Identifying and categorizing the valuation models of start-ups using the Meta Synthesis method

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Abstract

Today, due to the rapid growth of technology in the world and the tendency of companies towards startup companies, the evaluation issue is of special importance. In valuing startup companies, classifying valuation models into quantitative and qualitative methods is used, so the present study aims to identify and classify the valuation models of start-up companies using the meta Synthesis method. In this research, with a qualitative research approach and meta synthesis tools, which includes Wilson's seven steps, 162 of the findings of previous researches have been systematically evaluated and analyzed. In this regard, nine main categories and 63 sub-categories (code) were extracted from the texts of previous articles using meta synthesis qualitative analysis method and examined and weighted using Shannon Entropy analysis. As a result, an explanation of the classification of start-up value models in start-ups was extracted. According to findings the main categories extracted are: Quantitative valuation includes cost-oriented, market-oriented, revenue-oriented, and actual methods, and qualitative valuation include human capital, organizational capital, market-based assets, industrial structure, and quality techniques. The results of this study will greatly help better understand the valuation of start-ups from the perspective of venture capitalists and financial managers of companies to identify and categorize the valuation models of start-ups.

Keywords: Meta synthesis qualitative approach, Valuation, Start-up companies, Technological dimension.

1. Introduction

In today's world, start-ups 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 (Wis 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 (Gbadegeshi et al, 2022). Therfore accurate valuation of these companies is crucial to resolving the conflict between the entrepreneurs and investors. This matter has led analysts to pay more attention to the start-up valuation model in the last decade.

In the early stages of start-up development, common valuation techniques for business projects face many problems. 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 start-ups 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 start-ups due to changes in their valuations. Despite the different valuation methods available, the general problem is that the valuation of start-ups 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 faced by entrepreneurs and investors in start-up companies, it seems necessary to provide a valuation model for such companies. This research seeks to find an efficient model to address the challenges facing investors and entrepreneurs among the existing corporate valuation models. The goal of this research is to identify and classify the valuation models of start-up 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 focus on the classification of valuation models of start-ups using the meta synthesis method. Existing corporate valuation research seeks to compensate for the lack of information needed

to standardize start-ups with additional information about the entrepreneur and the business project. However, none of the available research has provided a comprehensive classification of start-up valuation models for investors. In this article, the proposed classification by applying the meta-synthesis method, considering the quantitative and qualitative methods of investment models, presents the classification of the existing evaluation model of start-up companies.

In the following, after a brief definition of valuation, first, some methods and models of company evaluation are mentioned, and researches related to research literature are reviewed, and 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

One of the most important and key issues in the investment process is firm evaluation. 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 expected value. The challenge of valuing start-ups 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) believes that there is no standard valuation method that would work all the time for startups. Beacause they have different characteristics in each stage. Certain valuation method would be more appropriate for specific startup life cycle 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, both founders and investors have to use creative ways in substituting these inputs. At the early stage, the value of

the company is more related to the growth potential as opposed to the present value.

2.2. 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 especially useful 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

Discounted Cash Flow (DCF) Method commonly used for startup valuation and 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 the future cash flow can be forecasted, then 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) (Rohde Olsen, 2019).

In practice, many researchers consider this method to be the most common and most conceptually correct method. The discounted cash flow model is very popular in the 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 a majority of startups makes it impossible to estimate the earnings multiple. (Hidayat et al, 2022). Rohde Olsen (2019) argue that the weakness of the discounted cash flow model includes its inability to predict cash flow, growth rate, and capital cost of start-ups. 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 & 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, does 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 accounting number of the firm. Some of 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 that you are trying to value and the companies 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 who 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 the process of identifying comparable companies. A logical comparison would be to form a peer group of 8 to 15 similar publicly listed startups. However, usually startups are not publicly listed meaning that such a comparison will have to be with companies within the same industry that are at a later stage 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 (Rohde Olsen, 2019).

In general, due to the ambiguities associated with high-tech start-ups, 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 start-ups (Festel, Wuermseher and Cattaneo, 2013). Schootbrugge and Wong (2013) argue that Using multiples to value start-ups usually results in a false valuation of the firm's value, which results in the benefit of the founder and the loss of the investor.

2.2.5. Real Options Valuation Model (ROVM)

the most common limitations of DCF method are the difficulty in estimating future cash flow and finding appropriate rate of return. For early-stage startups that requires initial investment such as for R&D, DCF value would be most likely to be a negative one which would discourage the investors. The real options approach first proposed by Myers (1987) 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 that 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 expire 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 DFC method and where the startup has significant competitive advantages over the competition. Despite real options ability to capture flexibility, this valuation technique has various implications. First of all, real options analysis is a technical task, which requires careful estimation of given inputs and requires practitioners to make many simplifying assumptions. This suggests that strong and technical competencies are in fact needed for practitioners employing this method. As with the other methods, real option analysis does not take into account the impact of term sheet agreements. Furthermore, the estimation of volatility 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 for startups experiencing infrequent trading it will most likely will be violated. Additionally, option pricing models assume that the underlying inputs are known and constant. However, factors such as interest rate 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 (Rohde Olsen, 2019).

2.2.4. Venture capital model

The venture capital model is one of the investors' most widely used models to value young companies. This model was first used by Sahlman (1990) a professor at Harvard University. Venture capital model is a method used by risky investors to decide to invest by evaluating start-ups that have high growth potential. This model combines the features of a discounted cash flow model and multiplicative methods to determine the value of a start-up (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).

Venture capital financing is usually calculated by experts in the field and they value a business based on the projected returns on investment and on how and when to exit (Aydın, 2015; Chavda, 2014; Festel, Wuermseher and Cattaneo, 2013). Risky investors use multi-stage financing approaches using specialized valuation tools to take advantage of 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.

3- Research questions

1) What are determinants of identifying and classifying the valuation models of start-up companies?

2) How to prioritize the identified indicators and categories?

4. Research methodology

[1]. Small and medium-sized enterprises

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 is it an analysis of secondary data and primary data from selected studies, but rather 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 researches, and in this way promotes current knowledge and creates a comprehensive view of the issues. Meta-synthesis requires the researcher to review and combine the findings of related qualitative research carefully. To achieve this research goal, the meta- synthesis method according to Wilson's model (2001) was used. This model consists of seven steps which will be described in the next part and the different dimensions of the method of this research will be explained in the form of these steps. This approach has been used in various researches, including, Hatami, et al (2019), Eghtesadifard, et al (2020), Karimi, et al (2021), nazarian, et al (2021), Khavari, et al (2022) and Gupta & Chauhan (2023).

4.1. Step 1: Setting up the research questions

Various dimensions are used to formulate the research question, such as the community being studied, what, when, and how the method is performed. An appropriate question in meta- synthesis can examine a particular phenomenon, its dimensions, consequences, and it's 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 start-ups.
Community (who)	Various works, including articles, book chapters, dissertations that have identified and categorized the valuation models of start-up 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 start-up companies

4.2. Step 2: A systematic review of the literature

To collect research data, secondary data called past documents had been used. These documents have included all the research in identifying and classifying the valuation models of start-ups. For this study, articles and researches conducted from 2000 to 2020 have been studied. In order to collect and categorize the content of the articles produced in the field of research, it was referred to the Google search engine and databases of scientific articles. 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 start-ups
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. Frequency of studies found in each database

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

4.3. 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 in each review, and these articles are not 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 aims to eliminate 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 that is below a good score (below 31) is then elinimated. 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, finally, 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

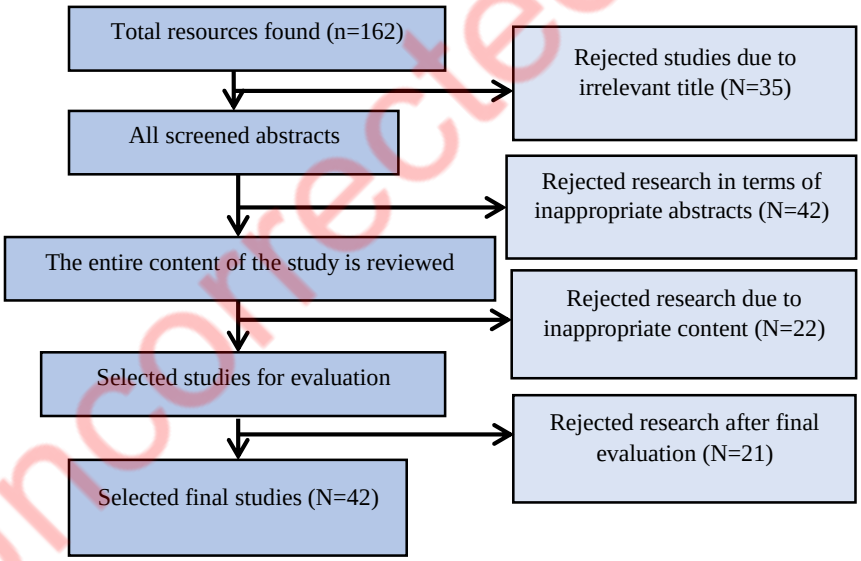

Figure 1. Review and selection process

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	٥	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	٥	28
42	4	4	4	5	4	4	4	4	4	٥	29

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
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	٥	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	٣	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

4.4. Step 4: Extract article information

After identifying and selecting appropriate sources, the articles were carefully reviewed individually, and 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 et al (2016), Miloud et al (2012), Heyes et al (2018), Hsieh(2013)	Replacement cost
Rahardjo et al. (2019), Charumathi et al (2014)- Savaneviciene et al (2015)	Re-ownership method
Ahangari (2017); Gharibi (2007); Rahardjo et al (2019)	Historical cost
Miloud et al.(2014)- Carolin Bock et al. (2020) - Shariatpanahi et al. (2020) - Guo et al. 2017	Base price
Dusatkova et al (2016)- Doffou(2015)- Chih-Hung Hsieh (2013)- Bock et al (2020)	factor analysis

References	Indicators
Heyes et al. (2018)- Sorwar (2003)- Jacoby et al (2018) ; Gharibi & Tabatabaiyan (2007)	Based Stock Valuation Model with Learning
Chih-Hung Hsieh et al (2013)- Sorwar et al(2003)- Aswath Damodaran(2009)- Asta Savaneviciene et al (2015)- Bock et al(2020); Gharibi(2007)	offer and acceptance
Dusatkova (2016); Gharibi, Islami Bidgoli, 2009; Taghavi Fard , 2019; Ahmad Mousaei, 2010; Shariatpanahi et al. (2020); Štefan Slávik (2019)- Douglas Paulsen part (2016)	Technical knowledge
Rahgozar(2006); Chih-Hung Hsieh (2012); Gharibi (2007); Nabizadeh et al (2018)	intrinsic value
Dusatkova et al (2016) - Miloud et al(2012) - Charumathi1 et al (2015)- Bock et al(2020)- Shariatpanahi et al (2020)	Industry standards
Dusatkova et al(2016)- Miloud et al (2014)- Rahardjo et al (2019) ; Chih-Hung Hsieh (2013); Eisenmann (2020); Slávik(2019); Gharibi,(2007)	Market pricing
Heyes et al. (2018)- Bock et al. (2020)- Shariatpanahi et al. (2020)	Expert opinion
Lisbon (2016)- Oliveira et al (2018)- Bock et al (2020)- Guo(2017); Gharibi(2018)	Technical evaluation
Bock et al (2020)- Shariatpanahi et al(2020); Pahle et al (2021)	Strategic importance
Dubiansky (2005); Ashrafi Tabar et al (2019) Gharibi & Ahangari, 2017	Market position
Damodaran (2009); Gharibi(2007)	Cash flow
Gharibi & Ahangari(2017); Bock et al(2020) et al (2020)- Shariatpanahi et al (2020)- Slávik (2019) - Paulsen Part (2016)- Guo et al (2012)- Dhochak1 et al (2019)	Cost cutting
Rohde Olsen (2019)- Savaneviciene et al (2015); Islami Bidgoli; Mousaei (2010)	Cash flow discounted
Dusatkova et al (2016)- Bock et al (2020)- Shariatpanahi et al(2020)	Venture capital
Dusatkova et al (2016)- Miloud et al (2014)- Rahardjo et al (2019)- Chih-Hung Hsieh (2013)- Sorwar et al(2003)- Bock et al (2020)- Shariatpanahi et al (2020)- Paulsen part (2016)- Dhochak1 et al (2019); Dehghani Eshrat Abad, (2019-2020)	Future profitability
Bock et al. (2020)- Shariatpanahi et al. (2020) - Ashrafi Tabar et al. (2019)-	First Chicago Method

References	Indicators
Bock et al. (2020)- Shariatpanahi et al. (2020)- Dehghani Eshrat Abad, (2019-2020)	Gross earnings
Lisbon (2016)- Reinfeld (2018)- Dubiansky (2003)-	Tax components
Ahangari (2017); Taghavifard (2019), Bocket et al (2021), Shariatpanahi et al (2020), Slávik (2019), Guo et al (2017)- Pahle et al (2021)	Gordon modelc
Dusatkova et al (2016)- Miloud et al (2014)- Rahardjo et al (2019)- Chih-Hung Hsieh (2013)- Sorwar et al (2003)- Bock et al (2020)- Shariatpanahi et al (2020)- Paulsen (2016) - Dhochak1 et al (2019) – Dehghani Eshrat Abad, (2019-2020)	financial and economic evaluation
Ahangari, (2017); Gharibi, 2007; Bock et al (2019); Shariatpanahi et al (2020)- Slávik (2019); Paulsen part (2016) ; Guo et al (2017)- Dhochak et al (2019)-	Black Scholes
Rohde Olsen (2019); Savaneviciene et al (2015); Islami Bidgoli, (2009); Shariatpanahi et al (2020)	The success rate in laboratory steps
Dusatkova et al (2016) - Miloud et al (2014) - Doffou(2015) - Heyes et al (2017) - Chih-Hung Hsieh (2013) - Bock et al (2020)	decision tree algorithm
Dusatkova et al (2016)- Rahardjo et al (2019)- Charumathi et ai (2014); Gharibi & Ahangari, (2017); Bock et ai (2020); Shariatpanahi et al (2020)	Risk assessment
Dubiansky (2003)- Charumathi et al (2014) - Bock et ai (2020)	Stochastic Differential Equation
Rohde Olsen (2019)- Dubiansky(2003); Gharibi & Ahangari,(2017); Gharibi et al, (2007); Rad, 2015; Bock et al (2019)- Shariatpanahi et al (2020); Pahle et al. 1400; Dhochak et al (2019)	Monte-Carlo
Rohde Olsen (2019) - Dubiansky (2003) Gharibi & Ahangari (2017); Gharibi et al.(2007); Rad (2005); 2015- Bock et al. (2019) - Shariatpanahi et al. (2020)-	Intangible Business
Rohde Olsen (2019)- Dubiansky (2003) Rad, 2005;); Gharibi et al 2007); (- Bock et al. (2020); Shariatpanahi et al. (2020)	Valuation based on the concept of real option
Rohde Olsen (2019)- Dubiansky (2003) Gharibi & Ahangari (2017); Gharibi et al. 2007; Rad (2005); Pahle et al (2021); Bock et al (2020)- Shariatpanahi et al (2020)	Valuation based on the concept of financial option
Bock et al. (2019); Taghavi Fard et al.(2009);	Staff training hours

References	Indicators
Islami Bidgoli,(2009); -Paulsen part (2016)- Bock et al. (2020) Shariatpanahi et al. (2020)	Costs of entrepreneurs
Bock et al. (2020)- Shariatpanahi et al. (2020)	Number of entrepreneurs
Damodaran (2009) - Eisenmann (2020). - Batista de Oliveira et al (2018) - Savaneviciene (2018) - Bock et al (2020) - Shariatpanahi et al (2020) - Paulsen part (2016)	The average level of education of entrepreneurs
Olsen (2019)- Dubiansky(2003)-Gharibi & Ahangari (2017); Gharibi et al. 2007; Rad, 2006; Bock et al (2020)- Shariatpanahi et al (2020); Pahle (2021), Dhochak et al. (2019)	The average number of years of entrepreneurial experience
Bock et al. (2020)- Shariatpanahi et al. (2020)	Total working hours of entrepreneurs
Gharibi (2007); Olsen (2019)	Investment in research and development(R&D)
Bock et al (2020) Dusatkova et al (2016) Gharibi (2007)	The ratio of R&D expenditures to total costs
Bock et al. (2020)- Shariatpanahi et al. (2020)	The ratio of R&D expenditures to total sales
Bock et al (2020)- Shariatpanahi et al(2020) - Guo et al (2017) Pahle et al. (2021)	Total salaries and bonuses of managers and administrative and sales expenses
Bock et al. (2020)- Shariatpanahi 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)- Chih-Hung Hsieh(2013)- Sorwar (2003)- Damodaran(2009)-Lisbon(2016)- Eisenmann(2020)- Dubiansky(2003)- Savaneviciene et al (2015)- Bock et al(2020)- Shariatpanahi et ai (2020)- Paulsen part (2016); Pahle et al. (2021)	Relative market share
Jacoby et al.- Reinfeld (2018)- Dubiansky(2003)- Gharibi(2007); Bock et al (2020)- Shariatpanahi et al (2020) Pahle et al. (2021)	Brand reputation
Islami Bidgoli et al. (2009) -Bock et al (2020) Dhochak et al (2019)-- Slavik (2019)	brand Cash flow or profit
Damodaran (2009)- Batista de Oliveira et al (2018) Gharibi (2007); Aghaei (2004)	Brand royalty rates

References	Indicators
Dehghani Eshratabad, 2020 Nabizadeh et al (2018); Bock et al. (2020)	Total brand value
Dusatkova et al (2016)- Shariatpanahi et al (2020)- Paulsen part (2016)- Guo et al (2017)	Strong evidence from customers to buy the product
Miloud et al. (2012) rad, (2006); Aghaei,(2004 & 2007) Bock et al. (2020)-	Customer experience
Puska et al (2018); Miloud et al (2012) Taghavifard (2019)	Market / industry characteristics
Nabizadeh et al (2018); Cheng et al (2018)	Distinctive product or service
Nabizadeh et al (2018)- Cheng et al (2018)- Chih-HungHsieh(2013) Gharibi (2007)	Industry growth rate
Miloud et al (2012); Cheng et al (2018)	Structural diversity of industry
Miloud et al (2012); Cheng et al (2018)	industry Competitive advantage
Jenabi et al (2019); Dusatkova et al (2016) ;Doffou(2015)	Delphi
Doffou(2015); Rahgozar (2005)- Savaneviciene et al (2015) – Gharibi(2007) ; Miloud et al (2012)	Brainstorm
Slavik (2019) -C39- Miloud et al (2012) Rad (2015)	Econometrics
Paulsen part(2016)- Shariatpanahi et al. (2020); Miloud et al (2012)	Use the opinions of experts
Zheng et al (2010); Srinivasan et al (2009); Miloud et al (2012)	royalty free

5.4. 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 start-ups 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		

Indicators	Code	Dimensions
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		

Indicators	Code	Dimensions
Delphi	Qualitative techniques	
Brainstorm		
Econometrics		
Use the opinions of experts		
royalty free		

6.4. 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 the opinion of these two evaluators is 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 results of the analysis 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 evaluator

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

Table 8. Analysis quality control

	Amount	Meaningful number
Kappa amount of agreement	0.74	0.001
Number of cases	42	

In addition to Kappa Cohen, three quantitative criteria of 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	0.81	0.77	0.84
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, to evaluate the validity and reliability of the extracted codes, the content validity ratio (CVR) index of Lavashe has been used. This index was designed by Lavache. so, 63 factors identified in the previous steps were given to 16 expert in the form of a checklist, whose characteristics are as described in the 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, and 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.

7.4. Step 7: 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 researches 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 codes 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:

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

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:

$$k = \frac{1}{Ln(a)};\ \text{a} = \text{Number o options}$$

The significance coefficient of each category must be calculated. Each category has a higher information load, the greater the importance of W_j. 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 10. Determining the importance and emphasis of past research on identifying and classifying start-up valuation models

Indicators	Frequency	Unreliability E_j	Significance factor W_j	Rank
Replacement cost	9	0.0200	0.0211	5
Re-ownership method	10	0.0216	0.0227	4
Historical cost	6	0.0148	0.0156	8
Base price	3	0.0086	0.0091	11
factor analysis	6	0.0148	0.0156	8
Based Stock Valuation Model with Learning	4	0.0108	0.0114	10
offer and acceptance	5	0.0129	0.0135	
Technical knowledge	10	0.0216	0.0227	4
intrinsic value	14	0.0274	0.0289	1
Industry standards	11	0.0231	0.0243	3
Market pricing	11	0.0231	0.0243	3

Expert opinion	9	0.0200	0.0211	5
Technical evaluation	12	0.0246	0.0259	2
Strategic importance	5	0.0129	0.0135	9
Market position	8	0.0183	0.0193	6
Cash flow	6	0.0148	0.0156	8
Cost cutting	8	0.0183	0.0193	6
Cash flow discounted	2	0.0062	0.0066	12
Venture capital	6	0.0148	0.0156	8
Future profitability	2	0.0062	0.0066	12
First Chicago Method	2	0.0062	0.0066	12
Gross earnings	6	0.0148	0.0156	8
Tax components	3	0.0089	0.0091	11
Gordon modelc	5	0.0129	0.0135	9
financial and economic evaluation	2	0.0062	0.0066	12
Black Scholes	1	0.0035	0.0037	13
The success rate in laboratory steps	2	0.0062	0.0066	12
decision tree algorithm	2	0.0062	0.0066	12
Risk assessment	6	0.0148	0.0156	8
Stochastic Differential Equation	6	0.0148	0.0156	8
Monte-Carlo	7	0.0166	0.0175	7
Intangible Business	3	0.0086	0.0091	11
Valuation based on the concept of real option	1	0.0035	0.0037	13
Valuation based on the concept of financial option	4	0.0018	0.0114	11
Staff training hours	7	0.0166	0.0175	7
Costs of entrepreneurs	3	0.0086	0.0091	11
Number of entrepreneurs	8	0.0183	0.0193	6

The average level of education of entrepreneurs	5	0.0129	0.0135	9
The average number of years of entrepreneurial experience	3	0.0086	0.0091	11
Total working hours of entrepreneurs	3	0.0086	0.0091	11
Investment in research and development(R&D)	2	0.0062	0.0066	12
The ratio of R&D expenditures to total costs	3	0.0086	0.0091	11
The ratio of R&D expenditures to total sales	2	0.0062	0.0066	12
Total salaries and bonuses of managers and administrative and sales expenses	2	0.0062	0.0066	12
Advertising expenses	1	0.0035	0.0037	13
Distribution and sales expenses	5	0.0129	0.0135	9
Relative market share	8	0.0183	0.0193	6
Brand reputation	7	0.0166	0.0175	7
brand Cash flow or profit	5	0.0129	0.0135	9
Brand royalty rates	5	0.0129	0.0135	9
Total brand value	5	0.0129	0.0135	9
Strong evidence from customers to buy the product	6	0.0148	0.0156	8
Customer experience	1	0.0035	0.0037	13
Market / industry characteristics	6	0.0148	0.0156	8
Distinctive product or service	5	0.0129	0.0135	9
Industry growth rate	8	0.0183	0.0193	6

Structural diversity of industry	4	0.0108	0.0114	10
industry Competitive advantage	1	0.0035	0.0037	13
Delphi	3	0.0086	0.0091	11
Brainstorm	1	0.0035	0.0037	13
Econometrics	4	0.0108	0.0114	10
Use the opinions of experts	2	0.0062	0.0066	12
royalty free	1	0.0035	0.0037	13

4. Discussion and conclusion

Determining the value of startups is controversial due to the lack of historical data and many uncertain factors about the future of the company (Fostel 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 start-ups. 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 start-up companies (start-ups) was extracted as main categories (codes). The main categories (codes) extracted are: quantitative valuation, including cost-oriented, market-oriented, revenue-oriented, 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 start-ups using the meta synthesis method. Studying, reviewing, and classifying the valuation models of start-up companies is a new step for the growth and development of these companies.

Identifying and classifying valuation models of startup companies, in addition to adding knowledge in this field, makes entrepreneurs gain a better understanding of their business valuation models and facilitates 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 start-up valuation, this study provides new information about the classification of valuation methods used in the valuation of start-up 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 comes with weaknesses such as generalizability and credibility. Therefore, the generalization of results should be done with caution. Also, the existence of 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.

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