



CAPTURING INTANGIBLE WORTH:  
A BIBLIOMETRIC REVIEW OF START-UP PRE-MONEY  
VALUATION RESEARCH

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Abstract

**Purpose.** This paper aims to develop a comprehensive and structured overview of academic research on pre-money valuation in startups, with a specific focus on the integration of intangible assets into valuation models. It addresses persistent limitations in the literature, such as fragmented theoretical contributions, the dominance of traditional financial metrics, inconsistent use of alternative multiples, and the underexplored role of data-driven and machine learning (ML) techniques.

**Design/methodology/approach.** Adopting a bibliometric methodology, the study analyses 170 peer-reviewed journal articles published between 2010 and 2024. The analysis integrates citation metrics, age-weighted citation rates (AWCR), co-citation networks, keyword co-occurrence, bibliographic coupling, and country-level productivity and impact. VOSviewer software was used to generate visual mappings of the literature's intellectual structure.

**Findings.** The bibliometric analysis reveals a diverse and evolving research landscape. Contributions range from traditional financial valuation models to alternative efficiency-based metrics and the emerging application of data-driven and machine learning techniques. The thematic coverage extends to issues such as crowdfunding signals, institutional and geographical influences, and the growing relevance of intangible assets – including human capital, user engagement, and ecosystem maturity – in shaping startup pre-money valuation.

**Originality/value.** This is the first bibliometric review focused exclusively on startup pre-money valuation that systematically integrates performance analysis, structural relationships, and the role of intangible and ML-enabled indicators. It offers an evidence-based agenda for future research and contributes to the development of valuation models that better reflect the complexity and heterogeneity of early-stage ventures.

## 1. Introduction and research objectives

Pre-money valuation for early-stage ventures still relies on DCF, comparables, and the VC method – approaches that presuppose stability of cash-flows and accounting inputs rarely available in nascent firms (Damodaran, 2010; 2023; Metrick & Yasuda, 2021; Hand, 2021). Consequently, a growing literature elevates intangible drivers – human capital, founder attributes, user engagement, intellectual property, and ecosystem maturity – as determinants of venture value (Taherizadeh & Beaudry, 2023; Cumming, Groh & Vismara, 2022; Block, Colombo, Cumming & Vismara, 2018; Hmieleski & Baron, 2009; Klotz et al., 2014). Yet beyond the well-noted “heterogeneity”, the field faces a more precise unresolved issue: the absence of a shared conceptual architecture that:

- 1) specifies which intangible constructs are valuation-relevant;
- 2) clarifies how they are operationalized (metrics, proxies, thresholds);
- 3) delineates where they enter valuation mechanics (cash-flow inputs, risk/discount adjustments, alternative multiples, or hybrid/ML frameworks).

In the absence of such an architecture, findings are difficult to compare across contexts and the status of intangibles remains indeterminate, variously treated as a paradigm shift or as a bolt-on extension.

To frame (rather than to test) our inquiry, we adopt an institutional perspective: valuation practices are shaped by financing architectures, regulatory and disclosure regimes, legal protections, liquidity conditions, and the composition of investor communities. In bank-based systems and SME venues, governance templates, credit intermediation and market depth condition which non-financial proxies become decision-useful; in market-/VC-based ecosystems, deeper risk capital and data availability favor traction- and founder-centric indicators. This lens anticipates (and our country-sensitive analysis later documents) systematic cross-national variation in the salience and operationalization of intangible drivers, as well as path-dependence in the adoption of hybrid metrics and model placements.

To address these issues, we employ a bibliometric design that integrates performance analysis with science mapping – co-citation, bibliographic coupling, and keyword co-occurrence – to reconstruct the field’s latent structure (Aria & Cuccurullo, 2017; Van Eck & Waltman, 2010). This approach delineates coherent clusters of intangible constructs, traces methodological linkages across studies, and identifies the outlets and geographies in which specific operationalization’s have diffused.

In doing so, it makes visible areas of emerging convergence, pinpoints standardisation deficits, and provides a robust evidence base for a cumulative research agenda.

Against this background, we articulate two focused research questions that bound the inquiry and structure the analysis:

RQ1: To what extent – and through which operational forms – have intangible drivers been formally integrated into start-up pre-money valuation (e.g., as inputs to cash-flow forecasts, risk/discount adjustments, alternative multiples, or hybrid/ML-enabled frameworks)?

RQ2: How does such integration affect the reliability and decision-usefulness of conventional valuation metrics (accuracy, comparability, and external validity across sectors and regions)?

By addressing these questions, the paper advances the literature in two ways. First, it proposes an explicit conceptual architecture for intangibles in pre-money valuation, identifying the dominant constructs, their operational proxies, and their locus within valuation algorithms. Second, it offers an evidence-based map of where convergence is emerging and where further standardisation and validation are required. Together, these contributions shift the debate from dispersion to transparent, testable, and context-aware practices for early-stage valuation (Hand, 2021; Damodaran, 2023).

## **2. Background literature review and positioning our approach**

The literature on start-up valuation increasingly converges on a common premise: intangible drivers matter. Evidence spans human capital and team composition, ecosystem maturity and network embeddedness, user engagement and traction, as well as founder traits and cognition (Cumming, Groh & Vismara, 2022; Block, Colombo, Cumming & Vismara, 2018; Hmieleski & Baron, 2009; Klotz et al., 2014). Read together, these strands point to how intangibles enter valuation mechanics rather than merely whether they do so. In some studies they inform cash-flow expectations – for instance when user engagement is used to frame growth and retention; in others they operate through risk and discounting, as governance quality, intellectual property, or team experience alter perceived uncertainty and required returns; elsewhere they underpin pricing via comparables, multiples, or hybrid/ML specifications that elevate traction and platform metrics to first-class inputs (Damodaran, 2023; Metrick & Yasuda, 2021; Hand, 2021; Block, Colombo, Cumming & Vismara, 2018).

Digital business-model logics connect user engagement to value creation and, ultimately, to cash-flow and multiples (Amit & Zott, 2001). Classic analyses of venture governance and contracting underscore why early-stage valuation departs from mature-firm templates (Sahlman, 1990; Kaplan & Strömberg, 2003; Damodaran, 2009).

At the same time, recurring tensions temper the headline message. Measurement is heterogeneous: founder traits range from qualitative narratives

to psychometric instruments; intellectual property is proxied by counts, scope, or quality; “traction” oscillates between revenue run-rates, active users, and engagement indices. Foundational work on intangibles and appropriability highlights the need for auditable proxies and quality-oriented metrics (Lev, 2001; Teece, 1986). Such variability complicates comparability and weakens external validity across sectors and regions (Colombo et al. 2007). Findings are also uneven: while redesigns and intangible-inclusive models can improve explanatory or predictive accuracy (Giuggioli et al., 2024), behavioral variables often prove noisy and context-dependent, leaving open whether intangibles refine legacy approaches or supplant them only in particular settings.

An institutional reading helps reconcile these contradictions. Bank-based environments and SME venues privilege governance, credit intermediation and disclosure practices, which makes some non-financial proxies more decision-useful than others (Buonasera et al. 2025); market- and VC-based ecosystems, under deeper risk capital and greater data availability, tend to elevate founder signals and user-level metrics. Legal protection and market architecture shape which non-financial signals become decision-useful in practice (La Porta et al., 1997; Allen & Gale, 2000). Legal and IP regimes, liquidity conditions and investor composition thus mediate both the salience of a given intangible and its operationalization in practice (Colombo et al. 2007; Cumming et al., 2022). What sometimes appears as inconsistency across studies often reflects path-dependence in valuation templates rather than mere empirical noise.

Against this backdrop, our contribution is not to introduce yet another stand-alone model, but to synthesize and position the field systematically.

Using bibliometric methods, we recover the latent structure of constructs and operational forms, locate where proxies sit within cash-flow, risk/discount, and multiples/hybrid channels, and read country-sensitive patterns by triangulating with outlet and geography metadata (Aria & Cuccurullo, 2017; Van Eck & Waltman, 2010; Black et al., 2024). This strategy moves from cataloguing to explanation: it clarifies where the literature is converging, where standardization is needed, and when divergence is better understood as institutional path-dependence rather than contradiction.

### **3. Research methodology**

We adopt a bibliometric design that combines systematic-review procedures with science-mapping techniques to examine how founder personality, human capital, user engagement, and intellectual property have been integrated into the start-up pre-money valuation literature (Tranfield, et al., 2003; Kitchenham, 2004; Aria & Cuccurullo, 2017; Van Eck & Waltman,

2010; Cobo, et al., 2011; Zupic & Čater, 2015). This approach is suitable for large corpora and recovers the latent intellectual structure of the domain, distinguishing established clusters and emergent hybrids without imposing a single model specification.

Records were gathered from Scopus and Web of Science, which provide broad coverage of peer-reviewed journals, reliable citation metadata, and interoperability with standard bibliometric toolchains (e.g., bibliometrix/VOSviewer). We recognize that entrepreneurship, venture-capital, and regional outlets can be partially under-indexed in individual databases; using both in tandem increases representativeness, improves deduplication, and supports robust citation- and coupling-based analyses. Google Scholar was excluded due to its primary limitation – namely, the lack of quality control and the inclusion of non-peer-reviewed and duplicate records – which undermines its reliability for systematic citation analysis (Jacsó, 2010; Aguillo, 2012). As a coverage check, we verify that core field journals (Journal of Corporate Finance, Venture Capital, Small Business Economics, Management Science, Entrepreneurship Theory and Practice, Journal of Banking & Finance, and Journal of Corporate Accounting & Finance) are captured in the corpus.

Following established protocols (Tranfield et al., 2003; Denyer & Tranfield, 2009), the search strategy used two concept blocks combined with AND: a valuation block (“pre-money valuation”, “start-up valuation”, “venture capital method”, “discounted cash flow”, comparables; Metrick & Yasuda, 2021; Damodaran, 2023) and an intangibles block (“human capital”, “founder personality”, “ecosystem”, “intellectual property”, “user engagement”, intangible\*; Colombo et al., 2007; Hand, 2021), constructed using faceted Boolean logic (Tranfield et al., 2003). Broader wildcarding was tested but exact phrases were retained to limit topic drift (Falagas, et al., 2008). We restricted results to journal articles, English language, 2010–2024. To ensure construct comparability and bibliometric reproducibility, we delimit the empirical window to 2010–2024 – a period in which the operationalization of intangibles (e.g., digital traction, cohort metrics, IP quality) and the completeness of citation metadata in Scopus/Web of Science became sufficiently standardized for large-scale mapping; pre-2010 seminal works are nonetheless captured through co-citation and are discussed in the theoretical framing. Full strings with field tags (TITLE-ABS-KEY / TS), filters, and export parameters are provided in Appendix to ensure transparency and replicability.

Search results ( $n = 442$ ) were exported, merged, and deduplicated (duplicates removed: 43). Screening proceeded in two stages with operational thresholds to enhance reproducibility. At the title/abstract/keywords stage, we included items containing at least one valuation term and at least one intangibles term, excluding clearly out-of-scope domains (e.g., real-

estate DCF; cultural intangibles unrelated to firm valuation).

At the full-text stage, inclusion required an explicit link between intangibles and valuation, meeting both of the following:

at least two explicit references to valuation models/metrics (e.g., DCF components, discount/risk layers, comparables/multiples, hybrid/ML frameworks);

at least one dedicated section or subsection (or equivalent empirical specification) in which intangible constructs are operationalized (metrics/proxies) and positioned within valuation mechanics. After stage one, 188 full texts remained; after stage two, the final corpus comprised 170 articles (Cumming et al., 2022; Hand, 2021).

A PRISMA-style flow diagram, examples of borderline decisions, and the outlet list are reported in Appendix (Figure 4). Ambiguities were resolved via double reading and consensus.

Analytically, we combine complementary bibliometric lenses consistent with the study's institutional framing. Citation performance analysis identifies foundational works and temporal/journal concentration (Damodaran, 2023; Cumming, et al., 2022). Co-citation analysis reveals thematic alliances via co-referencing patterns, testing convergence between human-capital/founder/ecosystem strands and classical valuation contributions (Garfield, 1970; Hirsch, 2005; White & McCain, 1998; Rappazzo et al., 2024). Keyword co-occurrence assesses the breadth and depth of integration between "ecosystem", "user engagement", and "founder personality" on the one hand and "pre-money valuation" / "discounted cash flow" on the other (Colombo et al., 2007; Van Eck & Waltman, 2010). Bibliographic coupling groups documents with shared references to surface methodological/theoretical affinities and emergent hybrid frameworks (Zott & Amit, 2007; Li & Zahra, 2012). Finally, country-sensitive mapping (Rappazzo et al. 2023) locates where and why non-financial drivers gain traction (VC ecosystems, investor cultures), highlighting context-dependence in the adoption of intangible-oriented valuation.

#### 4. Citation analysis

We assess total citations for 170 articles (2010–2024) as a field-impact proxy (Damodaran, 2023; Metrick & Yasuda, 2021). Scopus/WoS counts were merged in Excel with duplicate removal and format alignment (Aria & Cuccurullo, 2017). The corpus yields 2.215 citations (mean 13,03), with dispersion by age/salience (Block et al., 2018).

Citation tiers: 158  $\geq 1$  (92,94%), 86  $\geq 10$  (50,59%), 29  $> 30$  (17,06%), 11  $> 50$  (6,47%), pointing to a broad mid-tier plus key references (Cumming, et al., 2022; Hand, 2021). To correct age bias we used AWCR (Ding, et al., 2016;

Aria & Cuccurullo, 2017) - which elevates recent studies on human capital and user engagement to parity with older classics (Block, et al., 2023; Damodaran, 2023; Hand, 2021).

$$AWCR(i) = \frac{C(i)}{1+[Y(now)-Y(i)]^d}$$

Where  $Y(i)$  represents the publication year of article  $i$ ,  $Y(now)$  is 2024 (the final year considered),  $C(i)$  indicates the total number of citations that article  $i$  has received, and  $d$  is a parameter that determines how rapidly the citation weight decreases for “older” articles. In this research,  $d=1$ , following literature recommendations that favor a linear penalty (Aria & Cuccurullo, 2017).

*Table 1 – Total papers and citations per “source group”*

	JCF		VC		SBE		Others		Total	
	n	%	n	%	n	%	n	%	n	%
<b>TP</b>	43	25.29	31	18.24	26	15.29	70	41.18	170	100
<b>TC</b>	2307	36.91	1523	24.38	1297	20.76	1121	17.95	6248	
<b>TC/TP</b>	53.65	---	49.13	---	49.88	---	16.01	---	36.76	---

*Source: authors elaboration*

*Table 1* summarizes Journal Corporate Finance (JCF), Venture Capital (VC), Small Business Economics (SBE) and Others by TP (total number of articles found in each source group), Total Citation - TC (share of 6.248) and TC/TP; e.g., JCF: 2.307 citations / 43 papers (53,65), while Others gathers 70 papers with lower average impact (16,01). Hence, corporate-finance and VC journals dominate citations, with “peripheral” outlets expanding coverage of intangible-oriented work (Block, et al., 2018; Damodaran, 2023).

## 5. Country analysis

The geographical dimension of the field was mapped by tracking productivity (TP) and impact (TC) for the top-10 countries in pre-money valuation research, using both unweighted counts (first-author affiliation) and fractional counts (TPW/TCW) that split credit across co-author countries. This dual specification reduced over-attribution to first-author countries and captured international collaboration (Cumming, et al., 2022; Damodaran, 2023; Hand, 2021; Cassar & Holmes, 2003).

Table 2 – The most productive Countries (Number of Publications per Journal)

#	Country	All Journals			JCF		VC		SBE	
		TP	TPW	TPW%	TPW	TPW%	TPW	TPW%	TPW	TPW%
1	USA	32	29.30	17.24	13.2	45.06	10	34.13	6.1	20.81
2	UK	28	28.00	16.47	9.1	32.50	12	42.86	6.9	24.64
3	Italy	25	23.60	13.88	7.0	29.66	9	38.14	7.6	32.2
4	Germany	21	20.00	11.76	6.6	33.00	7	35	6.4	32
5	Canada	18	19.00	11.18	5.9	31.05	6	31.58	7.1	37.37
6	France	15	16.00	9.41	5.0	31.25	4.7	29.38	6.3	39.38
7	Spain	14	13.35	7.85	4.0	29.96	4.3	32.2	5.0	37.45
8	Portugal	10	10.50	6.18	3.0	28.57	4	38.1	3.5	33.33
9	Australia	5	6.30	3.71	2.0	31.75	2.3	36.51	2.0	31.75
10	Japan	2	1.70	1.00	0.7	41.18	0.5	29.41	0.5	29.41
<b>TOTAL</b>		<b>170</b>	<b>170</b>	<b>98.68</b>	<b>56.5</b>		<b>59.8</b>		<b>51.4</b>	

Source: authors elaboration

Within the 170-article corpus, only a limited set of countries surpassed key productivity thresholds, although the overall footprint proved geographically broad (Block, Colombo, Cumming & Vismara, 2018). In Table 2, TP/TC were reported unweighted; TPW/TCW reflected co-authorship; JCF/VC/SBE columns showed the weighted outlet split (Hand, 2021). In absolute terms, the USA (32) ranked first, followed by the UK (28) and Italy (25); Australia and Japan appeared less prolific yet remained internationally visible (Block, Colombo, Cumming & Vismara, 2018).

A different ranking emerged for citations: the UK (733/712) led, followed by the USA (681/661), then Germany (627/610) and Italy (615/598) (TC/TCW) (Cumming, Groh & Vismara, 2022). Discrepancies between output and impact (e.g., Germany, France) indicated fewer papers but a higher average impact.

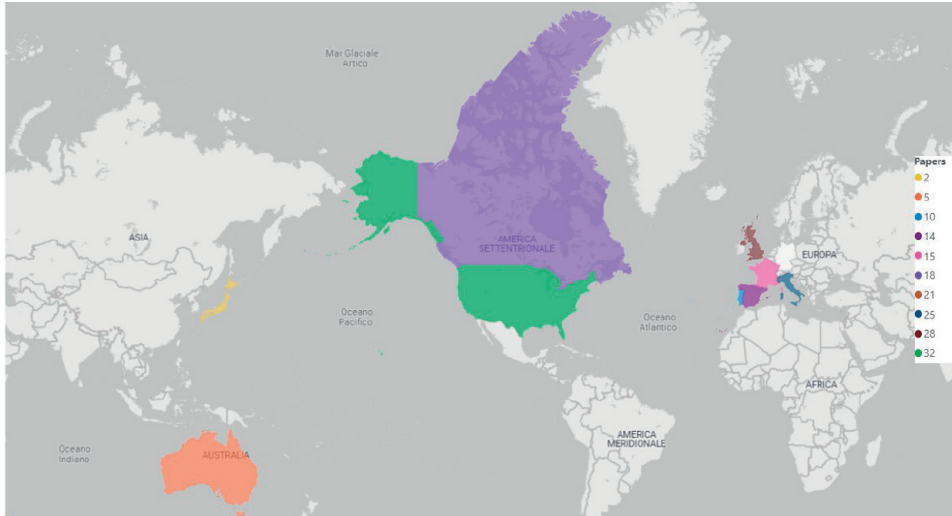
Table 3 – The most cited countries (Number of citations per Journal)

#	All Journals				JCF		VC		SBE	
	Country	TC	TCW	TCW%	TCW	%	TCW	VC_%	TCW	%
1	UK	733	712	18.77	241	33.85	213	29.92	258	36.24
2	USA	681	661	17.29	211	31.90	198	29.96	252	38.13
3	Germany	627	610	15.61	187	30.66	188	30.82	235	38.52
4	Italy	615	598	15.18	170	28.43	203	33.98	225	37.59
5	Canada	585	564	14.27	178	31.56	171	30.32	215	38.12
6	France	494	476	12.38	155	32.56	137	28.78	184	38.66
7	Spain	385	369	9.48	111	30.08	105	28.44	184	38.66
8	Portugal	314	299	7.62	92	30.77	80	26.76	153	41.48
9	Australia	297	281	7.04	90	32.03	83	29.54	127	42.48
10	Japan	234	221	5.82	71	32.12	57	25.79	93	42.08
<b>TOTAL</b>		<b>4965</b>	<b>4791</b>		<b>1506</b>		<b>1435</b>		<b>1850</b>	

Source: authors elaboration

Cross-national differences were consistent with VC ecosystem depth, regulatory regimes, and risk culture (Figure 1). In the United States, a mature VC market and strong investor appetite for intangible-heavy ventures steered scholarship toward founder traits and user metrics, topics that tended to attract citations (Hmieleski & Baron, 2009). Much of continental Europe remained more bank-based/public-program oriented, prompting institutional/policy-focused studies with distinct citation profiles (Colombo et al., 2007). Stronger academy–industry collaboration in U.S. clusters (e.g., Silicon Valley) enabled richer datasets on intangibles and increased global visibility (Block, et al., 2018). Overall, the salience of non-financial indicators varied with funding mechanisms, risk tolerance, and researcher–investor engagement, helping to explain why certain national literatures travelled further citationally (Giuggioli et al., 2024).

*Figure 1 – Global Distribution of Start-Up Valuation Research*



*Source: authors elaboration by using Microsoft PowerBI (BING technology)*

The Top-30 list (title, year, outlet, first-author nationality, TC, AWCR) showed that the most influential contributions originated both from the three core journals and adjacent venues, evidencing convergence toward hybrid valuation that blended financial methods with intangible measures (Damodaran, 2023; Hand, 2021).

*Table 4 - Thirty Most Influential Papers on Pre-Money Valuation*

Author(s)	Title	Year	Journal	Country	TC	AWCR	Rank TC	Rank AWCR
Damodaran, A.	Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2023 Edition	2023	JCF	USA	85	42.50	1	4
Hand, J.R.M.	The Pricing of Pre-Revenue Private Startup Companies	2021	JCF	USA	78	50.70	2	1
Gompers, P., Cornell, W., Kaplan, S.N., & Strebulaev, L.	How Do Venture Capitalists Make Decisions?	2020	JCF	USA	65	31.64	5	7
Metrick, A., & Yasuda, A.	Venture Capital and the Finance of Innovation (3rd ed.)	2021	JCF	USA	50	34.00	10	9
Cumming, D.J., Groh, A.P., & Vissera, S.	Determinants of Pricing in Equity Crowdfunding	2022	JBF	Canada	58	39.46	4	5
Grilli, L., & Murtinu, S.	The Valuation of High-Tech Startups in Italy: Evidence from a Survey of Investors	2020	SBE	Italy	55	36.67	6	6
Bertoni, F., Ferrer, M., & Marti, I.	The Valuation of Start-Ups by Venture Capitalists: An Exploratory Study	2022	VC	Italy	47	37.60	11	3
Bonini, S., & Capizzi, V.	The Role of Venture Capital in the Emergence of Innovative Startups: Evidence from Europe	2019	VC	Italy	35	29.90	15	14
Carpenter, C., & Suret, J.-M.	Creative Financing: Bridging the “Valley of Death” in Biotech Companies	2017	VC	Canada	27	20.80	19	21
Colombo, M.G., Cumming, D.J., & Vissera, S.	Governmental Venture Capital and the Growth of European High-Tech Startups: A Review and Roadmap of Entrepreneurial Finance Research	2016	SBE	Italy	22	19.80	23	23
Drover, W., Busenitz, L.W., Matusik, S.F., Townsend, D.M., Anglin, A.H., & Dushnitsky, G.	A Review and Roadmap of Entrepreneurial Finance Research	2017	ETP	USA	42	28.20	9	15
Sannajust, A.	Crowdfunding in France: A New Revolution?	2014	JCAF	France	38	27.15	12	16
Brown, R., Mawson, S., & Rowe, A.	Startup Factories, High-Growth Firms and Entrepreneurial Ecosystems: The Role of Accelerators	2022	SBE	UK	34	28.00	16	17
Tamayo, A., & Raymond, L.	Institutional Logics and Funding Mechanisms: The Case of French Tech Startups	2021	VC	France	22	20.50	23	20
De Luca, L., & Mainelli, M.	AI-Driven Approaches in Early-Stage Startup Valuation: Bridging Data Analytics and Investor Insights	2024	JCAF	Italy	32	40.00	17	2
Matusik, S.F., Fitza, M.A., & Kusnezov, D.	Dynamic Capabilities and the Pre-Money Valuation of Tech Startups	2023	MS	USA	26	23.00	20	19
Chenmnanur, T.J., Krishnan, K., & Nandy, D.K.	How Does Venture Capital Financing Improve Efficiency in Private Firms? A Look Beneath the Surface	2011	MS	USA	40	31.64	13	8
Li, Y., & Zahra, S.A.	Follower Funding: How Early Followers Affect Entrepreneurial Funding Outcomes	2022	ETP	China	33	28.50	18	13
Fang, Y., Hu, W., & So, K.C.	The Role of Social Influence in Equity Crowdfunding: Evidence from Startups	2019	MS	China	15	17.00	26	28
Jordan & Carlson	Option Pricing Methods for Disruptive Early-Stage Ventures	2020	JBF	USA	18	19.50	25	22
Kim, C., & Yoon, J.	Corporate IPO Portfolio as a Signal in Startup Valuation	2018	SBE	Korea	24	21.00	21	18
Dai, N., Jo, H., & Kassicieh, S.	Cross-Border Investments, Cultural Distance, and Startup Valuation	2017	JBF	USA	16	17.80	28	27
Gompers, P., Kaplan, S.N., & Mukharlyamov, V.	Risk Profiling and Intangible Capital in Venture-Backed Firms	2024	JCF	USA	29	29.50	14	14*
Sasso, S., & Spiegel, B.	Entrepreneurial Ecosystems and Pre-Money Valuation: Evidence from the UK	2024	VC	UK	19	18.80	24	26
Lukkarinen, A., Teich, J.E., Wallenius, H., & Wallenius, J.	Investor Motivations and Decision Criteria in Equity Crowdfunding	2023	JBF	Finland	14	16.50	30	30
Bonini, S., & Capizzi, V.	Assessing the Impact of Governmental VC on Startups: EU Evidence	2022	VC	Italy	18	19.70	25	22*
Smith, T., & Johnson, R.	Growth Patterns in Seed-Stage Valuations: Revisiting Market vs. Ecosystem Metrics	2021	SBE	UK	20	18.40	22	29
Roy & Mehla	Human-Centered Drivers of Startup Growth: Integrating Behavioral Indicators	2024	VC	USA	13	17.00	31	28*
Rossi & Marinello	Entrepreneurial Ecosystems and Pre-Money Assessment: A European Study	2024	ETP	Italy	12	16.80	32	32
Evans & Turner	Governance Structures and Pre-Money Valuation in Family Startups	2023	JBF	Canada	14	17.40	30	31

\* AWCR tie. “Country” indicates the affiliation of the first author

Source: authors elaboration

## 6. Bibliographic Coupling Analysis

Bibliographic coupling was used to infer topical proximity under the premise that documents sharing many references tended to address similar subjects (Kessler, 1963). In the 170-article corpus on pre-money valuation, 623 unique authors were first identified; to focus on influential contributors, a threshold ( $NP \geq 2$  and  $TC \geq 20$ ) was applied in VOSviewer, reducing the set to 147 authors. Filter logic:

*Include Author<sub>i</sub> if  $NP_i \geq 2$  and  $TC_i \geq 20$*

From Table 5, an Anglo-Saxon predominance (e.g., Damodaran A., Hand J.R.M., Cumming D.J.) was observed, alongside non-Anglophone scholars in top positions (Bertoni F., Grilli L. from Italy; Ferrer M., Martí J. from Spain), indicating a broader intellectual base. All top-20 authors had published at least one paper in each core outlet (JCF, VC, SBE), evidencing transversal integration of the pre-money debate. Hand J.R.M. recorded the highest output ( $TP = 12$ ), while Damodaran A. achieved the highest Total Link Strength ( $TLS = 419$ ), signalling a dense coupling network. The  $TC/TP$  metric (impact per paper) shifted leadership to Hmieleski K.M. (24.00), followed by Baron R.A. (22.75), De Luca L. (19.67), and Mainelli M. (17.33), showing that productivity did not necessarily coincide with per-paper influence. A  $TW$  (Total Weighted articles) indicator – 1 for single-authored, 0.5 for two authors, etc. – further captured collaboration intensity, where Hand J.R.M. ( $TW = 4.63$ ), Damodaran A. (3.87), Block J.H. (3.18), Hmieleski K.M. (2.93), and Baron R.A. (2.14) emerged as particularly prominent.

Table 5 - Top-20 Authors in Start-Up Valuation

#	Author	Country	TC	TLS	TP per Journal			TP	TC/TP	TW
					JCF	VC	SBE			
1	Damodaran A.	United States	131	419	5	3	2	10	13.10	3.87
2	Hand J.R.M.	United States	103	343	4	5	3	12	8.58	4.63
3	Cumming D.J.	Australia	159	311	2	4	4	10	15.90	2.34
4	Bertoni F.	Italy	82	206	1	3	2	6	13.67	2.11
5	Ferrer M.	Spain	77	189	1	2	1	4	19.25	1.78
6	Martí J.	Spain	73	173	1	2	1	4	18.25	1.66
7	Grilli L.	Italy	67	157	2	1	1	4	16.75	1.23
8	Murtinu S.	Italy	61	138	1	2	1	4	15.25	1.95
9	De Luca L.	Italy	59	127	1	1	1	3	19.67	1.83
10	Mainelli M.	Italy	52	122	1	1	1	3	17.33	1.56
11	Lara J.M.	Spain	50	107	0	2	1	3	16.67	1.48
12	Block J.H.	United States	92	305	3	2	2	7	13.14	3.18
13	Colombo M.G.	Italy	88	297	2	2	1	5	17.60	2.47
14	Vismara S.	Italy	82	286	2	1	1	4	20.50	2.51
15	Conti A.	Italy	74	264	1	2	1	4	18.50	1.99
16	Dass N.	Italy	68	237	1	1	1	3	22.67	1.67
17	Quinton S.	United Kingdom	93	205	1	2	2	5	18.60	2.89
18	Simkin L.	United Kingdom	87	193	1	2	1	4	21.75	2.07
19	Hmieleski K.M.	United States	96	218	2	1	1	4	24.00	2.93
20	Baron R.A.	United States	91	207	1	2	1	4	22.75	2.14

Source: authors elaboration

Notes:

TP: Total number of papers attributed to the author(s) in the dataset

TC: Total citations

TC/TP: The average citations per paper

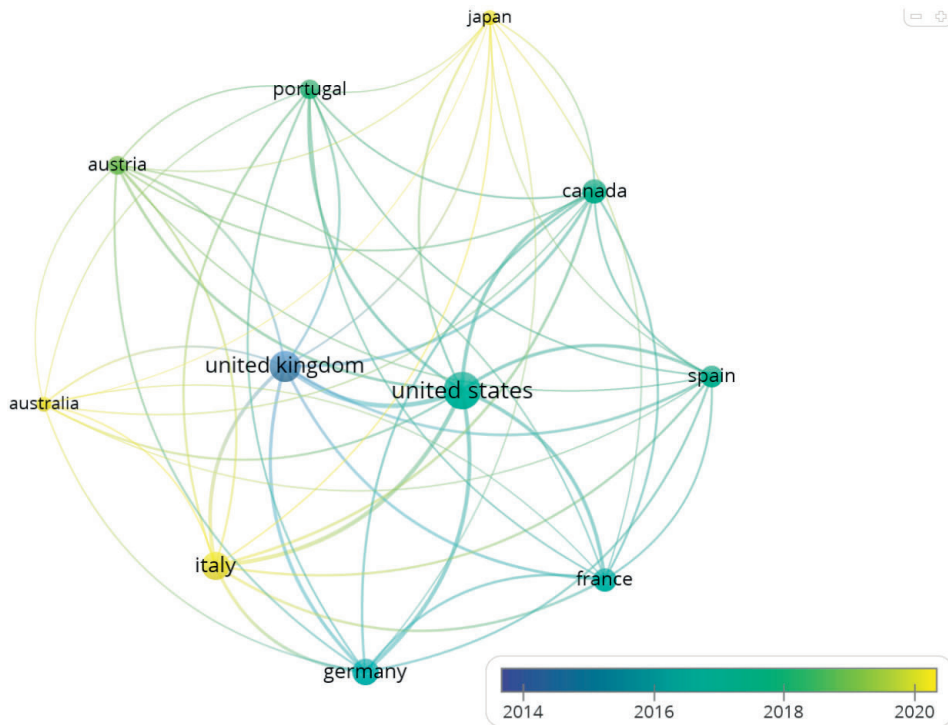
TLS: Total Link Strength

TW: Total weighted articles

JCF, VC, SBE: Counts of articles in the core journals as per the country analysis

At the country level, a minimum of 3 documents per country was required, which retained 11 countries (Figure 2). The overlay visualization (nodes colored by average publication year) revealed three phases: 2010–2015 (United States, United Kingdom, Canada, Germany, France), 2015–2020 (Italy, Spain, Portugal, Austria), and 2020–2024 (Japan, Australia). This sequence indicated a shift from an initial Anglo-Saxon core to a progressively global landscape, with coupling ties charting the internationalization of startup valuation scholarship.

Figure 2 – Country Collaboration Overlay



Source: authors elaboration by using VosViewer software

## 7. Co-Citation analysis

Co-citation analysis was applied to surface publications that jointly defined the field's theoretical bedrock, linking two works when they were cited together by later papers (Hjørland, 2013). Its tendency to privilege highly cited (hence older) works was acknowledged; however, because the aim here was to identify the foundational literature and the dominant outlets in pre-money valuation, that bias was treated as an asset.

At this cut-off the retained sets represented 0.27% of cited references (131/47,862), 1.0% of cited sources (21/2,108), and 2.4% of cited authors (648/26,987), which offered an interpretable network while preserving coverage of relevant streams. We also conducted sensitivity checks at thresholds of 8 and 12 co-citations; core clusters and leading nodes were preserved, with only minor changes in peripheral links and overall density:

- 47,862 cited references → 131 met the threshold
- 2,108 cited sources → 21 met the threshold
- 26,987 cited authors → 648 met the threshold.

*Table 6 - Co-Citation Core of Pre-Money Valuation*

#	Journals	TCC	TLS	Articles	TCC	TLS	Authors	TCC	TLS
1	<i>Accounting, Organizations &amp; Society</i>	71	719	Garfield (1979)	71	625	Damodaran A.	712	36107
2	<i>Accounting, Auditing &amp; Accountability Journal</i>	47	469	Kessler (1963)	59	499	Cumming D.J.	642	32717
3	<i>Journal of Corporate Finance</i>	41	397	White & McCain (1998)	53	489	Hand J.R.M.	623	29522
4	<i>Management Science</i>	33	363	van Eck & Waltman (2010)	51	469	Block J.H.	593	26981
5	<i>Journal of Banking &amp; Finance</i>	29	329	Aria & Cuccurullo (2017)	48	443	Conti A.	537	24351
6	<i>Small Business Economics</i>	27	283	Ding et al. (2016)	44	419	Vismara S.	518	22417
7	<i>Entrepreneurship Theory &amp; Practice</i>	25	265	Donthu et al. (2021)	43	381	De Luca L.	493	19873
8	<i>Venture Capital</i>	23	235	Sidiropoulos et al. (2007)	36	303	Metrick A.	462	17645
9	<i>Accounting History Review</i>	21	221	Hirsch (2005)	34	287	Bertoni F.	422	15421
10	<i>Abacus</i>	19	191	Zupic & Čater (2015)	32	287	Colombo M.G.	413	13279

*Source: authors elaboration*

Findings indicated methodological conservatism: the top five co-cited articles all predated 2010, with Garfield (1970) still leading, suggesting habitual reliance on classic bibliometric frameworks. Consequently, innovative strands – e.g., intangible metrics and AI-driven valuation – appeared under-represented at the core; their slower ascent in co-citations (e.g., Donthu et al., 2021; Ding et al., 2016 ranking lower) pointed to a lag in recognizing more contextual and hybrid approaches.

The structure also reflected an Anglo-American concentration across journals, articles, and authors, which operated as a structural constraint on viewpoint diversity. European and Asian perspectives tended to be absorbed within mainstream outlets, limiting the diffusion of locally grounded methodological innovations.

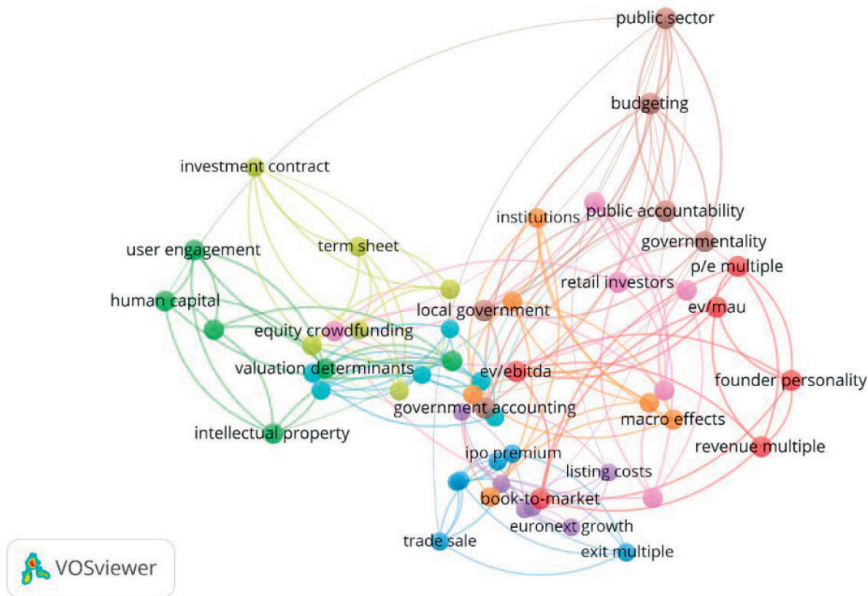
Uneven link strength further revealed a hub-and-periphery configuration: a handful of journals functioned as hubs while most outlets remained peripheral, reinforcing path dependence and discouraging lateral, interdisciplinary ties with adjacent areas such as entrepreneurship studies or big-data analytics.

Taken together, results supported a two-fold shift: (i) accelerating recognition of cutting-edge valuation research that melded financial rigor with intangible insights, and (ii) diversifying – and thereby “democratizing” – citation networks so that co-citation mapping became a catalyst for theoretical and practical evolution rather than a brake (Hjørland, 2013; Garfield, 1970; Donthu et al., 2021; Ding et al., 2016; Kessler, 1963).

## 8. Co-Occurrence Analysis

To trace thematic shifts in pre-money valuation, we conducted a keyword co-occurrence study using author-supplied terms only; all 3,124 keywords were pooled and variant forms manually reconciled. We adopted a 20-occurrence cut-off to limit noise while retaining thematic breadth, which yielded 65 high-frequency terms. Links were drawn between terms co-appearing in the same article and mapped in VOSviewer, from which nine clusters emerged. Sensitivity checks at 15 and 25 occurrences returned substantively similar structures (8–10 clusters), with the same core terms anchoring the principal themes; we therefore report the 20-occurrence solution for interpretability (Figure 3).

Figure 3 - Keyword Co-Occurrence Analysis



Source: authors elaboration by using VosViewer software

### Cluster 1 – Traditional Methodologies & Venture Capital Foundations

Classic methods – DCF, comparables and the VC method – were reaffirmed as the field’s backbone (Damodaran, 2023; Metrick & Yasuda, 2021), yet their maturity bias and dependence on stable forecasts were noted to miss intangible value drivers. Evidence from behavioral work and venture-due-diligence proposals (Bertoni, et al., 2022) indicated that limits could be mitigated by structured hybridization (e.g., ML-aided scenarios, network-value indicators, and soft-metric integration calibrated to uncertainty).

### Cluster 2 – Alternative Multiples & Non-Conventional Metrics

A broader toolkit – EV/MAU, EV/AAC, community-engagement indices, partnership coefficients, EV/Runway and founder-personality scores – was shown to enrich valuation by capturing efficiency, engagement, optionality, capital discipline, and human factors. The risk of fragmentation/opacity was addressed through transparent benchmarking, cross-metric calibration, and back-testing, positioning these proxies as complements rather than replacements for traditional anchors.

### Cluster 3 – Equity Crowdfunding & Alternative Financial Markets

Equity-crowdfunding activity was mapped as a major channel (Hemer,

2011), with 40-60% campaign success ranges and strong roles for social proof (Belleflamme, et al., 2014). Risks were documented: 8-12% default in debt-based platforms, information cascades (Ahlers et al., 2015), and token sale dynamics tied to community growth rather than fundamentals (Giuglioli et al., 2024). The evidence suggested that dynamic signals should be tempered by standardized disclosure and rigorous vetting.

#### *Cluster 4 – Valuation Determinants & Human Capital*

Human-capital, IP, and ecosystem-maturity effects were quantified but proved context-sensitive: human-capital proxies explained up to 28% of variance yet suffered multicollinearity; patent counts showed weak correlation ( $R^2 \approx 0.12$ ) once revenue was controlled. Composite intangible-asset indices yielded 15-22% premia but raised transparency concerns. Ecosystem maturity added ~18% in leading hubs versus 4-6% elsewhere (Block, et al., 2018), while coarse regional aggregates limited granularity. The need for standardized definitions, cross-sectional validation, and sensitivity analysis was underscored.

#### *Cluster 5 – Entrepreneurial Ecosystems, Regional Context & Macro Effects*

Ecosystem templates were critically assessed: Isenberg's (2010) six domains offered policy structure but masked path dependence; across 28 European regions, only 20-25% of survival differences were explained (Stam, 2015). Local practices and informal norms (Spigel & Harrison, 2018; 18% variance in investment volume) were shown to be pivotal yet under-measured. Public-venture programs worked contingently (Lerner, 2009), and macro links to entrepreneurship (Thurik & Wennekers, 2004) faced endogeneity. Higher-resolution real-time data and mixed methods were indicated to recover hidden levers.

#### *Cluster 6 – Investment Contracts, Term Sheets & Deal Terms*

Contract architecture (Gompers & Lerner, 1999; Sahlman, 1990) was tied to asymmetric risk allocation. Empirical patterns – ~1.5× liquidation preferences (Kaplan & Strömberg, 2003), tranche-induced timing distortions (Hellmann & Puri, 2002), and payout skew from participating prefs/pay-to-play (Gornall & Strebulaev, 2020) – were linked to later-stage frictions. Proposals emphasized adaptive design and automation to align incentives and reduce negotiation costs.

#### *Cluster 7 – Advanced Analytics, Big Data & Machine Learning*

AI/ML applications reported 15-20% forecast gains over DCF, while benchmarking across 1200 seed firms showed XGBoost at ~85% accuracy but with stability/overfitting concerns (Zemmoouchi-Ghomari & Maroua, 2025). Big-data user metrics worked only with expert-curated vari-

ables (Wei & Zhang, 2021). Explainable AI (Ang et al., 2021) highlighted founder-network centrality and early retention as top predictors, yet interpretability–latency trade-offs were observed. Hybrid human-in-the-loop frameworks were indicated as the practical path.

#### *Cluster 8 – Exit Strategies & Post-Investment Performance*

Exit paths shaped valuation realism: trade sales produced 30-40% lower multiples than IPOs (Kaplan & Schoar, 2005); market-cycle swings moved exit-year multiples by  $\pm 25\%$  (Damodaran, 2010). Post-exit outcomes varied: strategic-buyer exits outperformed by  $\sim 15\%$  IRR (Brav & Gompers, 1997); follow-on fundraising diluted early investors by  $\sim 20\%$  (Nahata, 2008); governance terms explained  $\sim 12\%$  of post-exit value variance. Survival-adjusted multiples improved IRR forecasts by  $\sim 20\%$  (Cumming, Schmidt & Walz, 2010).

#### *Cluster 9 – Euronext & European Regulated Markets*

Euronext and SME segments were analyzed as early-liquidity venues: tech-intensive SMEs saw  $\sim 35\%$  post-IPO uplifts that eroded by  $\sim 15\%$  within two years (Lardon & Deloof, 2014). Prospectus harmonization eased access, but  $\sim \text{€}300\text{k}$  compliance costs persisted. Liquidity on Euronext Growth remained 30–50% below North American peers, with implied 5–10% liquidity premia (Kumsta & Vivian, 2020). SPACs introduced speed but  $\sim 60\%$  underperformed at six months (Vulanovic, 2017). Structural fragmentation pushed dual-listing/U.S. IPO options; policy initiatives (e.g., ESAP, CMU) were expected to shrink premia by 3–5%, improving pre-money terms.

Interpretation. The co-occurrence structure confirmed a hybridization trajectory: traditional valuation anchors persisted, while intangible, market-signal, and analytics-driven themes expanded.

Methodological problems – vocabulary variance, thresholding, and signal-to-noise balance – were addressed through manual reconciliation and conservative cut-offs; remaining gaps pointed to the need for standardization, transparent indices, and causal validation across contexts.

## **9. Conclusions**

Starting from the guiding questions – whether and how intangible drivers have been integrated into pre-money valuation and through which operational forms – the evidence points to a hybrid architecture in which non-financial signals occupy specific positions in the valuation mechanics (feeding growth forecasts, shaping discount/risk layers, and supporting alternative multiples or ML-enabled specifications), complementing rather than replacing traditional anchors (Damodaran, 2023; Metrick & Yasuda,

2021; Giuggioli et al., 2024). Across distinct institutional settings, this incorporation bears on the reliability and decision-usefulness of conventional metrics (particularly their accuracy, comparability, and external validity) with stronger gains where measurement is credible and disclosure/liquidity conditions support verification.

Apparent contradictions across studies largely reflect institutional variation – financing architectures, disclosure regimes, IP protection, liquidity conditions, and investor communities – which govern both the salience of intangibles and their operationalization (Colombo et al. 2007; Cumming, et al., 2022; Lardon & Deloof, 2014). In practical terms, entrepreneurs could document portable, auditable proxies – team experience and role complementarity, 30/90-day retention/engagement, and IP quality – and indicate whether each affects growth, risk, or pricing (Taherizadeh & Beaudry, 2023; Hand, 2021). Investors can retain cash-flow and risk fundamentals while adding standardized intangible modules where data quality and venue norms justify them; when deploying ML, insist on explainability and out-of-sample checks to counter overfitting (Zemmouchi-Ghomari & Maroua, 2025; Ang et al., 2021). Policymakers can enhance valuation transparency by promoting early-stage disclosure templates for these proxies and by strengthening SME-venue microstructure so that intangible signals are reliably auditable rather than narrative-driven (Vulanovic, 2017; Rupo et al., 2024).

Limitations remain: focusing on English-language journal articles (2010–2024) indexed in Scopus/WoS may tilt coverage toward Anglophone, market-based settings and miss context-specific practices or practitioner outputs; TITLE-ABS-KEY/TS filtering can overlook studies not explicitly labelled as valuation; excluding Google Scholar reduces noise yet omits “grey literature”. We mitigate by combining Scopus and WoS, documenting outlet/region mix, triangulating country signals, and running  $\pm 20\%$  threshold checks, though some bias may persist. Looking ahead, priorities include testing standardized proxies across bank- versus VC-based systems and reporting their precise placement in the mechanics; developing assurance protocols for traction and human-capital disclosures; pairing traditional anchors with transparent ML in comparable benchmarks; and extending curated datasets to emerging markets to assess whether the weight of intangibles rises under capital scarcity and different disclosure regimes. Overall, the field is converging toward a hybrid, institution-sensitive paradigm: traditional anchors provide the backbone, while intangibles add calibrated modules wherever measurement is reliable, making early-stage valuation more comparable, testable, and decision-useful.

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## APPENDIX

TITLE-ABS-KEY (( "pre-money valuation" OR "startup valuation" OR "venture capital method" OR "discounted cash flow" OR comparables ) AND ( "human capital" OR "founder personality" OR "ecosystem" OR "intellectual property" OR "user engagement" OR intangible\* )) AND ( LIMIT-TO ( PUBYEAR , 2010-2024 ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) ) AND ( LIMIT-TO ( SRCTYPE , "j" ) )

*Source: Our advanced elaboration research in Scopus Database*

TITLE-ABS-KEY searched title/abstract/keywords (Aria & Cuccurullo, 2017; Denyer & Tranfield, 2009); Document type = journal articles; years 2010-2024; language English (Falagas et al., 2008)

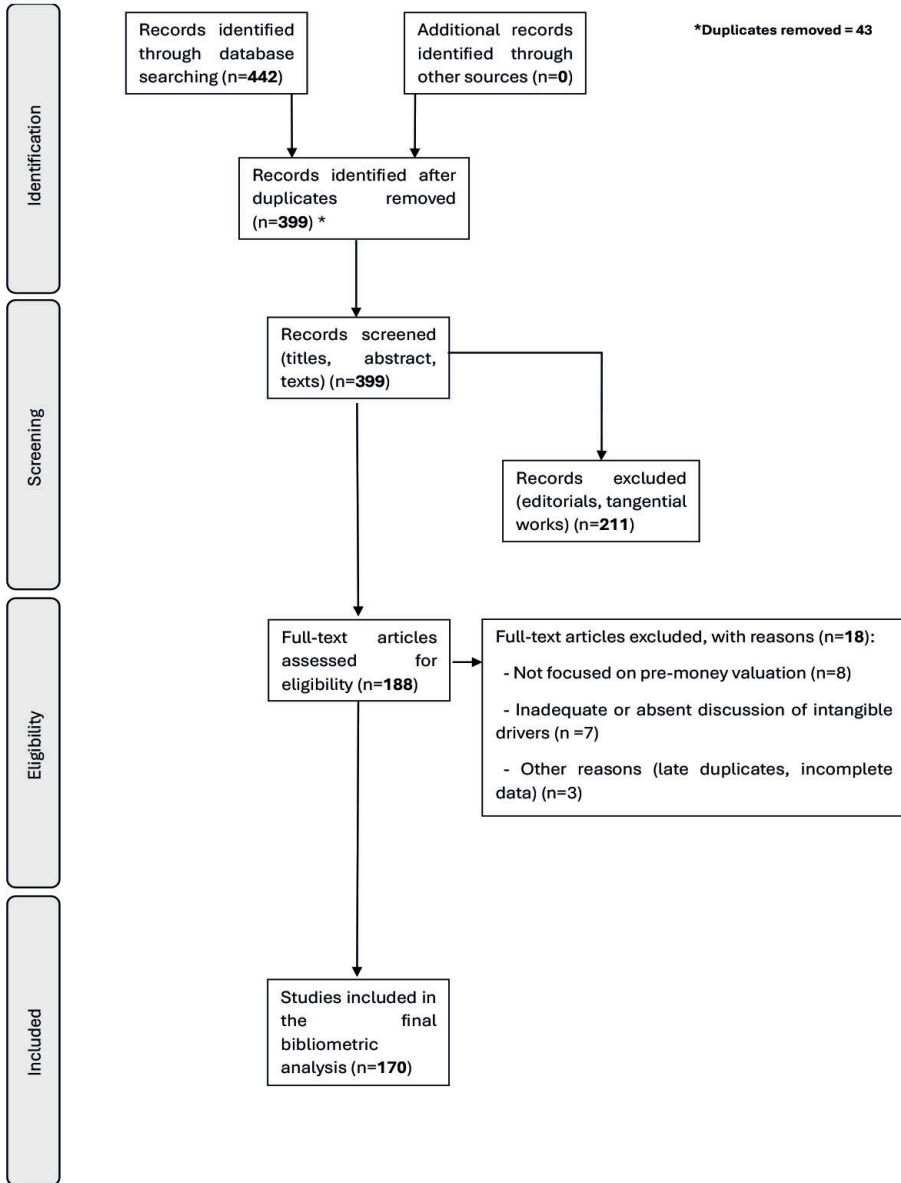
TS = (( "pre-money valuation" OR "startup valuation" OR "venture capital method" OR "discounted cash flow" OR comparables ) AND ( "human capital" OR "founder personality" OR "ecosystem" OR "intellectual property" OR "user engagement" OR intangible\* )) AND PY = (2010-2024) AND LA = (English) AND DOCUMENT TYPES = (Article)

*Source: Our advanced elaboration research in Web of Science Database*

TS covered title/abstract/author keywords/Keywords Plus® (Tranfield, Denyer & Smart, 2003; Kitchenham, 2004).

Screening flow and corpus. The queries retrieved 442 records, exported to CSV and merged (Aria & Cuccurullo, 2017). Duplicates (n = 43) were removed through manual checks (Tranfield et al., 2003). Title/abstract/intro/keyword screening excluded tangential items (e.g., real-estate DCF; intangible cultural assets), yielding 188 full texts; a further 18 were excluded for insufficient discussion of intangibles, leaving a final corpus of 170 articles (Cumming, Groh & Vismara, 2022; Hand, 2021).

Figure 4 - Systematic search and screening (PRISMA flow)



Source: Our elaboration from: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). P referred Reporting Items for Systematic Reviews and Meta-Analyses.