounds between the initial (929.00 or 37.2%) and development (839.00 or 33.6%) phases. The development phase is the best time to raise funds and expand the customer portfolio. Here, entrepreneurs make adjustments to their operations and better define their product or service and target audience. As for the initial phase, this is the moment of ideation, when the minimum viable product (MVP) is defined. It can also be seen that, as expected, there are fewer financing rounds in the profitability phase, when the SU exceeds its break-even point and prepares for the scale-up or IPO phase.

Finally, in terms of years, there is a greater concentration of funding rounds in 2021 and 2022 – which coincides with the years of the Covid-19 pandemic. On this occasion, entrepreneurs saw opportunities in the midst of adversity. The use of technology becomes even more important and gives rise to SUs related to the provision of innovative services such as telemedicine, online education and retail, home office, among others.

Table 6 shows the regressions where the dependent variable is value (VALUE). Models 1 to 3 (4 to 6) show the results of the hedonic regression (robustness tests). In Models 1 and 4, only the country control variables (IS, GDP and WGI) are considered. In Models 2 and 5, the independent variables of the SUs (AGE and STAGE) are added. Finally, Models 3 and 6 are complete, including all the independent variables for the sector (AD, RD, SG, SS and PROF).

In order to identify the best type of regression, the Breusch and Pagan test was applied, the result of which pointed to the panel data model. In turn, the Hausman test indicated the existence of residuals with fixed effects. The Wald test showed that the residuals had heteroskedasticity problems, which were corrected with robust errors. Finally, in order to control for possible

Table 5
Number of funding rounds

| Countries | | | Stages | | |
|--------------|--------|-------|---------------|--------|-------|
| Dep. Var. | VALUE | PRMV | Dep. Var. | VALUE | PRMV |
| Brazil | 3,183 | 296 | Initial | 13,930 | 929 |
| China | 37,749 | 816 | Development | 29,136 | 839 |
| India | 11,934 | 1,264 | Expansion | 6,425 | 445 |
| Indonesia | 1,635 | 73 | Profitability | 5,594 | 285 |
| South Africa | 584 | 49 | | | |
| Total | 55,085 | 2,498 | Total | 55,085 | 2,498 |
| Years | | | | | |
| Dep. Var. | VALUE | PRMV | Dep. Var. | VALUE | PRMV |
| 2010 | 1,704 | 26 | 2017 | 5,011 | 175 |
| 2011 | 2,114 | 65 | 2018 | 5,230 | 262 |
| 2012 | 1,982 | 50 | 2019 | 5,130 | 264 |
| 2013 | 2,126 | 80 | 2020 | 4,909 | 298 |
| 2014 | 3,317 | 125 | 2021 | 7,182 | 386 |
| 2015 | 5,146 | 198 | 2022 | 6,225 | 370 |
| 2016 | 5,009 | 199 | Total | 55,085 | 2,498 |

Notes: Dep. Var. - Dependent variables.

Table 6
Regression results (value)

| Regression | Hedonic regression | | | Robustness test | | |
|-------------------------------|---------------------|---------------------|--------------------|---------------------|--------------------|--------------------|
| Models | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| Startup independent variables | | | | | | |
| AGE | | 0.6522 (0.000) *** | 0.4062 (0.000) *** | | 0.2632 (0.000) *** | 0.4512 (0.000) *** |
| STAGE | | 0.2593 (0.000) *** | 0.2613 (0.000) *** | | 0.2632 (0.000) *** | 0.2564 (0.000) *** |
| Sector independent variables | | | | | | |
| AD | | | -0.4365 (0.856) | | | -0.8677 (0.724) |
| RD | | | 2.8666 (0.030) ** | | | 2.7927 (0.036) ** |
| SG | | | -0.0364 (0.483) | | | -0.0331 (0.527) |
| SS | | | 0.0494 (0.248) | | | 0.0491 (0.254) |
| PROF | | | -0.7178 (0.216) | | | -0.7058 (0.225) |
| Country control variables | | | | | | |
| SI | 0.9483 (0.000) *** | 0.4506 (0.000) *** | 0.3540 (0.000) *** | 0.9576 (0.000) *** | 0.4591 (0.000) *** | 0.3402 (0.000) *** |
| GDP | -0.1725 (0.619) | 2.4683 (0.000) *** | -1.2780 (0.219) | -0.2557 (0.463) | 2.3996 (0.000) *** | -1.7780 (0.095) |
| WGI | 4.3123 (0.000) *** | 0.9735 (0.000) *** | 1.3703 (0.000) *** | 4.3610 (0.000) *** | 1.0042 (0.000) *** | 1.4093 (0.000) *** |
| Constant | -4.8099 (0.000) *** | -3.2112 (0.000) *** | -2.3853 (0.015) ** | -4.8103 (0.000) *** | -3.199 (0.000) *** | -2.1145 (0.033) ** |
| Sector dummy FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Robust standard errors | Yes | Yes | Yes | Yes | Yes | Yes |
| Value L1 | No | No | No | Yes | Yes | Yes |
| Prob > F | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Observations | 55,085 | 28,587 | 15,235 | 55,085 | 28,587 | 15,235 |

Notes: The upper values are those of the coefficients, while the lower values (in brackets) represent their level of significance. Value L1 refers to the inclusion of the value variable lagged by one year. Coefficients are statistically significant at 1% (***) and 5% (**).

endogeneity problems, a fixed-effect dummy variable for sector was included. In the case of the robustness tests, the dependent variable was lagged by one year. It can be seen that all the models (1 to 6) are statistically significant (Prob > F = 0.0000).

The hedonic regressions (Models 2 and 3) show that the independent variables AGE, STAGE and RD

have positive and statistically significant coefficients. Thus, as the SU evolves in age and stage of development, its value increases. In fact, the maturity of the SU signals the evolution of the business, promoting it to more advanced stages. According to Sathaworawong et al. (2018), the positive relationship between age and funding value may be related to the logic of venture capital divestment

time. The older the SU, the faster the VCIs can realize their return.

Hidayat et al. (2022) believe that older SUs, those in more mature stages, signal a lower likelihood of bankruptcy, making them more valuable. Sathaworawong et al. (2018) support this argument. For them, there is an expansion in the production and sales revenue generation of SUs as they evolve from the early stage to scale-up.

As for investment in R&D, it offers VCIs a reduction in the information asymmetry that exists between them and entrepreneurs. In addition, Prashantham (2021) highlights the existence of a growing movement by multinationals to explore local innovation environments – those with unique skills and talent pools. These strategic partnerships take place mainly with SUs in countries other than their headquarters, increasing their attractiveness.

With regard to R&D (Model 3), for every 1% more of the SU's revenue invested in research and development, its value increases by 286%. The same results can be seen in the robustness tests (Models 5 and 6) and are similar to those obtained by Wasserman (2017), Sathaworawong et al. (2018) and Hidayat et al. (2022) – see Table 1. These authors find that investment in technological factors, especially in the case of younger SUs, is non-financial information that adds value to them. As for the other independent variables of the sector (AD, SG, SS and PROF), they are not statistically significant.

These results confirm hypotheses *H1 – The age of the startup is positively related to its valuation*, *H2 – The stage of development of the startup is positively related to its valuation* and *H4 – The level of investment in research and development in a sector is positively related to the valuation of startups in that sector*. In practice, it can be seen that the maturity of SUs reduces the information asymmetry between their entrepreneurs and the market. According to Hidayat et al. (2022), SUs that have been in the market for a longer period of time signal less uncertainty to VCIs and can therefore obtain a higher valuation. As for investment in R&D, it signals a higher level of innovation by SUs, which promotes more competitive performance vis-à-vis their competitors and increases their value (Ho et al., 2016; Chen et al., 2021).

However, the sector control variables AD, SG, SS and PROF were not statistically significant in their relationship with the amount raised in the financing rounds. It is possible that the level of investment in advertising, growth, size and profitability of the sector are not as relevant during the financing round as the

characteristics of the SUs. Therefore, it appears that VCIs give more weight to the characteristics of the companies themselves in their valuations.

Regarding the country control variables (SI, GDP and WGI), they show a positive and statistically significant relationship, both in the hedonic regression and in the robustness tests. The existence of a thriving capital market, a favorable economic scenario and a better level of governance encourage VCIs to invest in the SUs of that country.

Table 7 shows the regressions where the dependent variable is the pre-money valuation (PRMV). The evolution of Models 1 to 6 is similar to that shown in Table 5. In addition, the same assumption tests were carried out as for the regression models with the dependent variable VALUE. Once again, the independent variables AGE and STAGE of the SUs continue to have a positive and statistically significant relationship. These results confirm those obtained by Hsu (2007) and Miloud et al. (2012) – see Table 2. The expectation is that as SUs overcome the initial challenges, they will provide greater opportunities for growth and will be better valued in the next stages of development.

However, when considering the value of the SU before the financing round, the size of the sector (SS) becomes significant. On average, every 1% increase in sector revenue increases the value of the SU by more than 80%. The size of the sector indicates the maximum capacity of the SU – within it – to generate revenue, signaling the growth potential of the business to VCIs (Miloud et al., 2012; Jordan & Smith, 2019). This confirms *H6 – The size of a sector is positively related to the evaluation of the startups in that sector*. As for the other independent variables of the sector (AD, RD, SG and PROF), they are not statistically significant.

In addition, the sector control variables AD, RD, SG and PROF are not statistically significant. As in Table 6, VCIs do not attach much importance to the characteristics of the sector in emerging markets. One possible explanation for this could be their incipient level of maturity compared to developed countries. If the VCI finds that a particular characteristic of the sector stands out, it becomes significant even before the funding round – see SS. As for the country control variables (SI, GDP and WGI), only GDP is statistically non-significant.

Table 7
Regression results (*pre-money valuation*)

| Regression Models | Hedonic regression | | | Robustness test | | |
|-------------------------------|----------------------|---------------------|----------------------|----------------------|---------------------|---------------------|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| Startup independent variables | | | | | | |
| AGE | | 1.4755 (0.000) *** | 1.0686 (0.048) ** | | 1.4644 (0.000) *** | 1.0705 (0.044) ** |
| STAGE | | 0.3026 (0.000) *** | 0.2742 (0.029) ** | | 0.2915 (0.0000) *** | 0.2633 (0.039) ** |
| Sector independent variables | | | | | | |
| AD | | | -0.2954 (0.958) | | | -0.8274 (0.844) |
| RD | | | 5.8151 (0.469) | | | 6.1957 (0.444) |
| SG | | | -0.4507 (0.079) | | | -0.4790 (0.072) |
| SS | | | 0.8675 (0.043) ** | | | 0.8867 (0.046) ** |
| PROF | | | 0.5312 (0.859) | | | 0.5848 (0.847) |
| Country control variables | | | | | | |
| SI | 2.1670 (0.000) *** | 1.0368 (0.000) *** | 0.9496 (0.014) ** | 2.1101 (0.000) *** | 0.9821 (0.001) *** | 0.9410 (0.015) ** |
| GDP | 1.2289 (0.251) | 0.9116 (0.436) | -2.2566 (0.230) | -1.1824 (0.273) | 0.9315 (0.429) | -2.0416 (0.275) |
| WGI | 8.8477 (0.000) *** | 3.2169 (0.030) ** | 1.9918 (0.415) | 8.3501 (0.000) *** | 2.8720 (0.063) | 1.6525 (0.473) |
| Constant | -15.3273 (0.000) *** | -7.4224 (0.000) *** | -19.6771 (0.010) *** | -15.0212 (0.000) *** | -7.0494 (0.005) *** | -20.0685 (0.011) ** |
| Sector dummy FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Robust standard errors | Yes | Yes | Yes | Yes | Yes | Yes |
| PRMV L1 | No | No | No | Yes | Yes | Yes |
| Prob > F | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Observations | 2,498 | 1,209 | 580 | 2,497 | 1,209 | 580 |

Notes: The upper values are those of the coefficients, while the lower values (in brackets) represent their level of significance. Value L1 refers to the inclusion of the value variable lagged by one year. Coefficients are statistically significant at 1% (***) and 5% (**).

5 Conclusion

SUs are innovative companies made up of a group of people looking for a repeatable and scalable business model – one that makes an impact on society, either through a product or a service that solves a problem. These companies operate under conditions of extreme uncertainty. In addition, in their initial phase, SUs show negative results due to little or no revenue. Because they have no history, their asset value is irrelevant.

Furthermore, estimating their relative value requires the existence of comparable companies, which are difficult to identify due to their innovative nature. There is no capitalization value. Finally, the application of the discounted cash flow method is inaccurate due to the imprecision of its growth projection and the calculation of the discount rate. Thus, assigning a value to SUs is a difficult task and prone to inaccuracies, which makes this process even more relevant.

In this way, identifying elements that help to mitigate the uncertainties involved in this process contributes to a more appropriate valuation. These elements are particularly relevant for VCIs – market agents that invest funds in new ventures with low turnover and therefore higher risk. These include the age and stage of the SUs, as well as characteristics of the sector in which

they operate – e.g. investment in advertising and R&D, growth and profitability of the industry.

In view of the above, this study aims to investigate the main factors affecting the valuation of emerging market SUs from the perspective of VCIs. To this end, 55,085 (2,498) financing rounds of 36,565 (2,014) SUs are analyzed for the dependent variable value (pre-money valuation). The SUs are located in countries that are key partners of the OECD (Brazil, China, India, Indonesia and South Africa), in the period from January 1, 2010 to December 31, 2022. The objectives are verified through hypotheses tested by hedonic regression and robustness tests.

The results of the tests presented in Tables 6 and 7 point to the confirmation of hypotheses *H1 – The age of the startup is positively related to its valuation*, *H2 – The stage of development of the startup is positively related to its valuation*, *H4 – The level of investment in research and development in a sector is positively related to the valuation of startups in that sector* and *H6 – The size of a sector is positively related to the valuation of startups in that sector*. These results confirm those obtained by Wasserman (2017), Sathaworawong et al. (2018) and Hidayat et al. (2022) for the dependent variable value – see Table 1, as well as those presented by Hsu (2007), Miloud et al. (2012) and Sievers et al. (2013) for the dependent variable pre-money valuation – see Table 2.

In fact, as SUs evolve in terms of age and stage of development, there is a reduction in the degree of uncertainty about their viability, which stimulates the investment of resources by VCIs. This reduction in information asymmetry allows for a reduction in agency conflicts, aligning the interests of entrepreneurs and VCIs. In turn, the allocation of resources to R&D, the size of the sector and the greater volume of revenues signal to VCIs the innovative nature of the products and services in that industry. These aspects are important indicators in their process of selecting SUs with investment potential. They also reflect a higher level of competitiveness in the market and point to the growth potential of the business.

This study contributes to academia by empirically confirming the application of corporate finance theories – signaling, information asymmetry, agency – to early-stage companies. Investors and markets can benefit from the results presented by identifying non-financial determinants that allow a more accurate assessment of the real growth potential of SUs. In turn, these become aware that factors such as age and stage of development, as well as the volume of investment in R&D and the size of the sector in which they operate, are the focus of greater attention by VCIs. These aspects therefore need to be better monitored in order for them to be more successful in their funding rounds.

As for governments and regulators, this research provides them with information that can help them design policies to encourage domestic investment – and attract foreign capital – in sectors that are more strategic for the country and better serve the interests of markets and society. The technological leap needed by emerging economies requires the promotion of disruptive ventures, which is an inherent characteristic of SUs. Thus, this study differs from others in that it presents a set of unconventional aspects that draw the attention of VCIs to SUs located in emerging countries and that allow for a more adequate assessment of their capacity to evolve.

On the other hand, the fact that these SUs operate in emerging markets limited the collection of other non-financial indicators, such as the characteristics of the managers and entrepreneurs – the level of academic training of the board members, the experience of the founding team, the diversity of the management, etc. However, for Sathaworawong et al. (2018), the attributes that qualify the training and experience of the managers of SUs, especially their founders, can make the difference between their success or failure. Therefore, if they could

have been obtained for the companies in the sample, the explanatory power of the model would have been increased.

Another limitation is related to the number of observations of the dependent variable pre-money valuation provided by the database during the sample period. As mentioned in the analysis of Table 4, its number is around 5% of the total number of observations of the other dependent variable value. Unfortunately, in the case of emerging markets, there are more data on the values raised by SUs during financing rounds than historical data. This may have contributed to the non-significance of the variable of investment in R&D in the sector.

Finally, to further develop this study, we suggest comparing emerging and developed countries and types of SUs – e.g. (non-)environmentally sensitive, (non-)technological. We also recommend analyzing the characteristics of entrepreneurs – such as those mentioned above – as well as using other proxies for the value of SUs – e.g. post-money valuation. In the case of emerging markets, it would be particularly interesting to investigate the attention paid by VCIs to sustainable aspects of SUs – e.g. carbon dioxide emissions, use of renewable energy, water consumption, gender parity in management, existence of governance mechanisms, etc.

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SUPPLEMENTARY MATERIAL

Supplementary material accompanies this paper.

Supplementary Data 1 – Database PRMV

Supplementary Data 2 – Stata Output VALUE

Supplementary Data 3 – Output Stata_PRMV

Supplementary Data 4 – Stata Output VALUE. Pdf

Supplementary Data 5 – Stata Scripts PRMV

Supplementary Data 6 – Stata Output VALUE.do

Supplementary material for this article can be found online at <https://doi.org/10.7910/DVN/OHISO5>

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The authors have no conflicts of interest to declare.

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