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Measuring Value in Development with Advanced Real Options for International Sequential Acquisitions

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Abstract: Even though the application of real options theory in international business research has increased substantially, the measurement of collaborative synergies in international sequential acquisition by means of advanced real options is still the theoreticall gap which needs to be filled by new research and promising area for empirical research. This paper moves the field forward and highlights the fact that strategic synergies can be considered as compound real options for growth that are opened by an international sequential acquisition and, thus, add market value to the acquirer. Our research is presented as a theory-building inductive case-based study. This paper aims to integrate sequential compound real options with real options that have changing volatility in order to evaluate collaborative tacit synergies (a value in development) of sequential international acquisitions; thus, it contributes to corporate finance, international business, and strategic management theory with a fresh evaluation of the applications of advanced real options.

Keywords: sequential acquisition; synergy; real options; international strategy

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> *"So, it is incorrect to say that real options will always increase the value of a project or that only risky projects are selected. People who make these criticisms do not truly understand how real options work. However, having said that, real options analysis is just another financial analysis tool, and the old axiom of garbage in, garbage out still holds".* (Mun 2010)

1. Introduction

Global strategic decisions, such as alliances, mergers, and acquisitions (M&A), provide opportunities for researchers to test international business (IB) theory from the viewpoints of other disciplines (Leiblein et al. 2022). International sequential acquisition comprises a specific type of strategic and financial decision that has intriguing implications for the study of collaborative synergies in the strategic management discipline. It is represented by general management and real options theory and is typified by corporate finance. Moreover, Leiblein et al. (2022, p. 525) argue that "... by clarifying what makes global decisions strategic, we open up the potential to build upon the already impressive intellectual traffic between the international business and strategic management fields".

By identifying types of collaborative synergies, and to what extent sequential international acquisition provides an added market value, this paper aims to connect and contribute to research at the intersection of international business, strategic management, and corporate finance. Moreover, Chi et al. (2019) also argue that there is a strong connection between international business (IB) and real options theory (ROT) due to several reasons (Chi et al. 2019). On the one hand, an international business decision regarding the mode of entry, the timing, or the scale of foreign entry provides a robust context for the application of real options theory because of its uncertainty and irreversibility (Chi et al. 2019, p. 525). On the other hand, such decisions ultimately influence multinational enterprise (MNE) value creation that facilitates the acceptance of real options theory among international business researchers thanks to IB and ROT theoretical economic roots (Chi et al. 2019, p. 525).

This paper aims to integrate sequential compound real options with real options that have changing volatility in order to evaluate collaborative tacit synergies (a value in development) of sequential international acquisitions and, thus, to contribute to corporate finance, international business, and strategic management theory with a fresh measurement of the applications of advanced real options. Specifically, this paper also contributes to these disciplines by providing a cohesive analytical construct as a measurement tool in order to evaluate collaborative synergies, taking as an illustrative example Aesop's sequential acquisition performed by Natura Cosméticos S.A. (2012–2016).

The rest of the paper is organized as follows: The key literature review provides a scientific conversation on the value of exchange and development in sequential international acquisition, as well as the necessity of integrating two advanced real options (a compound one and one with chaining volatility). These two theoretical propositions derive from the scientific discussion above. Next, empirical research on the sequential international acquisition of the Aesop brand by Brazilian Natura Cosméticos S.A. justifies the provided propositions. The theoretical and empirical contributions of the paper are discussed in the section on findings and discussion. To conclude, the limitations of the research are presented and a future research direction is suggested in the last section.

2. Key Literature Review

2.1. Explicit and Tacit Synergies as a Value in Development

The value of merger and acquisition deals is derived from the synergistic combination of the assets of an acquirer with those of a target (Feldman and Hernandez 2022). Synergy can be defined as a combination of two firms' core competencies and dynamic capabilities that are more valuable together than they are isolated (Čirjevskis 2023a). Synergy has been researched by scholars from multiple disciplines, such as strategic management and corporate finance, employing multiple theoretical lenses (e.g., resource-based view, dynamic capability view, and open innovation theory) (Čirjevskis 2022a, 2022b, 2023b; Feldman and Hernandez 2022).

Lastly, scholars Hao et al. (2020) unpacked two types of collaborative synergy: explicit synergy, defined as a synergy deriving from the exchange by collaborative partners of tangible and intangible assets or market information in order to renew processes or capabilities, and tacit synergy, defined as a synthesis of cross-boundary resources to integrate, reconfigure, and develop new core competencies or modes of strategic thinking (Hao et al. 2020; Čirjevskis 2023a).

Collaborative partners can share, exchange, and integrate cross-boundary knowledge and capabilities (core competencies) in order to develop and exploit new competencies that they would not be able to achieve on their own (Cui and O'Connor 2012). Hao et al. (2020, p. 433) argue "that partnership synergy entails relational rents of both resource complementarity and the potential to leverage existing and newly acquired resources, thereby prescribing a path for overcoming organizational inertia".

An acquirer can pursue synergism through collaborating with target firms as "value in exchange", referred to by Hao et al. (2020) as explicit synergy (Vargo and Lusch 2008; Zhou 2011), and "value in development", such as the rearrangement of perspectives and building of new core competencies referred to by Hao et al. (2020) as tacit synergy (e.g., Čirjevskis 2023a). Even though Hao et al.'s (2020) has referred to explicit and tacit synergies' functions in linking contextual factors to radical innovation, the current paper sheds new light on the examination of synergy by exploring how explicit and tacit synergies function in linking contextual factors to sequential acquisition in international business.

If synergy is a process to renew core competencies so that collaborative partners create value greater than the sum of their efforts (Hao et al. 2020), then, in the case of international sequential acquisition, it can be proposed that, in a partial acquisition, partners pursue a "value in exchange" (explicit synergies), and when consummating the full acquisition, partners can pursue a "value in development" (tacit synergies). These synergies can be analyzed and predicted with applications of advanced real options.

In a sequential acquisition, the acquirer first purchases a stake of the shares of a target firm, referred to as toeholds (Bulow et al. 1999; Zardkoohi 2004; Xu et al. 2010), before consummating the full acquisition later. This strategy reflects a "real options" approach to addressing uncertainty (Xu et al. 2010, p. 166). Therefore, the synergism of an international sequential acquisition can also be calculated sequentially as sequential compound real options ("call-on-call"). Thus, other things being equal.

Proposition 1. *In a partial acquisition, partners pursue a "value in exchange" in search of explicit synergies, while in consummating the full acquisition, partners pursue a "value in development", generating tacit synergies, and this synergism can be evaluated with the application of real options.*

Next, this paper discusses the traditional valuation of collaborative synergies as well as the application of advanced real options to measure it.

2.2. Evaluating Collaborative Synergies: Discounted Free Cash Flows, Net Present Value, and Real Options

ROT emphasizes the value of staged investment when investments are required in uncertain investment contexts (Trigeorgis and Reuer 2017). The key idea from the corporate finance literature is that "the net present value of future cash flows is driven by the size, timing, and uncertainty of those cash flows" (Feldman and Hernandez 2022, p. 558). Even though the discounted free cash flow (DFCF) technique is the most widely used approach for investment valuation, standard net present value (NPV) techniques do not consider the flexibility embedded in the investment process (Benninga and Mofkadi 2022). The recognition of managerial flexibility as a real option (a right but not an obligation) is an essential extension of the NPV analysis.

Indeed, carrying out sequential investments with uncertain value can be thought of as exercising real options for the development of the next investments that may turn out to be valuable sometime in the future (Kogut 1991; Barney et al. 2023). In this sense, Chi et al. (2019) argue that, in the presence of uncertainty, the "real options" approach provides management by gathering updated information to invest if and only if it is profitable to do so (Chi et al. 2019; Trigeorgis 1996). In a global context, the purpose of these sequential acquisitions "– beyond evaluating ongoing business opportunities in a country – is often to build relationships with government officials, business leaders, and other critical stakeholders in a country" (Barney et al. 2023, p. 1110).

A sequential compound option is put in place when a specific real option's value is stipulated by the value of the next real option (call-on-call option) (Copeland and Keenan 1998). Therefore, at each stage, the investment can be re-evaluated and (possibly) abandoned or expanded (Benninga and Mofkadi 2022). In this vein, strategic synergies of sequential international acquisition can be considered as a compound real option when a synergy of a partial acquisition is opened by a synergy of full acquisition and, thus, can add market value to the acquirer (Čirjevskis 2023b).

For instance, the sequential compound option could have been employed when the two retail giants Carrefour and Tesco initiated a strategic alliance in 2018, which in turn could have become a merger. The two retailers divorced, choosing the option to abandon in 2021 due to the strong impact of the institutional context (Čirjevskis 2022b). Moreover, stock volatility change is also a common feature of international sequential acquisitions because market capitalizations of an acquirer and target can also change significantly during an announcement of a full acquisition. In this vein, the recombining lattice is employed when volatility is constant, and the non-recombining lattice is used when volatility changes (Culík 2016).

The Black–Scholes option pricing model (BSOPM) is one of the numerically easiest models for evaluating options of any kind. However, analysts should recognize that the assumptions given in the BSOPM valuation are fixed—specifically, constant volatility (σ), constant underlying value (So), constant risk-free rate (r), and no exercise before the final option maturity—and, thus, are not relevant to real options when an MNE sequentially

acquires an international venture, and when the stock volatility of an MNE and future market values of partners change significantly after the announcement of the full acquisition. Thus, other things being equal.

Proposition 2. *Non-recombining lattices with changing volatilities can be bundled with sequential compound real options to evaluate collaborative synergies when an MNE is pursuing sequential horizontal integration from partial acquisition to total acquisition of an international venture.*

3. Research Design and Methodology

Trigeorgis and Tsekrekos (2018) encourage further research that can facilitate more practical applications of ROT to decision making by capturing and evaluating flexibility in managerial decisions that strategy makers are faced with. In presenting a theory-building inductive case-based study, this paper responds empirically to this scientific recommendation for international business and financial management researchers.

The primary research method used to develop a cohesive analytical real option construct provides a measurement tool to evaluate the collaborative synergies of international sequential acquisition. The application of advanced real options is a widely approved method in the corporate finance community and is rarely used in business management. The data for this research were collected from V-Lab (the Volatility Laboratory), Finbox (an online platform for securities and trading data for the stock market), Trading Economics (official sources of information on more than 20 million economic indicators), and Natura Cosméticos S.A. and KPMG management reports, which are all official data sources with verified content also used by other researchers and practitioners.

In this research, non-recombining lattices are applied that integrate the application of two different advanced real options: an advanced real option with changing volatility when an MNE's stock volatility changes noticeably at the time of announcing a full takeover and a sequential compound real option (call-on-call) when future market values of partners change noticeably within four weeks before the announcement of the full acquisition.

Integrating these two types of real options in the cohesive analytical construct provides a measurement tool to evaluate the collaborative synergies of Aesop's sequential acquisition by Natura Cosméticos S.A. and, thus, can be employed to solve the problem of valuation of the collaborative tacit synergies (a value in development) of sequential international acquisitions.

4. Data Analysis and Interpretation: From Partial Acquisition to Total Ownership: Aesop's Acquisition by Natura Cosméticos S.A. 2012–2016

Earlier in 2012, Natura & Co Holding S.A., one of Brazil's most significant beauty and cosmetics companies, acquired a 65% stake in Aesop. The deal was valued at AUD 68 million (nearly USD 100 million). Established in 1987 and headquartered in Melbourne, Australia, Aesop is an Australia-based skincare company that has become a famous brand worldwide for body products. Subsequently, in 2016, Natura completely acquired Aesop. Under the complete ownership of Natura, Aesop grew in leaps and bounds between 2012 and 2022, as its gross sales increased from USD 28 million to USD 537 million, and the geographic footprint also rose from 8 to 29 markets.

Natura Cosméticos S.A.'s share price volatility in December 2012 (one week after the announcement of the partial acquisition) was around 24.0% (V-Lab 2022). Accordingly, in December 2016 (one week after the announcement of the acquisition of a full 100% stake in Aesop), Natura Cosméticos S.A.'s share price volatility spiked to 40% (V-Lab 2022). Therefore, to measure the collaborative synergies, advanced real options with changing volatility can be employed.

Moreover, the future market values of the collaborative partners also changed within four weeks before the announcement of the full acquisition, as shown in Table 1. This creates an opportunity to employ sequential compound real options to measure the synergism of the partial acquisition and full acquisition together. The duration of obtaining full synergies

was assumed to be six years, which included the period from 2012 to 2018 (four years) to exclude the influence of the next international expansion of Natura Cosméticos S.A., namely, the acquisitions of the Body Shop in 2018 and Avon in 2019 (Čirjevskis 2020).

Therefore, having supplemented real options with changing volatility with sequential compound real options ("call-on-call"), the author quantitatively measured all types of synergies (value in exchange and value in development) that could be generated by this deal. Based on the acknowledged recommendations of Dunis and Klein (2005) on the correspondence of financial options parameters with real options parameters for synergy valuation, the parameters of the non-recombining lattices were defined, which are given in Table 1.

Table 1. Parameters of real options with changing volatility and data.

Parameters of Financial Options	Parameters of Real Options with Changing Volatility and Data
Stock price (So)	The cumulated market value of Aesop and Natura Cosméticos S.A. as separate entities (four-week average) before the announcement of the partial acquisition was USD 12.397 bn (Finbox 2022b; Pound Sterling Live 2012; KPMG 2012, p. 28).
The strike price (partial acquisition) (K)	The hypothetical future market value of the separate entities was forecasted by the EV/EBITDA multiples of Aesop and Natura Cosméticos S.A. in 2012 as USD 12.927 bn (Annual Report Natura Cosméticos S.A 2012, p. 6; Finbox 2022a; KPMG 2012, p. 30).
The strike price (full acquisition) (K2)	The hypothetical future market value of the separate entities was forecasted by the EV/EBITDA multiples of Aesop and Natura Cosméticos S.A. in 2016 as USD 4.227 bn (Natura Cosméticos S.A. 2016, p. 17; Finbox 2022a; Exchange Rate 2023; Statista 2023; KPMG 2012, p. 30).
Stock volatility of an acquirer during the time of partial ownership of a target's shares (σ1)	Natura Cosméticos S.A.'s historical volatilities within the first week after the announcement of the partial acquisition of Aesop, 20 December 2012–27 December 2012, were 24.0% (V-Lab 2022).
Stock volatility of an acquirer during the time of total ownership of a target's shares in the next two years (σ2)	Natura Cosméticos S.A.'s historical volatilities within the first week after the announcement of the full acquisition were 40% (V-Lab 2022).
Risk-free rate (r1)	The annualized risk-free interest rate in Brazil in 2012 was 11.0% (Trading Economics 2022).
Risk-free rate (r2)	The annualized risk-free interest rate in Brazil in December 2016 was 16.44% (World Development Bond 2023).
Time to maturity (T1 and T2)	The duration (T1) was the period from 2012 to 2016 (four years), when Natura Cosméticos S.A. kept 65% of Aesop's stock. The time of synergy expectation (T2) by management during the period from 2016 to 2018 is two years after the 100% acquisition of Aesop.
Time increment (δt)	One-year time intervals for six years to account for the change in the up and down factors of the lattice-based real options method

Source: Developed by the author.

Regarding the binomial option pricing model's parameters, Natura Cosméticos S.A. kept 65% of Aesop's stock from 2012 to 2016, as shown in Table 2.

Table 2. Binomial option pricing model parameters: Natura Cosméticos S.A. kept 65% of Aesop's stock (2012–2016) with a volatility of 24% and a risk-free rate of 11%.

Time increment (years)	$\delta t = \frac{t}{N}$	1.00
Up factor (u)	$u = e^{\sigma\sqrt{\Delta T}} = \frac{1}{d}$	1.271
Down factor (d)	$\frac{1}{u}$	0.787
Risk-neutral probability (p)	$p = \frac{e^{r\Delta T} - d}{u - d}$	0.680

Source: Developed by the author.

Since the up and down factors depend on the volatility factor, which changes after four years up to 40%, there will be two sets of up and down factors (u, u′, d, and d′) corresponding to the two volatility factors as well as two risk-neutral probability factors (p and p′) corresponding to the two sets of up and down factors (Kodukula and Papudesu 2006, p. 169), as shown in Table 3.

Table 3. Binomial option pricing model parameters: Natura Cosméticos S.A. kept 100% of Aesop's stock (2017–2018) with a volatility of 40% and a risk-free rate of 16.44%.

Time increment (years)	$\delta t = \frac{t}{N}$	1.00
Up jump factor (u′)	$u = e^{\sigma\sqrt{\Delta T}} = \frac{1}{d}$	1.492
Down jump factor (d′)	$\frac{1}{u}$	0.670
Risk-neutral probability (p′)	$p = \frac{e^{r\Delta T} - d}{u - d}$	0.619

Source: Developed by the author.

To construct a binomial tree, one-year time intervals for six years were used. After the fourth year, the risk-free rate and the volatility increased. Thus, for the next two years, the calculated u′ and d′ were used, and the binominal tree became non-recombining starting in the fifth year, as shown in Figure 1. Next, by pursuing backward induction, real options with changing volatility bundle with sequential compound real options, which is the main theoretical and practical contribution of this paper.

Because full ownership (second "call" option) is dependent on partial ownership (first "call" option), the option value (synergies) is calculated in order, starting with the longest option (full ownership) and employing the risk-free rate (r2) and the strike price (K2). Moreover, the risk-neutral probability (RNP) p′ was used for nodes in years 6, 5, and 4. The value of the option (synergies) for full ownership was estimated using the binomial lattice.

The option values of the longest option (full ownership) then became the underlying values for the preceding option (partial ownership), for which the option values (synergies) were estimated, also employing backward induction. The risk-neutral probability (RNP) p was used for nodes in years 3, 2, and 1 following Kodukula and Papudesu's (2006, p. 172). The top numbers are underlying values. The bottom numbers are option values. The red color option values specify the option to abandon ("out of money") or no synergies generated. Lastly, the market value added (synergies) was estimated at the bottom of node "A", as shown in Figure 1.

Exercising the option of the partial acquisition's synergies creates the option for total ownership; thus, the option values of full acquisition synergies were employed as the underlying values (top numbers), as shown in Figure 2.

In this case study, the option lives of four and six years were used for a partial acquisition and a full acquisition, respectively. A closer examination of the Natura and Aesop collaborative synergy option results indicates that the real option valuations for the option to ally and the option to acquire were USD 3.79 bn and USD 11.03 bn, respectively. The combined sequential real option with changing volatility option (synergies) calculation justifies the theoretical propositions provided, as shown in Figure 3.

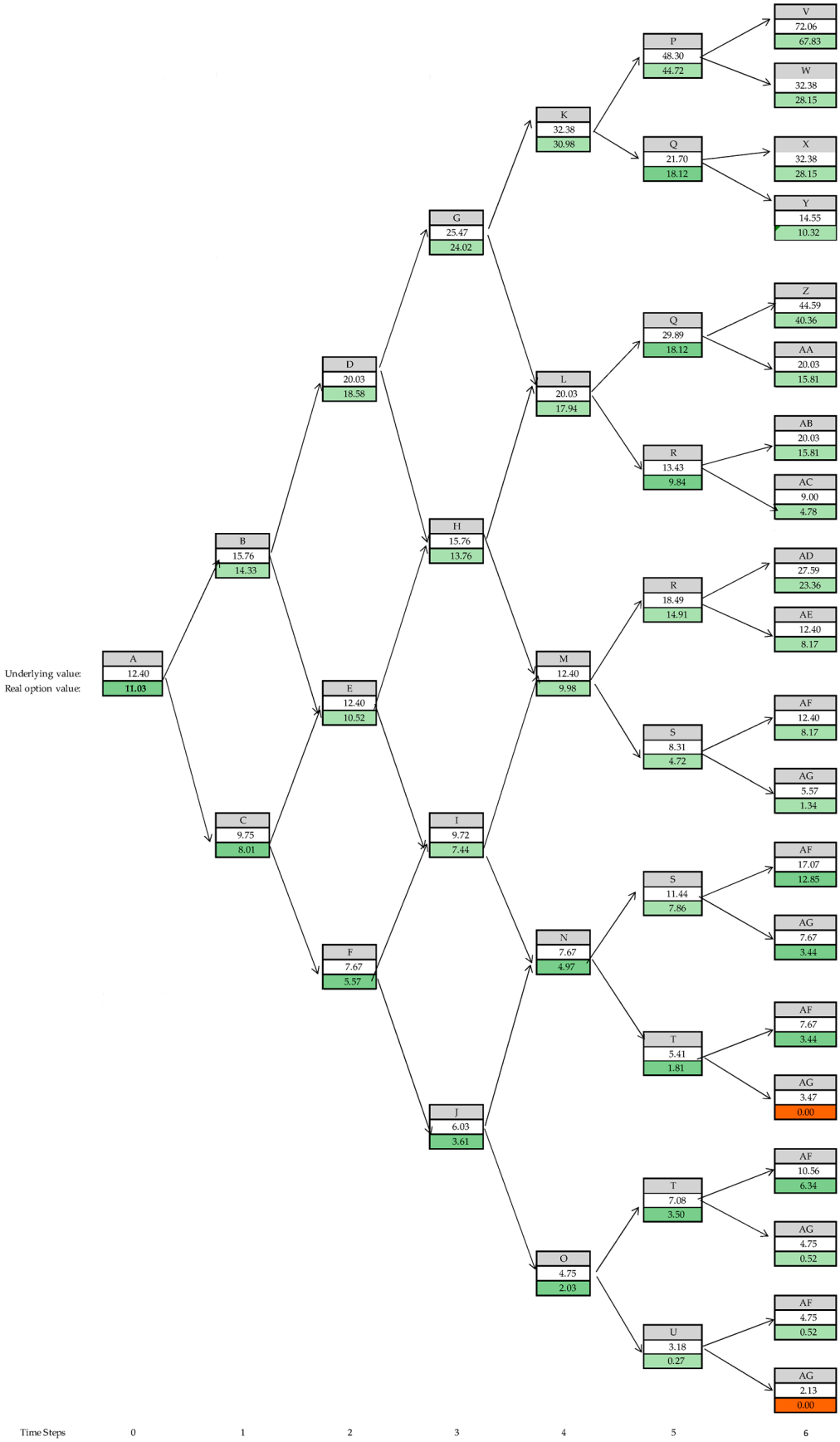

Figure 1. Binomial lattice for the acquisition (successor) option of the sequential compound option (in USD billion).

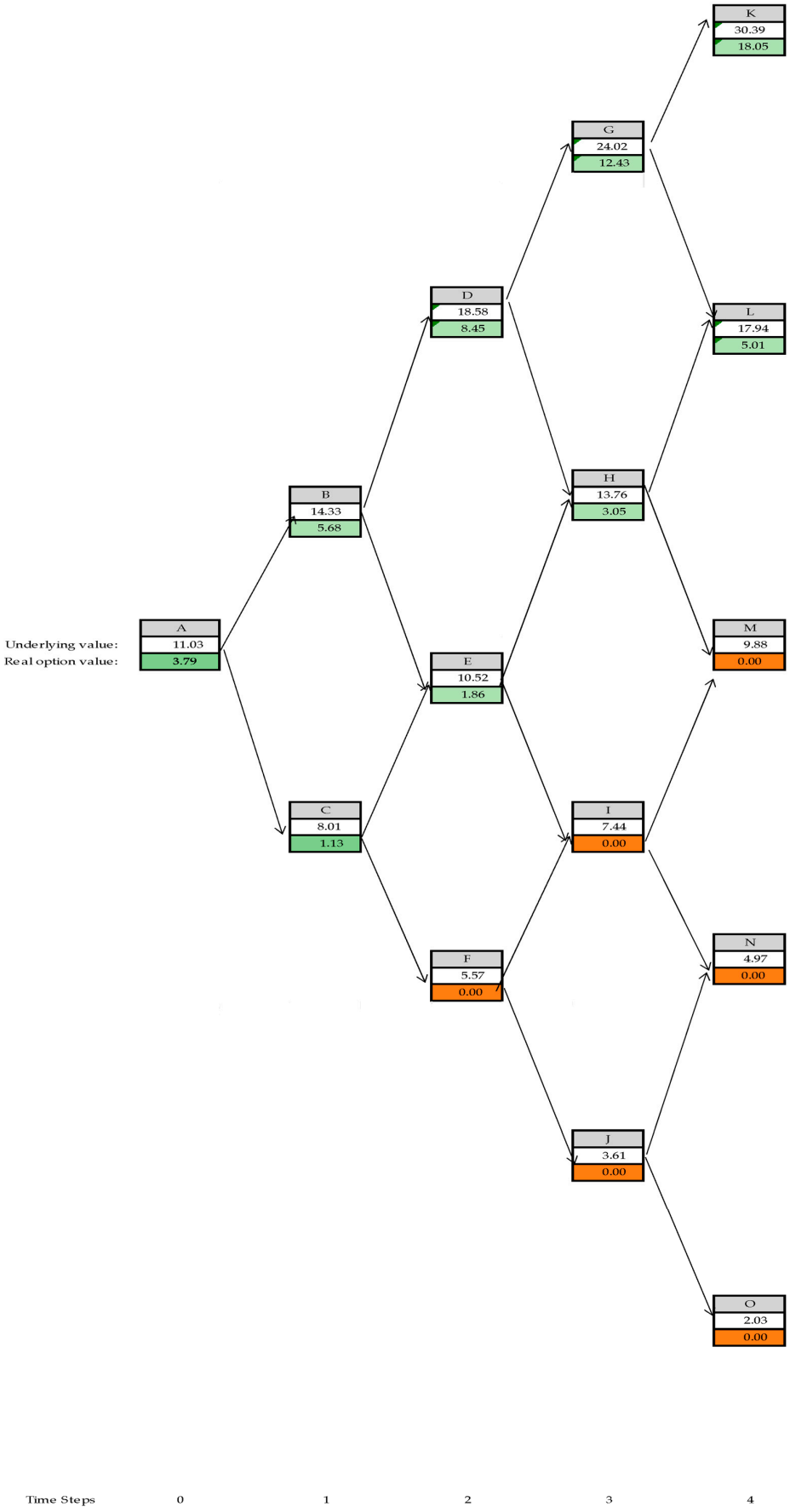

Figure 2. Binomial lattice for the alliance (predecessor) option of the sequential compound option (in USD billion).

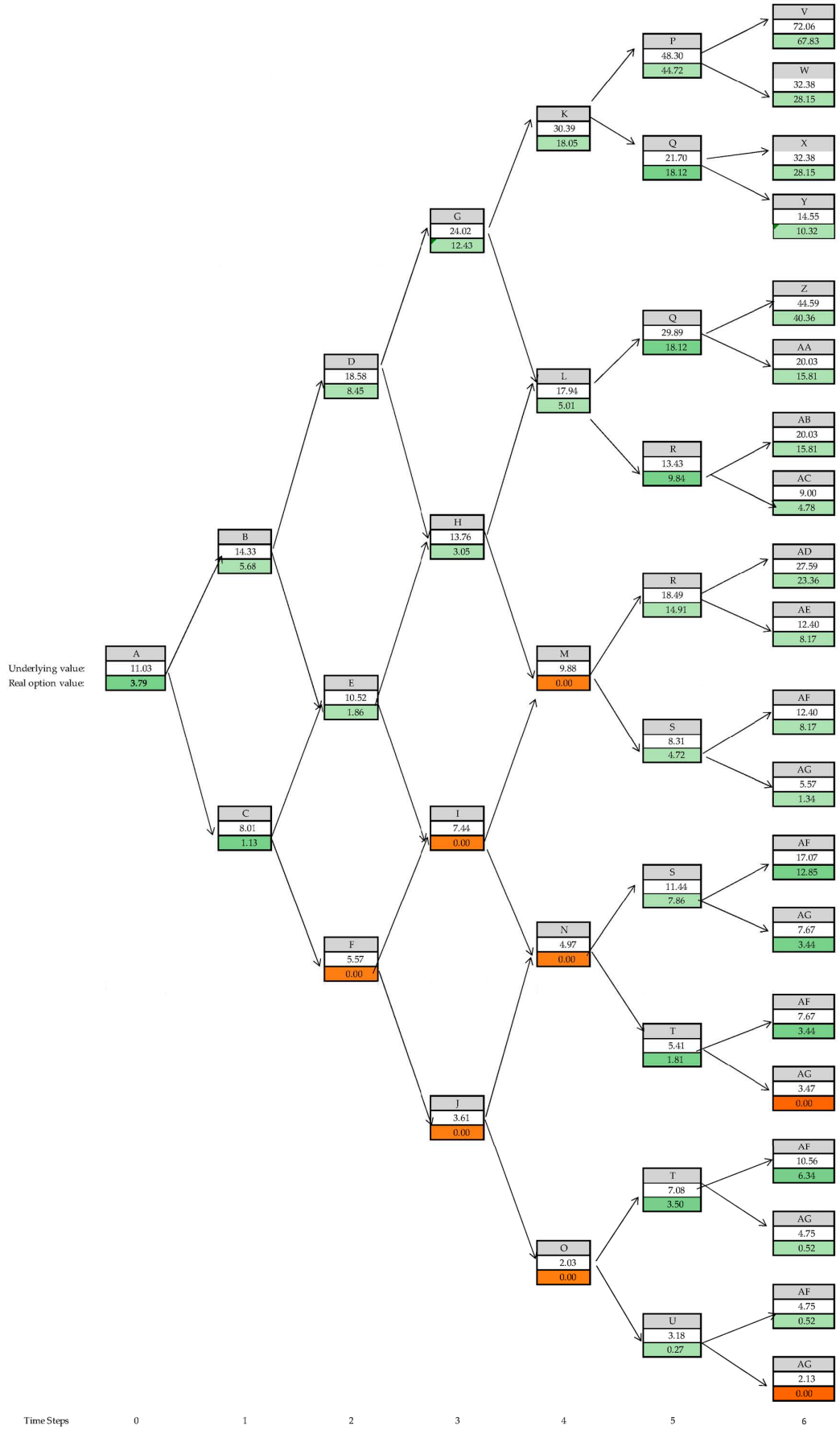

Figure 3. Non-recombining binominal lattice for the combined sequential compound option and option with changing volatilities (in USD billion).

5. Findings, Discussion, and Contributions

This study suggests that ROT has deepened our understanding of some of the fundamental issues regarding collaborative synergies of international sequential acquisition in IB research. The current study conceptualizes international sequential acquisitions as synergy mechanisms measured by advanced real options, as opposed to financial options as tools for hedging (Xu et al. 2010), and thus provides a new way of viewing real option strategies in global strategic management. This is the main theoretical contribution of the current paper to the international business discipline.

When it comes to the contribution to the financial management and strategic management disciplines, having supplemented real options with changing volatility with sequential compound real options ("call-on-call") in a cohesive construct to measure collaborative synergies of a deal, this study contributes to ROT by providing a new perspective on the practice of applying advanced real options in strategic management.

Regarding managerial contributions of the paper, ROT's empirical contributions to a related research issue core to the IB field are discussed: What underlies an MNE's competitive advantage? (Chi et al. 2019). Chi et al. argue that "although ROT has strength in theoretical clarity, empirical research has yet to leverage this strength fully in studying MNE strategic decisions under uncertainty, primarily due to imprecise linkages between theory and empirics" (Chi et al. 2019, p. 543). Therefore, the paper's main contributions to IB research are on the empirical side of ROT testing in international contexts.

ROT acknowledges the importance of the resource-based view (RBV), knowledge-based view (KBV), and dynamic capability view (DCV) in the explanation of the antecedents of MNE competitive advantage but draws attention to two new sources of competitive advantage that also underscore firms' dynamic capabilities: the MNE's ability to seek and exploit growth options in a new region (Chi et al. 2019).

Chi et al. (2019) argue that, when the market entry mode involves the partial acquisition of an existing firm in a foreign country, "acquiring the target in stages can also enable the MNE to gain access to more information both on the foreign market and on the target firm" (p. 534). The current paper justifies this proposition and contributes to the applications of ROT in IB research by providing fresh empirical evidence.

Kogut and Chang (1996) show that an MNE's initial foreign investments can serve as platforms for subsequent entry. With the empirical research performed on the application of ROT, this study contributes to IB and ROT, and its results support this finding empirically.

6. Conclusions, Limitations, and Future Research

"Real options" theory and its applicability in the context of strategic problems has always been ridden with some controversy, and differing approaches will inevitably provide differing results. Therefore, there are several limitations to this research. First, there is uncertainty as to when synergy can be realized by the parties and recognized by the market. In this sense, the time to maturity is largely unknown. Second, in the evaluation of the option premium in an M&A deal, this study did not clarify whether the premium incorporates both tacit and explicit components of the synergy. Third, regarding managerial practices, it would be advisable to calculate a range of values for different scenarios.

There are also several paths for future research. First, the effects of explicit and tacit synergies on international sequential acquisition may be different in varying institutional and cultural contexts. Future studies may test theoretical propositions in different international contexts or by conducting comparative studies across geographic regions and different industries.

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