11 Frugal Innovation in Brazilian Multinationals

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11.1 INTRODUCTION

Multinationals from emerging markets (EMs), especially in Latin America, made a splash on the international scene in the 1970s, stimulated by a context of import substitution. In early 2000, a second wave of internationalization set in around the capture of resources and knowledge. Today, emerging market multinational companies (EMNCs) compete for global leadership through catch-up strategies based on imitation, acquisition, and reverse transference. And yet, while this strategy seizes knowledge and capabilities, innovation is still the engine of competitive advantage and differentiation.

As noted in Chapter 1, the challenges and opportunities generated in EMs drove multinationals to develop innovation mechanisms. A variety of terms have been coined accordingly (low cost, jugaad, shanzhai, reverse innovation, bottom of the pyramid innovation, etc.). Among these, frugal innovation is of note beyond its potential for simply cutting costs. Frugal innovation is an innovation strategy to develop products as good as those already on the market and with a value proposition that is often more sustainable but at a lower cost thanks to internal and open processes with partner organizations.

In this chapter, we suggest that the competitive advantage of EMNCs is achieved through an innovation-aligned catch-up strategy. We report on cases of Brazilian MNCs that placed frugal innovation at the center of this alignment. We conclude by building on the findings and their implications.

11.2 THEORETICAL BACKGROUND

11.2.1 Frugal Innovation

Out of the growth in emerging economies, millions have been lifted out of poverty and made gains in purchasing power, giving way to new market segments (Zeschky, Winterhalter, & Gassmann, 2014a). These include the middle class, the "good enough" market, and the low-income market (Gadiesh, Leung, & Vestring, 2007; Govindarajan & Trimble, 2012; Prahalad & Mashelkar, 2010). Consumers in these new segments require innovations and business models that are best suited to their institutional context and economic surplus (Prahalad & Hart, 2002; Prahalad & Mashelkar, 2010).

Some terminologies and concepts thus emerged in an attempt to demonstrate and highlight how innovation takes place in the context of emerging economies (Bernardes, Borini, Rossetto, & Pereira, 2018; von Zedtwitz, Corsi, Søberg, & Frega, 2015; Zeschky et al., 2014a). The types addressed are structurally different with respect to their original motivation, mechanisms, proposition, and value offering. While some solutions may emerge from remodeling an existing product or process, others may be brand new (Zeschky et al., 2014a). This conceptual variety can be summarized as frugal innovation (von Zedtwitz et al., 2015).

At first, the concern was to save resources and minimize environmental impacts so that companies could create robust products with cost advantages and other benefits (*The Economist*, 2010). Here, frugal innovation targeted middle- and low-income segments, especially in EMs. However, studies suggest that bottom-of-the-pyramid consumers, despite income constraints, sought products that did not carry the stigma of poorer markets (Tiwari, Luise, & Katharina, 2016).

Frugal innovators have thus taken advantage of the opportunities offered by digital transformation to significantly reduce costs and improve quality (Kalogerakis, Fischer, & Tiwari, 2017). Frugal innovators deliver high technology at low cost by reducing and leveraging

R&D resources. They bet on alternative technologies and take advantage of open systems architectures (Ray & Ray, 2010).

Put differently, today's assumed frugal innovation value proposition considers not only the low-cost requirements of products, but also innovation capability that manifests the novel, with a sustainable component (Tiwari & Herstatt, 2014; Zeschky, Winterhalter, & Gassmann, 2014b). Based on capabilities, companies yield differential environmental impact, reducing the cost of acquisition, production, and distribution (Hossain, 2017; Rosca, Arnold, & Bendul, 2016).

To encourage this understanding of frugal innovation, companies: (a) focus on core product functionality, meeting or exceeding quality standards; (b) embed a sustainable component in its value chain that results in responsible innovations; (c) intensify the pursuit of cost reduction, including through (d) open innovation networks that reduce the cost of product development and innovation risk (Kalogerakis et al., 2017; Tiwari & Bergmann, 2018; Tiwari et al., 2016).

In this way, frugal innovation is an innovation strategy to develop products as good as those already on the market and with a value proposition that is often more sustainable, but at a lower cost thanks to internal and open processes with partner organizations. The main features of this definition can be summarized as follows:

a) Cost: Frugal innovation aims not only at a price reduction for the consumer but also at economic efficiency in the supply chain (Tiwari & Herstatt, 2012d). Companies must express innovation capacity in cost, so that they can offer cheaper products with other features, maximizing the value paid by the customer (Agnihotri, 2015);
b) Open Innovation: Collaboration with external partners at all stages of the often geographically different industry innovation process for improved quality (Tiwari & Herstatt, 2012a, 2012c);
c) Sustainability Oriented Innovation: Contributions to company performance with increasing pressure for sustainable resource use (Brem & Ivens, 2013).

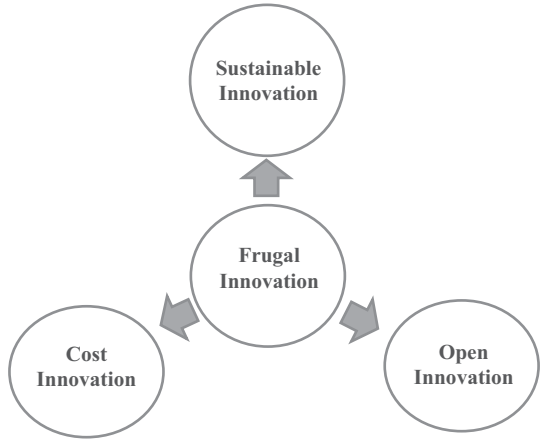

FIGURE 11.1 Strategic dimensions of frugal innovation adopted in the chapter
Source: The authors, based on development.

Frugal products and services can be produced for any consumer group, facilitating accessibility and opening new market segments, regardless of the specific point in the price criterion (Tiwari et al., 2016). Figure 11.1 demonstrates key dimensions. Their application indicates how EMNCs (in this case, Brazilian multinationals) deploy frugal innovation to consolidate competitiveness.

11.2.2 Aligning the Catch-up Strategy with Frugal Innovation

As is well known, the environment surrounding EMNCs is marked by challenges in infrastructure, social development, legal protection, corruption, health, and education (Cuervo-Cazurra, 2007; Meyer, Mudambi, & Narula, 2011), with implications at headquarters and subsidiaries (Cuervo-Cazurra, 2012). While such adversities are evident, they can serve as a competitive advantage by becoming a source of innovation (Prahalad & Mashelkar, 2010; Simula, Hossain, & Halme, 2015). This is the case with frugal innovation. Due to the conditions of their home country, EMNCs are already inclined to

FIGURE 11.2 Strategies of leading global EMNCs
Source: The authors, based on development.

make products as good as those already available in the market and sustainably – i.e., frugal innovations managed at low costs.

The local context of the country shapes and directs the capabilities and competencies to innovate (Murtha & Lenway, 1994; Porter, 1990). In the past, EMNCs suffered a competitive disadvantage with regard to more robust innovation activities (Kothari, Kotabe, & Murphy, 2013; Luo & Tung, 2007). However, EMNCs are currently turning the international market into a springboard for overcoming such disadvantages (Luo & Tung, 2007). They have been aggressively investing in learning and assimilating technologies from multinationals in developed countries (Kothari et al., 2013) to build a high level of absorptive capacity of competences (Lane & Lubatkin, 1998; Mudambi & Navarra, 2004).

This confluence of factors and strategy has ushered in new forms of innovation related to business models, and new capabilities for new frugally oriented products and services (Bhatti, 2012; Bound & Thornton, 2012; Prahalad & Mashelkar, 2010; Simula et al., 2015). With the knowledge and technological capabilities acquired abroad, EMNCs give new life to products and services through frugal innovation. This is exported in the alignment in Figure 11.2, as EMNCs move from a competitive parity stage to a position of competitive advantage.

11.3 METHOD

This study used two research approaches: The first was to conduct case studies using secondary information to verify how the catch-up

strategy and frugal combination has been used by the leading Brazilian EMNCs in their markets. The second approach was quantitative in nature, through a survey with the multinational headquarters, in order to verify if the Brazilian MNCs bear this frugal orientation.

The research drew on a survey with intersectional design, conducted in 2015. The questionnaire consisted of twelve questions with five-point Likert scales. The research participants were CEOs, directors, and foreign trade managers. The universe of survey participants was identified through the following data sources: analysis of the project base GINEBRA-Business Management for the Internationalization of Brazilian Companies, secondary database (BCG Global Challengers and Fortune), and business magazines (*PIB* and *Epoca*). In this phase, 210 researchable multinational matrices were identified, to be contacted via email and telephone to participate in the survey. Responses were obtained from 62 headquarters of Brazilian multinationals, about 24 percent of the universe. Factor analysis was used in the review of the results.

The measurement proposal offered with this research is based on the notion that frugal innovation is a multidimensional construct (Rayees, 2017). The dimensions offered by Silva (2018) and used in this research not only encompass the main characteristics of products considered to be frugal but also cause or lead to manifestations of this innovation type (Silva, 2018). Given this, three dimensions were used: cost, open, and sustainability-oriented innovation.

As reported, each dimension is made up of four items measured on a five-point Likert scale. Before measuring the dimensions, the reliability of the questionnaire scales was estimated using Cronbach's Alpha test. All constructs had higher than acceptable indices (0.6). Table 11A.1 in the Appendix shows the operationalization of the measured constructs used in the survey.

11.4 CASES OF FRUGAL INNOVATION IN BRAZILIAN COMPANIES

As reported, the potential of frugal innovation is not restricted to middle- and lower-class products, as its innovations are not simply cheaper versions of existing technologies or products; they use the appropriate technology available to develop products that meet customer expectations of performance. Thus, the result is not a product aimed at low-income clients per se, as the innovations aim to create a sense of the new, albeit with fewer resources.

This section presents some cases of multinationals that are using frugal innovation to develop new products/services that meet customer expectations of performance at a lower cost. In each of the dimensions of frugal innovation presented, examples of how some Brazilian companies are establishing their competitiveness will be demonstrated.

11.4.1 Natura: Frugal Innovation Pulled by Sustainable Innovation Strategy

Natura & Co is a cosmetic multinational, currently formed by four iconic brands: Natura, AESOP, The Body Shop, and the newly acquired AVON. The company seeks to differentiate itself by generating positive economic, social, and environmental impact with products of natural origin. The Natura brand celebrated its fiftieth anniversary in 2019. Founded in Brazil, it also operates in Argentina, Chile, Colombia, the United States, France, Mexico, and Peru. It has a network of 1.7 million consultants, 45 stores, products in 3,800 pharmacies and is the leading online platform of the Brazilian cosmetics market (Natura, 2016a, 2018).

In 2019, with the acquisition of AVON, the holding company became the fourth-largest beauty group in the world, with annual revenues exceeding US$10 billion. The multinational's brands are aligned with the purpose of promoting, through beauty and social relations, a better way of living and doing business. In the Brazilian market, the company leads in direct sales of cosmetics (Natura, 2018).

The multinational is present in 73 countries and on all continents, with over 18,000 employees. The company has come to benefit from access to knowledge originating from already acquired brands. The company has created networks of excellence, collaboration centers on three strategic themes – digital, sustainability, and retail – to share best practices and build joint actions among group executives around the world (Natura, 2018).

Natura, while strongly focused on sustainability, shows how the combination of catch-up strategy and frugal innovation built a leading global eMNCs. Its strategy begins with the technological catch-up of the world's major cosmetic industries but adapted to the use of local biodiversity. This orientation involves three parts: (a) sustainability for the best product, (b) an inclusive approach to cost-cutting innovation and (c) collaborative development.

a) Sustainability for the best product

The company combined cosmetics, technology, and biodiversity in its innovation. Natura was not held hostage to the catch-up of the major technologies in the cosmetic industry. Thus, Natura was recognized for its ability to use sustainability as a basis for innovation in the cosmetics market, opting for a differential based on Brazilian ecological and cultural biodiversity. The result was a revolution within the company's technology platform and the value of Natura's products. As a result, the brand acquired expression within and beyond Brazil. The company was the first publicly traded company in the world to become a B Corp Company in 2014. Natura is now in the top twenty of the world's most sustainable companies, according to Corporate Knights Global 100 ranking (Natura, 2016a, 2018).

b) An inclusive approach to innovation

To maximize value for customers, shareholders, and society – and significantly reduce the use of financial and natural resources in emerging countries – Natura turned to frugal innovation (Rosca, Bendul, & Arnold, 2015). The company uses the mantle of

sustainability to achieve cost efficiency throughout the value chain. Given this, some goals are set: to reduce carbon emissions by 33 percent by 2013, increase production by decreasing water and energy consumption, and use biodiversity as a technological platform (Sebrae, 2016), among others.

c) Collaborative development

Natura has linked sustainable design with traditional and scientific knowledge for product development in an open innovation model – involving a network of national and global partners (Santos, Bianchi, & Borini, 2018). It currently develops projects in a global open innovation network of more than 200 partners, working with suppliers to reduce the impact of products by developing the use chain for recycled materials such as PET and glass (Natura, 2016a, 2018).

Building on the partnerships, in 2012, Natura launched the first cosmetic product with "green polyethylene" packaging in the Brazilian market. The objective was to reduce the environmental impact caused by this type of product. The material, also called "green plastic," was produced from sugarcane, a renewable source of plant energy, unlike ordinary plastic derived from petroleum. This innovation was a partnership between Natura and Braskem petrochemical (Bonatelli, 2010).

The company also built an eco-park for innovation in 2014. It is a technological center in the middle of the Amazon rainforest that researches assets and conducts business in the region, establishing social and environmental sustainability as its mission. This center provides space for partners committed to sustainable development principles, working in an integrated manner and reusing inputs from neighboring companies.

Finally, the company also launched the Applied Research Center on Human Behavior and Welfare in 2016. The center is made up of a network of thirty psychology and neuroscience researchers from the University of São Paulo (USP), the Federal University of São Paulo (Unifesp), and the Mackenzie Presbyterian University (UPM)

(Natura, 2016b). The aim is to structure a solid foundation of knowledge around human well-being from the integration of different areas such as neuroscience, positive psychology, social psychology, and applied health and human sciences. This center is the largest scientific base in the country focused on welfare research and aims to boost knowledge in the area through multidisciplinary research (Natura, 2016b).

11.4.2 Nubank: Frugal Innovation Pulled by High Technology Catch-up Strategy

Nubank is a Brazilian start-up that operates in the financial services segment. It was founded in 2013 with the objective of offering low-cost financial services in an economy where more than 55 million consumers still do not have a bank account. The complexity of the process to open an account was the trigger for the creation of Nubank. The principles of the combination of catch-up and frugal innovation materialized in (a) low-cost orientation to the essentials, (b) the social inclusion of the excluded, and (c) a culture of collaborative innovation.

a) Low-cost orientation to the essentials

Nubank uses technology and design to offer free financial services, including transfers, bill payments, and savings. Many of Nubank's customers are using credit cards or banks for the first time. The company is focused on easy-to-understand products and services, such as credit cards that can be 100 percent managed by a mobile app. The company does not charge annual fees or service fees, which are common in traditional banks in Brazil. This is possible due to the fact that the company does not depend on a physical structure like a traditional bank. In this way, Nubank reduces costs so as to not charge annuity and fees to its customers.

b) In favor of social inclusion of those without a bank account

In Brazil, consumers found it hard to find traditional companies and options without high interest rates. Nubank became that option

by way of its customer-friendly technology, bringing safe and simple solutions for users to solve and control their accounts from their smartphones. The company accepts its customers based on the algorithms and the profile of the interested party. As a result, consumers with a good payment history receive lower interest rates. In 2018, Nubank reached a milestone of 5 million credit card customers and 2.7 million account holders. By the following year, the company announced 12 million users across the country, across its products, including credit cards, bank accounts, personal loans, and investments. The company is the most valuable start-up in Latin America and the first Brazilian start-up to approach the US$10 billion mark without going public. That same year, the company began its internationalization process in Mexico and Argentina, with the launch of an international credit card for the Mexican consumer free of annual fees.

c) A culture of collaborative innovation

In 2019, Nubank was the most innovative company in Latin America (Gagne, 2019). Much of this result lies in the maintenance of a start-up culture despite Nubank's breakneck growth. The culture of innovation promotes interactions of professionals from different areas and nationalities, such as the three founders.

Altogether Nubank's workforce includes more than twenty-five nationalities and 30 percent LGBT employees (Desiderio, 2019). The company culture emphasizes agility and rapid feedback. However, beyond internal innovation, companies cannot be closed to new ideas from outside of the company. For instance, The Xpeer Xperience day invites company executives to work in the customer service operation once a year. This experiment serves as a learning experience for executives as they, too, listen to customers and collaboratively think through new product and service strategies.

11.5 SURVEY OF BRAZILIAN MULTINATIONALS

As mentioned earlier, sixty-two multinationals agreed to participate in the survey. Table 11.3 shows the statistical profile of the economic

sectors of the participating multinationals. It is found that 51.6 percent of the sample belongs to the manufacturing sector. In Brazil, this sector includes activities related to industrial production, which involves companies that transform raw materials into products for end consumers or other businesses. Companies that transform steel into machines, sugar cane into biofuels, and manufacture consumer goods such as automobiles and clothing are some examples of participants in this sector.

The second-most-significant sector in the sample was that of information and communication, with a 14.5 percent share, which includes the combination of industrial, commercial, and services activities that capture electronically, transmit and disseminate data and information, and sell equipment and products intrinsically linked to these processes. The other sectors with significant representation in the sample were professional and scientific activities at 9.7 percent and extractive industry at 6.5 percent. Table 11.1 presents the general

Table 11.1 *General profile of companies*

Sectors	*n*	%
Water, sewage, waste management, and decontamination activities	1	1.6
Administrative activities and complementary services	1	1.6
Financial, insurance, and related services activities	2	3.2
Professional, scientific, and technical activities	6	9.7
Trade; repair of motor vehicles and motorcycles	1	1.6
Construction	3	4.8
Education	1	1.6
Electricity and gas	1	1.6
Manufacturing industry	32	51.6
Extractive industries	4	6.5
Information and communication	9	14.5
Transportation, storage, and postal services	1	1.6
Total	**62**	**100**

Source: The authors, based on development.

profile of the sample, in relation to the activities that the companies perform.

To verify the adopted dimensional structure, we resorted to the use of factor analysis. The factorial analysis performed highlighted the three dimensions of the research from the twelve variables used (see Appendix). This technique organized and adjusted the twelve variables according to each previously defined construct. The quality of this adjustment was guaranteed by the KMO–Kaiser Meyer Olkim test index, above the recommended (greater than 0.5). Two other statistical tests were used to ensure that the variables in the survey belonged to the constructs. The first was the Bartlett statistical test, which was significant, and the second was the percentage of total variance explained above 60 percent.

Considering the cost innovation dimension, the factorial analysis confirmed that this construct is formed by the four variables. The analysis of Table 11.2 reveals that the cost innovation strategy most used by the Brazilian multinationals participating in the sample is related to the variable Cost 2. This reinforces that in the development of frugal products, some factors stand out as low-cost production, simpler, cheaper, low-design materials that focus on less sophisticated features, which in turn represent cost innovation (Zeschky et al., 2014a). Thus, when developing frugal innovation, Brazilian multinationals express their ability to innovate in cost by offering cheaper products with other features, maximizing the amount paid by the customer.

Considering the dimension innovation in cost, the sectors that stand out most in this kind of frugal strategy are the manufacturing and information and communication sectors. Among the ten multinationals that had the best score in this dimension, six belong to the manufacturing sector, and two belong to the information and communication sector. Regarding the presence and prominence of the information and communication sector in this dimension, such a result reinforces that low cost does not mean the use of low technologies in the development of new frugal products (Ojha, 2014) as frugal

Table 11.2 *Description of the cost innovation dimension*

Variables	*N*		Mean	Mode
	Valid	Absent		
Cost 1: The company has invested heavily in innovation to reduce the costs of processes and products/ services.	62	0	4.13	4
Cost 2: The company has invested heavily in innovation to reduce costs while increasing and creating functionality in products/services that are valued by target customers.	61	1	4.20	5
Cost 3: The company has invested heavily in innovation to develop cheaper and less-complex products.	61	1	3.84	4
Cost 4: The company has invested heavily in innovation to optimize/ increase the scale of production, through the recombination of existing products and processes.	61	1	4.11	4

Source: The authors, based on development.

innovation recombines the technologies of existing components in new ways, creating a change in the price of the package/performance without further investment in the development of new core technologies (Ray & Ray, 2011).

Regarding the sustainable innovation dimension, when analyzing Table 11.3, it appears that the variable Sustain 4 obtained the highest average of this dimension. This reveals that in the development phase of new products and processes, Brazilian multinationals seek to meet the requirements of stakeholders prior to market launch. It also stands out in this dimension that multinationals stimulate the search for sustainable innovation among their employees.

Table 11.3 *Description of the variables of the sustainable innovation dimension*

Variables	*N*		Average	Mode
	Valid	Absent		
Sustain 1: The company seeks innovations that are sustainable, even if they bring lower returns than traditional products available in the market.	62	0	3.55	4
Sustain 2: In the development of new products and processes, the company seeks better management of natural resources and use of raw materials from sustainable sources (triple bottom line and/or carbon footprint).	62	0	3.77	4
Sustain 3: The company encourages innovation focused on sustainability and challenges its employees to find innovative solutions for new processes and products based on this philosophy.	62	0	3.95	4
Sustain 4: The company seeks to know the perceptions and concerns of different stakeholders (customers, employees, suppliers, trade unions, NGOs) in the product development process.	62	0	4.11	4

Source: The authors, based on development.

The companies' interest in increasing the measurement level of their performance is evident, particularly in relation to social impacts associated with the life cycle of their products and services, as well as the companies' relationship with its stakeholders when they innovate in a sustainable way (Jay & Gerard, 2015). The multinationals with

Table 11.4 *Description of variables of the dimension open innovation*

	N			
Variables	Valid	Absent	Average	Mode
Open 1: The company has mechanisms of integration with suppliers that allow the participation of those in the improvement of new processes and products	61	1	3.62	4
Open 2: The innovation in processes or products has already benefited in some way with collaborative agreements with universities or research centers	61	1	3.54	5
Open 3: Technologies, products, or services that belong to the company domain are accessible and able to be enhanced with customer collaboration.	61	1	3.90	4
Open 4: The company has been engaged in innovation activities such as participation in research consortium and technology transfer agreements with other companies in the sector (strategic alliances and/or joint ventures).	61	1	3.39	4

Source: The authors, based on development.

the highest averages were Moura, Fibria, Nexxera, BR Foods, and Boticário Accumulators.

The third dimension confirmed by exploratory factor analysis concerns open innovation. When analyzing the variables in Table 11.4, it can be seen that individual form was the one that presented the lowest means in its variables. Table 11.4 also reveals that the Open 3 variable was the item with the highest average response, highlighting the interactive character of the open innovation process of Brazilian multinationals.

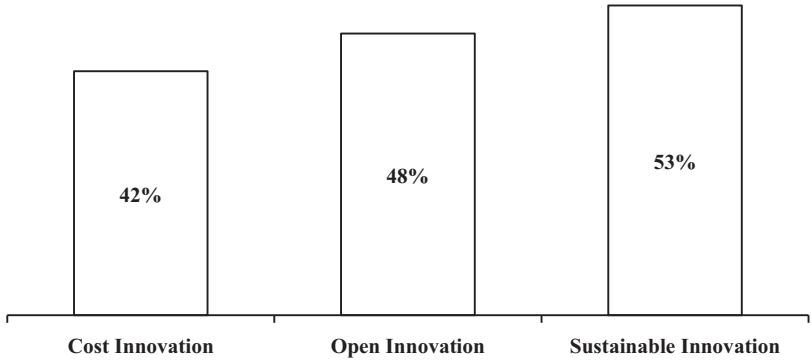

FIGURE 11.3 Dimensions of frugal in Brazilian multinationals
Source: The authors, based on development.

Data from this dimension reinforces the fact that frugal innovations can come from partnerships among companies considered global leaders, entrepreneurs, and local businesses. Often these partners are part of the global chain of world-class companies or part of a global open innovation system crowdsource type (Adriaens, Lange, & Zielinski, 2013). Considering the activities of the most representative economic sectors, the sectors worth noting include manufacturing and information and communication. Companies that stand out include Stefanini IT Solutions, Tupy, Movile, Positive, Fibria, and Embraer.

In this chapter, the factor analysis was initially used to confirm the dimensions of the theoretical framework from the twelve established variables. Moreover, the use of this technique enabled the identification of the most representative multinationals in each factor. By analyzing Figure 11.3, a reasonable balance of multinational participation in each dimension can be seen. Considering the sustainable innovation dimension, 53 percent of Brazilian multinationals are engaged in this type of innovation. Considering open innovation, 48 percent of research multinationals would adopt this model.

Finally, the innovation in cost dimension came to be practiced by 42 percent of the sample.

However, in conceptualizing frugal innovation as the culmination of the three dimensions, the result stands as a warning for EMNCs in Brazil in terms of the catch-up and frugal dual strategies because only 40 percent of the sample brought the three dimensions together at the same time. In other words, more than half of Brazilian EMNCs must move toward a frugal orientation if they wish to position themselves according to the approach we propose here.

11.6 CONCLUSION

The growing participation of emerging economies on the international scene and the prominence of their respective multinationals have drawn the world's attention to the types of innovation that occur in these markets and what models these companies should employ to innovate and compete. This is now more urgent as these multinationals rapidly internationalize and adopt innovative strategies that challenge traditional players in their markets.

From this context, new internationalization theories have attempted to explain this success from the perspective that these multinationals succeed by internationalizing themselves due to access and exploitation of resources available in other markets, especially developed countries. While seeking and possessing these resources is relevant to EMNC strategy, it does not guarantee a competitive advantage for these companies.

Emerging multinationals must still convert this knowledge into new capabilities that the international market does not yet know. Thus, this chapter shows that a strategic orientation based on a catch-up strategy aligned with frugal innovation comprises one of the solutions for the development of competitive advantages and the constitution of global leadership for EMNCs.

APPENDIX

Table 11A.1 *Constructs and variables used in the research*

Research constructs	Code
Cost innovation	
The company has invested heavily in innovation to reduce the costs of processes and products/services and increase productivity.	COST1
The company has invested heavily in innovation to reduce costs while increasing and creating new functionalities of products/services that are valued by target customers.	COST2
The company has invested heavily in innovation to develop cheaper and less complex products.	COST3
The company has invested heavily in innovation to optimize and increase the scale of production, through the recombination of existing products and processes.	COST4
Open innovation	
The company has mechanisms of integration with suppliers that allow the participation of those in the improvement of new processes and products.	OPEN1
The innovation in processes or products has already benefited in some way with collaborative agreements with universities or research centers.	OPEN2
Technologies, products, or services that are the company's domain are accessible and able to be enhanced with customer collaboration.	OPEN3
The company has engaged in innovation activities such as participation in research consortium and technology transfer agreements with other companies in the sector (strategic alliances and/or joint ventures).	OPEN4
Sustainable innovation	
The company seeks for sustainable innovations, even if they bring lower returns than traditional products available in the market.	SUSTIN1
In developing new products and processes, the company seeks better management of natural resources and the use of raw materials from sustainable sources (*triple bottom line* and/or carbon footprint).	SUSTIN2

Table 11A.1 (*cont.*)

Research constructs	Code
The company encourages sustainability-focused innovation and challenges its employees to find innovative solutions to new processes and products based on this philosophy.	SUSTIN3
The company seeks to understand the perceptions and concerns of different *stakeholders* (customers, employees, suppliers, trade unions, NGOs) in the product development process.	SUSTIN4

Source: Silva, 2018.

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