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Uncertainty and Entrepreneurship: A Critical Review of the Research, with Implications for the Field

Richard J. Arend
University of Southern Maine
richard.arend@maine.edu

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Uncertainty and Entrepreneurship: A Critical Review of the Research, with Implications for the Field

Richard J. Arend

L.L. Bean/Lee Surace Chair in Strategic Management, Professor of Business Administration, School of Business, College of Management & Human Service, University of Southern Maine, USA; richard.arend@maine.edu

ABSTRACT

Uncertainty and Entrepreneurship provides a critical review of the uncertainty research, with implications for a field that has had an existential relationship with it ever since Knight's clear delineation of the term as an essential wedge for new entry. We take a two-step approach in our literature review – where the objective facts are separated from the subjective interpretations – setting the new standard for such work. First, we provide the raw data taken directly from the hundreds of papers reviewed. This data is contextualized with definitions of key terms, the foundations of key concepts, and the limitations involved. Second, we provide our subjective analysis of that raw data. We assess the past research on uncertainty and its lack of evolution, discussing the theoretical and managerial implications. We find that much uncertainty-related *alchemy* exists – i.e., where a paper defines uncertainty as a condition that renders a focal decision unoptimizable, prior to it then suggesting a "new"

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optimization path. We make a clear and evidence-based case that the recent surge of such alchemy falls squarely on journal editors. We explain how this kind of misrepresentation of uncertainty has tarnished most of the recent theorizing in the field. As a result, we recommend significant changes.

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Prologue

. . . the darkness, to work its eternal alchemy. [Scott Haste]

There is value in separating the work in any literature review into two parts – the objective and subjective – to delineate the raw facts from their judgment. The exercise of explicitly and carefully separating the objective evidence from its subjective judgment in reviews of others' work allows a reader to see the raw original expressions and then judge the reviewer's interpretation of them. It is analogous to the presentation of contents in an empirical paper – readers see the data (e.g., in the descriptive statistics; in the description of the sampling) as well as the researcher's interpretation of the results of their statistical analysis. That delineation is, in fact, *the* scientific standard – a standard with two useful characteristics: First, it allows peers to trust each other but still verify the processes leading to the stated results. Second, it allows peers the freedom to interpret things differently based upon the given set of facts. (At a minimum, such information has been useful in catching academic fraud; it has also led to new results based on replication with updated empirical models – e.g., Shaver, 1998).

So, it is odd that this value of delineation has not been more recognized in research outside of empirical studies. Indeed, such objective-subjective separation in literature reviews should have been popularized in the social sciences, perhaps even made a requirement. But, it has not. Instead, the norm for literature reviews remains a seemingly seamless mixing of objective fact and subjective opinion, especially in relatively concept-heavy fields like entrepreneurship. So, it is not surprising that we have not seen many other reviews that provide the valuable separation. Very few even give their readers unfiltered access to the key relevant parts of those listed, reviewed papers in each paper's original authors' own words. That is unfortunate because such access provides two important benefits: it proves that the listed papers have been fully read by the reviewers; and, it allows the readers to interpret the words independently and to possibly reach different insights. This is why we chose to present in this two-part format.

We are left with explaining why almost all past literature reviews do not follow this suggested standard but remain highly cited nonetheless. They are highly cited for several reasons that have nothing to do with their violation of that standard, including: the name recognition of the authors and the journal; the promise that a substantial body of research is covered; and, the handy reference a review cite makes for general points that regular papers need to make (e.g., about a core concept or its consensus definition). While such review pieces have effectively inflated the impact factors of some journals like the *Academy of Management Annals* and the *Journal of Management*, there is *no* reason to believe that they fairly or fully capture the works they purport to summarize; rather, there is reason to believe that they have *not* on several occasions. One possible explanation for why almost none of these previous reviews has provided their raw data is that the outlet did not have the space to accommodate it; an explanation that has been recently rendered invalid, as online supplements have been available for overflow materials for years. A less practical explanation is that it is messy to do so, in the sense that the review's authors cannot sweep decades of diverse opinions into one neat message. Some of those opinions will invariably not fit, and that would detract from the unified conclusion being sold by those authors. (And, perhaps this need to separate out the raw data

is even more important when the review's authors are known for their unabashedly critical viewpoints.)

We believe that an objective, scientific review contains the raw, relevant facts, including: the number of papers used in the review; the journals they represent; the external quality scores of those journals; whether a paper references a common concept (here, that is Knight, 1921, and his definition of uncertainty); and, what the prescriptions are for the core problem (here, that is how to deal with uncertainty). Providing such facts involves a lot of cut-&-paste from the source materials (i.e., direct quotes). This part of our review explicitly "shows the work" done – evidencing that each paper was read, with relevant facts directly pulled from them (e.g., that paper's definition of uncertainty). Scientific value then emerges from analytical outputs, like the categorization of relevant factors, and from the identification of factual relationships among them. For example, in this review, objective facts emerge as answers to questions like how common is the Knightian definition of uncertainty in this literature, for theoretical relative to empirical papers? and, is the definition of uncertainty provided consistent with the measure of uncertainty applied, and with the treatments prescribed for dealing with it, in any one paper? (We note that some subjectivity can enter such consistency assessments, but that is why the raw data exists as a check.) Such scientific value depends on sticking to what the data says – being respectful and consistent with it – rather than ignoring it and choosing a different path.

So why is an objective and scientific review of uncertainty important right here and right now? Because, to be blunt, it blows up the past few decades of theorizing in entrepreneurship. How? Because the main, explicitly-cited conception of uncertainty is so ingrained in recent entrepreneurship theory and is so clearly defined in its specific conditions that identifying when its logic is contradicted – through a paper's own words – is easy. To be unequivocal, we are speaking about the logic of Knightian uncertainty being contradicted, a lot. (Alternatively, it could be that its logic is misrepresented, a lot; either way, though, almost all of the recent work has violated its intended definition.) This objective review of the literature shines a very bright light on the past darkness of what we term the *alchemy* involved in its treatment. By alchemy,

we mean that most papers are suggesting that they can turn lead into gold; in this case, they define Knightian uncertainty by stating that any decision plagued by it cannot be optimized prior to then suggesting an optimization path. This finding is not based on subjective judgment; it is based on the objective facts by quoting from the source.

We further argue that such logical inconsistency is at the core of recent entrepreneurship theorizing – from creation to effectuation to action to judgment – and it invades the vast array of discussions on opportunities. As such, the theorizing in our field appears, to a large part, to be based on alchemy, on anti-science. And, so, it is natural to then ask *why* has that basis been so widely adopted, promoted and cited? The answer seems to be that the private benefits of alchemy – of selling a magic treatment to untreatable uncertainty – currently outweigh the public harms to our field's legitimacy and to science itself. Our publication processes – pre and post – are broken, and with that breakage comes exploitation by alchemists as well as by those who innocently make logical contradictions and conceptual misrepresentations. So now, in the entrepreneurship field, we argue that there really is an urgent need to reset, repent and refocus to address these issues.

1.1 Outlining This Review

Table 1.1 depicts the flow of this two-part literature review. In Part I, we provide the objective facts. We supplement the raw data taken directly from the papers reviewed with several necessary and preliminary contextual cues: We provide definitions of key terms. We provide the foundations of key concepts. We explain why it is important to review this literature on uncertainty specifically. We also supplement the raw data with basic summaries: We provide details on the process and on the quantified outcomes of the review, such as the numbers of papers that qualified for it. We describe what the raw data revealed in specific categories, such as the various definitions of uncertainty found. And, we state the limitations of this review.

In Part II we provide the subjective analysis. We explain the value of providing a scholarly interpretation of a review's raw data. We critique, we judge, we hypothesize, we implicate, and we recommend action.

Table 1.1: Overview of the two-part literature analysis

PART I – Necessary Preliminaries and Objective Facts for the Literature on Entrepreneurial and Strategic Uncertainty	**PART II – A Subjective and Informed Critique of the Literature on Entrepreneurial and Strategic Uncertainty and Why This Alchemy Exists**
Definitional Matters	The Value of Subjective Analysis in a Literature Review
Conceptual Foundations	The Blunt Cause of Alchemy as Editorial Discretion
Reasons to Review the Entrepreneurial and Strategic Uncertainty Literature	A Tale of the Donkey and the Carpenter – the Value of Critique in the Entrepreneurship Field
Numbers of Publications in this Literature Review	Objective Evidence of Editorial Discretion in this Literature
The Relevant Contents of that Literature	The (Surprising) Lack of Past Reviews on Uncertainty
An Objective Analysis of the Main ESU Literature Review	Models and Frameworks Relating to Entrepreneurial and Strategic Uncertainty
An Objective Interpretation of the Analysis of the ESU Literature and Beyond	The Irrelevance of the Evolution of ESU Research
Limitations	Interpreting the Research from the Review
	Discussion (with Recommendations)
	Theoretical Implications
	Managerial-Practical Implications
	More Future Research
	Conclusions

We do so by drawing on the objective facts from Part I supplemented by additional relevant objective facts. We interpret the raw data summaries (e.g., over uncertainty definitions, types, measures, sources and treatments) in terms of what they mean for our field. We speak to the relevance of the past research on uncertainty and its evolution (or lack thereof) in our field and beyond. We discuss the theoretical and managerial implications. We also leverage this review to make a clear and pointed case that uncertainty-related alchemy exists, and its existence falls squarely on journal editors. We explain how the misrepresentation of uncertainty has tarnished almost all of the recent partial theorizing in the field. As a result, we recommend a change of direction in entrepreneurship theorizing. We then conclude the two-part assessment of this literature with a call to action.

Appendix

Table A.1: Table of journals and their uses in the analyses

Journal Name	Count for Main Lit. Rev.	Count for Non.-Ent. Bus. Lit. Rev.	Count for Econ. and Psych. Lit. Rev.	*UTD24* List Journal	*FT50* List Journal	*ABDC* Ranking (2023)
Academy of Management Annals	1					A*
Academy of Management Journal	3	4		X	X	A*
Academy of Management Review	21	1		X	X	A*
Administrative Science Quarterly	1	2		X	X	A*
American Economic Review	1		7		X	A*
Cambridge Journal of Economics	2					A
CEPR Discussion Papers	1					
Cogent Business & Management	1					
Economica	1					A
Entrepreneurship & Regional Development	2					A
Entrepreneurship Theory and Practice	5				X	A*
Frontiers in Psychology	2		26			
Journal of Business Research	1					A
Journal of Business Venturing	13				X	A*
Journal of Developmental Entrepreneurship	1					
Journal of Economic Behavior and Organization	1		9			A*
Journal of Economic Perspectives	1					A*
Journal of Institutional Economics	3					B
Journal of International Business Studies	3	10		X	X	A*
Journal of Management	5	9			X	A*
Journal of Management Studies	4	4			X	A*

Continued.

Table A.1: Continued.

Journal Name	Count for Main Lit Rev	Count for Non-Ent Bus Lit. Rev.	Count for Econ and Psych Lit. Rev.	*UTD24* List Journal	*FT50* List Journal	*ABDC* Ranking (2023)
Journal of Political Economy	1				X	A*
Journal of Product Innovation Management	2					A*
Journal of Small Business Management	2					A
Management Decision	2					B
Management International Review	1					A
Management Science	8	26		X	X	A*
Managerial and Decision Economics	1					B
Organization Science	5	2		X	X	A*
Project Management Journal	1					B
Small Business Economics	15					A
Strategic Entrepreneurship Journal	17				X	A
Strategic Management Journal	10	9		X	X	A*
Strategy Science	1					A
Brain and Cognition			2			
Canadian Journal of Economics			2			A
Cognition			9			
Econometrica			7		X	A*
Economic Theory			6			A*
Economics Letters			9			A
Games and Economic Behavior			5			A*
Group Decision and Negotiation			2			A
International Journal of Psychology			2			
Journal of Applied Psychology			2		X	A*

Continued.

Table A.1: Continued.

Journal Name	Count for Main Lit Rev	Count for Non-Ent Bus Lit. Rev.	Count for Econ and Psych Lit. Rev.	*UTD24* List Journal	*FT50* List Journal	*ABDC* Ranking (2023)
Journal of Behavioral Decision Making			6			A
Journal of Business Ethics			3		X	A
Journal of Consumer Research			4	X	X	A*
Journal of Economic Theory			11			A*
Journal of Financial Economics			4	X	X	A*
Journal of Risk and Uncertainty			3			A*
Journal of Risk Research			14			C
Journal of Social Psychology			4			B
Judgment and Decision Making			3			A
Psychological Science			3			A*
RAND Journal of Economics			2			A*
Risk Analysis			11			
Theory and Decision			6			A
Thinking Skills and Creativity			4			

Table A.2: Summary table of uncertainty definitions in the wider literature

Definitions	
Absence of applicable rationale/formalized decision rules are inapplicable	Lack of knowledge
Absence of perfect foresight, where the full set of states, their consequences, or the probabilities are not known or knowable; even large amounts of historical data do not guarantee that a strategy that was optimal in the past will also be the best in the future	Lack of understanding of the interrelationships
Agent behavior unpredictability + difficulty in predicting outcomes of decisions	Lack of valid basis of any kind for classifying instances
Agents are uncertain about which probability law (or model) to use to describe the asset-return processes	Lagged or conflicting feedback
All the knowledge pertaining to a transaction is available in the system at one moment in time, but is unequally distributed	Large set of shocks that change expectations of the future without changing current fundamentals
Ambiguity [in outcomes; in information]	Little is known regarding appropriate strategies
Amount of uncertainty regarding the consequences of the change	Mere possibility of a negative experience
Any departure from absolute determinism	Missing performance information
Black swan - which is considered a surprise by all theories would shift the weight to case-based reasoning	Neither outcomes nor probabilities are knowable
Bounded unknown probabilities in a project selection	Newness, unfamiliar contingencies, unexperience
Challenges the status quo and elicits different beliefs	No one in the business community appears to have anticipated it (i.e., placed a probability on its happening)
Changing stakeholders and stakeholder expectations	Noise
Choquet expectations	Nominal shocks
Complexity	Nonconformities in audit reports
Conditioned on a transition probability	Non-ergodic contexts/worlds
Conflicting knowledge on the hazard's probability of occurring	Non-optimizable
Conjunction "fallacy"	Non-recurring events, which cannot provide precursor signs for the development of the future
Consequences are unknown with some unknown likelihood	Not controllable, and independent
Consuming news information during crises—which tends to be distressing, constantly evolving, and inconsistent	Not knowing whether/not knowing how
Corresponds to expected utility loss from not knowing the state in some decision problem	Novel, temporally-sensitive

Continued.

Table A.2: Continued.

Definitions	
County-level uncertainty shock	Novelty
Critical contingencies that will affect outcomes are not yet fully known	Object was hidden in one of three possible locations and probabilistic information about the hiding location was manipulated across trials
Decision situations where there is an unknowable future	Obsolete information
Deviation	Omissions from the state space
Difference between the amount of information required to perform a task and the amount of information available	Parameters of the probability distribution governing the value of an idea are not known by the entrepreneur
Differences in forecasts	Partial ignorance
Differences in valuations are irreconcilable	Perceived environmental instability
Different ratios of face orientation to quantify uncertainty	Perceived inability to predict
Difficulty anticipating and understanding actions	Perceived work uncertainty brought on by the COVID-19 pandemic
Difficulty in identifying a clear reference group	Perception and feeling of unpredictability and lack of knowledge with regard to current or future events
Discontinuities	Precise exposure locations are unknown
Dispersed or missing information	Private idiosyncratic shocks
Distributions that are greater in the dispersive order	Problems w/unknown solutions
Diversity of customer requirements	Process with an unknown parameter
Doubt	Projections imprecise, but agreeing
Drawing unsubstantiated conclusions from scientific assessments of risk	Projections precise but conflicting
Dynamism (e.g., of customer requirements)	Proportion of risk items with unknown coordinates on the variability of loss frequency estimations
Endogenous fluctuations	Quality of knowledge concerning how effectively facts, numbers, or hypotheses represent reality, such as evidence confidence scales
Equivocality	Quantum lottery
Pervasive lack of confidence among investors and entrepreneurs in their ability to foresee	Rate of change
Estimates that are biased, with unknown precision	Relevant beliefs cannot be evaluated based on observations or evidence from an experiment

Continued.

Table A.2: Continued.

Definitions	
Ex ante difficulty in knowing	Risk
Extent to which actions will make a difference (i.e., impact uncertainty)	Risks that cannot be expressed in terms of mathematical probabilities
Fear-inducing stimulus and a hope-sustaining response	Set of alternative actions whose consequences depend on uncertain factors beyond one's control
Feeling afraid	Shifting landscape
Forecast errors	Shocks
Future is knowable, but not calculable	Situations where the probabilities of obtaining a payoff are unknown or at least difficult to ascertain
Future is unpredictably different from the past, and information about the future is incomplete, unknown, or unavailable	Societal preference intervals, which are ranges of values over which it is unclear whether society as a whole should accept or reject an option
Future outcomes are not readily knowable	Spatial hazard variability
General lack of knowledge	State probabilities unknown, with bounds on components that make up those probabilities
High doubt	State with multiple possible values
High growth volatility	Stochastic evolution of the resource positions over time
Higher variance	Stochasticity
Ignorance (of knowable information; of own ignorance)	Strategies cannot be formulated and controlled rationally and deliberately
Imperfect information (imprecision, ill-definition, arbitrariness)	Subjective feeling of being unsure (e.g., about the content, process or outcome of a task; about social interactions)
Implied stock market volatility	Subjective or "estimative" probabilities and an associated level of confidence
Impossibility of determining both the possible outcomes of a decision and their associated probabilities	Surprise
Impossible communications	Time-varying idiosyncratic volatility
Inability to anticipate	Transitory uncertainty shocks
Inability to create agreement over future	Unanalyzable
Inability to define appropriate means	Unanticipated

Continued.

Table A.2: Continued.

Definitions	
Inability to discover the truth	Uncharted territory with different actors advocated competing, alternative options
Inability to discriminate between relevant and irrelevant data	Unclarity of goals
Inability to establish cause–effect relationships	Unforeseeability
Inadequate or incomplete mental models	Unimaginable outcomes, their probabilities
Incentive is unknown	Uninsurableness
Incomplete information/knowledge	Unintended consequences of (bad) actions chosen
Incomplete knowledge regarding an action's potential consequences	Uninterpretable
Incomplete preferences	Uniqueness
Incomplete/open option set	Unknowingness
Incomplete/open outcome set	Unknown accuracy of beliefs
Information on all possible outcomes is just not available, and not all possible outcomes are knowable	Unknown psychological motivations
Information relevant is missing (due to ignorance [i.e., the information has never been observed and is unknown] or to memory failure [i.e., the information has been observed and is forgotten])	Unknown relevant variables and their functional relationships
Informational asymmetry	Unknown unknowns
Inherently stochastic	Unprecedented strength, scale, and nature of the storm, the potential damages were unpredictable and therefore uncertain
Inherently unmeasurable	Unpredictability
Instability	Unstable demands from outside
Insufficient knowledge	Unsure that reaching the conjecture is possible at all
Irresolvable	Variability/variation in the availability of pertinent information
Knowledge about the future is incomplete and many contingencies are unforeseen	Volatility/variance
Knowledge relevant to future predictions is not simply unknown, but unknowable	When a wide variety of explanatory variables has produced inconsistent empirical findings
Wide range of future states	Whether stimulus congruency was predictable or random

Table A.3: Summary table of uncertainty types in the wider literature

Types	
Adoption	Perceived effect
Aggregate demand uncertainty	Performance standard
Aggregate profit uncertainty as the conditional standard deviation of a common factor across unforecasted fluctuations in the sales growth of different industries	Policy uncertainty = the ease with which a given branch of a country's government can undo existing policies or implement new ones
Aleatoric (statistical) uncertainty	Political uncertainty = interim regimes becoming autocratic rulers; a lack of checks and balances in a country's political system; uncertainty about future government policies; uncertainty associated with changes in regulation or public policy and future government actions; uncertainty as to not only if and how a governmental action will occur but also where and when it may originate
Arbitral uncertainty	Predictive uncertainty = the uncertainty of $\tilde{y}$ given sigma; where mu and sigma-sq are unknown mean and variance, respectively
Asset return uncertainty (e.g., of shadow banks)	Procedural
Attributional uncertainty = unknown to "buyer" whether any difference to expectations is due to exogenous shocks and/or agent actions; known to "seller" ex post	Product quality
Behavioral uncertainty = difficulty in assessment of partner behavior and conduct based on readily available measures and caused by sociocognitive disparities and lack of common grounds; results from the possibility of strategic non-disclosure, disguise, or distortion of information' by exchange partners; the lack of predictability with respect to the behavior and actions of the foreign subsidiary's agents including its employees, managers, equity partners, and others empowered to act on behalf of the subsidiary in the host country	Production uncertainty
Belonging uncertainty, defined as the general concern about the quality of one's social relationships in an academic setting	Prognostic uncertainty
Business model	Prospective uncertainty = uncertainty about its future value (real options)

Continued.

Table A.3: Continued.

Types	
Buyer dependence uncertainty = uncertainty about its supplier's behavior or potential supply disruption	Psychological uncertainty = a *lack* the situational *understanding* needed to predict the future, reduced feeling of control, the general state of *unease* (derived from an employee's *inability to predict* outcomes in a given situation)
Buy-in	Public dissemination of scientific research regarding uncertainty/limitations (e.g., in mice).
Choice uncertainty	R&D
Communicating uncertainties	Radical
Comparative uncertainty aversion; ambiguity aversion	Rank uncertainty
Competitive uncertainty = the extent that top executives have difficulty reliably predicting or anticipating the actions of competitors or the consequences of these actions (i.e., in the absence of communication)	Regime
Consumer understanding	Regulatory uncertainty = the perception of significant regulatory instability
Consumption uncertainty	Relational uncertainty (i.e., the subjective feeling of being unsure with regard to social interactions)
Contemporaneous uncertainty = uncertainty regarding the current value of an asset (feedback learning), arising from incomplete information	Resource
Corruption uncertainty = uncertainty about the need to make unofficial payments to government officials to conduct business; not only statistical uncertainty but also the broader definition of uncertainty whose probability distribution is unknown, such as unmeasurable uncertainty; uncertainty associated with the size, target, frequency, and outcome of corrupt transactions	Resource access (to partner's)
Credit	Response uncertainty = a lack of understanding about what response options exist, or about the consequences of response options, for addressing conditions in the environment; the inability to predict the likely consequences of a response choice
Cultural norms and behavior	Rules enforcement

Continued.

Table A.3: Continued.

Types	
Data	Sample size-based uncertainty = where the option uncertainty is differentiated based on the sample size of the information known (sampled) for the unknown distribution
Demand uncertainty = derives from the seller's lack of information about item-specific heterogeneity or the preference of local consumers (the seller's residual uncertainty should mostly be about local buyers' preference for a particular used car); the volatility of demand in a given national industry	Scientific uncertainty
Design process uncertainty	Scientific uncertainty message, accompanied by probabilities (20%, 70%, implicit ["will occur"] 100%) and time periods (10 or 30 years) in major ($\geq$ magnitude 8) earthquake risk estimates
Direct quantitative uncertainty	Second-order uncertainty (i.e., a distribution)
Domestic market uncertainty = is independent of what happens within a firm and is outside its control	Situational uncertainty
Domestic uncertainty about governmental policies (Delios and Henisz, 2003; Holburn and Zelner, 2010) ..	Social uncertainty = not knowing how to behave and what to expect in one's immediate and extended social and physical environment for reasons of social survival
Economic policy uncertainty = as individuals' inability to forecast the likelihood of events happening (e.g., the timing and content of govtl policy changes)	Social values
Economic uncertainty	State uncertainty = when managers and their firms find that the external environment is unpredictable - not predict how major stakeholders will behave.
Effect	Strategic uncertainty–that is, uncertainty about the opponent's play
Enforcement uncertainty = unpredictable requirement to adhere to a law/regulation	Structural uncertainty = the product of two variables: the uncertainty about growth persistence and the difference between the growth rate and its long-term mean. . . structural uncertainty is a function of how much uncertainty is perceived by agents and the degree to which the economy is in an expansion or contraction

Continued.

Table A.3: Continued.

Types	
Environmental uncertainty = unanticipated changes; frequent environmental shocks; the lack of predictability with respect to the outcomes and consequences of the firm's decisions in the host country environment; concerns an organization's inability to predict and comprehend the external environment; instability and unpredictability of the external environment; the inability to predict the external environment within which the MNE and its subsidiaries are situated	Subjective uncertainty
Epistemic uncertainty = events whose outcomes are viewed as potentially knowable	Supply chain
Epistemological uncertainty	Supply uncertainty
Evidence based uncertainty	Target uncertainty
Existential uncertainty	Task uncertainty
Exogenous uncertainty = uncertainty that firms can actively shape through investment or other means, may not be systematically related to option valuation per se	Technological uncertainty = when actors encounter digital technologies for the first time, they are unsure about what they are, how they perform, against which criteria they should be judged, and how they will affect their business
External	Temporal uncertainty = a fundamental "uncertainty about when crucial events or actions are going to occur
Extreme uncertainties and disruptions (e.g., that jeopardize physical flows of trade, investment, and workforce) = external shocks (e.g., cyber attacks)	Terrorism-induced uncertainty = uncertainty to firm investment decisions from disrupting global value chains, creating stress among workers, suppressing market demand, and increasing the cost of external financing
Felt uncertainty	Threshold uncertainty
Financial uncertainty	Trade uncertainty
Firm value uncertainty = volatility of stock price	Uncertainties about critical thinking in higher education
Firm-specific uncertainty = lies within firm's control	Uncertainties associated with competing standards
Fundamentally uncertainty = resource positions can change due to exogenous shocks, or "luck"	Uncertainty about both aggregate growth and/or firm-level growth
Government policy	Uncertainty about correlation among expert opinions
Ground motion uncertainty	Uncertainty about cost estimates

Continued.

Table A.3: Continued.

Types	
Human capacity	Uncertainty about factor values; real-world firms face two types of uncertainty when making capital allocation decisions
Income	Uncertainty about facts, numbers, and hypotheses that can be communicated in absolute quantitative forms such as probability distributions or confidence intervals
Indirect qualitative uncertainty	Uncertainty about individual preferences
Industry	Uncertainty about payoffs or feasible actions
Inflation uncertainty	Uncertainty about physical states of the world
Information uncertainty = ambiguity with respect to the implications of new information for a firm's value stemming from the volatility of a firm's underlying fundamentals and poor information	Uncertainty about self-protection
Inherent uncertainty of a real-time pandemic	Uncertainty about the inner workings of the firm
Input	Uncertainty about the magnitude of the impending news' market impact
Institutional uncertainty	Uncertainty about the relationship between aggregate and industry-level inflation
Intergroup uncertainty	Uncertainty about the values of alternatives
Internal	Uncertainty around the reduced risks from regulatory fines = the uncertainty surrounding government regulation
Investor uncertainty = regarding the content of upcoming firm earnings announcements	Uncertainty as a major source of complication in economic exchanges
Job insecurity	Uncertainty as gambles
Judgmental uncertainty	Uncertainty expressions like might and probably
Judiciary uncertainty	Uncertainty in future cost
Knightian uncertainty	Uncertainty in future price
Labor market	Uncertainty in prosocial decisions
Liability	Uncertainty of psychological motivation
Location uncertainty	Uncertainty of road accident loss
Macroeconomic	Uncertainty on a potential violator's guilt; legal uncertainty

Continued.

Table A.3: Continued.

Types	
Market fit	Uncertainty over the outcomes of competitive matches
Market instability uncertainty = uncertainty engendered by its competitors, new technology, and changing customer needs	Uncertainty regarding efficacy and safety
Mean-volatility joint ambiguity uncertainties	Uncertainty regarding preference heterogeneity among experts
Model uncertainty = doubts as to whether Q is the right model to describe the distribution of X; when different data-generating mechanisms or models are considered as possible or plausible by the decision maker; when uncertain and unreported assumptions make it difficult for readers of empirical research to use published reports as a basis for justified belief	Uncertainty regarding the benefits of a green technology = from different sources the uncertainty concerning an enhanced reputation and demand gain is primarily a result of the market and the new green technology itself
Natural	Uncertainty related to the behavior of transaction partners
Non-classical (quantum) uncertainty	Uncertainty related to the firms' ability to meet diverse stakeholder expectations
Norm uncertainty = no clear distributional information on a very bounded set of possibilities - for a willingness-to-pay (in a non-strategic) decision	Uncertainty shocks = the 2007–2009 financial crisis
Ontological	Uncertainty stress; perceived uncertainty stress
Operating	Uncertainty where one is exogenously given information about the unknown states as a "suggested prior"
Option uncertainty = uncertainty over distribution of outcomes for any one option, with more than one option available	Validity and credibility uncertainty [of the content, in ascertaining the quality (i.e., the validity and credibility) of the arguments presented by lobbying entities regarding the consequences of implementing certain public policies on public and/or private benefits]
Outcome uncertainty = possible policy outcome states are known but probabilities may not be	Work uncertainty = the sense of doubt about the meaning of a work situation, or of what it will bring in the future
Parameter uncertainty = the uncertainty about the parameter sigma given x (point forecasts)	

Table A.4: Summary table of uncertainty sources in the wider literature

Sources	
Acquiring another firm	Munificence
Acts of recombination	Nascent markets that are characterized by incomplete or fleeting market structures, unclear or contested product definitions, ambiguous demand, and lack of a dominant logic or legitimated category
Aging of population	Nationalist demands for more autonomy or independence
Alternative model specification (i.e., the choice of control variables in a model)	Natural disasters
Ambiguity (e.g., of the opportunity review and assessment processes)	Negative economic developments that can erase their investments of time and money
Ambiguous and non-definitive scenario spaces	Networking processes bound to involve unpredictability
Animal spirits	New and unpredictable interactions with unknown consequences, including unpredictable competitive interactions
Asymmetry in the information (e.g., between producers and consumers regarding the environmental practices behind a product or service)	New integration of systems (e.g., no one could say for sure how a communist and a capitalist system would function together in harmony)
Bankruptcy	New multipolar and globalized world
Beliefs that cannot be evaluated based on observations or evidence from an experiment	New products, technology or feature introductions
Breakthrough technology to produce discontinuous products and services	New ventures
Business failure	New, untried market opportunities
Causal ambiguity (in social cues)	Newness associated with the activities
Causal ignorance	News reports
Causal indeterminacy	New-to-the-world product or service
Changes (in demand, technology, consumer tastes, riavlry, or other environmental conditions, social norms, scientific or tech knowledge, simulated fitness landscape)	Noisy feedback, learning, signals
Climate change	Non-linearity
Competence gap in problem-solving	Nothing yet exists
Competitors do not always behave in rational or comprehensible ways, reflecting internal political realities within companies	Novel knowledge that defies prediction

Continued.

Table A.4: Continued.

Sources	
Complexity (e.g., structural information in the market)	Novel technology, market, or business model
Computational incapacity	Organization-environment interactions
Conflicting interpretations	Partial knowledge about explicit and latent, functional and price preferences of current and emerging customer segments + fluctuations over time, options and outcomes
Corruption as introducing arbitrariness and randomness into the costs of doing business	Political developments
Covid-19	Political instability
Created by disembedding	Process of entrepreneurship
Created by individualization	Public-sector imperfection due to rent-seeking induced uncertainty
Created worlds	Quantum indeterminism
Data imprecision	Questionable abilities
De novo entry	Questions of believability
Debated forecasts and beliefs about what will occur in the future	R&D as a partly random outcomes
Developing new markets and approaching new customers	Radical innovation
Differences (in forecasts, cultures, beliefs, ideologies, mental models, heterogeneity)	Recessions
Discontinuities	Remoteness of resulting innovation from local market needs
Disease	Revolutionary change
Dispersed knowledge, culture, geographic markets and regional resource endowments	Risky outcomes
Disrupting technologies - their influences are inevitably unpredictable regarding the economies and the societies	Rules and policy changes and their enforcement
Dissimilar learning contexts	Schumpeterian environments
Diversity of interests amongst members	Scientific innovation
Doubt caused by taking action	Serendipitous and purposeful intersubjective interactions between heterogeneous actors
Doubtfulness and apprehension	Shocks
Dynamic, fast changing, unpredictable contexts	Social change

Continued.

Table A.4: Continued.

Sources	
Dynamism (in resource needs of organizations and resource uncertainties of environments in this choice)	Speed of change and unpredictability of technology
Early mover/early stages of entrepreneurial endeavor	Speed of technological evolution of the industry
Earnings volatility	Start of international operations
Economic changes that the new product, service, or organizational form will entail	Stochasticity
Emergence of destructive black swans, such as wars and pandemics	Subjective judgments (e.g., where the value of a product is estimated by, for example, aesthetic appraisals)
Emerging industry in which traditional risk/return parameters are more difficult to determine	Surprise
Emerging tech	Technological and consumer/market evolutions and discontinuities
Empowerment of individuals against the changing conditions of globalization	Temporary demand shocks and cyclical fluctuation
Entering a new market	Threat of competitive preemption
Entrepreneurial opportunities	Transition economic conditions (unpredictable macro-econ, unstable institutions, poorly-developed infrastructure, volatile politics/legal regimes, govtl interventions)
Environmental change, complexity, dynamism	Transition of governing body (e.g., from British to Chinese in 1990s)
Environmental unknowns (in opportunities, resources, legitimacy, networks)	Turbulence
Epidemics	Turnover in top management
Equivocality	Uncertain consequences (e.g., R&D spending, diversification, acquisitions and divestitures, competitive actions)
Exogenous forces (e.g., changing demand and supply characteristics, technological changes, legislation, etc.)	Uncertain task environment and legal inefficiency of the institutional environment
Exogenous technological change in landscape outside firm's control + transaction-specific re: resource differences b/w firms	Uncharted waters = films spanning categories
Experimentation (R&D)	Unclear or contested product definitions
Fickleness of consumer tastes	Underlying stock market volatility
Financial crises	Unemerged best financing practice
Financial market imperfection due to asymmetric information between entrepreneurs and financial intermediaries	Unexplored market opportunities

Continued.

Table A.4: Continued.

Sources	
Firm size (small = more uncertain)	Unfamiliar environments (expanding to new countries)
Forecaster disagreement	Unforeseeable behavioral choices
Free will	Unforeseen consequences/contingencies
Future outcomes are not readily knowable	Unforeseen influences
General lack of knowledge (e.g., regarding that technology's value creation)	Unilateral moves towards full independence create deep political uncertainty
Goal ambiguity	Unimagined stuff
Heterogeneity (in knowledge)	Unintended outcomes (e.g., that are commonplace in entrepreneurial endeavors)
High failure rates	Unintentional action
High rates of change	Unique situations, generally speaking, because statistical calculations can be made (and hence risk is salient), but these tabulations vary in the extent to which investors see them
High velocity landscape	Uniqueness (of R&D project)
Hyper-competition	Unknowability of qualia
Ignorance and doubt	Unknowable outcomes
Ill-defined problems	Unknown behaviors of rivals and partners
Imperfect and unbalanced legal and financial supports	Unknown beliefs about necessary and sufficient conditions and relations among beliefs are correct
Imperfect information	Unknown demand
Inability to define appropriate means of achieving	Unknown efficacy of each strategy
Inability to discriminate between relevant and irrelevant data	Unknown goals
Inability to fully and accurately evaluate the product quality (e.g., reliability, durability, flexibility, ease of use) before consumption	Unknown levels of knowledge appropriation, development, and market demand for products and services
Incalculable profits	Unknown market value of a firm's resources and capabilities
Incomplete information	Unknown number and nature of possible acts, states and consequences, as well as about the probabilities of states
Incomplete or fleeting market structures	Unknown probabilities
Increasing levels of extent and mode of recombination	Unknown quality of the idea

Continued.

Table A.4: Continued.

Sources	
Increasing loss of distinction of a category	Unknown range of potential uses and values of the invention may be unknown
Individual heterogeneity over goals, motives, political agendas	Unknown resource characteristics (ends and means, factor mrkts)
Induced uncertainty by manipulating the variation of the vicarious information	Unknown situation (e.g., new technology, new market)
Industry volatility	Unknown unknowns
Information about the future is incomplete, unknown, or unavailable	Unknowns about the services, products, and markets themselves
Information asymmetry in the market	Unknowns over how user generated content (UGC) creates value, and who benefits from it
Information is not just dispersed, but is continuously and idiosyncratically generated by market agents	Unknowns with the focal technology itself, the market applications it can serve, the users adopting the technology, the ecosystem of activities that support the technology's commercialization, and the business model
Innovation (from R&D, in processes)	Unobservableness
Innovative governance, contracting, and firm structures	Unpredictability about supply and demand conditions, both present and future, opp costs
Innumerable number of micro problems, determining which are worth addressing, intuiting possible solutions, choosing solutions, and implementing these solutions	Unpredictability of an individual's future earnings in entrepreneurship, and opportunities
Instability	Unpredictability of demand
Institutional incongruences and contradictions (perecived or real)	Unpredictability of entrepreneur and team
Insufficient knowledge about which demand segments exist and how each segment's commercial viability evolves	Unpredictability of factors (exchange rates)
Intangible intensity	Unpredictability of new tech or a new market
Interactions	Unpredictability of people
Interactions of unknowns (pooled, sequential, and reciprocal)	Unpredictability of technological, market, political, competition, suppliers
Interconnectedness of the environment (customers, suppliers, distributors, competitors, government, public attitudes, technology, and financial markets) make analyzing the global environment difficult	Unpredictability of the institutional environment

Continued.

Table A.4: Continued.

Sources	
Internal limitations on creativity (of options)	Unpredictable actors - consumers, rivals, suppliers, investors, evaluators
Internal political processes	Unpredictable behaviors
Lack of a dominant design	Unpredictable business cycles
Lack of awareness	Unpredictable changes in the markets and industries
Lack of clarity	Unpredictable consequences/impacts
Lack of data and well-structured project planning	Unpredictable consumer preferences
Lack of distribution information (of possible outcomes) in a hypothetical case or lab experiment	Unpredictable economy
Lack of information about probability distributions involved	Unpredictable future costs
Lack of knowledge about production outcomes, competitive reactions, buyers' (subjective) preferences and other uncertainties associated with new products, new markets, and other elements of innovation and entry, regarding appropriate strategies or how best to achieve venture goals, regarding the scope or boundaries of the problem (what we do not know or what we should know), principles or functions (what the functions are that define how this technology works), and roles (network)	Unpredictable future developments and trends, and how they may become business relevant
Lack of reproduction typical of a category whose mode of recombination is diverse	Unpredictable incumbents reactions
Lack of sufficient information preventing the estimation of possible outcomes	Unpredictable industry growth
Lack of trust	Unpredictable institutions (and their policy changes)
Lack of understanding	Unpredictable integration of tech, of tech
Lagged or conflicting feedback from environments	Unpredictable job applicant's future productivity
Limitations of organizational information processing	Unpredictable management team capabilities, resource costs, competitor moves, market demographics, emergence of other technologies, technolog difficulty, regulatory changes
Limited foresight and time	Unpredictable market demand
Limits of human knowledge	Unpredictable political developments
Low quality of information (i.e., emergence)	Unpredictable prices and output rates from crops (due to weather)

Continued.

Table A.4: Continued.

Sources	
Luck and good fortune	Unpredictable underlying factors such as demand, prices, input costs, cash flow, project returns, technological factors, and regulatory and economic policy changes
Macroeconomic sources	Unpredictable investment returns
Major business expansion	Unstable demand, business models, regulations, technology
Market fluctuations, such as changes in interest rates, foreign exchange rates, equity prices, and real estate prices = external factors	Varying conditions of production in agriculture
Mass emigration	Venturing into new domains
Misalignments, incongruences, or contradictions between institutions on different levels, and how this affects entrepreneurial behavior	Volatility over customer, competitors, technologies, wages, underlying assets, consumer preferences
Mistrust of the people in charge of the institutions	Wide variety of explanatory variables has produced inconsistent empirical findings
	Yet to exist potential products and markets, resources

Table A.5: Summary table of uncertainty measures in the wider literature

Measures
A list of what is unknown
Absolute deviation of the residual term of a regression that estimates the expected returns to R&D and to physical capital and other control variables
Alliances with transition economy partners
Amount of experimentation
Amount of partial knowledge for the problem (ingredients known versus not)
Amount of the value of an idea that cannot be convincingly demonstrated by the entrepreneur
Anticipated count of PS2 games that are likely to overlap with games of the focal developer in a year
Application of judgment (e.g., not only to what consumer needs can be better met, but also to what solutions could better meet them)
Assumptions (e.g., expected value unknown, minimums observed; different platform types have different relationships with contextual factors on valuation)
Asymmetric information
BART measures
Bond-yield volatility
Brownian motion w/parameters known
Context (e.g., Covid-19; digital disruptions; new, very early-stage ventures; BLM; human-induced climate change; emerging industries; international alliances
Credit spread
Descriptions of things that can be uncertain, but not regarding their lack of information about states or probabilities or unknowns
Deviations between price and fundamental value
DOSPERT scale
Efforts envisioned that can result in a plurality of outcomes and thus the results of action are unknown at the time of contemplation
EFSA's various uncertainty measures
Entrepreneurial investment decisions
Entry timing
Environmental dynamism using Miller and Friesen's 1983 six-item scale
Events - (e.g., R&D spending, diversification, acquisitions and divestitures, competitive actions)
Ex post (e.g., as surprise; graphically measured after the fact as noise; luck; model mis-specification; occurrences of unanticipated outcomes; significant CARs; comparisons of profit function to entrepreneur's ex ante expectations)
Experimental (e.g., Ellsberg urn set up; unknown time until balloon pops)

Continued.

Table A.5: Continued.

Measures
Extent of recombination (captures the degree to which, in a given year, incumbent record labels recombine in their releases the elements of a focal style's offering with those of products in other styles)
Failure of intersubjective agreement between the relevant parties
Firm age—(<15 yrs old)
Firm growth mode
Frantic search (at a point in time for information)
Ignorance of which features customers would want
Importance × (Change × Complexity), with scores summed over sectors (competitive, consumer, technological, regulatory, economic, and socio-cultural)
Indefinite delays (e.g., to IPO [as treatment experience})
Industry proximity
Institutional ownership concentration
Interview responses/statements (e.g., "..did not know. . .;" "assessments from partners" and "problem-solving competence" (=feasibility; obstacles);"see" information incompleteness and gaps in competence; requests from partners for more "more data" and "proof of concept" and from distrust in form of requests for various assessments (technical, legal, reputational..); how founding teams described the change in a particular component of the environment (state uncertainty), how environmental changes will impact the new venture (effect uncertainty), and the new venture's ability to sustain, innovate, and/or lead (response uncertainty))
Iowa gambling task (IGT)
Knowable unknowns (through experimentation or marketing; through exploration)
Lack of established structures and institutional frameworks and standardized or settled procedures and processes
Landscape is generated anew at each shock (u is a new random draw from a uniform distribution [the landscape will shift over time to simulate uncertainty)
Leader tenure also serves as an inverse measure of political change, which is often associated with political uncertainty
List of hypotheticals (e.g., macro phenomena like GDP growth, micro phenomena like the growth rate of firms, and non economic events like war and climate change)
List of unknown things
Luck and good fortune
Media attention
Nascent and disrupted markets where ventures often operate without a clear industry structure
News-based Economic Policy Uncertainty (EPU) index
Novelty

Continued.

Table A.5: Continued.

Measures
Parameters of the probability distribution governing the value of an idea are not known by the entrepreneur
Positive variance
Probabilistic environment (if-then)
Proportion of feature firsts
Randomness
Rate of change and innovation in the industry
Regulatory exposure level
RICH and entrepreneurial self-efficacy measures
Risk (e.g., as a standard normal distribution; for options calculations; in terms of some mean and variance rather than the raw parameters; known probability distributions – based on different beliefs in action, assumption, or implicit reasoning;
Scenarios (operationalize uncertainty as a multi-dimensional construct composed of state, effect, and response types of uncertainty, operationalized as predictability and rate of change for the three; each of our decision scenarios was characterized by seven decision attributes—operationalized at two levels (either high or low); uncertainty (high) = unpredictability, unforeseeable, fluctuate high, no insights; potential opportunity's outcomes are fairly [un]certain {low/high}; scenarios that have unclear outcome distributions (e.g., going camping; drinking heavily; investing in a new venture); market uncertainty defining the context of the experimental choice task as an opportunity to invest in a newly emerging industry, namely clean energy)
Score of pre-IPO characteristics (=a new issuer scores one point for each of the three criteria: (i) it has above median pre-IPO sales growth, (ii) it reports a pre-IPO loss, and (iii) it has above median intangible intensity)
Sell-side coverage
Sense of doubt that blocks or delays action
State of technological development (from in production to works in the lab)
State-level volatility of GDP
Subjective priors (assumption that the value of the idea(vj) is either low(vl), medium(vm) or high(vh) with prior probabilities pl, pm, and ph respectively.. AND pl, ph > 0. (where at pl => loss occurs))

Continued.

Table A.5: Continued.

Measures
Survey question(s) – (the uncertain demand for innovative goods or services as a constraint on innovation and activities in influencing a decision to innovate (0 – none; 3 – very high) [UKIS survey]; vector of terms is used to note if a firm self-identifies as entrepreneurial, hybrid, or as a social enterprise (vs. structure as for-profit, non-profit, or hybrid; "Technological development is difficult to predict" as an indicator for technological uncertainty (from statement does not apply to item applies fully); "Products become outdated quickly" (instability proxy); about demand = whether not easily understandable, hard to predict; about institutions = whether difficult to rely on; about technological turbulence [adapted from Jaworski and Kohli (1993)]; considering the economic and community context for the new firm, how certain are you that the new business will be able to accomplish the following 11 items addressing: obtaining raw materials, attracting employees; obtaining startup capital; obtaining working capital; dealing with distributors; attracting customers; competing with other firms; complying with local, state, and federal regulations; keeping up with technological advances; obtaining help from a bank; and obtaining help from venture capital; effect uncertainty is measured as the predictability of the effects of demand change and technological change on their ventures; environmental uncertainty using the Miller and Friesen scale (10 items +2 more); environmental uncertainty was measured with three items, based on Miller and Dröge (1986) and Miller and Friesen (1983) [The market environment is changing very rapidly 2. Demand and tastes are unpredictable 3. The prices of products/services change frequently...]; institutional uncertainty is the result of perceived contradictions or incongruences between institutional levels, also referred to as institutional misalignment; intolerance of uncertainty was measured with a 12-item scale from Carleton *et al.* (2007); typical items include "Uncertainty makes me uneasy, anxious, or stressed" (unforeseen events, doubt, not full info, surprises); measured dynamic work environments by the three-item scale from De Hoogh *et al.* (2005), typical item was "your work environment is dynamic". (+ great opps for change + extent of challenge); It was not clear what developments and trends should be given special attention; We could hardly assess how the general conditions would develop for our company; We could hardly assess how our business opportunities would develop; letting outcomes for option A be certain and the probabilities for the outcomes in option B be fully or partially unknown, denoted as the A1 and A2 tasks, respectively; measured by two items based on Milliken's (1987) concept of state uncertainty; pairs of statements referring to high versus low uncertainty and had to indicate a mark closer to the statement that best represented their current situation on a 5-point scale (McKelvie *et al.*, 2011); items are: "The fluctuation in the demand for your product is moderate and steady" (low uncertainty) versus "‘The demand for your product will fluctuate significantly" (high uncertainty) and "‘Future technological innovations affecting the viability of the product seem likely, but they are likely to be incremental (not discontinuous)" (low uncertainty) versus "Future technological innovations affecting the viability of the product are likely to be frequent and major" (high uncertainty); response uncertainty is measured as the uncertainty on the firms' actions to sustain innovative leadership and the potential lead-time over competitors; state uncertainty is measured as uncertainty about the rate of demand change and rate of technological change; the team's perception regarding the "speed of change and unpredictability of technology in the firm's principal industry;" relied on afour-item measure of technological uncertainty (Atuahene-Gima and Li, 2004); asked about rapid change, and tech breakthroughs; 5-point Likert scale from very low to very high for questions of – "certainty refers to the amount of information needed to make a decision with confidence and the information available . . . please circle the level of certainty you have with regard to the following . . .;" considered four different sources of uncertainty (input/output, financial markets, governmental, competitor; assessed within market, technological, and competitive realms, and also with scales developed by DeSarbo *et al.* (2005) – 6 Qs each, some focusing on "rapid change", "difficulty in prediction", "size" and "frequency" of change, BUT many focusing on "threats" of rivals/customers, price sensitivities and opportunities; PSED survey question asks respondents to self-define and score on the term uncertainty (regarding financial contexts) and 5 levels from very low to very high)

Continued.

Table A.5: Continued.

Measures
Target price dispersion (before each earnings announcement using the most recent price target forecasts made by analysts before the announcement date and since the previous earnings announcement date)
Temporal exploration measure (the mean age of the cited patents)
Time spent as an entrepreneur (outside regular job market; how fast the venture closed)
Transfer of sovereignty over Hong Kong from the United Kingdom to China in 1997, the indicator has a value of 1 for 1984, and a value of 14 for 1997
Unforeseen dimensions are taken as parameters, as given, without being recognized as such
Use of a resourcefulness narrative (as a discursive, temporal account of past or ongoing entrepreneurial actions, whereby an entrepreneur is presented as using, assembling, or deploying resources in creative ways in order to overcome an impediment)
Use of knowledge of attributes of an entrepreneur by stakeholders given opportunity is uncertain
Use of opening behaviors (enlarge task by exploring not only new customer segments but also new advertising techniques that the company has never done before)
Uses of creativity
Variance/volatility (of factor's value (into the future) [demand]; as in traditional ROT; the monthly standard deviation of the returns for each biotech industry subfield index composed of publicly traded biotech firms; conditional variance of an aggregate indicator at the industry level, such as price level or industry output – we estimate GARCH (1, 1) models on a time series of monthly industry sales at the three-digit NACE level; in profits; the standard deviation of inflation rates), macropolitical uncertainty (i.e., the standard deviation of relative political extraction, and trade uncertainty (i.e., the standard deviation of tariff rates; profit variance in both the pre- and post-entry period; the standard errors of four regression slopes following past work -dependent variables were industry revenues, number of industry establishments, number of industry employees, and research and development intensity; an index of the standard errors of the regression slopes divided by their respective means was used as the indicator of unpredicted change for each of the four variables; variation in forecast error constructed based on the survey of professional forecasters, and regression-based forecasting models for GDP growth, inflation, S&P500 stock price index, and fuel prices; in the actual estimation of the effects of uncertainty, used data on these variables only over the period 1988–2011; in terms of volatility in the future value of entrepreneurship to the individual decision-maker; computed as the annual standard deviation in the daily value-weighted excess return on the NASDAQ; calculated the standard deviation of the number of start-ups taken public over the course of the rolling window period; in industry growth using the logarithm of the standard deviation of the growth rate of the industry where the firm entered; logarithm of standard deviation of employment growth rates in the industry (six-digit sector); measured as the standard errors of three regression slopes based on research -> dependent variables were the number of employees, amount of revenue, and number of firms for each industry, measured at the three-digit NAICS level; high levels of environmental dynamism represent dynamic industry conditions that are characteristic of uncertainty; option-implied volatility (e.g., computed using the method proposed by Bakshi *et al.* (2003), estimated from options on crude oil futures with maturity of approximately one year); past industry volatility on future earnings uncertainty in paid employment by using a sample of full-time employees to regress the industry volatility over the past twelve months on the individuals' earnings volatility (in terms of the standard deviation of earnings) in the subsequent twelve months; of each industry's gross product (tbe square root of tbe annual conditional variances) [the randomness, or volatility, in the external environment that cannot be altered by the actions of individual managers)

Continued.

Table A.5: Continued.

Measures
Venture stage (e.g., seed, R&D..)
VIX
Whether a patent uses unfamiliar components according to the extent to which its inventors recently and frequently recombined the set of components in the patent
OTHER
Feelings of uncertainty, like other emotions, can be studied in nonhuman animals
Intolerance of Uncertainty Inventory (a two-part scale separately assessing a unitary Intolerance of Uncertainty disposition to consider uncertainties to be unacceptable and threatening, and the consequences of such disposition)
The priming of uncertainty; negative and positive uncertainty increase the influence of affect in decisions
Uncertainty attitude
Uncertainty avoidance, a cultural dimension dealing with society's tolerance for ambiguity
Uncertainty bias, in which policy-makers do exactly what they accuse laypeople of doing, framing uncertainty in biased terms
Uncertainty effect = an aversion to unexplained transaction features by focusing on a research paradigm where researchers unintentionally manipulated the presence of unexplained transaction features and obtained a result
Uncertainty set = in classical robust optimization, when the input parameters are not specified exactly
Uncertainty-Threat Model to intergroup relations

Table A.6: Summary table of uncertainty treatments in the wider literature

Treatments	
Abide the institution	Inductive decision-making
Acquire a history of earnings	Informal information exchange
Acquire all consumers who do not buy from the incumbent (by providing subsidies and to drop the low-valuation customers by means of a high price after their uncertainty is resolved)	Information gathering
Acquisition of information about the project	Information search
Act (with intentionality; to learn)	Informational cues
Adapt	Innovate (due to larger additional profits)
Add connectivity, visibility, trust, openness,	Insurance
Add feedback (Bayesian updating)	Interfirm personnel flows
Adjust aspiration levels	Interlocking directorates
Adopt a promotion focus	Internal experimentation
Adopt complementary asset configurations with unilaterally specialized assets	Internationalise innovation
Adopt organizational ambidexterity	Intuit
Aim for big hits to compensate for a higher failure rate	Iterative learning during proactive DC deployment (to promote the balance between bias and variance (i.e., the main error components) in decision making)
Alleviate the irreversibility of R&D investment	Iterative path-dependent learning process undertaken through a series of actions
Alliance portfolio management	Join agglomerations or local urban milieus/consortia
Alliances and JVs	Judgment (consisting of intuition, understanding, and gut feeling)
Alter the institution	Keeping abreast of the political conditions in a country
Analogies	Knowledge
Analytics	knowledge sharing/transfer
Apply affordable loss	Launch a broader set of features
Apply broader, less selective innovation portfolios	Leading tech development

Continued.

Table A.6: Continued.

Treatments	
Apply chronology narratives with less difficult tasks set forth early on and then sequence a flow of self-reinforcing tasks that will increase the likelihood of action	Learn (as efficiently as possible; from arguments formulated as counter-theories even if objections are rejected (e.g., by identifying hidden premises); from spillovers; from thinking about and testing necessary conditions for an envisioned future to materialize; through failure analysis; about unknown "constraints"; by doing/experimenting; from the resolution of uncertainty; finding ways to lower the cost of testing multiple strategies, receiving guidance as to the types of tests likely to reduce signal conflation, and optimally sequencing tests based on previous beliefs; through experiments; various options or outcomes are imagined and considered, revisions to the other set may become expedient until a more refined consideration set is achieved)
Apply closing behaviors	Leverage the law of large numbers
Apply control variables	Licensing/subcontracting
Apply expert knowledge	Logically link assumptions to consequences
Apply heuristics and update	Long-term supply chain contracts
Appreciate and welcome new things	Lower the price for uninformed customers
Arms length proximity and face-to-face contacts between the actors involved	Manipulation of TMT compensation schemes
Avoid cognitive biases brought by inflated egos	Market spreading strategy
Avoid small-scale experimentation if the viability of the underlying technology appears to be threatened	Marketing activities [substantial effort to demonstrate the quality of their products through third-party expert certifications, product trials, advertisements, and positive product reviews, word of mouth comms]
Avoidance	Marketing practices are under continual revision as the firm's products/services shift and evolve
Base decisions on market and financial data	Match the mode of self-regulation and the decision-making context in which one operates
Bayesian updating with new information	Monitor and adjust investments in the exchange over time
Be curious	Multi-dimensional communicative stream

Continued.

Table A.6: Continued.

Treatments	
Be flexible and comfortable with ambiguity	Multinational production
Be innovative, flexible, creative, ideas-driven and continuously changing	Multiple approaches
Be less loss averse when potential gains exist	Multi-stage model
Be perceptive/experienced in many technologies to "have attention"	Mutual adjustment
Bear it	Mutual admiration and expectations of each individual's different skill sets
Become an insider (have close personal relations with other insiders of the industry)	Network (beginning with people already known; to provide a ready conduit of fine-grained information on reputation and trustworthiness, trust in relational contracting may be a self-reinforcing feature of entrepreneurial activity;)
Big bets (e.g., resource commitments to create and enact a new market order)	Norms and shared beliefs
Branching and anchoring (e.g., firms that cospecialize their upstream and their downstream assets across the value chain will achieve high value appropriation of the resulting diminishing value)	Observation and learning (from cues)
Bricolage	Obtaining the commitment of stakeholders who provide resources in exchange for co-participation
Broad exploration	Operate in well-developed market
Buffer	Opt for fixed earnings by hiring out services
Build scaffolding of resources for scaling	Opt for low commitment foreign operation modes
Change the level of activity by moving upward in the institutional hierarchy	Options creation and use
Checklist approach	Options thinking in personal skills investments, as well as the effects on scale that tightly held generalist skills imply
Choose a generic strategy	Organic organizational structures
Choose regular employment (guaranteed wages)	Organized rent-seeking
Clan control	Organizing support systems for the early phases of new venture creation
Cognitive generative processes (to expand and reconfigure composite memory/categorical memory)	Outsource
Cohesive and generative entrepreneurship	Overconfidence and illusion of control

Continued.

Table A.6: Continued.

Treatments	
Collect information (e.g., about other team members, such as ideas, thoughts, and potential)	Owning, controlling, and leveraging resources
Combine (e.g., good judgment and institutional entrepreneurship; activities for fit; causation and effectuation)	Partner (with firms from market economies (vs from transition economies); with firms from the same country)
Communications	Pause at learning plateaus to consolidate that knowledge about a focal domain
Compare performance feedback with organizational aspiration	Payment of incentives, gifts and bribes, in a general sense seeking to "... arrange a negotiated environment"
Compile reference groups	Peer-to-peer negotiation
Compose theories, test assumptions, compose solutions, evaluate feedback	Perform robustness analyses to make empirical findings more compelling and less prone to non-robust, trivial, and false-positive results
Conceive modes of action to get information	Performing effectively through proficiency, adaptivity, proactivity, or expansive agency
Concentrate innovation at the home-base when faced by high uncertainty	Personal consumption
Concentrate probabilities	Personal ties
Consider multiple strategies will perform more highly than those that commit to the first viable strategy	Personalized mentoring of new entrepreneurs
Consolidate	Persuade stakeholders to engage in risky projects in an uncertain future through visions, compelling narratives of the future (placing them in a broader narrative of a known past informed by a community's collective memory)
Contingency planning	Planning
Continually revise beliefs with new information gathered during entrepreneurial activity	Political activities
Continue search until at least two alternatives found that are ex ante equivalent in expected value before making a choice	Populate both the option and the outcome sets through judgment
Continuously alter strategy in an effort to fully capitalize on the potential gains inherent in dynamic environments	Prediction
Control (e.g., the future)	Price adjustments

Continued.

Table A.6: Continued.

Treatments	
Cooperate (e.g., among cofounders can exploit diversity of skills)	Proaction
Cope	Problem-solving
Copy product/process technologies	Process orientation
Corporate venturing (and spinouts)	Product diversification
Counterfactual reasoning	Project redefinitions
Craft strategies and attempt to shape the competitive environment	Proper updating rules
Create (e.g., missing information; new ecosystems; new options; strategy; a "white space" for experimenting)	Propose offerings that blend market categories
Crowdfunding [as a tool for both price discrimination and for reducing demand uncertainty (market testing)]	Provide functionality not easily replicated by alternative platforms
Decentralize	Providing self-enforceable high-powered incentives
Decrease investment	Pursue an opportunity while working in a firm
Decrease strategic and operational planning (and its sophistication)	Quick pace with a short time span to achievement of milestones
Defer	R&D (as an option)
Delay (e.g., entry, exit)	Rapid prototyping
Delegation of authority to local experts with expert knowledge	Real option investment w/ waiting to learn about future (identify shadow options, create them, manage them, exercise them; on opportunities that are not obvious to others and that, therefore, are undervalued)
Demand routines	Recursive market interactions
Develop strong bonds (of identification or commitment) between stakeholders	Reduce associative barriers
Develop theories to identify the states that define the problems and learn through experiments	Reduce innovation
Disconfirmation	Reduce investments
Discounting the offered wage	Reduce patenting activity
Discover	Reduce power asymmetries
Discovery-driven planning	Reduce willingness to pursue a new venture idea
Discussion and contestation	Relax capital market constraints
Diversify (but do so differently than rivals; earlier)	Rely on conjectures and develop different scenarios of potential actions and possible payoffs from these actions

Continued.

Table A.6: Continued.

Treatments	
Divest	Rely on existing networks
Divide the overall problem of structuring the venture into subproblems for which the management team can identify knowledge gaps	rely on information about managers/ entrepreneurs to successfully enroll stakeholders
Doing and thinking	Rely on ongoing personal ties in upstream and downstream transactions with their suppliers and distributors
Don't imitate firms with luck when you don't have it	Rely on other less-explicit social factors (such as high-status affiliations, familiarity with other members of syndicates, the quality of the entrepreneur, and the quality of an entrepreneur's storytelling)
Draw an uncertainty tree	Resort to strong ties
Dynamic networking processes	Review and redesign
Early containment of fixed costs and avoidance of irreversible investments (through real options)	Revive the distinctiveness of a part of the market
Early learning	Scenario planning (to investigate possible future situations and helps in transforming uncertainty into a source of competitive advantage;
Educational attainment, strong ties, and psychological capital (a composite index of optimism, self-efficacy, resilience, and hope)	Scientific research
Effectuation	Search (e.g., for new tech; w/a stopping rule;
Embed a vision of the future in a coherent and collectively held narrative of the past	Seek feedback
Embed flexibility	Seek funding for growth from informal sources
Empathize	Seek pre-commitments
Employ the trial-and-error learning approach	Select initiatives and give them meaning
Enforce routines	Selectionism paralleling experimentation
Engage directly with the environment, rather than seeking information from others	Self-commitment to cooperation
Engage in causally inferential action by forming beliefs, testing these beliefs, and responding to the feedback received	Self-efficacy
Engage in thoughtful and deliberate action at the exclusion of non-deliberative action, such as those observed in impulsive behavior	Sell stories formed with proximal initialization and narrower date ranges
Enlist government support	Sell to others when days are sunnier

Continued.

Table A.6: Continued.

Treatments	
Enter low uncertainty niches	Set price equal to incumbents' marginal cost
Entry into geographic regions that are less concentrated with other similar firms	Shape
Entry to entrepreneurship	Share (perceptions, attitudes, feelings, and behaviors in the face of outcome uncertainty [trust]; price uncertainties but allocate the yield risks entirely to the tenants;
Environmental scanning processes	Show more respect and appreciation to their employees to get more help from them and make full use of collective intelligence
Envisioning, pooling, and staging (to secure resources from external partners and exploit the identified productive opportunities in a timely manner)	Simplify(focus on fewer pieces of information) and adaptability (selective in their search for and attention to information and to only focus on information that is seemingly most relevant)
Establish a relation between self-committed actors	Simultaneous experimentation
Estimate likelihoods, and forecast values for any relevant parameters	Slack
Evade the institution	Smaller TMT size (and less diversity)
Exchange of threats	Social comparisons
Expectations	Social influence
Experience (local; in like projects)	Specialize
Experiential market learning	Speculate (make a passive bet on the future)
Experiment (e.g., with more uncertain theories; with small-scale launch, possibly to learn more about customer preferences;	Split up given problem into subproblems that are solved and combine the partial solutions into a satisficing whole
Exploit (e.g., knowledge spillovers; luck; network to control information flows)	Spread capital thinly over many projects
Explore (e.g., the fit and usefulness of beliefs; strategies that may be riskier may allow clarity at an earlier stage about the value of the underlying idea)	Stand out from the crowd through personalized development
Extensive market research	Stay with status quo
Few simple rules	Stimulate R&D investment
Financial risk management	Stimulus policies

Continued.

Table A.6: Continued.

Treatments	
Flexibility (e.g., in plant, equipment, sourcing, workforce,)	Strategic planning (directed at achieving a modification of the current state rather than directed at achieving some desired future state; emergent and continuously updated)
Focus on capabilities	Strong checks and balances
Follow rivals into new markets	Strong ties (i.e., family members and close friends) often serve as sources of assistance in uncertain situations.'
Follow VRIO	Structured, process-like approaches can be used to identify subproblems (to determine their uncertainty profiles)
Forecast	Studying what may be knowable
Forge links between specific types of communicative streams and audience responses	Substitute for formal contracts that are infeasible for user generated content
Forward/futures contracts	Superior capabilities with respect to sensing and seizing
Framing	Symbolic actions
Franchising agreements	Systematically consider information from the external environment in making and integrating strategic decisions
Functional matches between cognition and the environment	Temporal positioning, length, ordering
Gain market power	Test hypotheses (to update scenarios)
Gain/apply entrepreneurial experience	Top management size and diversity
Gather information from social networks, both pre- and post-investment	Transform (e.g., action into a narrative;
Generate (or make sense) of intermediary artifacts	Trial and error
Generate additional knowledge	Unbundle to identify "what" sources of uncertainty are actually relevant and how they interact
Generate cues in a communicative stream signaling that a company's management is adept	Undertake a more accurate self-evaluation
Generate feedback to higher-level institutions that encourage adjustment	Update beliefs over time
Geographic diversification	Use a bootstrapping approach
Give up	Use a systematic process of proposing and testing assumptions

Continued.

Table A.6: Continued.

Treatments	
Ground strategic management decisions on theories and experiments, similar to the structured and disciplined approach used by scientists	Use available means
Grow a culture toward entrepreneurial and investment behavior	Use behavioral signals to make support decisions
Grow and shrink operations to fit the circumstances	Use champions
Grow competence and confidence in using a given mode	Use distinct categories of "scientific" action to generate the information necessary for them to transform uncertainty into risk
Have strongly held beliefs about the value of those investments going forward	Use graphs and figures to depict multiple dimensions of measured uncertainties
Hedge	Use institutions
Heuristics	Use laws to reduce transactional uncertainties
Highlight distinctive elements such as altruism, pre-commitment, serendipity, and co-creation	Use market-supporting institutions
Hold the residual control rights in common	Use non-predictive approach
Horizontal M&As	Use policies to reduce the restrictions, costs, and uncertainty associated with entrepreneurial action
HR practices (e.g., entail the recruitment of employees who can fill a wide range of roles)	Use probationary contracts (as employer)
Hustle (as urgent, unorthodox actions that are intended to be useful in addressing immediate challenges and opportunities)	Use regulations to reduce the uncertainty associated with gaining access to resources
Hybrid entry	Use safe heuristics
Idea networking	Use sequential focus (not parallel) to learn about successive focal strategic domains

Continued.

Table A.6: Continued.

Treatments	
Identify knowable Opportunity-Ingredients (OIs) whose knowability varies across contexts	Use small stakes
Identify robust cross-country determinants of entrepreneurship	Use steppingstones to make progress in background domains without losing focus
Identify the optimal early-stage collaborators	Utilize project work and temporary organizations
Identify the stable or unstable/observable or unobservable conditions of venture success	Variation and selection
Imagine (non-actual world-states and actualize them with hard work; frame, and structure a new market order that is favorable to the focal firm)	Vertical integration
Imitate	Vicarious market learning
Implement a sufficient cognitive diversity (among proxy decision-makers using judgment of judgment)	Vigilance and externalization matter
Increase firm size	Visions
Increase interaction content (to better capture value from network effects through higher switching costs than firms with user-contributed content)	Voluntary restraint of rivalry
Increase investment (in generalist skills, entrepreneurial activity, and the strength of the relationship between balanced skills and entrepreneurial success)	Wait
Incremental resource allocations (to explore multiple emergent directions)	Wait for more information/certainty
	Based on willingness/preference to compete (testosterone/overconfidence)

Table A.7: List of common terms modified by label "entrepreneurial"

	Terms
Tier 1	Orientation (184k); spirit (174k); skills (146k); behavior (110k); process (93.5k)
Tier 2	Success (67.4k); intention (61.7k); education (48.4k); action (44.4k); self (42.8k); leadership (39.8k); opportunity (32.7k); business (32.5k); **learning** (32.1k); finance (32k); mindset (30k)
Tier 3	Ecosystem (29.4k); management (28.6k); characteristics (27.1k); venture (26.5k); **risk** (24.1k); firm (23.3k); attitude (22.6k); innovation (19.2k); thinking (16.5k); marketing (15,8k); strategy (15.1k)
Tier 4	Decision-making (13.2k); dynamics (12.5k); discovery (12.4k); context (11.6k); theory (10.8k); support (9.84k); model (9.35k); identity (8.78k); failure (8.73k); creativity (8.62k); **vision** (8.11k)
Tier 5	Network (6.06k); bricolage (5.89k); capability (5.72k); science (5.55k); engagement (4.8k); life (4.27k); government (4.16k); governance (3.88k); law (3.74k); policy (3.14k)
Tier 6	Resource (2.71k); power (2.58k); **judgment** (2.27k); **experimentation** (2.26k); engineering (2.03k); logic (2k); narrative (1.78k); goals (1.65k); **imagination** (1.62k); internationalization (1.61k); achievement (1.6k); outlook (1.55k)
Tier 7	Ethics (1.42k); persistence (1.34k); perceptions (1.23k); design (1.23k); ingenuity (1.19k); **uncertainty** (1.18k); movement (1.17k); funding (1.08k); corporate [*usually followed by culture or structure*] (1.01k)
Tier 8	Preferences (988); promotion (987); cooperation (976); agenda (976); story-telling (952); entrepreneurship (930); industry (913); influence (818); lifestyle (723); health (636); resourcefulness (630); **foresight** (567); boom (560); effect (539); medicine (525); property (513); intelligence (509)
Tier 9	Advice (486); tactics (386); affect (366); scenario (355); diversification (342); constraints (331); **risk management** (316); lessons (301); integration (298); wisdom (297); crime (296); selling (276); art (259); accounting (258); belief (254); reasoning (253)
Tier 10	Experiment (248); invention (234); religion (223); simulation (199); conviction (196); portfolio (189); drug (186); fire (178); utility (171); standards (162); spirituality (157); music (156); good (144); fraud (126); balance (112); deal (111)
Tier 11	HR (88); goal-setting (85); help (85); **gamble** (77); globalization (75); death (68); film (64); love (63); fulfillment (57); regret (54); happiness (53); conflicts (52); originality (51)

Continued.

Table A.7: Continued.

	Terms
Tier 12	Doubt (48); valuations (43); timing (41); aversions (37); prediction (37); hype (36); combat (34); **ambiguity** (34); **ignorance** (32); PR (31); defense (30)
Tier 13	Avoidance (28); AI (27); **alchemy** (26); tv (25); porn (24); naivete (21); morals (12); compromise (11); coopetition (11); conflicts of interest (10)
Tier 14	Joy (9); deception (8); stupidity (7); **unknowns** (5); therapy (4); lies (4); foolishness (3)

Note: the (bracketed numbers) indicate the number of results indicated by a *Google Scholar* search of the term as "entrepreneurial *term*" attempted on January 7, 2024; *k* denotes 1,000s; **bolded** terms relate to uncertainty or ways to learn about or predict knowable unknowns
Additions – as we would also like to get in on this game of "coin an unnecessary term to get cited more", we define the following terms that did not appear to have results in our search (and kindly ask readers to please cite us should they find the opportunity to use such terms):

- *entrepreneurial deduction* = when an entrepreneur makes an inference based on widely accepted facts or premises, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial induction* = when an entrepreneur makes an inference based on an observation, perhaps of a sample, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial abduction* = when an entrepreneur makes a probable conclusion from what they know, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial architecting* = when an entrepreneur plans, organizes, or structures like an architect, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial trade-offs* = when an entrepreneur exchanges one thing for another of more or less equal value, especially to find a compromise, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial anti-competitiveness* = when an entrepreneur tries to prevent or reduce competition in a market, or when a person does that to identify, create or exploit an opportunity

Table A.7: Continued.

- *entrepreneurial conflicts of commitment* = when an entrepreneur's external activities interfere with their responsibilities to venture
- *entrepreneurial misinformation* = when an entrepreneur disperses false or inaccurate information to deceive others, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial futility* = when an entrepreneur's actions are ineffective or useless
- *entrepreneurial bust* = when an entrepreneur faces a sudden decline or extreme drop in their venture's value, or the value of a pursued opportunity
- *entrepreneurial offense* = when an entrepreneur attacks or makes a proactive engagement, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial atheism* = when an entrepreneur lacks belief in a God or gods, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial evil* = when an entrepreneur acts in a morally reprehensible, wicked or sinful manner, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial hate/hatred* = when an entrepreneur displays intense or passionate dislike to a target, or when a person does that to identify, create or exploit an opportunity
- *entrepreneurial humor* = when an entrepreneur acts/behaves/speaks/communicates in a comical or amusing manner, or when a person does that to identify, create or exploit an opportunity.

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