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# Measuring Collaborative Synergies with Advanced Real Options: MNEs' Sequential Acquisitions of International Ventures

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**Abstract:** This paper aims to extend the real options theory valuing strategic collaborative synergies by advanced real options with changing volatility and contributes to the international business literature on MNEs' sequential acquisitions of international ventures. The proposition is that collaborative synergies can be valued with advanced real options with changing volatility when an MNE is pursuing the sequential acquisition of an international venture and the MNE's stock volatility is changing at the time of deciding on a full takeover. The paper discusses how recombining and non-recombining lattices with constant and changing volatilities can be employed to value the collaborative synergies of sequential international acquisitions. The theoretical proposition has been justified with the explanatory case study: Natura Cosméticos S.A.'s (Brazil) sequential acquisition of the Aesop brand (Australia). In conclusion, the paper discusses its findings, contributions, limitations, and future work.

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



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## 1. Introduction

Real options methodology is a relatively new approach for a wide range of valuation and decision-making issues of a company's management (Čulík 2016). The application of real options theory to the practice of international business is still a relatively new and loosely defined field (Li 2007). Employing real options as the theoretical lens to research international strategies has been a lacuna in international business literature (Eden 2009). Moreover, Chi et al. (2019) argued that existing empirical analyses of MNEs based on real options theory "typically focus on the perspective of a single firm, except for a few studies that examine JV formation and its alternatives" (Chi et al. 2019, p. 545).

This paper aims to fill these theoretical and empirical gaps. The paper explores how simple and advanced real options (options with changing volatilities) can be employed to value collaborative synergies when multinational enterprises (MNE) pursue sequential acquisitions of international ventures. Xu et al. (2010) argued that "sequential acquisitions are conceptualized as a real-option-based strategy", whereby the sequential acquirer resolves valuation uncertainty through information gathering and learning after first purchasing blocks of the shares of a target firm (Xu et al. 2010, p. 166). When an acquirer starts collaboration in the form of an alliance or trial partial acquisition and later makes a total purchase, this strategy also reflects a real options approach to addressing uncertainty (Xu et al. 2010).

Ragozzino et al. argued that financial economics and strategy have worked in quasi-independent ways over the years and two fields of research might be brought closer together toward the development of a real-option agenda that can be fruitful to various stakeholders (Ragozzino et al. 2016, pp. 437–38). This paper has contributed to this research agenda. The paper bridges the gap between real options theory (ROT) and adopting real option application for strategic decision-making on merger and acquisition (M&A) practices. Moreover, Ragozzino et al. argued that "the real options approach holds

tremendous potential for academics and practitioners. Yet, empirical work to date has not been able to bring conclusive evidence on the theory's merits and a normative framework ... " (Ragozzino et al. 2016, p. 437).

The paper aims to fill these empirical gaps and contributes to the theory of the financial management and practice of international business two-fold: on the theory side, the paper demonstrates how to employ more realistic advanced real options models to value collaborative synergies, and, on the practical side, disseminates the knowledge of advanced real options application in the case when multinational enterprises (MNEs) pursue sequential acquisitions of international ventures. Regarding managerial implications, the management of an acquirer's firm should actively strengthen the likelihood of full acquisition of international ventures in the synch of favorable market cues (Wang and Mahoney 2022). What is more, Trigeorgis and Reuer (2017, p. 57) argue, "we would encourage the use of real option with a greater focus on the individual project level of analysis, ... on individual real option cases". The current paper contributes to this scientific quest and seeks to address such research gaps.

Li (2007) also argued that future studies can focus on a refined treatment of multiple uncertainties through real options' application in international strategy. Knowledge accumulation, new core competencies absorption, and favorable conditions in the foreign market can trigger the exercise of sequential growth options in terms of a series of sequential international acquisitions (Chi et al. 2019). What is more, Kogut (1991) viewed collaborative synergies in a new international market as the purchase of a growth option and provided evidence that favorable market conditions trigger expansion via the subsequent acquisition of the partner's stock.

Volatility change is a typical feature of sequential acquisitions of ventures when MNEs pursue integrative strategies from partial acquisition or alliance to the total acquisition of an international venture. In such circumstances, the riskiness of obtaining collaborative synergies can rise dramatically at the time of an announcement of a full takeover. Valuing collaborative synergies with the simple real options, the stock volatility of the acquirer is assumed to be relatively constant over the option's life. However, if the stock volatility is changed during the option life (a duration of obtaining synergy), it can be accounted for by modifying the non-recombining binomial method. For example, Natura Cosméticos S.A. (Brazil) had pursued an acquisition strategy from the partial acquisition of Emeis Holdings (Australia) operated under the Aesop (Aesop) brand in 2012 to a total acquisition in the 2016 year; however, the stock volatility of Natura Cosméticos S.A was noticeably changed at the time of deciding on a full takeover. The application of a simple real option instead of an advanced real option with changing volatility would have provided an inaccurate result of synergy valuation.

Therefore, to further developed real options theory and international business disciplines, the paper provides theoretical and empirical contributions to a critical issue in international strategy: assessing prerequisites and the valuing of collaborative synergies in the sequential acquisitions process when MNEs' stock volatility is changing at the time of deciding on a full takeover. Multinational enterprises (MNEs) research on transnational mergers and acquisitions (M&As) capabilities, which emphasizes strong cross-venture integration of core competencies (Chi et al. 2019) can shed light on the benefit of advanced real options application to explore collaborative synergies phenomena. In this vein, "case studies may be a useful research method to advance these topics ... " (Raisch and Tushman 2016; Chi et al. 2019, p. 546).

Therefore, this paper contributes to this scientific request by asking the research questions: how can value collaborative synergies be valued when an MNE is pursuing integrative strategies from partial acquisition to the total acquisition of an international venture, and how does an MNE's stock volatility noticeably changes at the time of deciding on a full takeover? With the application of simple and advanced real options with changing volatility, this paper provides an answer to the research question and justifies the theoretical proposition.

The remaining part of the paper is organized as follows: in the Key Literature Review, the paper provides an extensive reading of the literature relating to the resource-based view (RBV) on collaborative synergies and rationales behind it to value collaborative synergies with real options valuation. The application of real options is discussed from the perspectives of advanced real options with changing volatility applications. The theoretical proposition has been derived from the literature review. Furthermore, the paper has answered the research question and justified the theoretical proposition by an explanatory case study: Aesop's acquisition by Natura Cosméticos S.A. within the 2012–2016 period. In conclusion, the paper discusses the Findings, Contributions, Limitations, and Future Work.

## 2. Key Literature Review

### 2.1. Exploring the Antecedents of Collaborative Competence-Based Synergies

The classic method used in academic research is to read the literature on a topic of interest and identify any gaps in previous studies since these gaps indicate opportunities for future research (Collis and Hussy 2009). This paper is bridging the gap between ROT, the resource-based view (RBV), in strategic management and global strategy practice in the search of antecedents of reciprocal synergy in strategic collaboration and their quantitative measurement. Thus, the current research is contributing to an application of advanced real option valuation models to measure a competence-based synergy of collaborative strategy and make them more accessible and compelling to the broad strategy and finance scholarly community (Hannah et al. 2021).

What is collaborative synergy? For Damodaran (Damodaran 2005), the synergy of strategic collaboration is the market value added that is created by two joining firms. This additional value derives from the new synergetic combination of the partner's idiosyncratic VRIN resources (Barney 1991), core competencies (Prahalad and Hamel 1990), and the partners' dynamic capabilities (Teece et al. 1997). Put simply, jointly collaborative partners will be able to integrate and reconfigure their existing core competencies and build new ones to better capitalize on new external international opportunities that would not be available to these partners operating standalone. There is a lot of evidence that the market value added by collaborative strategies derives from the synergistic combination (Feldman and Hernandez 2021) of idiosyncratic VRIN (Barney 1991) resources, core competencies (Čirjevskis 2020a), and dynamic capabilities (Teece et al. 2016) of collaborative partners.

Conventionally, collaborative synergy has been researched by scholars from strategic management and corporate finance (Feldman and Hernandez 2021) disciplines using different theoretical lenses (the resource-based view, dynamic capabilities view, and real options theory) (e.g., Čirjevskis 2021a). For instance, Barney and Hesterly (2018) argued that it is important for the management of collaborative firms to search through their resources and capabilities if it creates a customer value proposition (V), is hard (timely or costly) to imitate, rare (R), not easy to substitute (I), and the partnering firms' management systems allow substantial exploitation of those competences (O). Managers should then look for synergies between their firm's core competencies and those of the partner's firm (Barney and Hesterly 2018).

However, Knott (2015) argued that the resource-based view (RBV) and value-rarity-imitability-organization (VRIO) method encouraged users to evaluate resources relative to competitors but not to business partners. RBV still demonstrates "reasonably asking for an understanding of how firms' resources and capabilities truly play a role in M&A" (Ferreira et al. 2016). That is because the RBV has "a tendency to elicit static and inward-looking descriptions that are insufficiently geared to future-focused decisions" (Lockett et al. 2009; Knott 2015, p. 1816). Moreover, Błaszczuk (2018) argues that prior RBV studies paid relatively little attention to the subject of synergy and did not directly consider the assessment of potential synergy effects in a collaborative type of strategy. The current paper also aims to fill this research gap.

The greater the number of core competencies acquired by an MNE within the alliance or partial trial acquisition, the higher the likelihood it will take total ownership of a new venture after favorable market cues. Having examined the short-term wealth impact of cross-border acquisitions (M&As) by acquiring companies in 70 countries, Zhu found that acquiring firms that gained positive (negative) abnormal returns in previous cross-border acquisitions are more likely to experience positive (negative) abnormal returns in subsequent cross-border acquisitions (Zhu 2011). What is more, Wang and Mahoney only argued that the recent MNE's synergistic acquisitions will strengthen the likelihood of acquiring new international ventures after favorable market cues (Wang and Mahoney 2022; Čirjevskis 2020a).

The nature of firms' capabilities may not necessarily imply that superior resources and capabilities generate competitive advantage (Anand and Lu 2013). Recent research justified those collaborative synergies as the function of strategic complementarities, compatibilities, and the transferability of core competencies within collaborative deals (Čirjevskis 2021b). Collaborative synergies that are derived from the abilities of collaborative partners to mutually integrate and reconfigure external core competencies as well as their ability to build and create new core competencies internally during their collaboration are almost impossible to measure with operating profit margins (operational synergy) or discounted free cash flow and the cost of capital (financial synergies). In this vein, the market value added or collaborative competence-based synergies can be valued with a real options technique application.

## 2.2. Measuring Collaborative Synergies

The value of collaborative synergies or market value added can be calculated as follows:  $V(AB) > V(A) + V(B)$ , where  $V(AB)$  = value of a firm created by combining A and B,  $V(A)$  = value of firm of partner A, operating standalone, and  $V(B)$  = value of a firm of partner B, also operating isolated (Damodaran 2005). Conventionally, the valuation of the joining partners' firms is based on the analysis of discounted free cash flow (DFCF) forecasts. However, a valuation that is made relying solely on DFCF is inherent to several limiting assumptions, which seldom materialize in the real world. Thus, for example, (1) all uncertainty associated with the deal is already accounted for with an appropriate discount rate or a weighted average cost of capital (WACC); (2) DFCFs are deterministic and can be forecasted with precision—they are fixed and assumed as known for certain (Mun 2002, p. 59); and (3) managerial flexibility to actively manage the strategic collaboration after implementation is ignored, and the assumption is given in DFCF that the collaboration is managed passively—it is simply carried-out as forecasted and will not be altered after implementation (Brandão et al. 2005).

Recognizing the pitfalls of DFCF analysis for collaborative synergy's valuation, practitioners, managers, and consultants traditionally resort to complimentary valuation techniques such as the comparable EV/EBITDA multiples approach as follows: the enterprise value equals the EBITDA multiple multiplied by the LTM (long-term) EBITDA (e.g., KPMG 2012). However, such a technique is also missing managerial flexibility issues that are increasingly relevant in situations dealing with decision-making under uncertainty. If collaboration strategies are viewed as options instead of the DFCF forecast at the present moment, two important aspects are to be accounted for in alliance' and M&A ventures: firstly, the fact that, indeed, the future is uncertain, and secondly, managerial flexibility is a matter to be considered (Copeland and Keenan 1998; Brandão et al. 2005).

One more advanced approach to evidence of collaborative synergies is "looking at market reactions to acquisition announcements and gauging what the expected synergy value is and who obtains the gains" (Damodaran 2005, p. 33). Damodaran (2005) argued that research on stock returns volatility around M&A's announcements generally evidence that the value of the jointed partners' firms does increase in most collaborations and that the value increase is significant (Bradley et al. 1988). Dunis and Klein (2005) also argued that the announcement of a collaboration will be incorporated into the price immediately after

it has been made public (Dunis and Klein 2005, p. 4). Moreover, Dunis and Klein (2005) justified that the market often anticipates acquisitions long before the actual announcement day, and “the leakage of information before the announcement may also play a role here” (Dunis and Klein 2005, p. 5). In this vein, having employed the real option technique to measure a collaborative synergy, Dunis and Klein (2005) have recommended using the cumulated market value of the target and acquirer (four-week average) before the announcement of the deal terms as an equivalent of a stock price of the real option.

Respectively, the strike price is the hypothetical future market value of partners without collaboration. The standard deviation is the annualized standard deviation of weekly returns of the dominated partners after the collaboration announcement. Dunis and Klein (2005) argued that “. . . assuming semi-efficient markets that incorporate publicly available new information promptly, the calculation of the standard deviation of the acquirer stock price return was started the week after the announcement” (Dunis and Klein 2005, p. 7). Considering the time value of money, the acquirer’s country’s three-month rate on announcement day can be used as the risk-free rate ( $R_f$ ). When it comes to the duration of obtaining collaborative synergy it depends on the time of integration of the partners’ core competencies (Čirjevskis 2022b) and managerial expectations.

Do markets believe this collaboration? If synergy is perceived to exist in a collaborative endeavor, the market value of the partners’ firms, after an announcement of the collaboration, should be greater than the sum of the market values of the collaborative partners’ firms, before the announcement. Dunis and Klein (2005) named this phenomenon an abnormal return, namely, the difference between the expected firms’ prices without collaboration and the actual firms’ market price. Considering such parameters of strategic collaboration as (1) a stock return volatility of the acquirer before and after the announcement ( $\sigma$ ), (2) the market value of the partners’ firms, as a four-week average before the announcement of collaboration ( $S$ ), (3) the market values of the collaborative partners’ firms if operating independently ( $K$ ), (4) the time of synergy expectation by management ( $T$ ), and (5) the risk-free rate of acquirer’ country recognizing the time value of money ( $r$ ), an analyst obtains a set (five) of real option parameters to measure collaborative synergy.

### 2.3. Measuring Collaborative Synergies with a Real Options Valuation

Real options theory originated in 1977 with the ground-breaking idea of Stewart Myers that the Black–Scholes financial option pricing model developed in 1973 can be applied to capital budgeting as well (Folta and O’Brien 2004; Borison 2005). Myers (1977) originally defined “real options” as: “opportunities to purchase real assets on possibly favorable terms”. Since the inception of the term, it has been stretched substantially (Adner and Levinthal 2004; Tong and Reuer 2007). As Ragozzino et al. (2016) note, currently, that two main academic areas have devoted their attention to the study of real options: financial economics and strategic management.

At present, real options valuation (ROV) is a generic term referring to the process of recognizing embedded real options and attributing a particular monetary value to uncertainty and managerial flexibility (Copeland and Keenan 1998; Borison 2005; Kodukula and Papudesu 2006, pp. 53–65; Ehrhardt and Brigham 2006, p. 324). Regular appearance in the spotlight of academics, financial analysts, and business consultants has resulted in a wide range of ROV methodologies being proposed (Tong and Reuer 2007). Real options theory certainly is uneven and there are many contrasting viewpoints regarding it. However, it values an aspect that becomes increasingly relevant in situations dealing with decision-making under uncertainty: managerial flexibility.

The scholars Dunis and Klein (2005) recommend measuring collaborative synergies as the real options’ premium value by applying a simple real options approach using the Black–Scholes option pricing model. Indeed, the recommendations of Dunis and Klein (2005) on the application of simple real call options to measure the collaborative synergy of the acquisition are reasonable when an acquirer immediately obtains total ownership. However, when an acquirer pursues a sequential acquisition of the target, more advanced

real options application is needed. In this vein, Kodukula and Papudesu (2006, p. 66) listed the mainstream advanced ROV techniques and at the same time noted that there must be some consistency as to which should be applied in a particular situation.

The application of recombining binomial lattices to real options stems from the binomial option pricing model (BOPM) used to value financial options (Damodaran 2002, p. 126). Mun (2002, p. 143) notes that it is possible to derive a real option value with the help of the recombining binomial lattices approach that can be applied employing risk-neutral probability (RNP). RNP is the most widely accepted real options analysis technique in the usage of risk-neutral probabilities, which is also the reason for its detailed analysis. This approach is both a “road map” and a valuation tool. The RNP approach uses an approach (Brandão et al. 2005) that discounts free cash flow (FCF) at a risk-free rate, not a risk-adjusted one. This allows for ease of valuation, avoids double counting the risk (Mun 2002, p. 163), and applies the RNP approach to the “real world” as well, as noted by Hull (Hull 2022).

The application of recombining binomial lattices is also suitable when the sequential compound option exists. It is a case of when a particular real option’s value will be determined by the value of another real option, not an underlying asset per se (Copeland and Keenan 1998). Thus, the value of a particular sequential compound option is derived from another real option (Mun 2003, p. 49). Commonly sequential compound options are simply referred to as compound or (corporate) growth options (Copeland and Keenan 1998; Li 2007). Such an option exists when a collaborative strategy is multi-staged, and the success of the next phase (acquisition) depends on whether the prior phase (alliance) was successful or not (Childs et al. 1998).

Non-recombining binomial lattices are more robust, but with a higher number of periods that are also more difficult to calculate. Therefore, while such lattices are not preferred conventionally, they are needed for real options with changing volatility when volatility changes over time (Mun 2002, pp. 232–39; Brach 2003, p. 61), particularly, an option with changing volatilities (Kodukula and Papudesu 2006, p.168). When it comes to the measurement of collaborative synergies, the real option with changing volatility can be used when an acquirer pursues an acquisition strategy from partial acquisition to total acquisition and the stock volatility of the acquirer changes over time.

Regarding the contribution to a real options theory (ROT), Trigeorgis and Reuer (2017, p. 59) encourage new methodologies with a greater focus on the individual project level of analysis from a strategic perspective, and the collection of more data on individual real option cases. The current paper contributes to this scientific discussion and seeks to address the research gaps. What is more, ROT acknowledges the importance of resources, knowledge, and capabilities, but it focuses its attention on new sources of competitive advantage: to acquire and exercise appropriate growth options in the right geographic location (Chi et al. 2019; Chang and Rosenzweig 2001). This paper justifies this proposition by adding fresh empirical evidence on how Natura Cosméticos S.A is creating a cosmetic powerhouse by exercising growth options on a global scale.

**Proposition 1.** *Collaborative synergies can be valued with real options with changing volatility (with non-recombining binomial lattices) when MNE is pursuing integrative strategies from partial acquisition to the total acquisition of an international venture and MNE’s stock volatility is noticeably changing at the time of deciding on a full takeover.*

The case study of Aesop’s partial acquisition by Natura Cosméticos S.A. in 2012 and its total acquisition in 2016 will illustrate the application of advanced real options with changing volatility to measure the collaborative synergies of this deal, and, therefore, it justifies the theoretical proposition in the next subchapter.

### 3. Method

The explanatory nature of the paper’s research question (“how”) prompted the author to conduct an explanatory case study (Eisenhardt and Graebner 2007). The paper employs an explanatory case study to obtain a “more robust theory because the propositions are more deeply grounded in varied empirical evidence” (Eisenhardt and Graebner 2007, p. 27). Yin argued that explanation can always occur as part of a description and the whole interpretation that is dedicated to explain how or why events have come about (Yin 2011). Moreover, “when a study is preoccupied with an overarching explanation, the explanation drives the structure of the entire study” (Yin 2011, p. 216), as in the current paper. This paper relies on an extensive archival search that included company reports, internal documents, industry publications, and analyst dates to value the collaborative synergy of MNE’s sequential acquisition of the target firm with advanced real options answering the research question.

As objects of research, the author has chosen a global player who is especially active in the global operation scope in the beauty industry: Natura Cosméticos S.A. Eisenhardt and Graebner (2007) argued that it is appropriate to use a case study if phenomenon-driven research questions (“how”) are the subjects of investigation. A case study can be considered as an experiment that could be repeated (Yin 2011). When it comes to the presentation of evidence, Eisenhardt and Graebner (2007) state that there is no strict norm in large-scale studies when presenting results. The conceptual model of the research is presented in Figure 1.

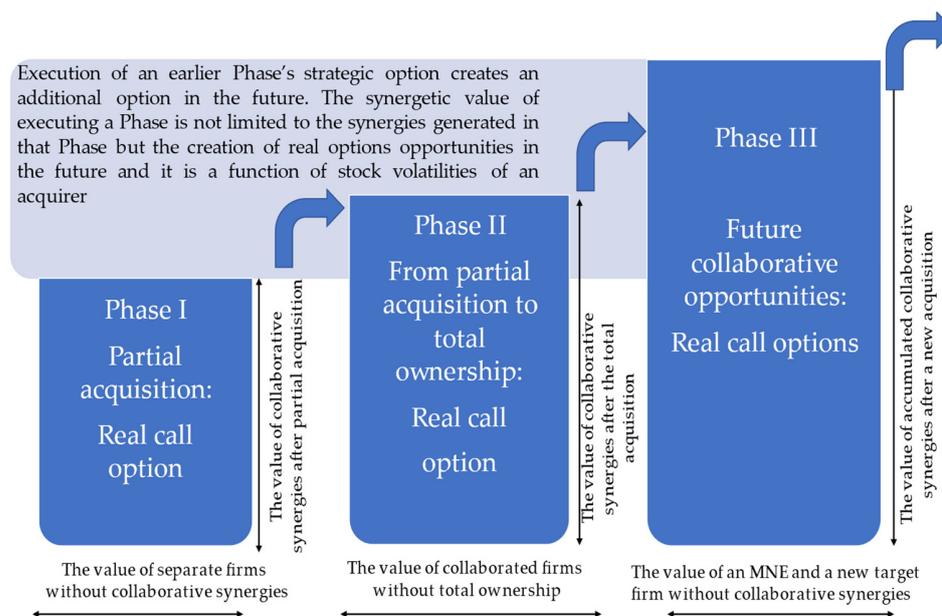


Figure 1. The conceptual model of the research (adopted from Čirjevskis (2022a) and modified).

The conceptual model’s arrows correspond to the provided theoretical proposition and explain the sequences of the case study and how the research question will be answered: (1) how can value collaborative synergies be valued when an MNE is pursuing integrative strategies from partial acquisition to the total acquisition of an international venture, and how does an MNE’s stock volatility noticeably change at the time of deciding on a full takeover?

“A case study helps to explain both the process and outcome of a phenomenon through observation and analysis of the cases under investigation as it includes both quantitative and qualitative data” (Tellis 1997, p. 1). In this vein, as outlined in the literature review, first and foremost the value of the real option(s) is determined by the valuation method used in the calculations. Differing approaches will inevitably provide differing results. In this vein, as the most widely accepted method of analyzing a real options problem currently appears to be the application of recombining and non-recombining lattices, this is

the technique applied and compared in this research as well, namely, the real option with changing volatility application to measure the collaborative synergies of Aesop's sequential acquisition by Natura Cosméticos S.A. The collaborative synergies as the premium value of advanced real options were measured by employing an Excel spreadsheet in the Microsoft Office app.

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

Based in Brazil and founded in 1969, Natura Cosméticos S.A., the seller of world-class wellness and beauty products, is the leading direct-selling company in Latin America. In December 2012 "Brazilian cosmetics company Natura Cosmetics S.A. has agreed to buy a 65% stake in Australian high-end beauty-product retailer Emeis Holdings for USD 71.6 million, expanding its international presence" (Glazer 2012, p. 1). The stock volatility of Natura Cosméticos S.A. on 20–27 December 2012 (one week after the announcement of partial acquisition) was about 24.0% (V-Lab 2022). Natura Cosméticos S.A. was expected to complete the deal by April 30, 2012. Emeis Holdings operates under the Aesop (Aesop) brand name across Australia, Asia, Europe, and North America including having a presence in Paris, Tokyo, and New York (Glazer 2012).

The partial acquisition enabled Natura Cosméticos S.A. to increase its exposure in the international markets outside of Latin America and integrated the core competencies of both firms generating strategic collaborative synergy. In December 2016 Natura Cosméticos S.A. acquired a whole 100% stake and obtained total ownership of Aesop. The stock volatility of Natura Cosméticos S.A. on 20–27 December 2016 (one week after the announcement of the total acquisition) was about 40% (V-Lab 2022). The acquirer had pursued an acquisition strategy from partial acquisition to total acquisition; however, the stock volatility of Natura Cosméticos S.A. was noticeably changed (16% more) at the time of deciding on a full takeover. In this vein, the advanced real option with changing volatilities was applied to measure the collaborative synergies generated within six years of this deal.

The duration of obtaining synergies was assumed to be six years which included the period from 2012 to 2016 (four years) when Natura Cosméticos S.A. kept 65% of Aesop stock-taking for four years and the period from 2016 to 2018 (two years) after the 100% acquisition of Aesop. The milestone year of 2018 was chosen to exclude the impact of the series of next sequential acquisitions of international ventures of Natura Cosméticos S.A., namely, the impact of competence-based synergies of USD 1.11 bn generated by Natura Cosméticos S.A.'s acquisition of The Body Shop within the years 2018–2020, and the impact of competence-based synergies was USD 2.8 bn as result of the acquisition of Avon in the years 2019–2022 (Čirjevskis 2020a, pp. 15, 19).

##### *4.1. Prerequisites of Competence-Based Synergies of Natura Cosméticos S.A.'s Acquisition of the Aesop Brand of Emeis Holdings*

"The litmus test for a core competence? It is hard for competitors to copy or procure" (Bain & Company 2022, p. 1). Barney and Hesterly (Barney and Hesterly 2018) provided the VRIO framework to recognize the core competencies of the corporations responding to four questions as to whether their resources and capabilities are valuable, rare, costly or/and timely to imitate, or efficiently and effectively organized. Having assessed the potential of the competence-based synergy of the collaboration between Aesop and Natura Cosméticos S.A., it is obvious that the complementarity, compatibilities, and transferability of core competencies of Aesop and Natura Cosméticos S.A. helped them to develop their further growth.

Aesop has obtained core competencies in geographic expansions in the cosmetic segment with a strong presence in department stores. Over the years, Aesop launched in the United State market in 1990, followed by its expansion in Asia and Europe. "Their business model has been successful in various countries around the world" (KPMG 2012, p. 10). Among other core competencies are a recognized brand and sustainable high-quality

products in skin, body, and hair care as well as natural botanical ingredients used in the products for men, the household, and domestic animals (KPMG 2012).

Natura Cosméticos S.A.'s core competencies are in the research of users' needs and behaviors, high-quality ingredients, brand management, and in e-commerce. What is more, Natura Cosméticos S.A.'s core competence is in delivering natural cosmetics and an ethical approach to producing cosmetics (Čirjevskis 2020b). The conclusion on the compatibilities and complementarities of their competencies and their impact on their global value chain is as follows: Natura's and Aesop's core competencies complement each other, thanks to their strong, loyal customer base all over the world, worldwide stores, brand management, and the same ethical principle of being a force for good. To measure tacit collaborative synergies (Čirjevskis 2022b), that Natura Cosméticos S.A. generated pursuing a strategy from partial acquisition to total acquisition, an advanced real option with changing volatilities was used.

#### 4.2. Measuring Collaborative Synergies with a Non-Recombining Lattice

In the simple real options valuation, the underlying volatility is assumed to be relatively constant over the option's life. Therefore, a single volatility is employed across the binomial tree during the option duration. However, if the volatility is expected to change during the option's life, it can be accounted for by modifying the binomial method. Start with the initial volatility factor, build the binomial tree, and calculate the asset values at each node of the tree using the corresponding "up" and "down" factors up to the time point where the volatility changes (Kodukula and Papudesu 2006). From that time point on, calculate the asset values using the new up and down factors related to the new volatility factor and the new risk-neutral probability (RNP) which will result in a non-recombining lattice. The option value calculation method using backward induction will be the same for the entire tree (Kodukula and Papudesu 2006, p. 168).

To calculate and analyze the collaborative synergies of Natura Cosméticos S.A.'s acquisition of Aesop, a simple real call option with constant volatility and a real option with changing volatility will be used employing recombining and non-recombining lattices. The parameters of the recombining and non-recombining lattices are given in Table 1.

Binomial option pricing model's parameters: Natura Cosméticos S.A. kept 65% of Aesop's stock from 2012 until 2016 as shown in Table 2.

First, a non-recombining lattice has been applied to measure collaborative synergies with constant volatility assuming that with 2012–2018 years' volatility would be constant at 24% as it was at the beginning of the collaborative deal. Figure 1 illustrates a six-steps non-recombining lattice for measuring collaborative synergies as an American real call option. Each node branches into two pathways that do not meet with the other branches along the way (i.e., they do not recombine) (Mun 2003) starting from the year 2016 ear when Natura acquired a full stake in Aesop. The above lattice' nodes shown in Figure 2 are the lattice of the underlying values, (so) and the below lattice's node is the valuation of collaborative synergies as the real options of American type, obtained using the backward induction approach and applying a risk-neutral probability (RNP) analysis (Mun 2003).

The simple real options valuation provides the result of USD 6.23 bn. The synergetic value can also be measured using a recombining lattice as shown in Figure 3. In the recombining lattice, the amount of computational work is significantly reduced because the identical values for a particular period are collapsed and summarized as unique nodes (Mun 2003, p. 191).

Mun argued that the results obtained using the recombining and non-recombining lattice approaches are similar (Mun 2002, p. 192). This paper has justified that the results are the same. Second, 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 corresponding to the two volatility factors. They will be denoted by  $u$ ,  $u'$ ,  $d$ , and  $d'$ , respectively. "There will also be 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 1.** Parameters of advances real options with changing volatilities; sequential acquisition of Aesop by Natura Cosméticos S.A.

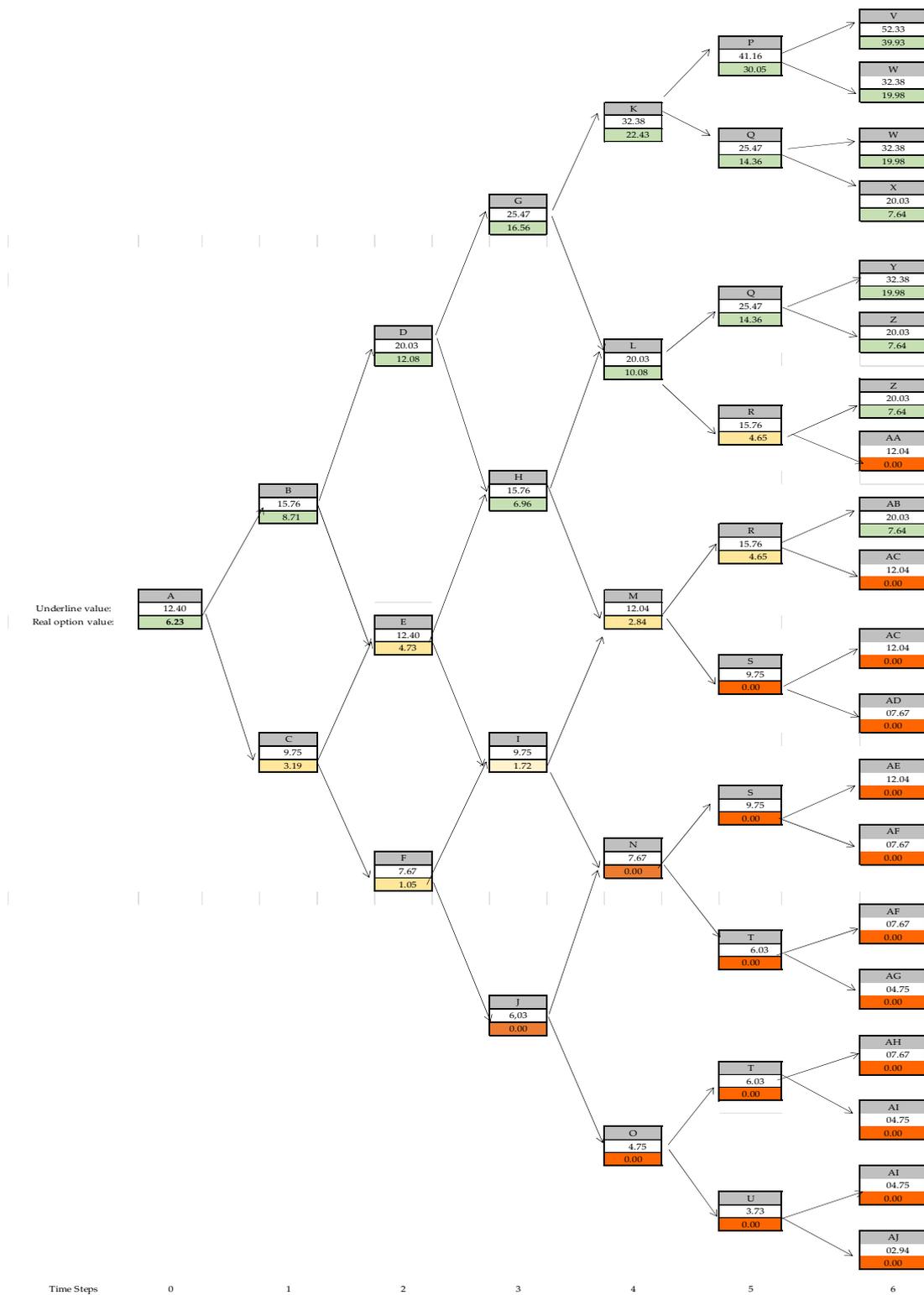
Parameters of Financial Options	Parameters of Real Options with Changing Volatility	Data
Stock price (So)	The cumulated market value of Aesop and Natura Cosméticos S.A. (four-week average) before the announcement of the deal	The market capitalization of Natura Cosméticos S.A (NTCO) on 31 December 2012, was USD 12.287 bn (Finbox 2022a). The market value of Aesop was AUD 114.690 M (KPMG 2012, p. 28) or USD110.3 M (Pound Sterling Live 2012). Therefore, the cumulated market value of the separated entities before the partial acquisition (So) equals USD 12.397 bn.
The strike price (K)	The hypothetical future market value of the separate entities is forecast by the EV/EBITDA multiples of Aesop and Natura Cosméticos S.A. in 2012	In 2012, Natura Cosméticos S.A. consolidated EBITDA reached BRL 1511 billion (Annual Report Natura Cosméticos S.A. 2012, p. 6) and on 31 December 2012, the EV/EBITDA multiple was 17.4 (Finbox 2022b). Therefore, the hypothetical future market value of Natura Cosméticos S.A. as a separate entity was USD 12.847 bn. According to the KPMG report (KPMG 2012), Aesop’s EBITDA in 2012 was AUD 6.852 M. As shown by KPMG, the median EV/EBITDA market multiples of comparable companies are equal to 12.2. (KPMG 2012, p. 30). Thus, the future value of Aesop without acquisition was AUD 83.5944 M or USD 80.4 M. Therefore, the hypothetical future market value of the separate entities was forecasted as USD 12.927 bn.
Stock volatility of an acquirer the during the time of partial ownership of a target’s shares ( $\sigma_1$ )	Natura Cosméticos S.A.’s historical volatilities within the first week after the announcement of the partial acquisition of Aesop: 20–27 December 2012.	The stock volatility of Natura Cosméticos S.A on 20–27 December 2012 (one week after the announcement of partial acquisition) was 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 ( $\sigma_2$ )	Natura Cosméticos S.A.’s historical volatilities within the first week after the announcement of the full acquisition	The sock volatility of Natura Cosméticos S.A on 20–27 December 2016 (one week after the announcement of the total acquisition) was 40% (V-Lab 2022).
Risk-free rate (r)	The annualized risk-free interest rate in Brazil in 2012	The annualized risk-free interest rate in Brazil in 2012 was 11.0% (Trading Economics 2022).
Time to maturity (T1 and T2)	Duration of gaining collaborative tacit synergy when Natura Cosméticos S.A. kept 65% of Aesop’s stock was four years (T1). The time to maturity after full acquisition was assumed to be two-years (T2)	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 ( $\delta t$ )	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	1.0 year

Source: Developed by the author.

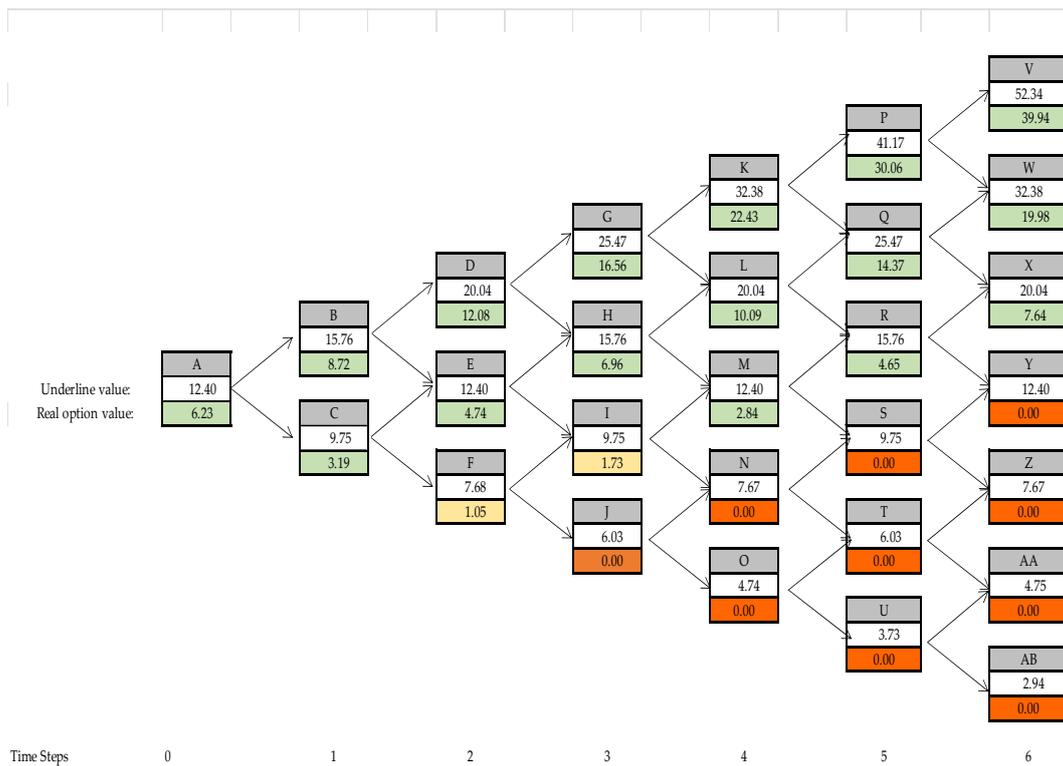
**Table 2.** Binomial option pricing model’s parameters: Natura Cosméticos S.A. kept 65% of Aesop’s stock (2012–2016) with a volatility of 24%.

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

Developed by the author.



**Figure 2.** Non-recombining lattices measuring collaborative synergies of Aesop’s acquisition by Natura Cosméticos S.A. assuming constant volatility (24%) within the 2012–2018 years’ period. Source: Developed by the author.



**Figure 3.** Recombining lattices measuring collaborative synergies of Aesop’s acquisition by Natura Cosméticos S.A assuming constant volatility (24%) within the 2012–2018 years’ period. Source: Developed by the Author.

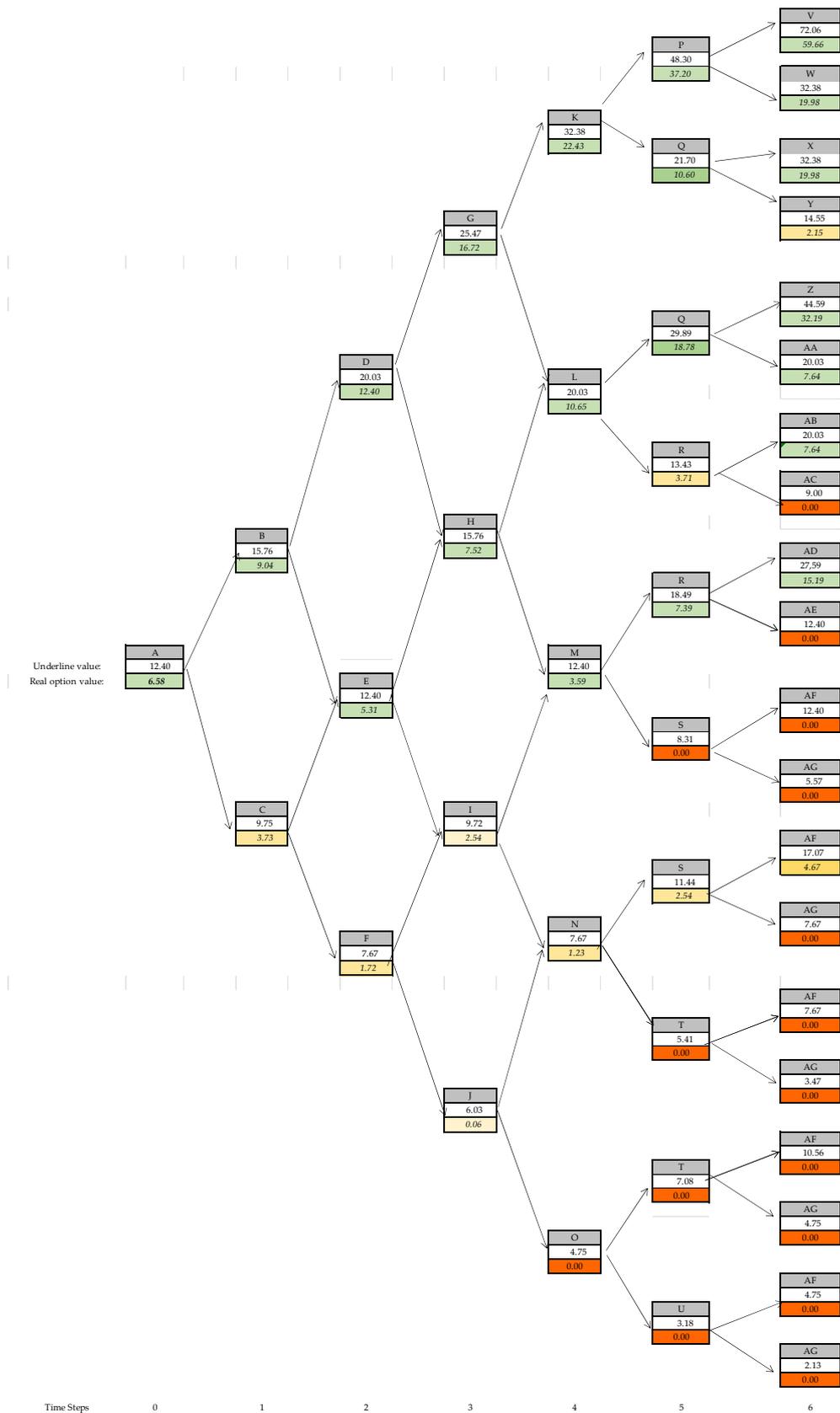
**Table 3.** Binomial option pricing model’s parameters: Natura Cosméticos S.A. kept 100% of Aesop’s stock (2017–2018) with a volatility of 40%.

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')	$p = \frac{e^{r\Delta T} - d}{u - d}$	0.543

Source: Developed by the author.

Having constructed a binomial tree, one-year time intervals for six years have been used to account for the changes in the up and down factors after the first four years. After the first four years (the period 2012–2016), the volatility increased, and the up and down factors changed as well. Therefore, for the next two years (the period 2017–2018), the joint firms’ market values are calculated using  $u'$  and  $d'$ , and the binominal tree will no longer be recombining starting in the fifth year as shown in Figure 3 where the top values at each node represent the joint firms’ market value.

Then, having used backward induction, the option values at each node of the binomial tree have been calculated. According to the (Kodukula and Papudesu 2006, PMP) recommendation, the value of  $p'$  as the risk-neutral probability (RNP) for nodes in years 6, 5, and 4 was used. For the nodes in years 3–1, and year 0, however, the value of  $p$  as the risk-neutral probability was used (Kodukula and Papudesu 2006, p. 172). These are the bottom italicized numbers in Figure 4. Therefore, the expected value of collaborative synergies when an MNE is pursuing integrative strategies from partial acquisition to the total acquisition of an international venture and the MNE’s stock volatility is noticeably changing at the time of deciding on a full takeover is at the bottom of node “A” as shown in Figure 4.



**Figure 4.** Non-recombining lattices measuring collaborative synergies of Aesop’s sequential acquisition by Natura Cosméticos S.A. by real options with changing volatility within the 2012–2018 years’ period. Source: Developed by the author.

The volatility of the market capitalization of an MNE is expected to remain the same during the duration of obtaining collaborative synergy in partial acquisition deals but may change due to the announcement of a total acquisition, such as those encountered by the Natura Cosméticos S.A. case study. If the volatility ( $\sigma_1$ ) was assumed to be constant (24%) during the sequential acquisition of Aesop by Natura Cosméticos S.A., the collaborative synergies (as the option value) would be USD 6.23 bn, whereas with 40% volatility ( $\sigma_2$ ) that augmented after four years the synergy result increases up to USD 6.58bn. Further sensitivity analysis shows the following results regarding the volatility and synergetic value's correlations: 50%—USD 6.82 bn, 45%— USD 6.70 bn, 35%—USD 6.46 bn, 20%—USD 6.15.

Employing advanced real options with changing volatility application, the result of collaborative synergies in this case, increases the synergy result by about USD 0.35 bn for a 16% increase in volatility. Therefore, consideration of volatility changes when an MNE is pursuing integrative strategies from partial acquisition to total acquisition provides a more accurate prediction of the collaborative synergies of the deal which justifies the theoretical proposition.

## 5. Findings and Discussions

Have the expected collaborative synergies been fully realized and are the added market value as predicted? Or has Natura Cosméticos S.A. maybe demonstrated the inability to achieve the anticipated synergies of the combined (Aesop and The Body Shop) companies' operations since the completion of these transactions? Having taken the real market enterprise value (EV) of Natura Cosméticos S.A. in 2020 ([MarketScreener 2022](#)) BRL 77.653 bn or USD 19.41 bn ([Exchange Rates UK 2022](#)), one should conclude that Natura Cosméticos S.A. has not fully realized their forecasted collaborative synergies by sequential acquisitions of international ventures, namely, Aesop's acquisition in the years 2012–2018 that would have generated the collaborative value of synergies equal USD 6.28 bn according to current research and The Body Shop acquisition in 2017 that would have generated the value of collaborative synergies with a real options value was USD 1.1bn ([Čirjevskis 2020a](#)). Specifically, the theoretical EV in 2020 would be equal to USD 20.8 bn (USD 12.4 bn + USD 6.58 bn+ USD 1.1 bn). The estimated value of synergies shows evidence that Natura Cosméticos S.A. has not fully realized their forecasted reciprocal synergies (real options value) thus far.

However, the connection of the theoretical (forecasted) EV with real market EV largely depends on the timing of the stock prices taken and it is entirely difficult to justify very precisely not only in the current research but in practice as well. Meanwhile, having compared the calculated market value added (real options value) with the Aesop's and The Body Shop's acquisition (takeover) premium paid, it can be concluded that these sequential international acquisitions still have added market value to the Natura Group thanks to the generated collaborative synergies of these acquisitions. Moreover, as stated, by David Boynton (The Body Shop), João Paulo Ferreira (Natura), and Michael O'Keeffe (Aesop) in their CEOs message, "With Natura's original purpose: 'We exist to fight for a fairer and more beautiful world' that group can have a positive impact on the world, that is strengthened by synergies, gains in efficiency, and the integration of three businesses" ([Natura Cosméticos S.A. 2018](#), Management report, p. 1).

Thanks to collaborative synergy, Natura Cosméticos S.A. is demonstrating strong acquisition-based dynamic capabilities ([Anand et al. 2005](#); [Čirjevskis 2017](#)) by sensing global market demand for eco-friendly cosmetic products, seizing opportunities through the acquisition of companies with the same principle of being a "force for good" and a very similar customer value proposition, and transforming their outbound logistics of the global value chain by globalizing its marketing operations as well as promoting a socially responsible business model of being "a force for good", on a global scale.

## 6. Conclusions, Contributions, Limitations, and Future Work

The importance of global strategy is indisputable in international business (IB) research (Leiblein et al. 2022) “Applications of real options theory to international business research have generated considerable new insights, advancing our understanding of fundamental IB questions including market entry or exit, entry mode choice, and multinational networks” (Chi et al. 2019, p. 547). This current examination of real options theory’s key concepts and mechanisms of their application to international business strategy shows the richness and strong potential of real options theory as it extends its reach beyond a mere prediction of the fundamental relationship between uncertainty, managerial flexibilities, and valuation.

The incorporation of real options into the synergy valuation measures managerial flexibility arising from sequential acquisitions of international ventures. This is a major theoretical and managerial contribution of the current paper to international business discipline and real options theory. Having bridged the resources-based view’s framework with the real options theory, this paper is a fresh contribution to the international business literature with a cross-disciplinary approach, namely, international business strategy and corporate finance.

Bettanti and Lanati argued that from a value-creation perspective, future studies can focus on improving the usefulness of real options logic and making it more accessible to firms and managers coping with riskiness issues (Bettanti and Lanati 2022). This paper contributes to this scientific discussion by demonstrating how advanced real options approaches can help to deal with synergetic uncertainty in international business strategy development. Moreover, Chi et al. (2019) argued that future research on real options theory “might yield more precise predictions on the conditions for two MNEs” collaborators and the dynamics of their collaborative relationship across stages or over time (Chi et al. 2019, p. 545).

This paper contributes to this scientific quest by providing fresh insights into valuations of the collaborative synergies with real options with changing volatility (with non-recombining binomial lattices) when an MNE is pursuing integrative strategies from partial acquisition to the total acquisition of an international venture and an MNE’s stock volatility is noticeably changing at the time of deciding on a full takeover. Leiblein et al. also argue that real options models may prove to be a fruitful approach to the development and evaluation of global strategies (Leiblein et al. 2022). Having applied the theoretical lenses of the resource-based view and real options theory, the paper may prove to be a fruitful approach to the development and evaluation of global strategies’ synergies

When it comes to limitations, non-recombining binomial lattices, while not conventionally preferred, are needed for rainbow options and for an option with changing volatilities (Mun 2002, pp. 232–39; Brach 2003, p. 61; Kodukula and Papudesu 2006, p. 168). The current research has justified those arguments. Even though non-recombining binomial lattices are robust in the application of advanced real options, they are also more difficult to calculate with a higher number of periods (six years in the current paper) and that is a major limitation of the usage of this method in practice.

The research also exemplifies the limitation of the real option application to measure a collaborative synergy of sequential acquisitions of international ventures. It is difficult to validate the synergetic effect of one isolated acquisition deal when several acquisitions happen within the anticipation of the duration of obtaining synergies such as Natura Cosméticos S.A.’s 100% acquisition of Aesop in 2016, the acquisition of The Body Shop in 2017, and the acquisition of Avon in 2019.

This research, being explanatory and interpretive, raises several opportunities for future research, both in terms of theory development and findings validation. The theoretical proposition discussed in the current research can be employed to generate several hypotheses for further empirical testing using a broader sample and quantitative research methods on MNEs’ sequential acquisitions of international ventures or when an MNE pursues collaborative strategies from alliance to full ownership (e.g., the Fiat Chrysler Automobiles strategic deal within the 2009–2014 period). Certainly, the testing of the proposition pre-

sented here should help determine the applicability of real options valuation to sequential M&A deals and bring this emerging theory closer to international business research.

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