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A Comprehensive Analysis of Startup Valuation Models: Insights from Meta-Synthesis

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Abstract

In today's rapidly evolving technological landscape, the valuation of startup companies holds significant importance, given the increasing interest in startups among companies. Valuation models for startups typically fall into two categories: quantitative and qualitative methods. This study employs a qualitative research approach, utilizing meta-synthesis methodology, to identify and categorize these valuation models. Through a systematic evaluation of 162 previous research findings using Wilson's seven-step meta-synthesis process, nine main categories and 63 sub-categories were extracted from the literature. These categories were then analyzed and weighted using Shannon Entropy analysis. The findings reveal two overarching categories: quantitative valuation, encompassing cost-oriented, market-oriented, revenue-oriented, and actual methods, and qualitative valuation, comprising human capital, organizational capital, market-based assets, industrial structure, and quality techniques. This study's outcomes offer valuable insights for venture capitalists and financial managers, facilitating a deeper understanding of startup valuation and the classification of valuation models.

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1. Introduction

In today's world, startups play an important role in creating employment, wealth, and sustainable development in both developed and developing countries, and a large part of the economy and production of these countries is based on these companies. The ability to raise capital is pivotal for technology and innovation startups aiming for fast growth and large scale (Wise et al., 2022). The startups used various sources of funding to establish and develop themselves. Most of the startups used public funding programs, both locally and internationally. They also used private finances to kick off their operations. The startups used their early sales as a good financing source. They also borrowed from public and private organizations and used equity to finance (Gbadegeshin et al., 2022). Therefore, an accurate valuation of these companies is crucial to resolving the conflict between entrepreneurs and investors. This matter has led analysts to pay more attention to the startup valuation model in the last decade.

Common valuation techniques for business projects face many problems in the early stages of startup development. Valuation methods are generally divided into three main groups: valuation methods that rely on cash flows, comparable transactions, and asset analysis. The main difficulty in using these methods in evaluating startups is that these companies can provide little information about their history. This issue may be due to either a lack of accounting data (short history, i.e., the company has neither profit nor income) or a lack of market data (there is no comparable company or no direct competitor) or most of the company's assets are intangible (Rahardjo and Sugiarto, 2019).

Many investors are frustrated with investing in startups due to changes in their valuations. Despite the different valuation methods available, the general problem is that the valuation of startups is complex, leading to significant reductions in purchase or sale value of between 20 and 40 percent compared to public companies (Aydın, 2015). Thus, to reduce the challenges entrepreneurs and investors face in startup companies, providing a valuation model for such companies seems necessary. This research seeks an efficient model to address the challenges facing investors and entrepreneurs among the existing corporate valuation models. This research aims to identify and classify the valuation models of startup companies. To do this, the evaluation models of researchers and the findings of previous researchers should be considered. The meta-synthesis tool has systematically analyzed the factors affecting the content items.

The innovation of this study is focused on the classification of valuation models of startups using the meta-synthesis method. Existing corporate valuation research seeks to compensate for the lack of information needed to standardize startups with additional information about the entrepreneur and the business project. However, none of the available research has provided a comprehensive classification of startup valuation models for investors. This article presents the proposed classification by applying the meta-synthesis method, considering the quantitative and qualitative methods of investment models, and the classification of the existing evaluation model of startup companies.

In the following, after a brief definition of valuation, some company evaluation methods and models are first mentioned, and research related to research literature is reviewed. While stating the methodology and explaining the steps of meta-synthesis, the findings of each stage are also presented. Finally, the findings are discussed, and practical suggestions and research limitations are stated.

2. Theoretical foundations and literature review

2.1 Evaluation

Firm evaluation is one of the most important and key issues in the investment process. Stock valuation in the field of investment analysis in general and in particular, is a stage of fundamental analysis. Regardless of the angles in question in investing, techniques and methods are needed to

determine the firm's expected value. The challenge of valuing startups is further enhanced by the many existing and well-known valuation methods that characterize innovative investment. Despite the different valuation methods, the overall problem is valuing startups; the challenges of using the valuation method increase when making an investment decision.

The valuation of startups is useful to entrepreneurs as they can determine their exit value and control rights (as specified by the number of shares in the valuation) after every investment round. The ultimate return for venture capitalists (investors) is positively associated with the difference between exit proceeds at a liquidity event (in the event of an initial public offering or mergers and acquisitions) and the price they paid to invest in venture firms (Hidayat et al., 2022).

Rahardjo and Sugiarto (2019) believe that no standard valuation method would always work for startups. Because they have different characteristics at each stage, certain valuation methods would be more appropriate for specific startup life cycles depending on the availability of information (revenues/EBITDA, operating history, comparable firms and source of values). For early-stage startups without sufficient financial data to rely on, founders and investors have to use creative ways to substitute these inputs. At the early stage, the company's value is more related to the growth potential than the present value.

Some methods and models of corporate evaluation

2.2.1 Capital Asset Pricing Model (CAPM)

The CAPM—initially proposed by Sharpe (1964) with further contributions by Lintner (1965), Mossin (1966), and Black (1972)—states that the expected return of a given asset (r_i) is defined by the sum of a risk-free rate (r_f) and a premium ($r_m - r_f$) that is proportional to the risk (β) of this asset (Kayo et al., 2020).

This model is instrumental in determining the required rate of return on an asset and provides a theoretical basis for estimating the price of an asset using the company's expected cash flow. Therefore, the capital asset pricing model is not an independent valuation method; however, this model is used to determine the cost of capital required when deciding to invest, after which the value of a company can be assessed using the method of discounted cash flows (Elbannan, 2015). The capital asset pricing model assumes that they offset the time value of capital and any potential risks while investing in each other (Dawson, 2015).

Over the last four decades, the capital asset pricing model has been one of the most common asset valuation techniques. This model is the Foundation of many asset pricing models and has been used by most researchers to estimate return and cost of capital.

2.2.2 Discounted cash flow method

The discounted Cash Flow (DCF) Method is commonly used for startup valuation and is based on Simple discounted cash flow (DCF) formulas. DCF method can be used especially in the growth stage of startups once the revenue is generated; hence, future cash flow can be forecasted using an estimated discount rate (Rahardjo and Sugiarto, 2019). The DCF method discounts all free cash flow to all available investors at a weighted cost of capital. The value of a firm is obtained by discounting cash flows to the firm (i.e. the residual cash flows after meeting all operating expenses, reinvestment needs, and taxes, but prior to payment to either debt or equity holders) at a weighted cost of capital (WACC) (Olsen, 2019).

In practice, many researchers consider this method the most common and conceptually correct method. The discounted cash flow model is very popular in corporate financing because it involves various risks in estimating the cost of a firm's capital; this model operates independently of market shocks and considers the firm's future investment plans.

However, in the startup context, this method has flaws. First, future cash-flow estimation is complex and inaccurate, especially given the difficulty of determining the appropriate discount rate. Second, the lack of earnings (actual and reported) for most startups makes it impossible to estimate the earnings multiple. (Hidayat et al, 2022). Olsen (2019) argues that the discounted cash flow model's weakness is its inability to predict the cash flow, growth rate, and capital cost of startups. Also, this model is not able to adapt to real-world changes such as corporate liquidation or business change.

2.2.3 Asset-based valuation model

This model was first introduced by Lee (1996) and later developed by Reilly and Schweihs (1999). Asset-based valuation refers to one of the approaches used to calculate the value of a business. It values a business based on the assets it possesses. The method evaluates assets and liabilities, obtains their fair market value, and deducts the liabilities from assets. However, this method ignores growth opportunities and focuses on tangible assets, which, as mentioned above, do not represent a majority of the startups (Hidayat et al., 2022).

2.2.4 Relative valuation method

The basic idea behind using multiples is that similar assets and companies should sell for similar prices. Relative valuation uses ratios to determine the value of a company. A relative valuation is achieved by multiplying the average of a given industry ratio with a specific firm accounting number. The most commonly used relative valuation metrics are price to earnings, enterprise value (EV) to revenue and enterprise value to EBIT. Common practice is to identify a peer group of 8 to 15 peers and take the average of the multiples of the peers. Identifying a legitimate peer group requires carefully considering the similarities between the corporation you are trying to value and those in the peer group. Relative valuation in general, faces difficulties in valuing startups. First, the measures used in relative valuation can lead to negative valuations. Startups that are early in the corporate life cycle often have negative EBIT and net income, and it, therefore, does not make sense to multiply these measures with the average of a peer group. Also, startups very early in the life cycle often don’t have any revenue, which rules out the use of the enterprise value to revenue multiples. In addition to the problems with what metric to use, relative valuation also faces implications in identifying comparable companies. A logical comparison would be to form a peer group of 8 to 15 similar publicly listed startups. However, startups are usually not publicly listed, meaning such a comparison will have to be with companies within the same industry later in the corporate life cycle. These firms usually have different risk, cash flows, and growth characteristics than the young firm being valued, and therefore, such a valuation does not make sense in practice (Olsen, 2019).

In general, due to the ambiguities associated with high-tech startups, the lack of historical records, the lack of publicly available data, and fluctuations in their financing costs, such ratios and multiples are not suitable for valuing startups (Festel et al., 2013). Van de Schootbrugge and Wong (2013) argue that Using multiples to value startups usually results in a false valuation of the firm's value, which results in the founder's benefit and the investor's loss.

2.2.5 Real Options Valuation Model (ROVM)

the most common limitations of the DCF method are the difficulty in estimating future cash flow and finding an appropriate rate of return. For early-stage startups requiring initial investment, such as for R&D, DCF value would most likely be negative, discouraging the investors. The real options approach was first proposed by Stewart (1984) and based on the financial valuation framework. So, the main advantage of this model is its ability to consider the level of risk and uncertainty associated with new investments, which discounted cash flow models and asset-based methods lack. The options

will give the taker rights (not obligation) to buy (call option) or to sell (put option) the underlying assets before or at the expiration date (Rahardjo and Sugiarto, 2019).

Real options analysis allows for capturing flexibility in outcomes, which is one of the weaknesses of DFC valuation and relative valuation. This makes this valuation technique a powerful tool in cases where it is difficult to capture the expected expansion opportunities in the DFC method and where the startup has significant competitive advantages. Despite real options' ability to capture flexibility, this valuation technique has various implications. First, real options analysis is a technical task that requires careful estimation of given inputs and practitioners to make many simplifying assumptions. This suggests that practitioners employing this method need strong technical competencies. As with the other methods, real option analysis does not take into account the impact of term sheet agreements. Furthermore, the volatility estimation presents a challenge in the context of a startup. As mentioned earlier option pricing theory is built on the assumption that it is possible to create a replicating portfolio using the underlying asset and riskless lending or borrowing. This assumption may hold up in practice for frequently traded stocks, but it will most likely be violated for startups experiencing infrequent trading. Additionally, option pricing models assume the underlying inputs are known and constant. However, factors such as interest rates and volatility are not always constant. The Black and Scholes model specifically assumes that the price of an asset follows a continuous process, which is not the case for startups due to infrequent funding rounds (Olsen, 2019).

2.2.6 Venture capital model

The venture capital model is one of the investors' most widely used models to value young companies. Sahlman and Tayib (2012), a professor at Harvard University, first used this model. The venture capital model is a method risky investors use to decide to invest by evaluating startups with high growth potential. This model combines the features of a discounted cash flow model and multiplicative methods to determine the value of a startup (Aydın, 2015).

The venture capital (VC) method is comprised of six steps:

- Estimate the Investment Needed
- Forecast Startup Financials
- Determine the Timing of Exit (IPO, M&A, etc.)
- Calculate Multiple at Exit (based on comps)
- Discount to PV at the Desired Rate of Return
- Determine Valuation and Desired Ownership Stake (Shao et al., 2021).

Experts in the field usually calculate venture capital financing and value a business based on the projected returns on investment and how and when to exit (Aydın, 2015; Chavda, 2014; Festel et al., 2013). Risky investors use multi-stage financing approaches and specialized valuation tools to exploit various investment opportunities (Becsky-Nagy and Fazekas, 2015).

Researchers have worked on the phenomenon of venture capitalization valuation. Cumming and Dai (2011) studied the size of venture capital, credit, and the conditions that limit the effect of bargaining power and valuation of the investee. Their results indicate a positive correlation between the size of venture capital and the price paid per unit invested. Peter and Anyieni (2015) examined the impact of venture capital financing on the growth of SMEs[1]and how governments can use this model to accelerate the achievement of the Millennium Development Goals.

[1]. Small and medium-sized enterprises

2.3 Research questions

1) What are the determinants of identifying and classifying the valuation models of startup companies?

2) How do we prioritize the identified indicators and categories?

3. Research methodology

Meta-synthesis is a qualitative study that examines the information and findings of other qualitative studies related to the subject. As a result, the sample for meta-synthesis is selected from qualitative studies based on their relationship with the research question. Meta-synthesis is not an integrated review of the qualitative literature nor an analysis of secondary and primary data from selected studies; rather, it is an analysis of the findings of these studies. It explores new and fundamental topics and concepts by providing a systematic approach to researchers and combining different qualitative research, promoting current knowledge and creating a comprehensive view of the issues. Meta-synthesis requires the researcher to review and combine related qualitative research findings carefully. According to Sandelowski and Barroso's model (2001), the meta-synthesis method was used to achieve this research goal. This model consists of seven steps, described in the next part and the different dimensions of this research method will be explained in the form of these steps. This approach has been used in various kinds of research, including Hatami et al. (2019), Eghtesadifard et al. (2020), Karimi et al. (2021), Nazarian et al. (2021), Khavari et al. (2022) and Gupta and Chauhan (2023).

3.1 Step 1: Setting up the research questions

Various dimensions formulate the research question, such as the study community, what, when, and how the method is performed. An appropriate question in meta-synthesis can examine a particular phenomenon, its dimensions, consequences, and determinants. If the research question is too limited and rigorous, it will lead to few studies being identified and reducing the generalizability of the findings. Table 1 shows the general research questions to start the meta-synthesis method.

Table 1. General questions to start the meta-synthesis method

Parameter	Research question
Research purpose (what)	*Indicators that are effective in identifying and categorizing the valuation models of startups.*
Community (who)	*Various works, including articles, book chapters, and dissertations, have identified and categorized the valuation models of startup companies.*
Time range (when)	*All works available between 2000 and 2020*
How to do it?	*Thematic review of works, identification of key points, analysis and classification of identified concepts and categories about valuation models of startup companies*

3.2 Step 2: A systematic review of the literature

Secondary data, called past documents, was used to collect research data. These documents have included all the research in identifying and classifying the valuation models of startups. Articles and research from 2000 to 2020 have been studied for this study. In order to collect and categorize the content of the articles produced in the field of research, the Google search engine and scientific article databases were used. In order to search for research articles on keywords as described in Table 2, individually or in combination, through the National Library site and other libraries, research institutes and sites such as Science Direct, Google Scholar, Springer, Emerald, Researchgate, Mag Iran, Normags, etc. were examined, and a total of 162 studies were found.

Table 2. Searched words

Keywords English
Valuing startups
Evaluation of startup companies
Technology value pricing

Using the criteria mentioned above, a search of the introduced databases was performed, and all available studies were collected in a large file based on the relevance of their title to the keywords. The frequency of studies related to each database is specified in Table 3.

Table 3. The frequency of studies found in each database

Database	***Number of articles***
Scopus	*25*
Science Direct	*71*
ProQuest	*49*
Magiran	*17*
Total	*162*

3.3 Step 3: Search and select the right texts

At this stage, the appropriateness of the received article with the question and purpose of the research is checked. For this purpose, the articles are reviewed several times, and the researcher removes several articles from each review. These articles have not been reviewed in the meta-synthesis process. The review and selection process in this study is summarized in Figure 1.

After removing inappropriate studies for the research objectives and questions, the researcher should evaluate the quality of the research method. This step eliminates research where the researcher does not trust the findings. The most commonly used tool for assessing the quality of initial qualitative research studies is the Critical Appraisal Skills Program, which helps determine qualitative research studies' accuracy, validity, and importance by asking ten questions. These questions focus on the following: 1. Research Objectives 2. The logic of research method 3. Research Design 4. Sampling Method 5. Data Collection 6. Reflexivity (which refers to the relationship between the researcher and the participants) 7. Ethical considerations 8. Accuracy of analysis Data 9. Clear expression of findings 10. Value of research.

To use this tool, articles have been studied; each article is assigned a score between 1 and 5 in terms of having the above characteristics. Based on the 50-point scale of the Critical Appraisal Skills Program, the researcher proposes the following scoring system and categorizes the studies based on their methodological quality (Table 4). Very good (41-50), Good (31-40), Medium (21-30), Poor (11-20), Very poor (0-11). Any article with a good score (below 31) is then eliminated. In this study, the remaining 55 studies of the title, abstract, content, and research methods in the previous section were evaluated using the Critical Appraisal Skills Program. After assigning points to the characteristics of each study and deleting studies with a score less than 31, 42 studies were accepted in the evaluation process, of which 11 studies received very good points and 31 studies received good points.

After conducting four stages of review, out of 162 studies, 120 were excluded, and 42 studies were selected for data analysis. The review and selection process in this study is summarized in Fig. 1

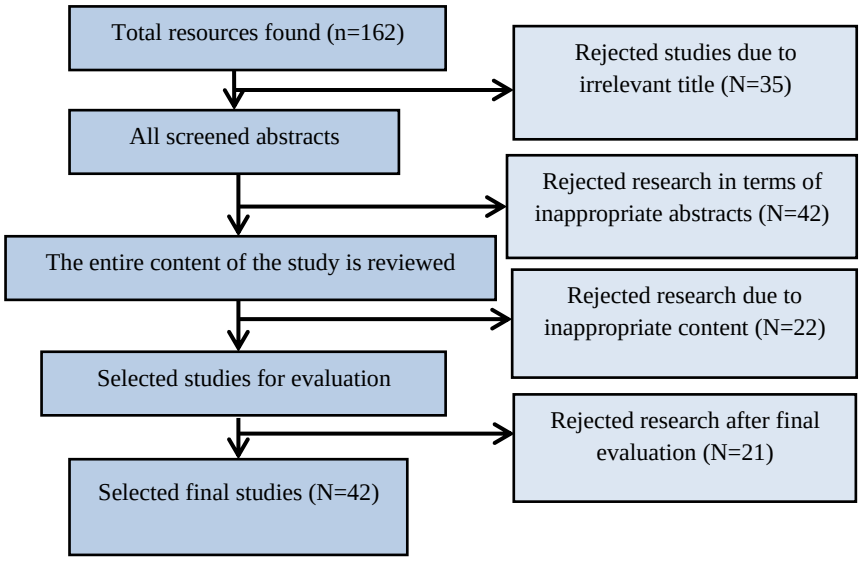

Figure 1. Review and selection process

Table 4. The outcome of the Critical Appraisal Skills Program

Total scores	*Research Methods*	*Clear expression of findings*	*Accuracy of data analysis*	*Ethical considerations*	*Reflexivity*	*Data collection*	*Sampling method*	*Research plan*	*Methodological logic*	*Research purposes*	*Criteria* / *Article*
38	*4*	*3*	*3*	*5*	*4*	*4*	*4*	*3*	*4*	*4*	*1*
39	*4*	*4*	*4*	*5*	*3*	*4*	*4*	*4*	*4*	*4*	*2*
37	*4*	*5*	*4*	*5*	*3*	*4*	*2*	*4*	*3*	*3*	*3*
40	*4*	*4*	*4*	*5*	*4*	*3*	*4*	*5*	*4*	*3*	*4*
39	*3*	*4*	*3*	*5*	*4*	*4*	*3*	*4*	*4*	*5*	*5*
44	*4*	*4*	*4*	*5*	*5*	*4*	*4*	*5*	*4*	*5*	*6*
30	*3*	*3*	*3*	*5*	*3*	*3*	*3*	*2*	*3*	*2*	*7*
32	*3*	*2*	*3*	*5*	*3*	*3*	*3*	*4*	*3*	*3*	*8*
32	*2*	*3*	*4*	*5*	*3*	*2*	*3*	*3*	*4*	*3*	*9*
37	*4*	*3*	*4*	*5*	*3*	*3*	*4*	*3*	*4*	*4*	*10*
39	*4*	*4*	*4*	*5*	*3*	*4*	*4*	*3*	*4*	*4*	*11*
33	*3*	*4*	*3*	*5*	*4*	*3*	*4*	*2*	*3*	*2*	*12*
32	*2*	*3*	*4*	*5*	*2*	*3*	*4*	*4*	*3*	*2*	*13*
39	*4*	*4*	*4*	*5*	*3*	*4*	*4*	*3*	*4*	*4*	*14*
38	*3*	*4*	*4*	*5*	*4*	*4*	*3*	*4*	*4*	*3*	*15*
39	*4*	*4*	*3*	*5*	*4*	*4*	*4*	*4*	*4*	*3*	*16*
37	*4*	*4*	*4*	*5*	*4*	*3*	*3*	*3*	*3*	*4*	*17*
41	*4*	*4*	*4*	*5*	*4*	*4*	*4*	*4*	*4*	*4*	*18*

40	4	4	4	5	4	3	4	4	4	4	19
29	2	3	2	5	3	4	3	2	3	2	20
37	3	4	4	5	3	4	4	3	4	3	21
39	4	4	4	5	3	4	4	3	4	4	22
45	4	4	**5**	5	4	4	5	4	5	5	23
39	4	4	4	5	3	4	4	3	4	4	24
39	4	3	4	5	4	4	3	4	4	4	25
34	3	3	4	5	3	4	4	3	3	2	26
39	4	4	4	5	3	4	4	3	4	4	27
41	4	4	4	5	4	4	4	3	4	**5**	28
42	4	4	4	5	4	4	4	4	4	**5**	29
39	4	4	4	5	3	4	4	3	4	4	30
43	4	4	4	5	4	4	4	4	5	5	31
42	4	4	4	5	4	4	**5**	4	4	4	32
39	4	4	4	5	3	4	4	3	4	4	33
36	3	3	4	5	3	4	3	4	4	3	34
38	3	3	4	5	4	3	4	4	4	4	35
35	3	3	3	5	4	4	4	3	3	3	36
37	4	3	4	5	4	3	3	3	4	4	37
40	3	4	4	5	4	**3**	4	4	4	5	38
42	4	4	4	5	4	4	5	4	4	4	39
40	4	4	4	5	4	3	4	5	4	3	40
39	3	4	3	5	4	4	3	4	4	5	41
44	4	4	4	5	5	4	4	5	4	5	42

3.4 Step 4: Extract article information

After identifying and selecting appropriate sources, the articles were carefully reviewed individually, information related to the research topic was extracted from them, and the articles were classified based on the identified components and codes. Table 5 shows the extraction of codes from selected articles.

Table 5. Extraction of initial codes

References	Indicators
Dusatkova & Zinecker (2016), Miloud et al (2012), Hsieh(2013)	*Replacement cost*
Rahardjo and Sugiarto (2019), Charumathi & Sudhakar (2014)- Savaneviciene et al. (2015)	*Re-ownership method*
Ahangari (2017); Rahardjo and Sugiarto (2019)	*Historical cost*
Miloud et al.(2012)- Bock et al. (2020)	*Base price*
Dusatkova & Zinecker (2016),- Doffou(2015)- Hsieh (2013)- Bock et al. (2020)	*factor analysis*
Sudarsanam et al (2003)-; Gharibi & Tabatabaiyan (2008)	*Based Stock Valuation Model with Learning*
Hsieh et al (2013)- Sudarsanam et al (2003)- Damodaran (2007)- Asta Savaneviciene et al (2015)- Gharibi & Tabatabaiyan (2008), Bock et al. (2020),	*Offer and acceptance*
Dusatkova (2016); Gharibi & Tabatabaiyan (2008); Taghavi Fard , 2019; Mousaei, et al (2010)	*Technical knowledge*

Rahgozar(2008); Hsieh (2013); Gharibi & Tabatabaiyan (2008)	*intrinsic value*
Dusatkova et al (2016) - Miloud et al (2012) - Charumathi & Sudhakar (2014)- Bock et al(2020)-	*Industry standards*
Dusatkova et al(2016)- Miloud et al (2012)- Rahardjo and Sugiarto (2019) ; Hsieh (2013); Eisenmann (2020); Gharibi & Tabatabaiyan (2008)	*Market pricing*
Bock et al. (2020)-	*Expert opinion*
Bock et al (2020)- Guo et al (2016)	*Technical evaluation*
Bock et al (2020)	*Strategic importance*
Dubiansky (2005); Ashrafitabar & Hanafizadeh (2019)	*Market position*
Damodaran (2007); Gharibi & Tabatabaiyan (2008)	*Cash flow*
Bock et al(2020)	*Cost cutting*
Olsen (2019)- Savaneviciene et al (2015); Mousaei (2010)	*Cash flow discounted*
Dusatkova et al (2016)- Bock et al (2020)-	*Venture capital*
Dusatkova et al (2016)- Miloud et al (2012)- Rahardjo and Sugiarto (2019)- Hsieh (2013)- Sudarsanam et al (2003)- - Bock et al. (2020)-Dehghani Eshrat Abad(2020)	*Future profitability*
Bock et al. (2020)- Ashrafitabar & Hanafizadeh (2019)	*First Chicago Method*
Bock et al. (2020)- - Dehghani Eshrat Abad, (2019-2020)	*Gross earnings*
Dubiansky (2005)-	*Tax components*
Ahangari (2017); Taghavifard (2019), Bock et al (2020),	*Gordon model*
Dusatkova et al (2016)- Miloud et al (2012)- Rahardjo and Sugiarto (2019)- Hsieh (2013)- Sudarsanam et al (2003)- - Bock et al (2020)- Paulsen (2016) - Dehghani Eshrat Abad, (2019-2020)	*a financial and economic evaluation*
Ahangari, (2017); Gharibi & Tabatabaiyan (2008), Bock et al (2020);	*Black Scholes*
Olsen (2019); Savaneviciene et al (2015);	*The success rate in laboratory steps*
Dusatkova et al (2016) - Miloud et al (2012) - Doffou(2015) - Hsieh (2013) - Bock et al (2020)	*decision tree algorithm*
Dusatkova et al (2016)- Rahardjo and Sugiarto (2019)- Charumathi et ai (2014); Bock et ai (2020);	*Risk assessment*
Dubiansky (2005)- Charumathi & Sudhakar (2014) - Bock et ai (2020)	*Stochastic Differential Equation*
Olsen (2019)- Dubiansky(2005); Gharibi & Tabatabaiyan (2008), Bock et al (2020)-	*Monte-Carlo*
Olsen (2019) - Dubiansky(2005) Gharibi & Tabatabaiyan (2008- Bock et al. (2020) -	*Intangible Business*
Olsen (2019)- Dubiansky(2005) Gharibi & Tabatabaiyan (2008) - Bock et al. (2020)	*Valuation based on the concept of real option*
Olsen (2019)- Dubiansky(2005) Gharibi & Tabatabaiyan (2008), Bock et al (2020)-	*Valuation based on the concept of financial option*
Bock et al. (2020); Taghavi Fard et al.(2009);	*Staff training hours*
Bock et al. (2020)-	*Costs of entrepreneurs*
Bock et al. (2020)-	*Number of entrepreneurs*
Damodaran (2007) - Eisenmann (2020). - de Oliveira et al (2018) – Savaneviciene et al (2015) - Bock et al (2020) -	*The average level of education of entrepreneurs*
Olsen (2019)- Dubiansky(2005), Gharibi & Tabatabaiyan (2008); Bock et al (2020)-	*The average number of years of entrepreneurial experience*
Bock et al. (2020)-	*Total working hours of entrepreneurs*
Gharibi & Tabatabaiyan (2008), Olsen (2019)	*Investment in research and development(R&D)*
Dusatkova et al (2016) Bock et al (2020) Gharibi & Tabatabaiyan (2008)	*The ratio of R&D expenditures to total costs*
Bock et al. (2020)-	*The ratio of R&D expenditures to total sales*
Bock et al. (2020)-	*Total salaries and bonuses of managers and administrative and sales expenses*

Bock et al. (2020)	*Advertising expenses*
Srinivasan et al (2009) - Bock et al. (2020)	*Distribution and sales expenses*
Dusatkova et al (2016)- Miloud et al (2012)- Doffou(2015)- Hsieh(2013)- Sudarsanam et al (2003)- Damodaran (2009)- Eisenmann(2020)- Dubiansky(2005), Savaneviciene et al (2015)- Bock et al(2020)-	*Relative market share*
Dubiansky(2005)- Gharibi & Tabatabaiyan (2008); Bock et al (2020)-	*Brand reputation*
Bock et al (2020)	*brand Cash flow or profit*
Damodaran (2007)- de Oliveira et al (2018) Gharibi & Tabatabaiyan (2008);	*Brand royalty rates*
Dehghani Eshratabad, et al (2020) Bock et al. (2020)	*Total brand value*
Dusatkova et al (2016)- Guo et al (2016)	*Strong evidence from customers to buy the product*
Miloud et al. (2012) Bock et al. (2020)-	*Customer experience*
Puska et al (2018); Miloud et al (2012) Taghavifard (2019)	*Market/industry characteristics*
Chan et al. (2012)	*Distinctive product or service*
Chan et al (2012)- Hsieh(2013) Gharibi & Tabatabaiyan (2008)	*Industry growth rate*
Miloud et al (2012); Chan et al (2012))	*Structural diversity of industry*
Miloud et al (2012); Chan et al (2012)	*industry Competitive advantage*
Janabi & Dehmarde Qala No (2019); Dusatkova et al (2016) ;Doffou(2015)	*Delphi*
Doffou(2015); Rahgozar (2008)- Savaneviciene et al (2015) – ; Miloud et al (2012), Gharibi & Tabatabaiyan (2008)	*Brainstorm*
Miloud et al. (2012)	*Econometrics*
Miloud et al. (2012)	*Use the opinions of experts.*
Zheng et al (2010); Srinivasan et al (2009); Miloud et al (2012)	*royalty free*

3.5 Step 5: Analysis of qualitative findings

During the analysis, the researcher looks for topics that have emerged among the studies in meta-synthesis. This is known as a case study. Once the subjects have been identified, the examiner forms a classification and places similar and related classifications on the subject that best describes it. Topics provide the basis for creating explanations, patterns, and theories or hypotheses.

All factors extracted from articles were considered Indicators in this study. Then, considering the meaning of each of them, the Indicators were defined in a similar concept, and similar concepts were categorized in the codes to identify the dimensions explaining the classification of valuation models of startups in the main components of the research. In table 6, the indicators, dimensions and related codes of qualitative analysis are presented:

Table 6. Extraction of indicators, dimensions and related codes

Indicators	***Code***	***Dimensions***
Replacement cost	*Cost-based*	*Valuation of intangible assets (qualitative)*
Re-ownership method		
Office expenses		
base price		
Multi-criteria comparison	*Market-based*	
Based Stock Valuation Modelwith Learning		
offer and acceptance		
Technical knowledge		

intrinsic value		
Industry standards		
Market pricing		
Expert opinion		
Technical evaluation		
Strategic importance		
Market position		
Cash flow	*Income-based*	
cost cutting		
Cash flow discount		
Venture capital		
Future profitability		
First Chicago Method		
Gross earnings		
Tax components		
Gordon model		
A financial and economic evaluation		
Black Scholes	*The real option method*	
The success rate in laboratory steps		
decision tree algorithm		
Risk assessment		
Stochastic Differential Equation		
Monte-Carlo		
Intangible Business		
Valuation based on the concept of real authority		
Valuation based on the concept of financial authority		
Staff training hours	*Human capital*	*Valuation of intangible assets (qualitative)*
Costs of entrepreneurs		
Number of entrepreneurs		
The average level of education of entrepreneurs		
The average number of years of entrepreneurial experience		
Total working hours of entrepreneurs		
Investment in research and development	*Organizational capital*	
The ratio of R&D expenditures to total costs		
The ratio of R&D expenditures to total sales		
Total salaries and bonuses of managers, administrative expenses, and sales		
Advertising expenses	*Market-based assets*	
Distribution and sales costs		
Relative market share		
Brand reputation		
Cash flow or brand profit		
Brand royalty rates		
Total brand value		
Strong evidence from customers to buy the product		
Customer experience		
Market/industry characteristics	*Industrial structure*	
Distinctive product or service		
Industry growth rate		
Structural diversity of industry		
Competitive advantage in the industry		
Delphi	*Qualitative techniques*	
Brainstorm		
Econometrics		
Use the opinions of experts		
royalty free		

3.6 Step 6: Quality control and content analysis

The reliability and validity of the measurement tool need to be tested for quality control. The method of agreement between the evaluators is used to evaluate the reliability of the selected articles. In this way, another researcher examines these articles. If these two evaluators' opinions are close to each other, it indicates reliability.

In this study, this evaluation was performed on extractive codes. The coding status of the first and second researchers is shown in Table 7, and the analysis results obtained from SPSS statistical software are shown in Table 8. As can be seen, the obtained significant number for the kappa index is less than 0.05, so the assumption of the independence of the extracted codes is rejected, and the dependence of the extracted codes on each other is confirmed, so it can be claimed that the tools used to extract the codes were sufficiently reliable.

Table 7. The interaction of the first and second evaluators

The sum of the first evaluator	*The second evaluator comment*			
	Yes	*No*		
39	*38*	*1*	*yes*	*The first evaluator*
3	*3*	*0*	*No*	*Comment*
42	*41*	*1*		*42*

Table 8. Quality control

	Amount	**Meaningful number**
Kappa amount of agreement	*0.740*	*0.001*
Number of cases	*42.000*	

In addition to Kappa Cohen, three quantitative criteria of the Holst coefficient, P-Scott coefficient, Kappa Cohen index, and Kerpindroff alpha have been used to evaluate the validity, verifiability, and reliability. Table 9 shows the results of these indicators:

Table 9. Results of quality control indicators

Quality control indicators	**Holstein coefficient**	**P-Scott coefficient**	**Kappa Cohen Index**	**Kerpindoroff Alpha**
Value	0.766	0.810	0.770	0.840
Number			42	

As shown in Table 9, the value of these coefficients is more than 0.7 and indicates the reliability of the extracted code.

In this study, Lavashe's content validity ratio (CVR) index was used to evaluate the validity and reliability of the extracted codes. Lavache designed this index. So, 63 factors identified in the previous steps were given to 16 experts as a checklist, whose characteristics are described in Table 10.

Table10. Characteristics of experts

Characteristics of experts	**Number**
University professors	8
Certified Public Accountant (CPA)	3
Financial managers and managers of audit institutions	5
Total	16

The opinions of experts in the field of test content are used to calculate this index. By explaining the test objectives to them and providing operational definitions of the content of the questions, they are asked to rate each question based on the Likert scale: "Item is necessary," "Item is useful but not necessary" and "item is not necessary." Then, according to the following formula, the content validity ratio is calculated:

$$CVR = \frac{Number\ of\ specialists\ who\ have\ selected\ the\ necessary\ option - \frac{Total\ number\ of\ specialists}{2}}{\frac{Total\ number\ of\ specialists}{2}}$$

Based on the number of experts who evaluated the questions, the minimum CVR is acceptable, 0.62 for ten experts. In this study, the CVR based on ten experts (university professors) was 0.84, more than 0.62; therefore, the content validity is confirmed.

4. Report and study findings

At this stage of the meta-synthesis method, the findings of the previous steps are presented. At this stage, using the Shannon entropy method, the level of support of previous research from the findings of this research is shown statistically. According to Shannon's entropy method, data processing is presented based on content analysis with a new perspective, both quantitatively and qualitatively. Entropy in information theory is an indicator for measuring uncertainty expressed by a probability distribution. Based on this method, the content of the design will be analyzed. After identifying the research indicators based on content analysis and determining the units of analysis (words and themes), the Shannon entropy method will be used to analyze the data as follows:

The frequency of each identified code should be determined based on content analysis. In the next step, the desired frequency matrix must be normalized. For this purpose, the linear normalization method is used:

$$n_{ij} = \frac{x_{ij}}{\sum x_{ij}}$$

The entropy E_j is then calculated as follows:

$$E_j = -k \sum \left[n_{ij} LN(n_{ij}) \right]$$

K is calculated as a fixed value as follows, which holds the value of E_j between zero and one:

The following equation is used for this purpose:

$$k = \frac{1}{Ln(a)};\ \mathrm{a} = \mathrm{Number\ of\ options}$$

The significance coefficient of each category must be calculated. Each category has a higher information load, increasing Wj's importance. The following equation is used for this purpose:

$$W_j = \frac{E_j}{\sum E_j}$$

Therefore, in the first step, the decision matrix is formed. The scores obtained from the decision matrix around the issue are presented in Table 9:

Table 11. Determining the importance and emphasis of past research on identifying and classifying startup valuation models

Indicators	Frequency	Unreliability E_j	Significance factor W_j	Rank
Replacement cost	9	0.020	0.021	5
Re-ownership method	10	0.021	0.022	4
Historical cost	6	0.014	0.015	8
Base price	3	0.008	0.009	11
factor analysis	6	0.014	0.015	8

Based on the Stock Valuation Model with Learning	4	0.010	0.011	10
offer and acceptance	5	0.012	0.013	
Technical knowledge	10	0.021	0.022	4
intrinsic value	14	0.027	0.028	1
Industry standards	11	0.023	0.024	3
Market pricing	11	0.023	0.024	3
Expert opinion	9	0.020	0.021	5
Technical evaluation	12	0.024	0.025	2
Strategic importance	5	0.012	0.013	9
Market position	8	0.018	0.019	6
Cash flow	6	0.014	0.015	8
Cost cutting	8	0.018	0.019	6
Cash flow discounted	2	0.006	0.006	12
Venture capital	6	0.014	0.015	8
Future profitability	2	0.006	0.006	12
First Chicago Method	2	0.006	0.006	12
Gross earnings	6	0.014	0.015	8
Tax components	3	0.008	0.009	11
Gordon model	5	0.012	0.013	9
a financial and economic evaluation	2	0.006	0.006	12
Black Scholes	1	0.003	0.003	13
The success rate in laboratory steps	2	0.006	0.006	12
decision tree algorithm	2	0.006	0.006	12
Risk assessment	6	0.014	0.015	8
Stochastic Differential Equation	6	0.014	0.015	8
Monte-Carlo	7	0.016	0.017	7
Intangible Business	3	0.008	0.009	11
Valuation based on the concept of real option	1	0.003	0.003	13
Valuation based on the concept of financial option	4	0.001	0.011	11
Staff training hours	7	0.016	0.017	7
Costs of entrepreneurs	3	0.008	0.009	11
Number of entrepreneurs	8	0.018	0.019	6
The average level of education of entrepreneurs	5	0.012	0.013	9
The average number of years of entrepreneurial experience	3	0.008	0.009	11
Total working hours of entrepreneurs	3	0.008	0.009	11
Investment in research and development(R&D)	2	0.006	0.006	12
The ratio of R&D expenditures to total costs	3	0.008	0.009	11
The ratio of R&D expenditures to total sales	2	0.006	0.006	12
Total salaries and bonuses of managers and administrative and sales expenses	2	0.006	0.006	12
Advertising expenses	1	0.003	0.003	13
Distribution and sales expenses	5	0.012	0.013	9
Relative market share	8	0.018	0.019	6
Brand reputation	7	0.016	0.017	7
brand Cash flow or profit	5	0.012	0.013	9
Brand royalty rates	5	0.012	0.013	9
Total brand value	5	0.012	0.013	9
Strong evidence from customers to buy the product	6	0.014	0.015	8
Customer experience	1	0.003	0.003	13
Market/industry characteristics	6	0.014	0.015	8

Distinctive product or service	5	0.012	0.013	9
Industry growth rate	8	0.018	0.019	6
Structural diversity of industry	4	0.010	0.011	10
industry Competitive advantage	1	0.003	0.003	13
Delphi	3	0.008	0.009	11
Brainstorm	1	0.003	0.003	13
Econometrics	4	0.010	0.011	10
Use the opinions of experts	2	0.006	0.006	12
royalty free	1	0.003	0.003	13

5. Discussion and conclusion

Determining the value of startups is controversial due to the lack of historical data and many uncertain factors about the company's future (Festel et al., 2013). Therefore, identifying appropriate valuation methods for valuing startups is crucial to address the investment challenges in startups.

This study aims to apply the meta-synthesis approach to review, identify, and categorize the valuation models of startups. So, based on the research findings, nine codes and 63 indicators were extracted from the texts of previous articles using the meta Synthesis qualitative analysis method. In order to analyze the content quantitatively and qualitatively, after identifying the research indicators based on the content analysis and determining the units of analysis (words and themes), Shannon entropy analysis was examined and weighted for data analysis.

In this way, The basis for classifying the valuation models of startup companies (startups) was extracted as main categories (codes). The main categories (codes) extracted are quantitative valuation, including cost-oriented, market-oriented, revenue-oriented, and real options methods; qualitative valuations include human capital, organizational capital, market-based assets, industrial structure, and quality techniques.

The contribution of this study is the focus on categorizing the valuation models of startups using the meta-synthesis method. Studying, reviewing, and classifying the valuation models of startup companies is a new step for the growth and development of these companies.

Identifying and classifying valuation models of startup companies and adding knowledge in this field helps entrepreneurs better understand their business valuation models and facilitate the ability to create, develop, transform, and measure business. In other words, startup partners can increase the value of their company and achieve more success and profitability by recognizing and emphasizing the value-enhancing factors.

Given the importance of startup valuation, this study provides new information about the classification of valuation methods used in the valuation of startup companies. In addition, banking, investment, and small private companies are advised to provide a valuation model in accordance with the existing conditions to reduce risky investments and achieve a specific standard in these companies because the valuation model is rarely used in these companies, and achieving a corporate valuation model minimizes the investment challenges in this category of companies.

With all its advantages, qualitative research has weaknesses, such as generalizability and credibility. Therefore, the generalization of results should be done with caution. Also, a small number of articles and studies in the relevant field is one of the limitations of the present study. The existence of large volumes of unstructured data that require much time to analyze is another limitation of the present study.

Resources

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